Solutions Companion

Java
AND ALGORITHMIC THINKING
FOR THE COMPLETE BEGINNER

3rd Revised Edition

Aristides S. Bouras

https://www.bouraspage.com

RCode: 240301

Warning and Disclaimer

This book is designed to provide the answers to all of the review questions, as well as the solutions to all review exercises of the book "JAVA AND ALGORITHMIC THINKING FOR THE COMPLETE BEGINNER – Third Edition". Every effort has been taken to make this book compatible with all releases of Java, and it is almost certain to be compatible with any future releases of it.

The information is provided on an "as is" basis. The authors shall have neither liability nor responsibility to any person or entity with respect to any loss or damages arising from the information contained in this book or from the use of the files that may accompany it.

Table of Contents

How to Report Errata

Although I have taken great care to ensure the accuracy of the content in this book, mistakes can still occur. If you come across any errors, either in the text or the code, I highly encourage you to report them to me. By doing so, you'll not only assist in saving other readers from potential confusion and frustration but also contribute to enhancing the quality of the next release. If you discover any errors, please report them by visiting one of the following addresses:

- https://tinyurl.com/28nwh2nf
- https://www.bouraspage.com/report-errata

Once I verify your reported error(s), your submission will be accepted. The errata will then be uploaded to my website and added to any existing list of corrections.

If you Like the Book

If you find the book valuable, please consider visiting the web store where you purchased it, as well as goodreads.com, to show your appreciation by writing a positive review and awarding as many stars as you think appropriate. By doing so, you will motivate me to keep writing and, of course, you'll be assisting other readers in discovering my work.

Chapter 11

1.7 Review Questions: True/False

1. true
2. false
3. true
4. false
5. false
6. true
7. true
8. false
9. false
10. false
11. true
12. true
13. false
14. false
15. false
16. true
17. true
18. false
19. false
20. true
21. false
22. false
23. true

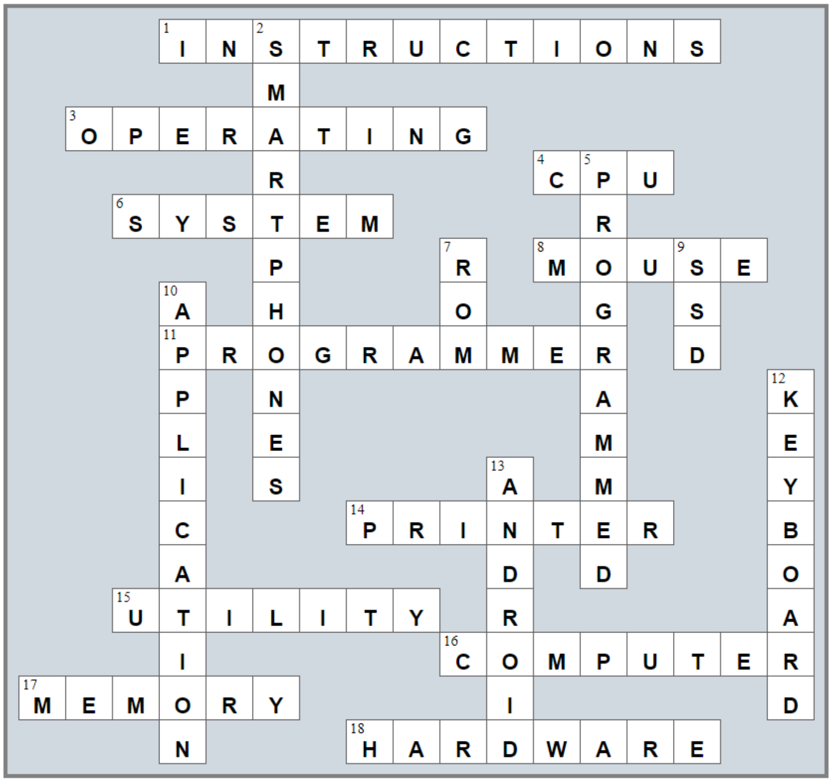
1.8 Review Questions: Multiple Choice

1. b
2. d
3. d
4. c
5. f
6. d
7. c
8. b
9. c
10. b
11. a

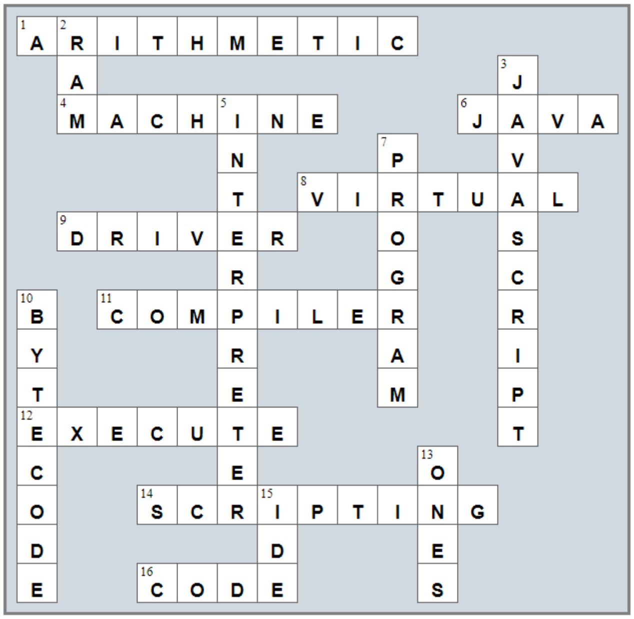
Review in "Introductory Knowledge"

Review Crossword Puzzles

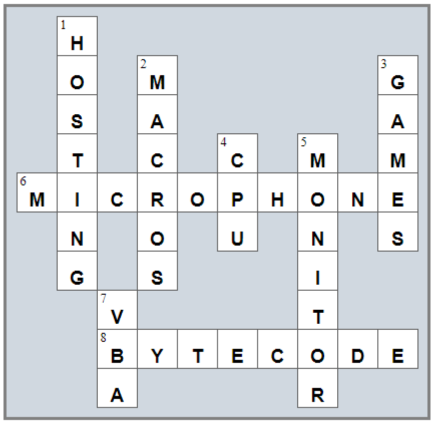
1.



2.



3.


1 H
O 2 M 3 G
S A A
T C 4 C 5 M M
6 M I C R O P H O N E
N O U N S
G S I
7 V T
8 B Y T E C O D E
A R

Chapter 4

4.17 Review Questions: True/False

1. true
2. false
3. false
4. false
5. false
6. true
7. false
8. true
9. true
10. true
11. false
12. false
13. true
14. true
15. false
16. true
17. false
18. false
19. false
20. true
21. true
22. true
23. false
24. false
25. false
26. false
27. true
28. true
29. false
30. false
31. false
32. false
33. false
34. true
35. false
36. false
37. false
38. false
39. true
40. true
41. false

4.18 Review Questions: Multiple Choice

1. c
2. b
3. c
4. a
5. a
6. a
7. b
8. d
9. a
10. d

Chapter 5

5.8 Review Questions: True/False

1. false
2. false
3. true
4. false
5. false
6. true
7. false
8. false
9. true
10. false
11. true
12. false
13. true
14. true
15. true
16. true
17. false

5.9 Review Questions: Multiple Choice

1. e
2. a
3. d
4. b
5. c
6. c
7. d
8. a

5.10 Review Exercises

1. 1 – c, 2 – d, 3 – a, 4 – b
2. 1 – d, 2 – c, 3 – b, 4 – a
3.

Value	Data Type	Declaration and Initialization
The name of my friend	String	`String name = "Mark";`
My address	String	`String address = "254 Lookout Rd. Wilson, NY 27893";`
The average daily temperature	Float	`double average = 70.3;`
A telephone number	String	`String phoneNumber = "1-891-764-2410";`
My Social Security Number (SSN)	String	`String ssn = "123-45-6789";`
The speed of a car	Float	`double speed = 90.5;`
The number of children in a family	Integer	`int children = 3;`

Chapter 6

6.4 Review Questions: True/False

1. true
2. true
3. true
4. false
5. false

6.5 Review Questions: Multiple Choice

1. c
2. a
3. b
4. b

Chapter 7

7.7 Review Questions: True/False

1. false
2. true
3. false
4. false
5. false
6. false
7. false
8. false
9. true
10. false
11. false
12. true
13. false
14. false
15. false
16. true
17. false
18. true
19. false
20. false
21. false
22. true
23. false
24. false

7.8 Review Questions: Multiple Choice

1. c
2. c
3. b
4. d
5. b
6. d
7. d
8. c

7.9 Review Exercises

1. ii, iv, v, ix, x
2. i. String, ii. Boolean, iii. String, iv. String, v. Float, vi. Integer
3. i. d, ii. f, iii. c, iv. e
4. i. 26, ii. 28
5. i. 5, ii. 6
6. i. 1, ii. 0, iii. 1, iv. 1, v. 0, vi. 1
7. i. 2 * 3, ii. 4.0
8. i. 2, ii. 0, iii. 1, iv. 0, v. 0, vi. 0
9. i. 2, ii. 5
10. My name is George Malkovich
11. i. (−3), ii. 1
12. California California California

Chapter 8

8.2 Review Questions: True/False

1. false
2. true
3. false
4. false

8.3 Review Exercises

1. Solution

Step	Statement	Notes	a	b	c	d
1	`a = Double.parseDouble(cin.nextLine())`	User enters value 3	**3.0**	?	?	?
2	`b = a + 10`		3.0	**13.0**	?	?
3	`a = b * (a - 3)`		**0.0**	13.0	?	?
4	`c = 3 * b / 6`		0.0	13.0	**6.5**	?
5	`d = c * c`		0.0	13.0	6.5	**42.25**
6	`d--`		0.0	13.0	6.5	**41.25**
7	`System.out.println(d)`	It displays: 41.25				

2. Solution

For the input value of 3

Step	Statement	a	b	c	d
1	`a = Integer.parseInt(cin.nextLine())`	**3**	?	?	?
2	`a = (a + 1) * (a + 1) + 6 / 3 * 2 + 20`	**40**	?	?	?
3	`b = a % 13`	40	**1**	?	?
4	`c = b % 7`	40	1	**1**	?
5	`d = a * b * c`	40	1	1	**40**
6	`System.out.println(a + ", " + b + ", " + c + ", " + d)`	It displays: 40, 1, 1, 40			

For the input value of 4

Step	Statement	a	b	c	d
1	`a = Integer.parseInt(cin.nextLine())`	**4**	?	?	?
2	`a = (a + 1) * (a + 1) + 6 / 3 * 2 + 20`	**49**	?	?	?
3	`b = a % 13`	49	**10**	?	?
4	`c = b % 7`	49	10	**3**	?
5	`d = a * b * c`	49	10	3	**1470**
6	`System.out.println(a + ", " + b + ", " + c + ", " + d)`	It displays: 49, 10, 3, 1470			

For the input value of 1

Step	Statement	a	b	c	d
1	`a = Integer.parseInt(cin.nextLine())`	**1**	?	?	?

2	`a = (a + 1) * (a + 1) + 6 / 3 * 2 + 20`	**28**	?	?	?
3	`b = a % 13`	28	**2**	?	?
4	`c = b % 7`	28	2	**2**	?
5	`d = a * b * c`	28	2	2	**112**
6	`System.out.println(a + ", " + b + ", " + c + ", " + d)`	It displays: 28, 2, 2, 112			

3. Solution

For the input values of 8, 4

Step	Statement	a	b	c	d	e
1	`a = Integer.parseInt(cin.nextLine())`	**8**	?	?	?	?
2	`b = Integer.parseInt(cin.nextLine())`	8	**4**	?	?	?
3	`c = a + b`	8	4	**12**	?	?
4	`d = 1 + a / b * c + 2`	8	4	12	**27**	?
5	`e = c + d`	8	4	12	27	**39**
6	`c += d + e`	8	4	**78**	27	39
7	`e--`	8	4	78	27	**38**
8	`d -= c + d % c`	8	4	78	**−78**	38
9	`System.out.println(c + ", " + d + ", " + e)`	It displays: 78, −78, 38				

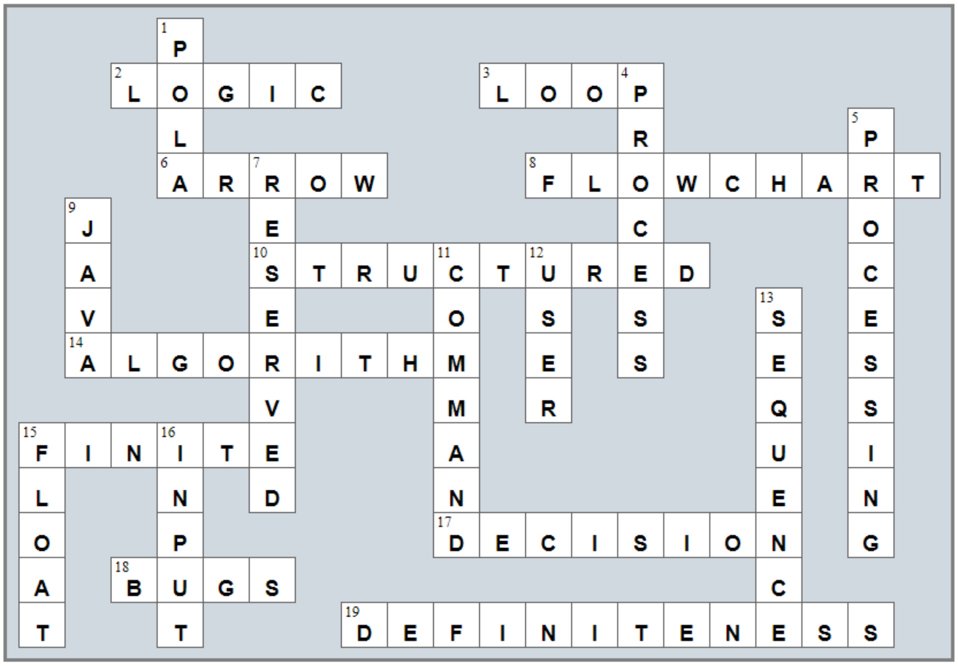
For the input values of 4, 4

Step	Statement	a	b	c	d	e
1	`a = Integer.parseInt(cin.nextLine())`	**4**	?	?	?	?
2	`b = Integer.parseInt(cin.nextLine())`	4	**4**	?	?	?
3	`c = a + b`	4	4	**8**	?	?
4	`d = 1 + a / b * c + 2`	4	4	8	**11**	?
5	`e = c + d`	4	4	8	11	**19**
6	`c += d + e`	4	4	**38**	11	19
7	`e--`	4	4	38	11	**18**
8	`d -= c + d % c`	4	4	38	**−38**	18
9	`System.out.println(c + ", " + d + ", " + e)`	It displays: 38, −38, 18				

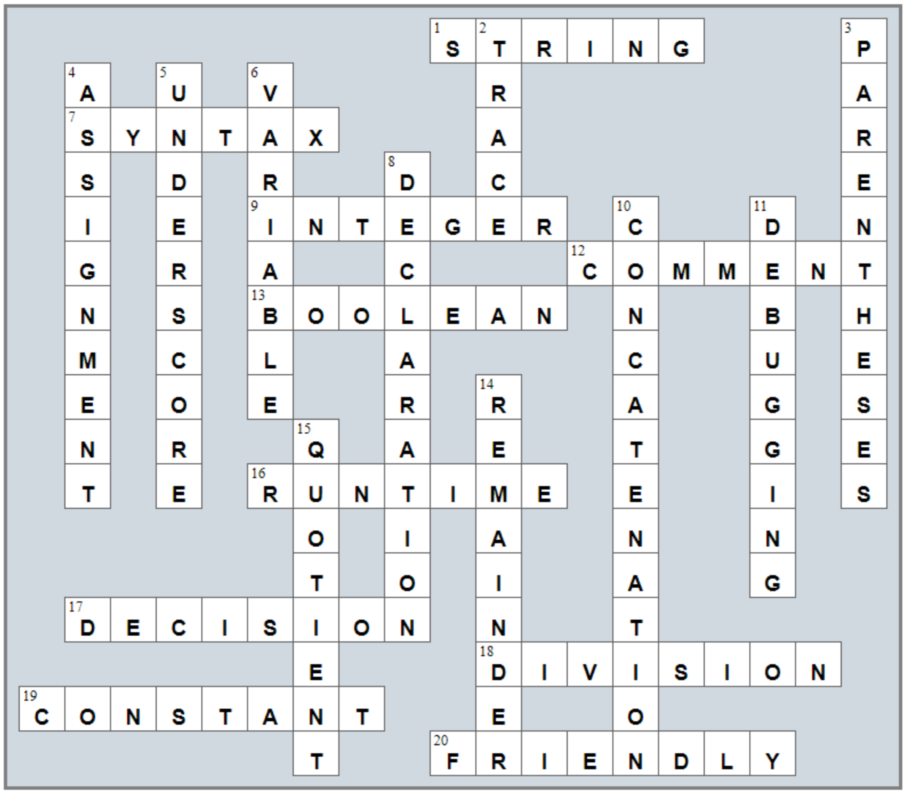
Review in “Getting Started with Java”

Review Crossword Puzzles

1.



2.



Chapter 10

10.2 Review Exercises

1. Solution

```
public static void main(String[] args) throws Exception {
  double gallons, milesDriven, mpg;

  System.out.print("Enter miles driven: ");
  milesDriven = Double.parseDouble(cin.nextLine());
  System.out.print("Enter gallons of gas used: ");
  gallons = Double.parseDouble(cin.nextLine());

  mpg = milesDriven / gallons;

  System.out.println("Your car's MPG is: " + mpg);
}
```

2. Solution

```
public static void main(String[] args) throws Exception {
  double b, h, area;

  System.out.print("Enter base: ");
  b = Double.parseDouble(cin.nextLine());
  System.out.print("Enter height: ");
  h = Double.parseDouble(cin.nextLine());

  area = 0.5 * b * h;

  System.out.println(area);
}
```

3. Solution

```
public static void main(String[] args) throws Exception {
  double angle1, angle2, angle3;

  System.out.print("Enter 1st angle: ");
  angle1 = Double.parseDouble(cin.nextLine());
  System.out.print("Enter 2nd angle: ");
  angle2 = Double.parseDouble(cin.nextLine());

  angle3 = 180 - angle1 - angle2;

  System.out.println(angle3);
}
```

4. Solution

```
public static void main(String[] args) throws Exception {
  int g1, g2, g3, g4;
  double average;

  System.out.print("Enter 1st grade: ");
  g1 = Double.parseDouble(cin.nextLine());
  System.out.print("Enter 2nd grade: ");
  g2 = Double.parseDouble(cin.nextLine());
  System.out.print("Enter 3rd grade: ");
  g3 = Double.parseDouble(cin.nextLine());
  System.out.print("Enter 4th grade: ");
  g4 = Double.parseDouble(cin.nextLine());

  average = (g1 + g2 + g3 + g4) / 4.0;

  System.out.println(average);
}
```

5. Solution

```
static final double PI = 3.14159;

public static void main(String[] args) throws Exception {
  double r, perimeter;

  System.out.print("Enter radius: ");
  r = Double.parseDouble(cin.nextLine());

  perimeter = 2 * PI * r;

  System.out.println(perimeter);
}
```

6. Solution

```
static final double PI = 3.14159;

public static void main(String[] args) throws Exception {
  double d, radius, volume;

  System.out.print("Enter diameter (in meters): ");
  d = Double.parseDouble(cin.nextLine());

  radius = d / 2;
  volume = 4 / 3 * PI * radius * radius * radius;

  System.out.println(volume);
}
```

7. Solution

Only a), e) and g) are syntactically correct. The latter is more user friendly.

8. Solution

```
public static void main(String[] args) throws Exception {
  String firstName, lastName, middleName, title;

  System.out.print("First name: ");
  firstName = cin.nextLine();
  System.out.print("Middle name: ");
  middleName = cin.nextLine();
  System.out.print("Last name: ");
  lastName = cin.nextLine();
  System.out.print("Title: ");
  title = cin.nextLine();

  System.out.println(title + " " + firstName + " " + middleName + " " + lastName);
  System.out.println(firstName + " " + middleName + " " + lastName);
  System.out.println(lastName + ", " + firstName);
  System.out.println(lastName + ", " + firstName + " " + middleName);
  System.out.println(lastName + ", " + firstName + " " + middleName + ", " + title);
  System.out.println(firstName + " " + lastName);
}
```

9. Solution

```
static final double PI = 3.14159;

public static void main(String[] args) throws Exception {
  double d, radius, perimeter, area, volume;

  System.out.print("Enter diameter: ");
  d = Double.parseDouble(cin.nextLine());

  radius = d / 2;
  perimeter = 2 * PI * radius;
  area = PI * radius * radius;
  volume = 4 / 3 * PI * radius * radius * radius;

  System.out.println(radius + " " + perimeter + " " + area + " " + volume);
}
```

10. Solution

```
public static void main(String[] args) throws Exception {
  double charge, tip, tax, total;

  System.out.print("Enter charge for a meal: ");
  charge = Double.parseDouble(cin.nextLine());

  tip = charge * 10 / 100;
  tax = charge * 7 / 100;
  total = charge + tip + tax;

  System.out.println(total);
}
```

11. Solution

```
public static void main(String[] args) throws Exception {
  int minutes, seconds, totalSeconds;
  double s, a;

  System.out.print("Enter the distance traveled (in meters): ");
  s = Double.parseDouble(cin.nextLine());
  System.out.print("Enter the minutes traveled: ");
  minutes = Integer.parseInt(cin.nextLine());
  System.out.print("Enter the seconds traveled: ");
  seconds = Integer.parseInt(cin.nextLine());

  totalSeconds = minutes * 60 + seconds;

  a = 2 * s / (totalSeconds * totalSeconds);

  System.out.println(a);
}
```

12. Solution

```
public static void main(String[] args) throws Exception {
  double f, c;

  System.out.print("Enter temperature in Fahrenheit: ");
  f = Double.parseDouble(cin.nextLine());

  c = 5 / 9 * (f - 32);

  System.out.println(c);
}
```

13. Solution

```
public static void main(String[] args) throws Exception {
  int w, h;
  double bmi;

  System.out.print("Enter weight in pounds: ");
  w = Integer.parseInt(cin.nextLine());
  System.out.print("Enter height in inches: ");
  h = Integer.parseInt(cin.nextLine());

  bmi = w * 703.0 / (h * h);

  System.out.println(bmi);
}
```

14. Solution

```
public static void main(String[] args) throws Exception {
  double sTotal, tip, total;
  int gRate;

  System.out.print("Enter subtotal: ");
  sTotal = Double.parseDouble(cin.nextLine());
  System.out.print("Enter gratuity rate (0 - 100): ");
  gRate = Integer.parseInt(cin.nextLine());

  tip = sTotal * gRate / 100;

  total = sTotal + tip;

  System.out.println("Tip is $" + tip + " and total is $" + total);
}
```

15. Solution

```
static final double VAT = 0.20;

public static void main(String[] args) throws Exception {
  double btaxPrice1, btaxPrice2, btaxPrice3, ataxPrice1, ataxPrice2, ataxPrice3, avg;

  System.out.print("Enter before-tax price 1: ");
  btaxPrice1 = Double.parseDouble(cin.nextLine());
  System.out.print("Enter before-tax price 2: ");
  btaxPrice2 = Double.parseDouble(cin.nextLine());
  System.out.print("Enter before-tax price 3: ");
  btaxPrice3 = Double.parseDouble(cin.nextLine());

  ataxPrice1 = btaxPrice1 + btaxPrice1 * VAT;
  ataxPrice2 = btaxPrice2 + btaxPrice2 * VAT;
  ataxPrice3 = btaxPrice3 + btaxPrice3 * VAT;

  avg = (ataxPrice1 + ataxPrice2 + ataxPrice3) / 3;

  System.out.println(avg);
}
```

16. Solution

```
static final int VAT = 0.20;

public static void main(String[] args) throws Exception {
  double ataxPrice, btaxPrice;

  System.out.print("Enter after-tax price: ");
  ataxPrice = Integer.parseInt(cin.nextLine());
  btaxPrice = ataxPrice / (1 + VAT);

  System.out.println(btaxPrice);
}
```

17. Solution

```
public static void main(String[] args) throws Exception {
  double iPrice, fPrice, saved;
  int discount;

  System.out.print("Enter price: ");
  iPrice = Double.parseDouble(cin.nextLine());
  System.out.print("Enter discount (0 - 100): ");
  discount = Integer.parseInt(cin.nextLine());

  fPrice = iPrice - iPrice * discount / 100;
  saved = iPrice - fPrice;

  System.out.println(fPrice + " " + saved);
}
```

18. Solution

```
static final int VAT = 0.20;

public static void main(String[] args) throws Exception {
  int iKWh, fKWh, kWhConsumed;
  double cost;

  System.out.print("Enter kWh at the beginning of the month: ");
  iKWh = Integer.parseInt(cin.nextLine());
  System.out.print("Enter kWh at the end of the month: ");
  fKWh = Integer.parseInt(cin.nextLine());

  kWhConsumed = fKWh - iKWh;

  cost = kWhConsumed * 0.06;
  cost += cost * VAT;

  System.out.println(kWhConsumed + " " + cost);
}
```

19. Solution

```
public static void main(String[] args) throws Exception {
  int soldYachts;
  double yachtsCost, insuranceCost, totalCost, totalEarnings;

  System.out.print("Enter number of yachts sold: ");
  soldYachts = Integer.parseInt(cin.nextLine());
  yachtsCost = soldYachts * 1000000;
  insuranceCost = 250000 * 12;
  totalCost = yachtsCost + insuranceCost;
  totalEarnings = soldYachts * 1500000;

  System.out.println(totalEarnings - totalCost);
}
```

20. Solution

```
public static void main(String[] args) throws Exception {
  int day, month, daysPassed;

  System.out.print("Enter current month: ");
  month = Integer.parseInt(cin.nextLine());
  System.out.print("Enter current day: ");
  day = Integer.parseInt(cin.nextLine());

  daysPassed = (month - 1) * 30 + day;

  System.out.println(daysPassed);
}
```

21. Solution

```
public static void main(String[] args) throws Exception {
  int day, month, daysPassed, daysLeft;

  System.out.print("Enter current month: ");
  month = Integer.parseInt(cin.nextLine());
  System.out.print("Enter current day: ");
  day = Integer.parseInt(cin.nextLine());

  daysPassed = (month - 1) * 30 + day;
  daysLeft = 360 - daysPassed;

  System.out.println(daysLeft);
}
```

Chapter 11

11.3 Review Questions: True/False

1. true
2. false
3. false
4. false
5. false
6. true
7. false
8. true
9. false
10. false
11. false
12. false
13. true
14. true
15. true
16. true
17. false
18. false

11.4 Review Questions: Multiple Choice

1. d
2. d
3. b
4. c
5. a
6. b

11.5 Review Exercises

1. Solution

For the input value of 9

Step	Statement	a	b	c
1	`a = Double.parseDouble(cin.nextLine())`	**9.0**	?	?
2	`a += 6 / Math.sqrt(a) * 2 + 20.4`	**33.4**	?	**?**
3	`b = Math.round(a) % 4`	33.4	**1.0**	**?**
4	`c = b % 3`	33.4	1.0	**1.0**
5	`System.out.println(a + ", " + b + ", " + c)`	It displays: 33.4, 1.0, 1.0		

For the input value of 4

Step	Statement	a	b	c
1	`a = Double.parseDouble(cin.nextLine())`	**4.0**	?	?
2	`a += 6 / Math.sqrt(a) * 2 + 20.4`	**30.4**	?	**?**
3	`b = Math.round(a) % 4`	30.4	**2.0**	**?**
4	`c = b % 3`	30.4	2.0	**2.0**
5	`System.out.println(a + ", " + b + ", " + c)`	It displays: 30.4, 2.0, 2.0		

2. Solution

For the input value of −2

Step	Statement	a	b	c
1	`a = Integer.parseInt(cin.nextLine())`	**−2**	?	?
2	`b = Math.abs(a) % 4 + Math.pow(a, 4)`	−2	**18**	**?**
3	`c = b % 5`	−2	18	**3**
4	`System.out.println(b + ", " + c)`	It displays: 18, 3		

For the input value of −3

Step	Statement	a	b	c
1	`a = Integer.parseInt(cin.nextLine())`	**−3**	?	?
2	`b = Math.abs(a) % 4 + Math.pow(a, 4)`	−3	**84**	**?**
3	`c = b % 5`	−3	84	**4**
4	`System.out.println(b + ", " + c)`	It displays: 84, 4		

3. Solution

```
public static void main(String[] args) throws Exception {
  double degrees, radians;

  System.out.print("Enter angle in radians: ");
  radians = Double.parseDouble(cin.nextLine());

  degrees = radians * 180 / Math.PI;

  System.out.println(degrees);
}
```

4. Solution

```
public static void main(String[] args) throws Exception {
  double a, b, hypotenuse;

  System.out.print("Enter right angle side A of a right-angled triangle: ");
  a = Double.parseDouble(cin.nextLine());
  System.out.print("Enter right angle side B of a right-angled triangle: ");
  b = Double.parseDouble(cin.nextLine());

  hypotenuse = Math.sqrt(Math.pow(a, 2) + Math.pow(b, 2));

  System.out.println(hypotenuse);
}
```

5. Solution

```
public static void main(String[] args) throws Exception {
  double adjacent, opposite, th;

  System.out.print("Enter angle θ (in degrees) of a right-angled triangle: ");
  th = Double.parseDouble(cin.nextLine());
  System.out.print("Enter length of adjacent side: ");
  adjacent = Double.parseDouble(cin.nextLine());

  opposite = Math.tan(th * Math.PI / 180) * adjacent;

  System.out.println(opposite);
}
```

Chapter 12

12.2 Review Exercises

1. Solution

i. a, e, g, h
ii. c, f

2. Solution

i. y = Math.pow(x + 3, 5 * w) / (7 * (x - 4))
ii. y = Math.pow(3 * Math.pow(x, 2) - Math.pow(x, 3) / 4, 1 / 5.0)
iii. y = Math.sqrt(Math.pow(x, 4) - 2 * Math.pow(x, 3) - 7 * x * x +x) / Math.pow(4 * (7 * Math.pow(x, 4) - 3 / 4.0 * Math.pow(x, 3)) * (7 * x * x + x), 1 / 3.0)
iv. y = x / (x - 3 * (x - 1)) + x * Math.pow(x - 1, 1 / 5.0) / ((Math.pow(x, 3) - 2) * Math.pow(x - 1, 3))
v. y = Math.pow(Math.sin(Math.PI / 3) - Math.cos(Math.PI / 2 * w) , 2)
vi. y = Math.pow(Math.sin(Math.PI / 2 * x) + Math.cos(3 * Math.PI / 2 * w), 3) / Math.pow(Math.tan(2 * Math.PI / 3 * w) - Math.sin(Math.PI / 2 * x), 0.5) + 6

3. Solution

```
public static void main(String[] args) throws Exception {
  double x, y;

  System.out.print("Enter value for x: ");
  x = Double.parseDouble(cin.nextLine());

  y = Math.sqrt(x * x + 1) * (Math.pow(x, 3) + Math.pow(x, 2));

  System.out.println(y);
}
```

4. Solution

```
public static void main(String[] args) throws Exception {
  double x, y;

  System.out.print("Enter value for x: ");
  x = Double.parseDouble(cin.nextLine());

  y = 7 * x / (2 * x + 4 * (x * x + 4));

  System.out.println(y);
}
```

5. Solution

```
public static void main(String[] args) throws Exception {
  double w, x, y;
  System.out.print("Enter value for x: ");
  x = Double.parseDouble(cin.nextLine());
  System.out.print("Enter value for w: ");
  w = Double.parseDouble(cin.nextLine());

  y = Math.pow(x, x + 1) / Math.pow(Math.tan(2 * w / 3 + 5) + Math.tan(x / 2 + 1), 3);

  System.out.println(y);
}
```

6. Solution

```
public static void main(String[] args) throws Exception {
  double w, x, y;

  System.out.print("Enter value for x: ");
  x = Double.parseDouble(cin.nextLine());
  System.out.print("Enter value for w: ");
  w = Double.parseDouble(cin.nextLine());

  y = (3 + w) / (6 * x + 7 * (x + 4)) + x * Math.pow(3 * w + 1, 1 / 5) * (5 * x + 4) / ((Math.pow(x, 3)
+ 3) * Math.pow(x - 1, 6));

  System.out.println(y);
}
```

7. Solution

```
public static void main(String[] args) throws Exception {
  double w, x, y;

  System.out.print("Enter value for x: ");
  x = Double.parseDouble(cin.nextLine());
  System.out.print("Enter value for w: ");
  w = Double.parseDouble(cin.nextLine());

  y = Math.pow(x, x) / Math.pow(Math.sin(2 * w / 3 + 5) - x, 2) + Math.pow(Math.sin(3 * x) + w, x + 1)
/ Math.pow(Math.sqrt(7 * w), 3 / 2);

  System.out.println(y);
}
```

8. Solution

```
public static void main(String[] args) throws Exception {
  double a, b, c, area, semi;

  System.out.print("Enter length A: ");
  a = Double.parseDouble(cin.nextLine());
  System.out.print("Enter length B: ");
  b = Double.parseDouble(cin.nextLine());
  System.out.print("Enter length C: ");
  c = Double.parseDouble(cin.nextLine());

  semi = (a + b + c) / 2;
  area = Math.sqrt(semi * (semi - a) * (semi - b) * (semi - c));

  System.out.println(area);
}
```

Chapter 13

13.2 Review Exercises

1. Solution

```
public static void main(String[] args) throws Exception {
  int lastDigit, n, result;

  System.out.print("Enter an integer: ");
  n = Integer.parseInt(cin.nextLine());

  lastDigit = n % 10;
  result = lastDigit * 8;

  System.out.println(result);
}
```

2. Solution

```
public static void main(String[] args) throws Exception {
  int digit1, digit2, digit3, digit4, digit5, number, r, reversedNumber;

  System.out.print("Enter a five-digit integer: ");
  number = Integer.parseInt(cin.nextLine());

  digit5 = number % 10;
  r = (int)(number / 10);

  digit4 = r % 10;
  r = (int)(r / 10);

  digit3 = r % 10;
  r = (int)(r / 10);

  digit2 = r % 10;
  digit1 = (int)(r / 10);

  reversedNumber = digit5 * 10000 + digit4 * 1000 + digit3 * 100 + digit2 * 10 + digit1;
  System.out.println(number + " + " + reversedNumber + " = " + (number + reversedNumber));
}
```

3. Solution

```
public static void main(String[] args) throws Exception {
  int n, result;

  System.out.print("Enter an integer: ");
  n = Integer.parseInt(cin.nextLine());

  result = n % 2;
  System.out.println(result);
}
```

4. Solution

```
public static void main(String[] args) throws Exception {
  int n, result;

  System.out.print("Enter an integer: ");
  n = Integer.parseInt(cin.nextLine());

  result = 1 - n % 2;

  System.out.println(result);
}
```

5. Solution

```
public static void main(String[] args) throws Exception {
  int days, hours, minutes, number, r, seconds, weeks;

  System.out.print("Enter an elapsed time in seconds: ");
  number = Integer.parseInt(cin.nextLine());

  weeks = (int)(number / 604800);  // 60 * 60 * 24 * 7 = 604800
  r = number % 604800;

  days = (int)(r / 86400);         // 60 * 60 * 24 = 86400
  r = r % 86400;

  hours = (int)(r / 3600);
  r = r % 3600;

  minutes = (int)(r / 60);
  seconds = r % 60;

  System.out.print(weeks + " week(s) " + days + " day(s) " + hours + " hour(s) ");
  System.out.println(minutes + " minute(s) and " + seconds + " second(s)");
}
```

6. Solution

```
public static void main(String[] args) throws Exception {
  int amount, r, usd1, usd10, usd20, usd5;

  System.out.print("Enter amount of money to withdraw: ");
  amount = Integer.parseInt(cin.nextLine());

  usd20 = (int)(amount / 20);
  r = amount % 20;
  usd10 = (int)(r / 10);
  r = r % 10;

  usd5 = (int)(r / 5);
  usd1 = r % 5;

  System.out.print(usd20 + " note(s) of $20 " + usd10 + " note(s) of $10 ");
  System.out.println(usd5 + " note(s) of $5 and " + usd1 + " note(s) of $1");
}
```

7. Solution

```
public static void main(String[] args) throws Exception {
  int distance, feet, inches, miles, r, steps, yards;

  System.out.print("Enter number of steps: ");
  steps = Integer.parseInt(cin.nextLine());

  distance = steps * 25;

  miles = (int)(distance / 63360);
  r = distance % 63360;

  yards = (int)(r / 36);
  r = r % 36;

  feet = (int)(r / 12);
  inches = r % 12;

  System.out.print(miles + " mile(s) " + yards + " yard(s) ");
  System.out.println(feet + " foot/feet and " + inches + " inch(es)");
}
```

Chapter 14

14.4 Review Questions: True/False

1. true
2. false
3. false
4. true
5. true
6. false
7. true
8. false
9. true
10. false
11. false
12. true
13. false
14. true
15. true
16. true
17. true

14.5 Review Questions: Multiple Choice

1. d
2. b
3. b
4. d
5. b
6. b
7. c
8. a
9. c
10. a

14.6 Review Exercises

1. Solution

```
public static void main(String[] args) throws Exception {
  String alphabet, randomWord;

  alphabet = "abcdefghijklmnopqrstuvwxyz";

  randomWord = ("" + alphabet.charAt((int)(Math.random() * 26))).toUpperCase() +
                     alphabet.charAt((int)(Math.random() * 26)) +
                     alphabet.charAt((int)(Math.random() * 26)) +
                     alphabet.charAt((int)(Math.random() * 26)) +
                     alphabet.charAt((int)(Math.random() * 26));

  System.out.println(randomWord);
}
```

2. Solution

```
public static void main(String[] args) throws Exception {
  String name,x , secretPassword;

  System.out.print("Enter name: ");
  name = cin.nextLine();

  x = name.toLowerCase().replace(" ", "");

  secretPassword = "" + x.charAt((int)(Math.random() * x.length())) +
                        x.charAt((int)(Math.random() * x.length())) +
                        x.charAt((int)(Math.random() * x.length())) +
                        (1000 + (int)(Math.random() * (9999 - 1000 + 1)));

  System.out.println(secretPassword);
}
```

3. Solution

First approach

```
public static void main(String[] args) throws Exception {
  int number, reversedNumber;
  String sNumber, digit1, digit2, digit3;

  System.out.print("Enter an three-digit integer: ");
  number = Integer.parseInt(cin.nextLine());

  sNumber = "" + number;

  digit1 = "" + sNumber.charAt(0);
  digit2 = "" + sNumber.charAt(1);
  digit3 = "" + sNumber.charAt(2);

  reversedNumber = 100 * Integer.parseInt(digit3) +
                    10 * Integer.parseInt(digit2) + Integer.parseInt(digit1);

  System.out.println(reversedNumber);
}
```

First approach

```
public static void main(String[] args) throws Exception {
  int number, reversedNumber;
  String sNumber;

  System.out.print("Enter an three-digit integer: ");
  number = Integer.parseInt(cin.nextLine());

  sNumber = "" + number;
  reversedNumber = Integer.parseInt("" + sNumber.charAt(2) +
                                          sNumber.charAt(1) + sNumber.charAt(0));
  System.out.println(reversedNumber);
}
```

4. Solution

```
public static void main(String[] args) throws Exception {
  String firstName, lastName, middleName;

  System.out.print("First name: ");
  firstName = cin.nextLine();
  System.out.print("Middle name: ");
  middleName = cin.nextLine();
  System.out.print("Last name: ");
  lastName = cin.nextLine();

  firstName = firstName.substring(0, 1).toUpperCase() + firstName.substring(1).toLowerCase();
  middleName = middleName.substring(0, 1).toUpperCase() + middleName.substring(1).toLowerCase();
  lastName = lastName.substring(0, 1).toUpperCase() + lastName.substring(1).toLowerCase();

  System.out.println(firstName + " " + middleName + " " + lastName);
  System.out.println(firstName + " " + middleName.charAt(0) + ". " + lastName);
  System.out.println(lastName + " " + firstName.charAt(0) + ".");
}
```

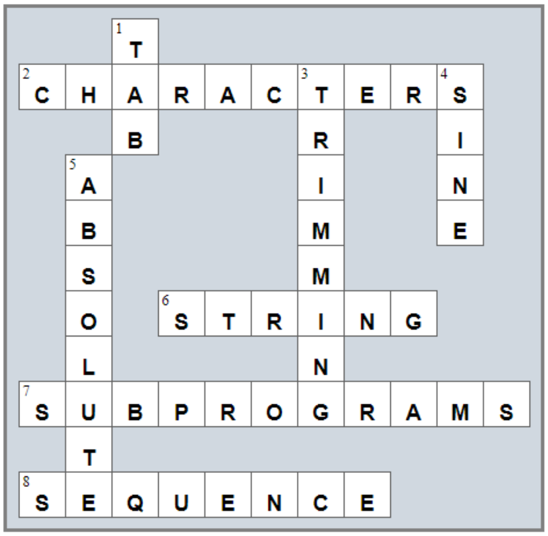
5. Solution

```
public static void main(String[] args) throws Exception {
  String word, abbreviation;

  System.out.print("Enter a long word: ");
  word = cin.nextLine();

  abbreviation = "" + word.charAt(0) + (word.length() - 2) + word.charAt(word.length() - 1);
  System.out.println(abbreviation);
}
```

Review in “Sequence Control Structures”

Review Crossword Puzzle

1.



		1 T								
2 C	H	A	R	A	C	3 T	E	R	4 S	
		B				R			I	
	5 A					I			N	
	B					M			E	
	S					M				
	O		6 S	T	R	I	N	G		
	L					N				
7 S	U	B	P	R	O	G	R	A	M	S
	T									
8 S	E	Q	U	E	N	C	E			

Chapter 15

15.9 Review Questions: True/False

1. true
2. false
3. false
4. false
5. false
6. false
7. false
8. true
9. true
10. true
11. true
12. true
13. true
14. true
15. false
16. false
17. false
18. true
19. true
20. false
21. true
22. true
23. true

15.10 Review Questions: Multiple Choice

1. b
2. a
3. a
4. a
5. c
6. d

15.11 Review Exercises

1. Solution

i. c, e, g
ii. a, j
iii. d, f
iv. b, h, i

2. Solution

a	b	c	a != 1	b > a	c / 2 > 2 * a
3	**−5**	**8**	true	false	false
1	**10**	**20**	false	true	true
−4	**−2**	**−9**	true	true	true

3. Solution

BE1 (Boolean Expression 1)	BE2 (Boolean Expression 2)	BE1 || BE2	BE1 && BE2	!(BE2)
false	**false**	false	false	true
false	**true**	true	false	false
true	**false**	true	false	true
true	**true**	true	true	false

4. Solution

a	b	c	a > 3 || c > b && c > 1	a > 3 && c > b || c > 1
4	**−6**	**2**	true	true

–3	**2**	**–4**	false	false
2	**5**	**5**	false	true

5. Solution

Expression	Value
`Math.pow(x + y, 3)`	8
`(x + y) / (Math.pow(x, 2) - 14)`	1
`x - 1 == y + 5`	`true`
`x > 2 && y == 1`	`false`
`x == 1 || y == -2 && !(flag == false)`	`true`
`!(x >= 3) && (x % 2 > 1)`	`false`

6. Solution

i. false
ii. true

7. Solution

i. `age < 12 && age != 8`

ii. `age >= 6 && age <= 9 || age == 11`

iii. `age > 7 && age != 10 && age != 12`

iv. `age == 6 || age == 9 || age == 11`

v. `age >= 6 && age <= 12 && age != 8`

vi. `age != 7 && age != 10`

8. Solution

i. `x != 4 || y == 3`

ii. `x + 4 > 0`

iii. `!(x <= 5) && y != 4`

iv. `x == false`

v. `!(x < 4 && z <= 4)`

vi. `x == 2 || x < -5`

9. Solution

i. `!(x < 4 || y == 10)`

ii. `!(x - 2 < 9)`

iii. `!(!(x < 2) && y == 4)`

iv. `!(x == false && y != 3)`

v. First approach: `!(!(x < 2 || y < 2))`
Second approach: `x < 2 || y < 2`

vi. `!(x == -2 || x > 2)`

Chapter 16

16.2 Review Questions: True/False

1. false
2. false
3. true
4. false
5. false
6. false
7. true
8. false

16.3 Review Questions: Multiple Choice

1. b
2. c
3. d
4. d
5. c

16.4 Review Exercises

1. Solution

The corrections/additions are in red

```
public static void main(String[] args) throws Exception {
  double x, y;

  x = Double.parseDouble(cin.nextLine());

  y = -5;
  if (x * y / 2 > 20) {
    y *= 2;
    x += 4 * x * x;
  }

  System.out.println(x + " " + y);
}
```

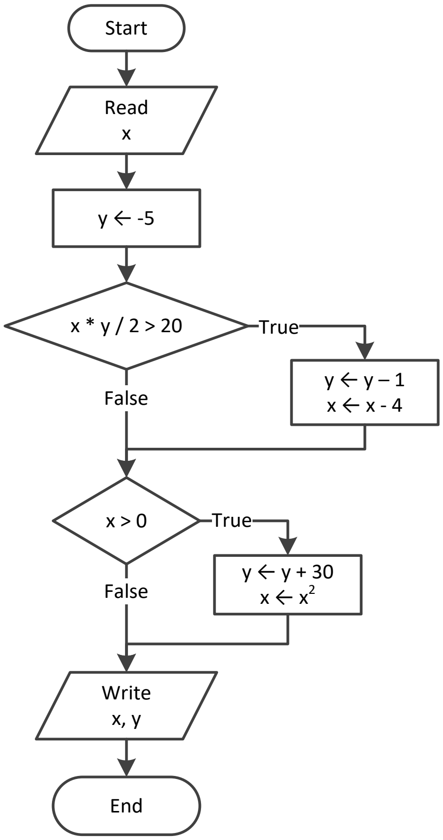
2. Solution

For the input value of 10

Step	Statement	x	y
1	`x = Double.parseDouble(cin.nextLine())`	**10.0**	?
2	`y = -5`	10.0	**–5.0**
3	`if (x * y / 2 > 20)`	false	
4	`if (x > 0)`	true	
5	`y += 30`	10.0	**25.0**
6	`x = Math.pow(x, 2)`	**100.0**	25.0
7	`System.out.println(x + ", " + y)`	It displays: 100.0, 25.0	

For the input value of −10

Step	Statement	x	y
1	`x = Double.parseDouble(cin.nextLine())`	**−10.0**	?
2	`y = -5`	−10.0	**−5.0**
3	`if (x * y / 2 > 20)`	true	
4	`y--`	−10.0	**−6.0**
5	`x -= 4`	**−14.0**	−6.0
6	`if (x > 0)`	false	
7	`System.out.println(x + ", " + y)`	It displays: −14.0, −6.0	



3. *Solution*

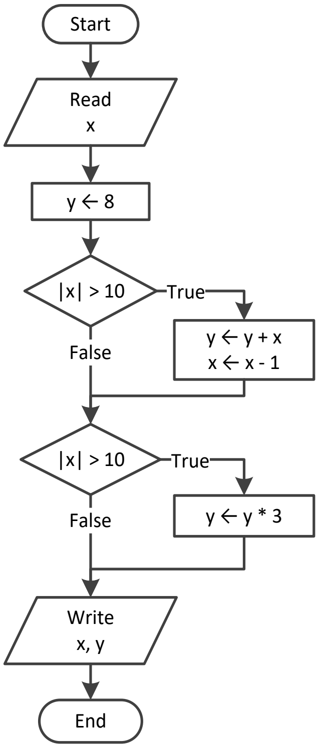
For the input value of −11

Step	Statement	x	y
1	`x = Integer.parseInt(cin.nextLine())`	**−11**	?
2	`y = 8`	−11	**8**
3	`if (Math.abs(x) > 10)`	true	
4	`y += x`	−11	**−3**
5	`x--`	**−12**	−3
6	`if (Math.abs(x) > 10)`	true	

7	System.out.println(x + ", " + y)	−12	**−9**
8	x = Integer.parseInt(cin.**nextLine**())	It displays: −12, −9	

For the input value of 11

Step	Statement	x	y
1	x = Integer.parseInt(cin.nextLine())	**11**	?
2	y = 8	11	**8**
3	if (Math.abs(x) > 10)	true	
4	y += x	11	**19**
5	x--	**10**	19
6	if (Math.abs(x) > 10)	false	
7	System.out.println(x + ", " + y)	It displays: 10, 19	



4. Solution

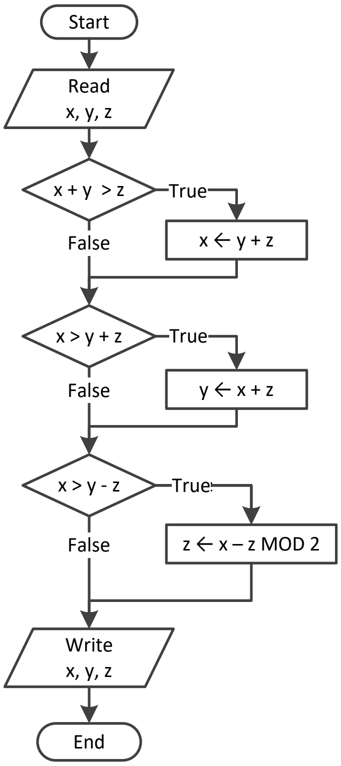
For input values of 1, 2 and 3

Step	Statement	x	y	z
1	x = Integer.parseInt(cin.nextLine())	**1**	?	?
2	y = Integer.parseInt(cin.nextLine())	1	**2**	?
3	z = Integer.parseInt(cin.nextLine())	1	**2**	**3**
4	if (x + y > z)	false		
5	if (x > y + z)	false		
6	if (x > y - z)	true		

7	`z = x - z % 2`	1	2	**0**
8	`System.out.println(x + ", " + y + ", " + z)`	It displays: 1, 2, 0		

For input values of 4, 2 and 1

Step	Statement	x	y	z
1	`x = Integer.parseInt(cin.nextLine())`	**4**	?	?
2	`y = Integer.parseInt(cin.nextLine())`	4	**2**	?
3	`z = Integer.parseInt(cin.nextLine())`	4	**2**	**1**
4	`if (x + y > z)`	true		
5	`x = y + z`	**3**	2	1
6	`if (x > y + z)`	false		
7	`if (x > y - z)`	true		
8	`z = x - z % 2`	3	2	**2**
9	`System.out.println(x + ", " + y + ", " + z)`	It displays: 3, 2, 2		



5. Solution

```
public static void main(String[] args) throws Exception {
  double x;

  System.out.print("Enter a number: ");
  x = Double.parseDouble(cin.nextLine());

  if (x > 0) {
    System.out.println("Positive");
  }
}
```

6. Solution

```
public static void main(String[] args) throws Exception {
  double x, y;

  System.out.print("Enter a number: ");
  x = Double.parseDouble(cin.nextLine());
  System.out.print("Enter a second number");
  y = Double.parseDouble(cin.nextLine());

  if (x > 0 && y > 0) {
    System.out.println("Both Positives");
  }
}
```

7. Solution

```
public static void main(String[] args) throws Exception {
  double x, y;

  System.out.print("Enter your age: ");
  x = Double.parseDouble(cin.nextLine());

  if (x > 14) {
    System.out.println("You can drive a car in Kansas (USA)");
  }
}
```

8. Solution

```
public static void main(String[] args) throws Exception {
  String str;

  System.out.print("Enter a string: ");
  str = cin.nextLine();

  if (str.equals(str.toUpperCase()) == true) {
    System.out.println("Uppercase");
  }
}
```

9. Solution

```
public static void main(String[] args) throws Exception {
  String str;

  System.out.print("Enter a string: ");
  str = cin.nextLine();
  if (str.length() > 20) {
    System.out.println("Many characters");
  }
}
```

10. Solution

```
public static void main(String[] args) throws Exception {
  double n1, n2, n3, n4;

  System.out.print("Enter 1st number: ");
  n1 = Double.parseDouble(cin.nextLine());
  System.out.print("Enter 2nd number: ");
  n2 = Double.parseDouble(cin.nextLine());
  System.out.print("Enter 3rd number: ");
  n3 = Double.parseDouble(cin.nextLine());
  System.out.print("Enter 4th number: ");
  n4 = Double.parseDouble(cin.nextLine());

  if (n1 < 0 || n2 < 0 || n3 < 0 || n4 < 0) {
    System.out.println("Among the provided numbers, there is a negative one!");
  }
}
```

11. Solution

```
public static void main(String[] args) throws Exception {
  double a, b, c;

  System.out.print("Enter 1st number: ");
  a = Double.parseDouble(cin.nextLine());
  System.out.print("Enter 2nd number: ");
  b = Double.parseDouble(cin.nextLine());

  if (a > b) {
    c = a;
    a = b;
    b = c;
  }

  System.out.println(a + ", " + b);
}
```

12. Solution

```
public static void main(String[] args) throws Exception {
  double average, t1, t2, t3;

  System.out.print("Enter 1st temperature: ");
  t1 = Double.parseDouble(cin.nextLine());
  System.out.print("Enter 2nd temperature: ");
  t2 = Double.parseDouble(cin.nextLine());
  System.out.print("Enter 3rd temperature: ");
  t3 = Double.parseDouble(cin.nextLine());

  average = (t1 + t2 + t3) / 3;

  if (average > 60) {
    System.out.println("Heat Wave");
  }
}
```

Chapter 17

17.2 Review Questions: True/False

1. false
2. true
3. true
4. false
5. false
6. false

17.3 Review Questions: Multiple Choice

1. b
2. c
3. c

17.4 Review Exercises

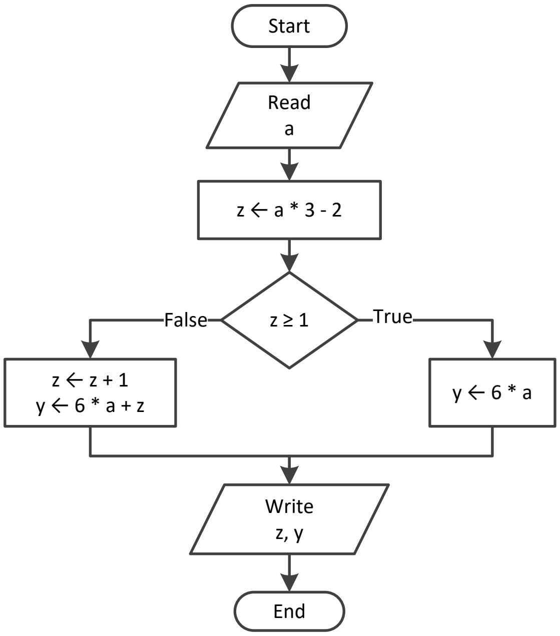
1. Solution

For input value of 3

Step	Statement	a	y	z
1	`a = Double.parseDouble(cin.nextLine())`	**3.0**	?	?
2	`z = a * 3 - 2`	3.0	?	**7.0**
3	`if (z >= 1)`	true		
4	`y = 6 * a`	3.0	**18.0**	7.0
5	`System.out.println(z + ", " + y)`	It displays: 7.0 18.0		

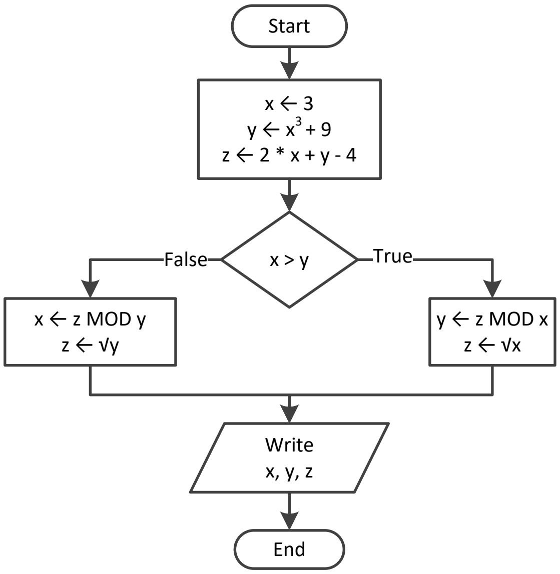
For input value of 0.5

Step	Statement	a	y	z
1	`a = Double.parseDouble(cin.nextLine())`	**0.5**	?	?
2	`z = a * 3 - 2`	0.5	?	**−0.5**
3	`if (z >= 1)`	false		
4	`z++`	0.5	?	**0.5**
5	`y = 6 * a + z`	0.5	**3.5**	0.5
6	`System.out.println(z + ", " + y)`	It displays: 0.5, 3.5		



2. *Solution*

Step	Statement	x	y	z
1	`x = 3`	**3.0**	?	?
2	`y = Math.pow(x, 3) + 9`	3.0	**36.0**	?
3	`z = 2 * x + y - 4`	3.0	36.0	**38.0**
4	`if (x > y)`	false		
5	`x = z % y`	**2.0**	36.0	38.0
6	`z = Math.sqrt(y)`	2.0	36.0	**6.0**
7	`System.out.println(x + ", " + y + ", " + z)`	It displays: 2.0, 36.0, 6.0		



3. Solution

```
public static void main(String[] args) throws Exception {
  double w, x, y, z;

  x = Double.parseDouble(cin.nextLine());
  w = x * 3 - 15;
  z = (w + 7) * (x + 4) - 10;
  if (w > x && z > x) {
    x++;
    y = x / 2 + 4;
  }
  else {
    y = x / 4 + 2;
  }
  System.out.println(y);
}
```

For input value of 10

Step	Statement	x	y	w	z
1	`x = Double.parseDouble(cin.nextLine())`	**10.0**	?	?	?
2	`w = x * 3 - 15`	10.0	?	**15.0**	?
3	`z = (w + 7) * (x + 4) - 10`	10.0	?	15.0	**298.0**
4	`if (w > x && z > x)`	true			
5	`x++`	**11.0**	?	15.0	298.0
6	`y = x / 2 + 4`	11.0	**9.5**	15.0	298.0
7	`System.out.println(y)`	It displays: 9.5			

For input value of 2

Step	Statement	x	y	w	z
1	`x = Double.parseDouble(cin.nextLine())`	**2.0**	?	?	?
2	`w = x * 3 - 15`	2.0	?	**–9.0**	?
3	`z = (w + 7) * (x + 4) - 10`	2.0	?	–9.0	**–22.0**
4	`if (w > x && z > x)`	false			
5	`y = x / 4 + 2`	2.0	**2.5**	–9.0	–22.0
6	`System.out.println(y)`	It displays: 2.5			

4. Solution

```
public static void main(String[] args) throws Exception {
  double num;

  System.out.print("Enter a number: ");
  num = Double.parseDouble(cin.nextLine());

  if (num > 100) {
    System.out.println("Provided number is greater than 100");
  }
  else {
    System.out.println("Provided number is less than or equal to 100");
  }
}
```

5. Solution

```
public static void main(String[] args) throws Exception {
  double num;

  System.out.print("Enter a number: ");
  num = Double.parseDouble(cin.nextLine());

  if (num >= 0 && num <= 100) {
    System.out.println("Provided number is between 0 and 100");
  }
  else {
    System.out.println("Provided number is not between 0 and 100");
  }
}
```

6. Solution

```
public static void main(String[] args) throws Exception {
  String name1, name2;
  int goals1, goals2;

  System.out.print("Enter team name 1: ");
  name1 = cin.nextLine();
  System.out.print("Enter team name 2: ");
  name2 = cin.nextLine();

  System.out.print("Enter goals " + name1 + " scored: ");
  goals1 = Integer.parseInt(cin.nextLine());
  System.out.print("Enter goals " + name2 + " scored: ");
  goals2 = Integer.parseInt(cin.nextLine());

  if (goals1 > goals2) {
    System.out.println("Winner: " + name1);
  }
  else {
    System.out.println("Winner: " + name2);
  }
}
```

7. Solution

```
public static void main(String[] args) throws Exception {
  int x;

  x = Integer.parseInt(cin.nextLine());
  if (x % 6 == 0) {
    System.out.println(x + " is a multiple of 6");
  }
  else {
    System.out.println(x + " is not a multiple of 6");
  }
}
```

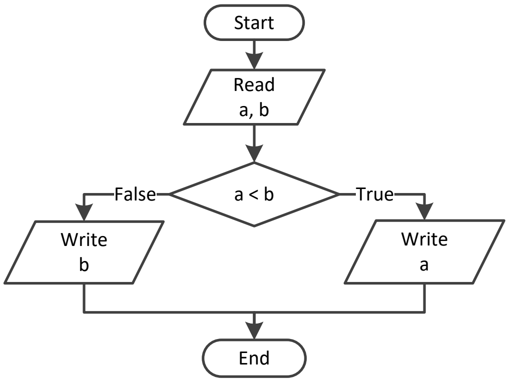
8. Solution

```
public static void main(String[] args) throws Exception {
  int x;

  x = Integer.parseInt(cin.nextLine());
  if (x % 6 == 0 || x % 7 == 0) {
    System.out.println(x + " is a multiple of 6 or a multiple of 7");
  }
  else {
    System.out.println(x + " is neither a multiple of 6 nor a multiple of 7");
  }
}
```

9. Solution

```
public static void main(String[] args) throws Exception {
  int x, y;

  x = Integer.parseInt(cin.nextLine());

  y = x % 4;
  if (y == 0) {
    System.out.println(x + " is a multiple of 4");
  }
  else {
    System.out.println(x + " is not a multiple of 4");
  }

  System.out.println("The structure is: " + x + " = " + (int)(x / 4) + " x 4 + " + y);
}
```

10. Solution



```
public static void main(String[] args) throws Exception {
  double a, b;

  a = Double.parseDouble(cin.nextLine());
  b = Double.parseDouble(cin.nextLine());

  if (a < b) {
    System.out.println(a);
  }
  else {
    System.out.println(b);
  }
}
```

11. Solution

```
public static void main(String[] args) throws Exception {
  double a, b, c;

  a = Double.parseDouble(cin.nextLine());
  b = Double.parseDouble(cin.nextLine());
  c = Double.parseDouble(cin.nextLine());

  if (a < b + c && b < a + c && c < a + b) {
    System.out.println("Provided numbers can be lengths of the three sides of a triangle");
  }
  else {
    System.out.println("Provided numbers cannot be lengths of the three sides of a triangle");
  }
}
```

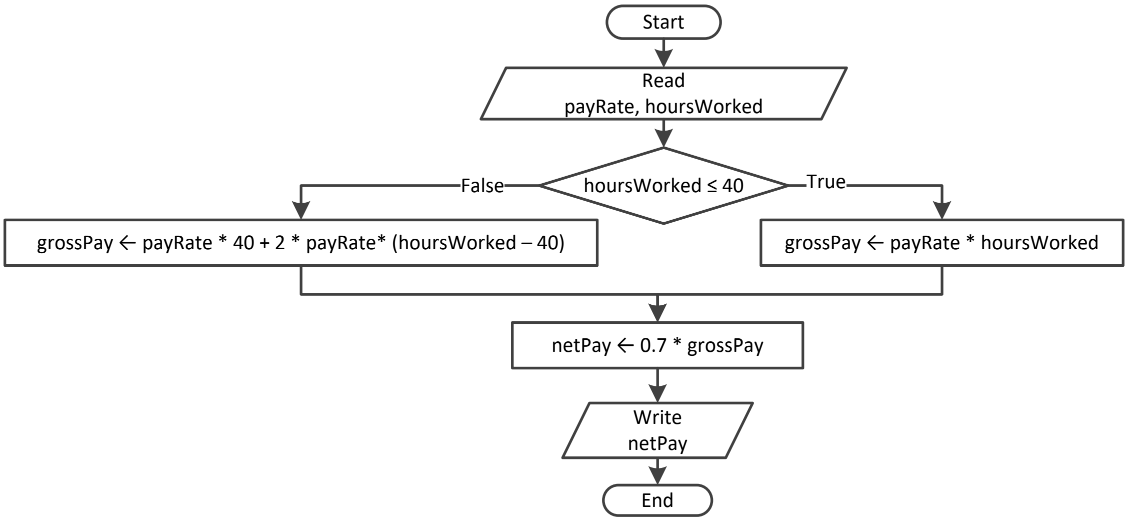
12. Solution

```
public static void main(String[] args) throws Exception {
  double a, b, c;

  a = Double.parseDouble(cin.nextLine());
  b = Double.parseDouble(cin.nextLine());
  c = Double.parseDouble(cin.nextLine());

  if (Math.pow(a, 2) == Math.pow(b, 2) + Math.pow(c, 2) ||
      Math.pow(b, 2) == Math.pow(a, 2) + Math.pow(c, 2) ||
      Math.pow(c, 2) == Math.pow(a, 2) + Math.pow(b, 2)) {
    System.out.println("Provided numbers can be lengths of the three sides of a right triangle");
  }
  else {
    System.out.println("Provided numbers cannot be lengths of the three sides of a right triangle");
  }
}
```

13. Solution

```
public static void main(String[] args) throws Exception {
  double a, average, b, c;

  System.out.print("Enter 1st jump in meters: ");
  a = Double.parseDouble(cin.nextLine());
  System.out.print("Enter 2nd jump in meters: ");
  b = Double.parseDouble(cin.nextLine());
  System.out.print("Enter 3rd jump in meters: ");
  c = Double.parseDouble(cin.nextLine());

  average = (a + b + c) / 3;

  if (average >= 8) {
    System.out.println("Qualified");
  }
  else {
    System.out.println("Disqualified");
  }
}
```

14. Solution



```
public static void main(String[] args) throws Exception {
  double grossPay, netPay, payRate;
  int hoursWorked;

  payRate = Double.parseDouble(cin.nextLine());
  hoursWorked = Integer.parseInt(cin.nextLine());

  if (hoursWorked <= 40) {
    grossPay = payRate * hoursWorked;
  }
  else {
    grossPay = payRate * 40 + 2 * payRate * (hoursWorked - 40);
  }

  netPay = 0.7 * grossPay;
  System.out.println(netPay);
}
```

15. Solution

```
public static void main(String[] args) throws Exception {
  int miles, milesLeft, r;

  System.out.print("Enter miles traveled: ");
  miles = Integer.parseInt(cin.nextLine());

  r = miles % 12000;

  if (r > 6000) {
    milesLeft = 12000 - r;
    System.out.println("Your car needs a major service in " + milesLeft + " miles");
  }
  else {
    milesLeft = 6000 - r;
    System.out.println("Your car needs a minor service in " + milesLeft + " miles");
  }
}
```

16. Solution

```
public static void main(String[] args) throws Exception {
  double a1, a2, s1, s2, t;

  System.out.print("Enter the time the two cars traveled: ");
  t = Double.parseDouble(cin.nextLine());
  System.out.print("Enter the accelaration for car A: ");
  a1 = Double.parseDouble(cin.nextLine());
  System.out.print("Enter the accelaration for car B: ");
  a2 = Double.parseDouble(cin.nextLine());

  s1 = 0.5 * a1 * Math.pow(t, 2);
  s2 = 0.5 * a2 * Math.pow(t, 2);

  System.out.println("Distance between them: " + Math.abs(s1 - s2) + " meters");

  if (s1 > s2) {
    System.out.println("Car A is first");
  }
  else {
    System.out.println("Car B is first");
  }
}
```

Chapter 18

18.2 Review Questions: True/False

1. true
2. false
3. false
4. false
5. false
6. true
7. false
8. true

18.3 Review Exercises

1. Solution

For input value of 5

Step	Statement	q	b
1	`q = Integer.parseInt(cin.nextLine())`	**5**	?
2	`if (q > 0 && q <= 50)`	true	
3	`b = 1`	5	**1**
4	`System.out.println(b)`	It displays: 1	

For input value of 150

Step	Statement	q	b
1	`q = Integer.parseInt(cin.nextLine())`	**150**	?
2	`if (q > 0 && q <= 50)`	false	
3	`else if (q > 50 && q <= 100)`	false	
4	`else if (q > 100 && q <= 200)`	true	
5	`b = 3`	150	**3**
6	`System.out.println(b)`	It displays: 3	

For input value of 250

Step	Statement	q	b
1	`q = Integer.parseInt(cin.nextLine())`	**250**	?
2	`if (q > 0 && q <= 50)`	false	
3	`else if (q > 50 && q <= 100)`	false	
4	`else if (q > 100 && q <= 200)`	false	
5	`b = 4`	250	**4**
6	`System.out.println(b)`	It displays: 4	

For input value of –1

Step	Statement	q	b
1	`q = Integer.parseInt(cin.nextLine())`	**–1**	?
2	`if (q > 0 && q <= 50)`	false	
3	`else if (q > 50 && q <= 100)`	false	
4	`else if (q > 100 && q <= 200)`	false	

5	`b = 4`	−1	**4**
6	`System.out.println(b)`	It displays: 4	

2. Solution

For input value of 5

Step	Statement	amount	discount	payment
1	`amount = Double.parseDouble(cin.nextLine())`	**5.0**	?	?
2	`discount = 0`	5.0	**0.0**	?
3	`if (amount < 20)`	true		
4	`discount = 0`	5.0	**0.0**	?
5	`payment = amount - amount * discount / 100`	5.0	0.0	**5.0**
6	`System.out.println(discount + ", " + payment)`	It displays: 0.0, 5.0		

For input value of 150

Step	Statement	amount	discount	payment
1	`amount = Double.parseDouble(cin.nextLine())`	**150.0**	?	?
2	`discount = 0`	150.0	**0.0**	?
3	`if (amount < 20)`	false		
4	`else if (amount >=20 && amount < 60)`	false		
5	`else if (amount >= 60 && amount < 100)`	false		
6	`else if (amount >= 100)`	true		
7	`discount = 15`	150.0	**15.0**	?
8	`payment = amount - amount * discount / 100`	150.0	15.0	**127.5**
9	`System.out.println(discount + ", " + payment)`	It displays: 15.0, 127.5		

For input value of −1

Step	Statement	amount	discount	payment
1	`amount = Double.parseDouble(cin.nextLine())`	**−1.0**	?	?
2	`discount = 0`	−1.0	**0.0**	?
3	`if (amount < 20)`	true		
4	`discount = 0`	−1.0	**0.0**	?
5	`payment = amount - amount * discount / 100`	−1.0	0.0	**−1.0**
6	`System.out.println(discount + ", " + payment)`	It displays: 0.0, −1.0		

3. Solution

```
public static void main(String[] args) throws Exception {
  double a, y;

  a = Double.parseDouble(cin.nextLine());
  if (a < 1) {
    y = 5 + a;
    System.out.println(y);
  }
  else if (a < 5) {
    y = 23 / a;
    System.out.println(y);
  }
  else if (a < 10) {
    y = 5 * a;
    System.out.println(y);
  }
  else {
    System.out.println("Error!");
  }
}
```

4. Solution

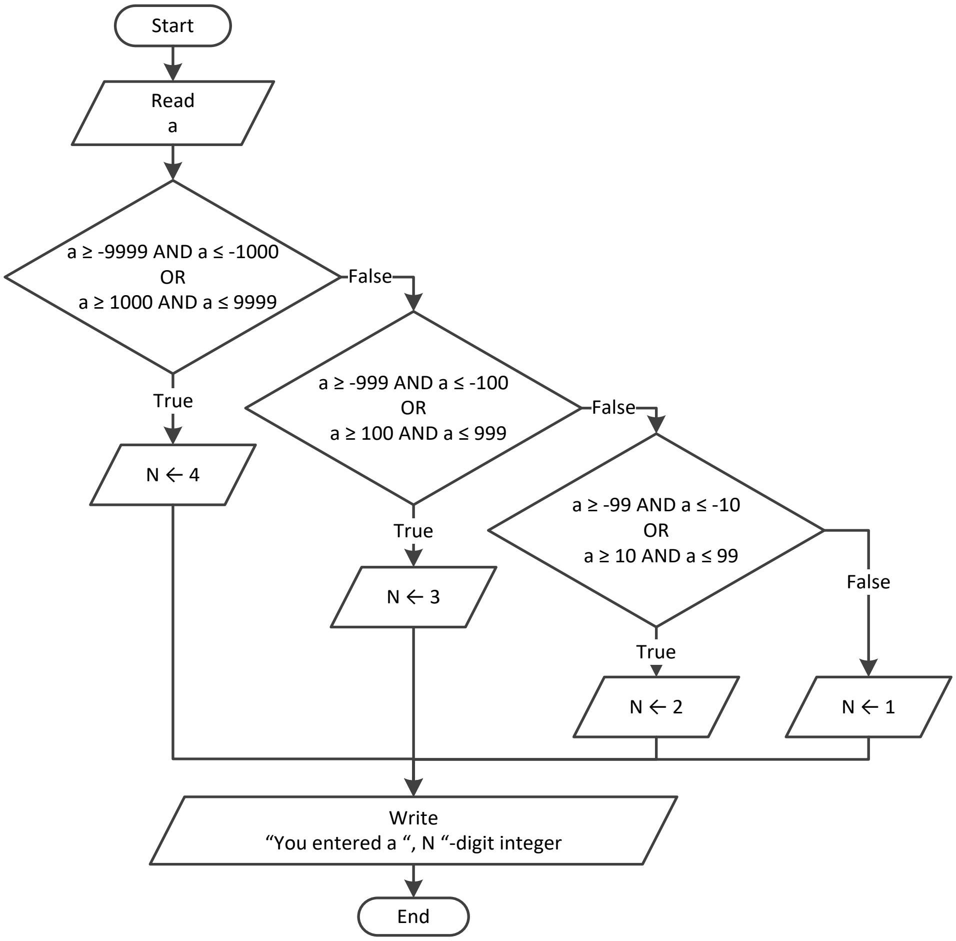
```
public static void main(String[] args) throws Exception {
  int n1, n2;

  System.out.print("Enter an integer: ");
  n1 = Integer.parseInt(cin.nextLine());
  System.out.print("Enter a second integer: ");
  n2 = Integer.parseInt(cin.nextLine());

  if (n1 % 2 == 0 && n2 % 2 == 0) {
    System.out.println("Both numbers are evens");
  }
  else if (n1 % 2 != 0 && n2 % 2 != 0) {
    System.out.println("Both numbers are odds");
  }
  else {
    System.out.println("Nothing special!");
  }
}
```

5. Solution

```
public static void main(String[] args) throws Exception {
  String name1, name2;
  int goals1, goals2;

  System.out.print("Enter team name 1: ");
  name1 = cin.nextLine();
  System.out.print("Enter team name 2: ");
  name2 = cin.nextLine();

  System.out.print("Enter goals " + name1 + " scored: ");
  goals1 = Integer.parseInt(cin.nextLine());
  System.out.print("Enter goals " + name2 + " scored: ");
  goals2 = Integer.parseInt(cin.nextLine());

  if (goals1 > goals2) {
    System.out.println("Winner: " + name1);
  }
  else if (goals2 > goals1)  {
    System.out.println("Winner: " + name2);
  }
  else {
    System.out.println("It's a tie!");
  }
}
```

6. Solution

First approach



```
public static void main(String[] args) throws Exception {
  int a, n;

  a = Integer.parseInt(cin.nextLine());

  if (a >= -9999 && a <= -1000 || a >= 1000 && a <= 9999) {
    n = 4;
  }
  else if (a >= -999 && a <= -100 || a >= 100 && a <= 999) {
    n = 3;
  }
  else if (a >= -99 && a <= -10 || a >= 10 && a <= 99) {
    n = 2;
  }
  else {
    n = 1;
  }

  System.out.println("You entered a " + n + "-digit integer");
}
```

Second approach

```
public static void main(String[] args) throws Exception {
  int a, n;

  a = Math.abs(Integer.parseInt(cin.nextLine()));

  if (a >= 1000 && a <= 9999) {
    n = 4;
  }
  else if (a >= 100 && a <= 999) {
    n = 3;
  }
  else if (a >= 10 && a <= 99) {
    n = 2;
  }
  else {
    n = 1;
  }

  System.out.println("You entered a " + n + "-digit integer");
}
```

Third approach

```
public static void main(String[] args) throws Exception {
  int a;
  String aString;

  a = Integer.parseInt(cin.nextLine());

  aString = "" + Math.abs(a);
  System.out.println("You entered a " + aString.length() + "-digit integer");
}
```

7. Solution

First approach

```
public static void main(String[] args) throws Exception {
  int a, n;
  a = Integer.parseInt(cin.nextLine());

  if (a >= -9999 && a <= -1000 || a >= 1000 && a <= 9999) {
    System.out.println("You entered a 4-digit integer");
  }
  else if (a >= -999 && a <= -100 || a >= 100 && a <= 999) {
    System.out.println("You entered a 3-digit integer");
  }
  else if (a >= -99 && a <= -10 || a >= 10 && a <= 99) {
    System.out.println("You entered a 2-digit integer");
  }
  else if (a >= -9 && a <= 9) {   //Include the value of zero
    System.out.println("You entered a 1-digit integer");
  }
  else {
    System.out.println("Error: Invalid value!");
  }
}
```

Second approach

```
public static void main(String[] args) throws Exception {
  int a, n;

  a = Math.abs(Integer.parseInt(cin.nextLine()));

  if (a >= 1000 && a <= 9999) {
    System.out.println("You entered a 4-digit integer");
  }
  else if (a >= 100 && a <= 999) {
    System.out.println("You entered a 3-digit integer");
  }
  else if (a >= 10 && a <= 99) {
    System.out.println("You entered a 2-digit integer");
  }
  else if (a >= 0 && a <= 9) {
    System.out.println("You entered a 1-digit integer");
  }
  else {
    System.out.println("Error: Invalid value!");
  }
}
```

Third approach

```
public static void main(String[] args) throws Exception {
  int a;
  String aString;

  a = Integer.parseInt(cin.nextLine());

  if (a >= -9999 && a <= 9999) {
    aString = "" + Math.abs(a);
    System.out.println("You entered a " + aString.length() + "-digit integer");
  }
  else {
    System.out.println("Error: Invalid value!");
  }
}
```

8. Solution

```
public static void main(String[] args) throws Exception {
  double cad, eur, gbp, jpy, usd;
  int ch;

  System.out.println("1. Convert USD to Euro (EUR)");
  System.out.println("2. Convert USD to British Pound Sterling (GBP)");
  System.out.println("3. Convert USD to Japanese Yen (JPY)");
  System.out.println("4. Convert USD to Canadian Dollar (CAD)");

  System.out.print("Enter a choice: ");
  ch = Integer.parseInt(cin.nextLine());

  System.out.print("Enter an amount in US dollars: ");
  usd = Double.parseDouble(cin.nextLine());

  if (ch == 1) {
    eur = usd * 0.94;
    System.out.println("$" + usd + " = " + eur + " EUR");
  }
  else if (ch == 2) {
    gbp = usd * 0.81;
    System.out.println("$" + usd + " = " + gbp + " GBP");
  }
  else if (ch == 3) {
    jpy = usd * 149.11;
    System.out.println("$" + usd + " = " + jpy + " JPY");
  }
  else {
    cad = usd * 1.36;
    System.out.println("$" + usd + " = " + cad + " CAD");
  }
}
```

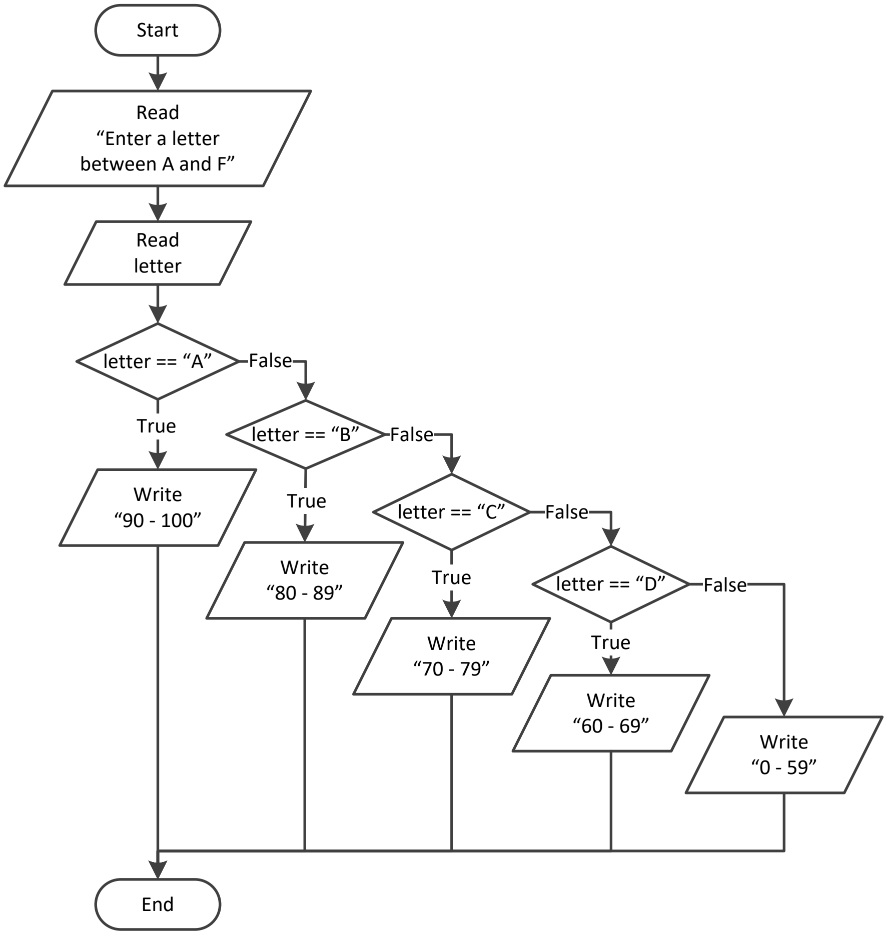
9. Solution

```
public static void main(String[] args) throws Exception {
  int m;

  System.out.print("Enter the number of a month between 1 and 12: ");
  m = Integer.parseInt(cin.nextLine());

  if (m <= 2 || m == 12) {
    System.out.println("Winter");
  }
  else if (m <= 5) {
    System.out.println("Spring");
  }
  else if (m <= 8) {
    System.out.println("Summer");
  }
  else {
    System.out.println("Fall (Autumn)");
  }
}
```

10. Solution

```
public static void main(String[] args) throws Exception {
  int m;

  System.out.print("Enter the number of a month between 1 and 12: ");
  m = Integer.parseInt(cin.nextLine());

  if (m < 1 || m > 12) {
    System.out.println("Error: Invalid value!");
  else if (m <= 2 || m == 12) {
    System.out.println("Winter");
  }
  else if (m <= 5) {
    System.out.println("Spring");
  }
  else if (m <= 8) {
    System.out.println("Summer");
  }
  else {
    System.out.println("Fall (Autumn)");
  }
}
```

11. Solution



```
public static void main(String[] args) throws Exception {
  String letter;

  System.out.print("Enter a letter between A and F: ");
  letter = cin.nextLine();

  if (letter.equals("A") == true) {
    System.out.println("90 - 100");
  }
  else if (letter.equals("B") == true) {
    System.out.println("80 - 89");
  }
  else if (letter.equals("C") == true) {
    System.out.println("70 - 79");
  }
  else if (letter.equals("D") == true) {
    System.out.println("60 - 69");
  }
  else {
    System.out.println("0 - 59");
  }
}
```

12. Solution

```
public static void main(String[] args) throws Exception {
  double n;
  int x, y;
  String number;

  System.out.print("Enter a number between 0.0 and 9.9: ");
  n = Double.parseDouble(cin.nextLine());

  x = (int)(n);
  y = (int)(n * 10) % 10;

  number = "";

  if (x == 1) {
    number += "One";
  }
  else if (x == 2) {
    number += "Two";
  }
  else if (x == 3) {
    number += "Three";
  }
  else if (x == 4) {
    number += "Four";
  }
  else if (x == 5) {
    number += "five";
  }
  else if (x == 6) {
    number += "six";
  }
  else if (x == 7) {
    number += "seven";
  }
  else if (x == 8) {
    number += "eight";
  }
  else if (x == 9) {
    number += "nine";
  }
  else if (x == 0) {
    number += "zero";
  }

  number += " point ";

  if (y == 1) {
    number += "one";
  }
  else if (y == 2) {
    number += "two";
  }
  else if (y == 3) {
    number += "three";
  }
  else if (y == 4) {
    number += "four";
  }
  else if (y == 5) {
    number += "five";
  }
  else if (y == 6) {
    number += "six";
  }
  else if (y == 7) {
    number += "seven";
  }
  else if (y == 8) {
    number += "eight";
  }
  else if (y == 9) {
    number += "nine";
  }
  else if (y == 0) {
    number += "zero";
  }

  System.out.println(number);
}
```

Chapter 19

19.2 Review Questions: True/False

1. true
2. false
3. true
4. false
5. true
6. false
7. true

19.3 Review Exercises

1. Solution

For input value of 1

Step	Statement	a	x	y
1	`a = Integer.parseInt(cin.nextLine())`	**1**	?	?
2	`x = 0`	1	**0**	?
3	`y = 0`	1	0	**0**
4	`case a == 1`	true		
5	`x = x + 5`	1	**5**	0
6	`y = y + 5`	1	5	**5**
7	`System.out.println(x + ", " + y)`	It displays: 5, 5		

For input value of 3

Step	Statement	a	x	y
1	`a = Integer.parseInt(cin.nextLine())`	**3**	?	?
2	`x = 0`	3	**0**	?
3	`y = 0`	3	0	**0**
4	`case a == 1`	false		
5	`case a == 2`	false		
6	`case a == 3`	true		
7	`x = x - 9`	3	**−9**	0
8	`y = y + 3`	3	−9	**3**
9	`System.out.println(x + ", " + y)`	It displays: −9, 3		

For input value of 250

Step	Statement	a	x	y
1	`a = Integer.parseInt(cin.nextLine())`	**250**	?	?
2	`x = 0`	250	**0**	?
3	`y = 0`	250	0	**0**
4	`case a == 1`	false		
5	`case a == 2`	false		
6	`case a == 3`	false		

7	`x = x + 3`	250	**3**	0
8	`y++`	250	3	**1**
9	`System.out.println(x + ", " + y)`	It displays: 3, 1		

2. *Solution*

For input values of 10, 2, 5

Step	Statement	a	x	y
1	`a = Integer.parseInt(cin.nextLine())`	**10**	?	?
2	`x = Integer.parseInt(cin.nextLine())`	10	**2**	?
3	`y = Double.parseDouble(cin.nextLine())`	10	2	**5.0**
4	`case a == 10`	true		
5	`x = x % 2`	10	**0**	5.0
6	`y = Math.pow(y, 2)`	10	0	**25.0**
7	`System.out.println(x + ", " + y)`	It displays: 0, 25.0		

For input values of 5, 2, 3

Step	Statement	a	x	y
1	`a = Integer.parseInt(cin.nextLine())`	**5**	?	?
2	`x = Integer.parseInt(cin.nextLine())`	5	**2**	?
3	`y = Double.parseDouble(cin.nextLine())`	5	2	**3.0**
4	`case a == 10`	false		
5	`case a == 3`	false		
6	`case a == 5`	true		
7	`x = x + 4`	5	**6**	3.0
8	`y += 7`	5	6	**10.0**
9	`System.out.println(x + ", " + y)`	It displays: 6, 10.0		

For input values of 4, 6, 2

Step	Statement	a	x	y
1	`a = Integer.parseInt(cin.nextLine())`	**4**	?	?
2	`x = Integer.parseInt(cin.nextLine())`	4	**6**	?
3	`y = Double.parseDouble(cin.nextLine())`	4	6	**2.0**
4	`case a == 10`	false		
5	`case a == 3`	false		
6	`case a == 5`	false		
7	`x -= 3`	4	**3**	2.0
8	`y++`	4	3	**3.0**
9	`System.out.println(x + ", " + y)`	It displays: 3, 3.0		

3. Solution

```
public static void main(String[] args) throws Exception {
  String name;

  System.out.print("Enter the name of a month: ");
  name = cin.nextLine();

  switch (name) {
    case "January":
      System.out.println("1");
      break;
    case "February":
      System.out.println("2");
      break;
    case "March":
      System.out.println("3");
      break;
    case "April":
      System.out.println("4");
      break;
    case "May":
      System.out.println("5");
      break;
    case "June":
      System.out.println("6");
      break;
    case "July":
      System.out.println("7");
      break;
    case "August":
      System.out.println("8");
      break;
    case "September":
      System.out.println("9");
      break;
    case "October":
      System.out.println("10");
      break;
    case "November":
      System.out.println("11");
      break;
    case "December":
      System.out.println("12");
      break;
    default:
      System.out.println("Error");
  }
}
```

4. Solution

```
public static void main(String[] args) throws Exception {
  int choice;
  double feet, inches, miles, yards;

  System.out.println("1. Convert Miles to Yards");
  System.out.println("2. Convert Miles to Feet");
  System.out.println("3. Convert Miles to Inches");

  System.out.print("Enter a choice: ");
  choice = Integer.parseInt(cin.nextLine());

  switch (choice) {
    case 1:
      System.out.print("Enter miles: ");
      miles = Double.parseDouble(cin.nextLine());
      yards = miles * 1760;
      System.out.println(miles + " miles = " + yards + " yards");
      break;
    case 2:
      System.out.print("Enter miles: ");
      miles = Double.parseDouble(cin.nextLine());
      feet = miles * 5280;
      System.out.println(miles + " miles = " + feet + " feet");
      break;
    case 3:
      System.out.print("Enter miles: ");
      miles = Double.parseDouble(cin.nextLine());
      inches = miles * 63360;
      System.out.println(miles + " miles = " + inches + " inches");
      break;
    default:
      System.out.println("Invalid choice!");
  }
}
```

5. Solution

```
public static void main(String[] args) throws Exception {
  String roman;

  System.out.print("Enter a Roman numeral between I and X: ");
  roman = cin.nextLine();

  switch (roman) {
    case "I":
      System.out.println("1");
      break;
    case "II":
      System.out.println("2");
      break;
    case "III":
      System.out.println("3");
      break;
    case "IV":
      System.out.println("4");
      break;
    case "V":
      System.out.println("5");
      break;
    case "VI":
      System.out.println("6");
      break;
    case "VII":
      System.out.println("7");
      break;
    case "VIII":
      System.out.println("8");
      break;
    case "IX":
      System.out.println("9");
      break;
    case "X":
      System.out.println("10");
      break;
    default:
      System.out.println("Error");
  }
}
```

6. Solution

```
public static void main(String[] args) throws Exception {
  int bottles;

  System.out.print("Enter the total number of wine bottles purchased in a month: ");
  bottles = Integer.parseInt(cin.nextLine());

  switch (bottles) {
    case 1:
      System.out.println("You are awarded 3 points");
      break;
    case 2:
      System.out.println("You are awarded 10 points");
      break;
    case 3:
      System.out.println("You are awarded 20 points");
      break;
    default:
      System.out.println("You are awarded 45 points");
  }
}
```

7. Solution

```
public static void main(String[] args) throws Exception {
  int i;
  String name;

  System.out.print("Enter your name: ");
  name = cin.nextLine();

  i = (int)(Math.random() * 3);

  switch (i) {
    case 0:
      System.out.println("Hello " + name + "!");
      break;
    case 1:
      System.out.println("Hi " + name + "!");
      break;
    case 2:
      System.out.println("What's up " + name + "!");
      break;
  }
}
```

8. Solution

```
public static void main(String[] args) throws Exception {
  String num;

  num = cin.nextLine();

  switch (num) {
    case "zero":
      System.out.println(0);
      break;
    case "one":
      System.out.println(1);
      break;
    case "two":
      System.out.println(2);
      break;
    case "three":
      System.out.println(3);
      break;
    case "four":
      System.out.println(4);
      break;
    case "five":
      System.out.println(5);
      break;
    case "six":
      System.out.println(6);
      break;
    case "seven":
      System.out.println(7);
      break;
    case "eight":
      System.out.println(8);
      break;
    case "nine":
      System.out.println(9);
      break;
    default:
      System.out.println("I don't know this number!");
  }
}
```

9. Solution

```
public static void main(String[] args) throws Exception {
  int b;

  System.out.print("Enter Beaufort number: ");
  b = Integer.parseInt(cin.nextLine());

  switch (b) {
    case 0:
      System.out.println("Calm");
      break;
    case 1:
      System.out.println("Light Air");
      break;
    case 2:
      System.out.println("Light breeze");
      break;
    case 3:
      System.out.println("Gentle breeze");
      break;
    case 4:
      System.out.println("Moderate breeze");
      break;
    case 5:
      System.out.println("Fresh breeze");
      break;
    case 6:
      System.out.println("Strong breeze");
      break;
    case 7:
      System.out.println("Moderate gale");
      break;
    case 8:
      System.out.println("Gale");
      break;
    case 9:
      System.out.println("Strong gale");
      break;
    case 10:
      System.out.println("Storm");
      break;
    case 11:
      System.out.println("Violent storm");
      break;
    case 12:
      System.out.println("Hurricane force");
      break;
    default:
      System.out.println("Invalid Beaufort number!");
  }
}
```

Chapter 20

20.2 Review Questions: True/False

1. true
2. true
3. false
4. false

20.3 Review Exercises

1. Solution

For input values of 20, 1

Step	Statement	x	y
1	`x = Integer.parseInt(cin.nextLine())`	**20**	?
2	`y = Integer.parseInt(cin.nextLine())`	20	**1**
3	`if (x < 30)`	true	
4	`case y == 1`	true	
5	`x = x % 3`	**2**	1
6	`y = 5`	2	**5**
7	`System.out.println(x + ", " + y)`	It displays: 2, 5	

For input values of 20, 3

Step	Statement	x	y
1	`x = Integer.parseInt(cin.nextLine())`	**20**	?
2	`y = Integer.parseInt(cin.nextLine())`	20	**3**
3	`if (x < 30)`	true	
4	`case y == 1`	false	
5	`case y == 2`	false	
6	`case y == 3`	true	
7	`x = x + 5`	**25**	3
8	`y += 3`	25	**6**
9	`System.out.println(x + ", " + y)`	It displays: 25, 6	

For input values of 12, 8

Step	Statement	x	y
1	`x = Integer.parseInt(cin.nextLine())`	**12**	?
2	`y = Integer.parseInt(cin.nextLine())`	12	**8**
3	`if (x < 30)`	true	
4	`case y == 1`	false	
5	`case y == 2`	false	
6	`case y == 3`	false	
7	`x -= 2`	**10**	8

8	`y++`	10	**9**
9	`System.out.println(x + ", " + y)`	It displays: 10, 9	

For input values of 50, 0

Step	Statement	x	y
1	`x = Integer.parseInt(cin.nextLine())`	**50**	?
2	`y = Integer.parseInt(cin.nextLine())`	50	**0**
3	`if (x < 30)`	false	
4	`y++`	50	**1**
5	`System.out.println(x + ", " + y)`	It displays: 50, 1	

2. Solution

For input values of 60, 25

Step	Statement	x	y
1	`x = Integer.parseInt(cin.nextLine())`	**60**	?
2	`y = Integer.parseInt(cin.nextLine())`	60	25
3	`if ((x + y) / 2 <= 20)`	false	
4	`if (y < 15)`	false	
5	`else if (y < 23)`	false	
6	`x = 2 * x + 5`	**125**	25
7	`y += 1`	125	**26**
8	`System.out.println(x + ", " + y)`	It displays: 125, 26	

For input values of 50, 8

Step	Statement	x	y
1	`x = Integer.parseInt(cin.nextLine())`	**50**	?
2	`y = Integer.parseInt(cin.nextLine())`	50	8
3	`if ((x + y) / 2 <= 20)`	false	
4	`if (y < 15)`	true	
5	`x = x % 4`	**2**	8
6	`y = 2`	2	**2**
7	`System.out.println(x + ", " + y)`	It displays: 2, 2	

For input values of 20, 15

Step	Statement	x	y
1	`x = Integer.parseInt(cin.nextLine())`	**20**	?
2	`y = Integer.parseInt(cin.nextLine())`	20	15
3	`if ((x + y) / 2 <= 20)`	true	
4	`if (y < 10)`	false	
5	`else if (y < 20)`	true	

6	`x = x * 5`	**100**	15
7	`y += 2`	100	**17**
8	`System.out.println(x + ", " + y)`	It displays: 100, 17	

For input values of 10, 30

Step	Statement	x	y
1	`x = Integer.parseInt(cin.nextLine())`	**10**	?
2	`y = Integer.parseInt(cin.nextLine())`	10	30
3	`if ((x + y) / 2 <= 20)`	true	
4	`if (y < 10)`	false	
5	`else if (y < 20)`	false	
6	`x = x - 2`	**8**	30
7	`y += 3`	8	**33**
8	`System.out.println(x + ", " + y)`	It displays: 8, 33	

3. Solution

```
public static void main(String[] args) throws Exception {
  int a;

  a = Integer.parseInt(cin.nextLine());

  if (a > 1000)
    System.out.println("Big Positive");
  else {
    if (a > 0)
      System.out.println("Positive");
    else {
      if (a < -1000)
        System.out.println("Big Negative");
      else {
        if (a < 0)
          System.out.println("Negative");
        else
          System.out.println("Zero");
      }
    }
  }
}
```

4. Solution

First approach

```
public static void main(String[] args) throws Exception {
  int age;

  System.out.print("Enter your age: ");
  age = Integer.parseInt(cin.nextLine());
  if (age < 0) {
     System.out.println("Error: Invalid age!");
  }
  else {
    if (age < 16) {
       System.out.println("You cannot drive either a small scooter or a car");
    }
    else {
      if (age < 18) {
        System.out.println("You can drive a small scooter");
      }
      else {
        System.out.println("You can drive a car and a small scooter");
      }
    }
  }
}
```

Second approach

```
public static void main(String[] args) throws Exception {
  int age;

  System.out.print("Enter your age: ");
  age = Integer.parseInt(cin.nextLine());

  if (age < 0) {
    System.out.println("Error: Invalid age!");
  }
  else {
    if (age < 16) {
      System.out.println("You cannot drive either a small scooter or a car");
    }
    else if (age < 18) {
      System.out.println("You can drive a small scooter");
    }
    else {
      System.out.println("You can drive a car and a small scooter");
    }
  }
}
```

Third approach

```
public static void main(String[] args) throws Exception {
  int age;

  System.out.print("Enter your age: ");
  age = Integer.parseInt(cin.nextLine());

  if (age < 0) {
    System.out.println("Error: Invalid age!");
  }
  else if (age < 16) {
    System.out.println("You cannot drive either a small scooter or a car");
  }
  else if (age < 18) {
    System.out.println("You can drive a small scooter");
  }
  else {
    System.out.println("You can drive a car and a small scooter");
  }
}
```

5. Solution

```
public static void main(String[] args) throws Exception {
  int soldHoverboards, employeesNum;
  double hoverboardsCost, insuranceCost, totalCost;
  double totalEarnings, profitLoss;

  System.out.print("Enter number of hoverboards sold: ");
  soldHoverboards = Integer.parseInt(cin.nextLine());
  System.out.print("Enter number of employees: ");
  employeesNum = Integer.parseInt(cin.nextLine());

  if (soldHoverboards < 0 || employeesNum <= 0) {
    System.out.println("Wrong value(s) entered");
  }
  else {
    hoverboardsCost = soldHoverboards * 150;
    insuranceCost = employeesNum * 1000;
    totalCost = hoverboardsCost + insuranceCost;

    totalEarnings = soldHoverboards * 250;
    profitLoss = totalEarnings - totalCost;

    if (profitLoss > 0) {
      System.out.println("Profit");
    }
    else if (profitLoss < 0) {
      System.out.println("Loss");
    }
    else {
      System.out.println("Broke even");
    }
  }
}
```

6. Solution

First approach: Using nested decision structures

```
public static void main(String[] args) throws Exception {
  int hour;
  String name;

  System.out.print("Enter your name: ");
  name = cin.nextLine();

  hour = 1 + (int)(Math.random() * 24);
  System.out.println("The hour is " + hour + ":00");

  if (hour >= 5 && hour <= 11) {
    System.out.println("Good Morning " + name + "!");
  }
  else {
    if (hour >= 12 && hour <= 18) {
      System.out.println("Good Afternoon " + name + "!");
    }
    else {
      if (hour >= 19 && hour <= 22) {
        System.out.println("Good Evening " + name + "!");
      }
      else {
        System.out.println("Good Night " + name + "!");
      }
    }
  }
}
```

Second approach: Using a multiple-alternative decision structure

```
public static void main(String[] args) throws Exception {
  int hour;
  String name;

  System.out.print("Enter your name: ");
  name = cin.nextLine();

  hour = 1 + (int)(Math.random() * 24);
  System.out.println("The hour is " + hour + ":00");

  if (hour >= 5 && hour <= 11) {
    System.out.println("Good Morning " + name + "!");
  }
  else if (hour >= 12 && hour <= 18) {
    System.out.println("Good Afternoon " + name + "!");
  }
  else if (hour >= 19 && hour <= 22) {
    System.out.println("Good Evening " + name + "!");
  }
  else {
    System.out.println("Good Night " + name + "!");
  }
}
```

7. Solution

```
public static void main(String[] args) throws Exception {
  double a, b, c;
  System.out.print("Enter the three sides of a triangle: ");
  a = Double.parseDouble(cin.nextLine());
  b = Double.parseDouble(cin.nextLine());
  c = Double.parseDouble(cin.nextLine());

  if (a >= b + c || b >= a + c || c >= a + b) {
    System.out.println("Provided numbers cannot be lengths of the three sides of a triangle");
  }
  else {
    if (a == b && b == c) {
      System.out.println("Equilateral");
    }
    else if (Math.pow(a, 2) == Math.pow(b, 2) + Math.pow(c, 2) ||
            Math.pow(b, 2) == Math.pow(a, 2) + Math.pow(c, 2) ||
            Math.pow(c, 2) == Math.pow(a, 2) + Math.pow(b, 2)) {

      System.out.println("Right (or right-angled)");
    }
    else {
      System.out.println("Not special");
    }
  }
}
```

8. Solution

```
public static void main(String[] args) throws Exception {
  int amount, pin, r, usd1, usd10, usd5;

  System.out.print("Enter your four-digit PIN : ");
  pin= Integer.parseInt(cin.nextLine());
  if (pin != 1234) {
    System.out.print("Wrong PIN. Enter your four-digit PIN : ");
    pin = Integer.parseInt(cin.nextLine());
    if (pin != 1234) {
      System.out.print("Wrong PIN. Enter your four-digit PIN : ");
      pin = Integer.parseInt(cin.nextLine());
    }
  }

  if (pin != 1234) {
    System.out.println("PIN locked!");
  }
  else {
    System.out.print("Enter the amount of money (an integer value) that you want to withdraw: ");
    amount = Integer.parseInt(cin.nextLine());
    usd10 = (int)(amount / 10);
    r = amount % 10;
    usd5 = (int)(r / 5);
    usd1 = r % 5;
    System.out.print(usd10 + " note(s) of $10 " + usd5 + " note(s) of $5 ");
    System.out.println("and " + usd1 + " note(s) of $1");
  }
}
```

9. Solution

First approach

```
public static void main(String[] args) throws Exception {
  double t, w;

  System.out.print("Enter temperature (in Fahrenheit): ");
  t = Double.parseDouble(cin.nextLine());
  System.out.print("Enter wind speed (in miles/hour): ");
  w = Double.parseDouble(cin.nextLine());

  if (t > 75) {
    if (w > 12) {
      System.out.println("The day is hot and windy");
    }
    else {
      System.out.println("The day is hot and not windy");
    }
  }
  else {
    if (w > 12) {
      System.out.println("The day is cold and windy");
    }
    else {
      System.out.println("The day is cold and not windy");
    }
  }
}
```

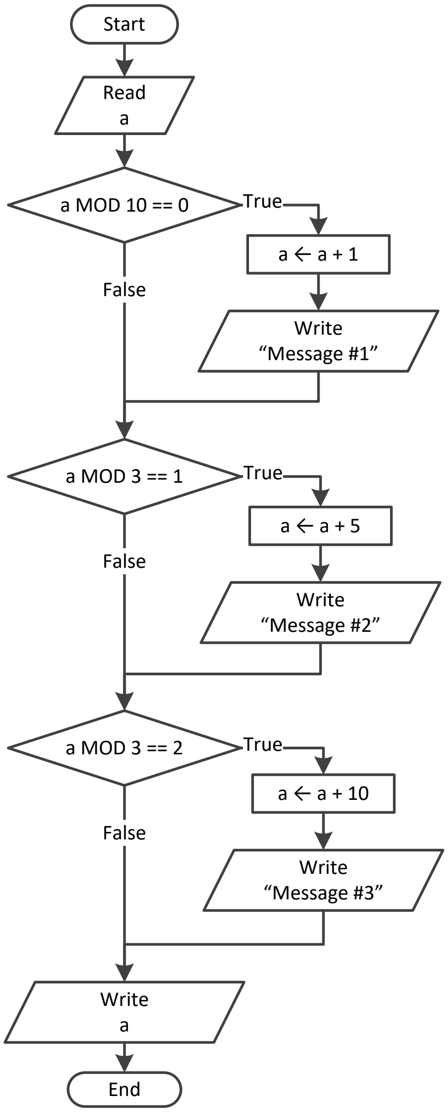
Second approach

```
public static void main(String[] args) throws Exception {
  double t, w;
  String message1, message2;

  System.out.print("Enter temperature (in Fahrenheit): ");
  t = Double.parseDouble(cin.nextLine());
  System.out.print("Enter wind speed (in miles/hour): ");
  w = Double.parseDouble(cin.nextLine());

  if (t > 75) {
    message1 = "hot";
  }
  else {
    message1 = "cold";
  }

  if (w > 12) {
    message2 = "windy";
  }
  else {
    message2 = "not windy";
  }

  System.out.println("The day is " + message1 + " and " + message2);
}
```

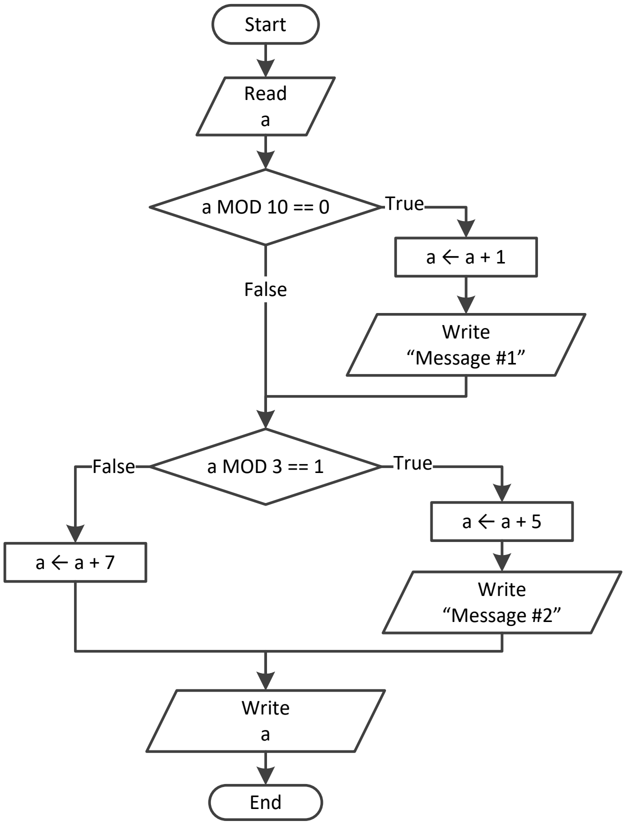
Chapter 21

21.4 Review Exercises

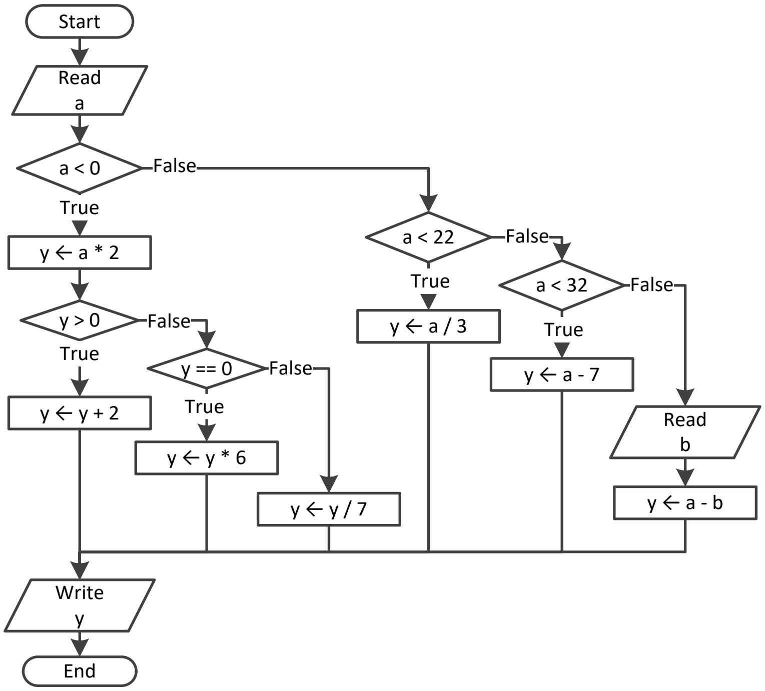
1. Solution



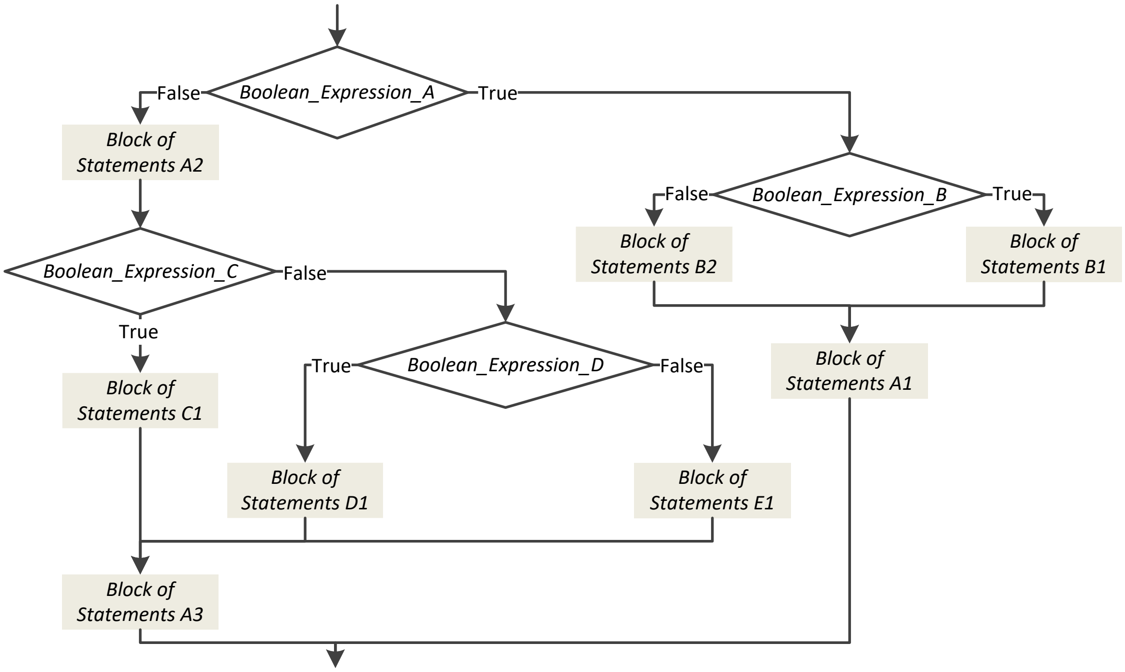
2. Solution



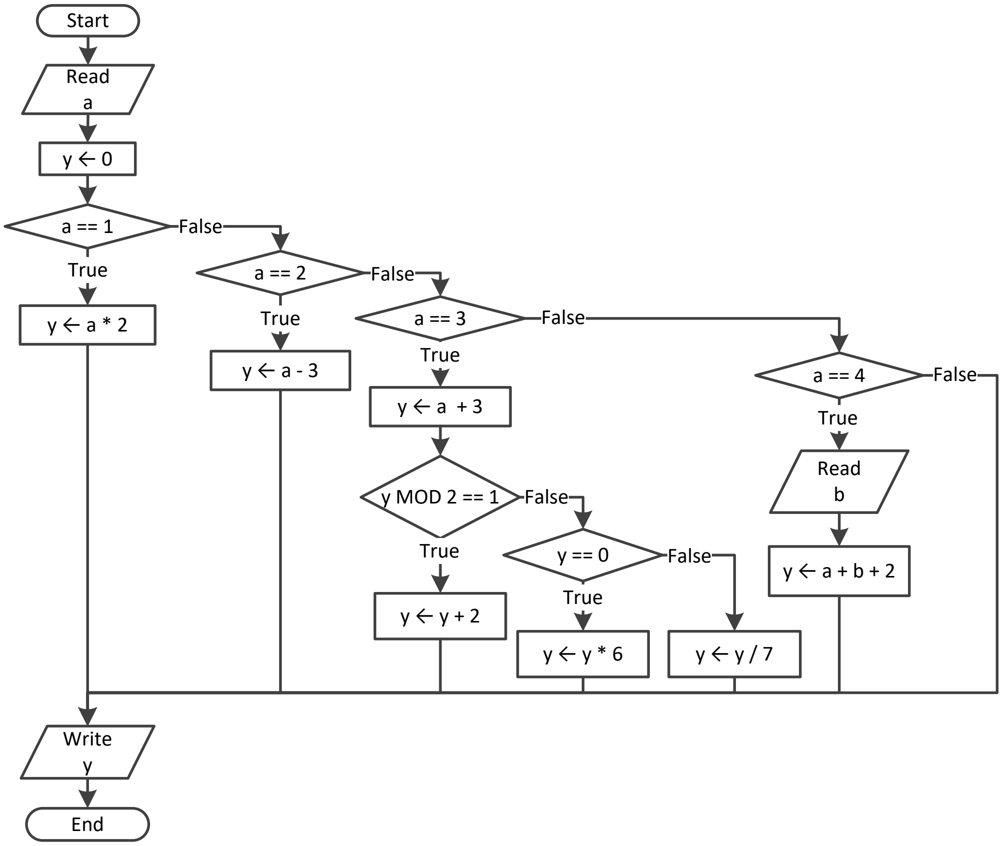
3. Solution



4. Solution



5. Solution



6. Solution

```
public static void main(String[] args) throws Exception {
  double x, y, z;

  x = Double.parseDouble(cin.nextLine());
  y = Double.parseDouble(cin.nextLine());

  if (x != 100 || y <= 10) {
    z = Double.parseDouble(cin.nextLine());
    if (z <= x + y) {
      x -= 3;
      y = x + 4;
    }
  }
  System.out.println(x + " " + y);
}
```

7. Solution

```
public static void main(String[] args) throws Exception {
  int x;

  x = Integer.parseInt(cin.nextLine());

  if (x == 1) {
    System.out.println("Good Morning");
    System.out.println("How do you do?");
    System.out.println("Is everything okay?");
  }
  else if (x == 2) {
    System.out.println("Good Evening");
    System.out.println("How do you do?");
    System.out.println("Is everything okay?");
  }
  else if (x == 3) {
    System.out.println("Good Afternoon");
    System.out.println("Is everything okay?");
  }
  else {
    System.out.println("Good Night");
  }
}
```

8. Solution

```
public static void main(String[] args) throws Exception {
  int a, b, c, d, y;

  a = Integer.parseInt(cin.nextLine());
  b = Integer.parseInt(cin.nextLine());
  c = a % 2;
  d = (int)(b / 5);

  if (a >= b)
    y = 1;
  else if (d > c && a > 2)
    y = 2;
  else if (d * c > a / b) {
    if (d * c > 10)
      y = 4;
    else
      y = 3;
  }
  else
    y = 5;

  System.out.println(y);
}
```

9. Solution

```
public static void main(String[] args) throws Exception {
  int x;

  x = Integer.parseInt(cin.nextLine());

  if (x > 0) {
    if (x % 10 == 0) {
      System.out.println("Last digit equal to 0");
    }
    else if (x % 10 == 1) {
      System.out.println("Last digit equal to 1");
    }
    else {
      System.out.println("None");
    }
  }
  else {
    if (x == -1) {
      System.out.println("Bye");
    }
    else {
      System.out.println("Invalid Number");
    }
  }
}
```

10. Solution

```
public static void main(String[] args) throws Exception {
  double a, b, y;

  a = Double.parseDouble(cin.nextLine());
  b = Double.parseDouble(cin.nextLine());

  y = a * b;

  if (y > 0) {
    y--;
    y /= 2;
  }
  else {
    y +=10;
    if (y > 0) {
      y /= 2;
    }
    else {
      y *= 2;
    }
  }
}
```

11. Solution

```
public static void main(String[] args) throws Exception {
  double a, b, c;

  a = Double.parseDouble(cin.nextLine());
  b = Double.parseDouble(cin.nextLine());
  c = Double.parseDouble(cin.nextLine());

  c = a * b + c;
  if (c > 0) {
    c /= 2;
    if (a > b) {
      a *= 2;
      b *= 2;
    }
    else {
      c /= 20;
      if (c <= 10) {
        b *= 2;
      }
    }
  }
  else {
    c /= 3;
    c /= 20;
    if (c <= 10) {
      b *= 2;
    }
  }
  System.out.println(a + " " + b  + " " + c);
}
```

Chapter 22

22.9 Review Questions: True/False

1. false
2. false
3. false
4. true
5. true
6. false
7. false

22.10 Review Questions: Multiple Choice

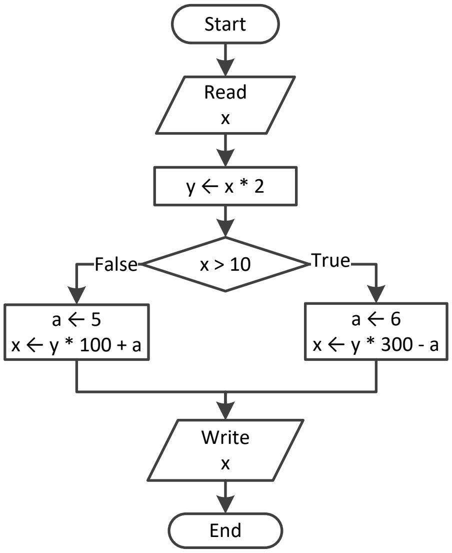
1. a
2. b
3. a
4. c

22.11 Review Exercises

1. *Solution*

```
public static void main(String[] args) throws Exception {
  int a, x, y;

  y = Integer.parseInt(cin.nextLine());
  x = Integer.parseInt(cin.nextLine());

  if (y > 0) {
    a = x * 4 * y + 1;
  }
  else {
    a = x * 2 * y + 6;
  }
  System.out.println(y);
  System.out.println(a);
}
```

2. *Solution*



3. Solution

```
public static void main(String[] args) throws Exception {
  double a, y;

  a = Double.parseDouble(cin.nextLine());

  if (a >= 10) {
    System.out.println("Error!");
  }
  else {
    if (a < 1) {
      y = 5 + a;
    }
    else if (a < 5) {
      y = 23 / a;
    }
    else {
      y = 5 * a;
    }
    System.out.println(y);
  }
}
```

4. Solution

```
public static void main(String[] args) throws Exception {
  int day, month;
  String name;

  day = Integer.parseInt(cin.nextLine());
  month = Integer.parseInt(cin.nextLine());
  name = cin.nextLine();

  if (day == 16 && month == 2 && name.equals("Loukia") == true) {
    System.out.println("Happy Birthday!!!");
  }
  else {
    System.out.println("No match!");
  }
}
```

5. Solution

It does not operate the same way when variable `a` is less than or equal to 10. The correct program is

```
public static void main(String[] args) throws Exception {
  double a, b, c, d;

  a = Double.parseDouble(cin.nextLine());
  b = Double.parseDouble(cin.nextLine());
  c = Double.parseDouble(cin.nextLine());
  if (a > 10) {
    if (c < 2000) {
      d = (a + b + c) / 12;
      System.out.println("The result is: " + d);
    }
    else {
      System.out.println("Error!");
    }
  }
  else {
    System.out.println("Error!");
  }
}
```

6. Solution

```
public static void main(String[] args) throws Exception {
  double a, b, c, d;

  a = Double.parseDouble(cin.nextLine());
  b = Double.parseDouble(cin.nextLine());
  c = Double.parseDouble(cin.nextLine());

  if (a > 10 && b < 2000 && c != 10) {
    d = (a + b + c) / 12;
    System.out.println("The result is: " + d);
  }

  if (a <= 10) {
    System.out.println("Error!");
  }
}
```

7. Solution

```
public static void main(String[] args) throws Exception {
  int a, b, y;

  a = Integer.parseInt(cin.nextLine());
  b = Integer.parseInt(cin.nextLine());

  y = 3;
  if (a > 0) {
    y = y * a;
    System.out.println("Hello Zeus");
  }

  System.out.println(y + " " + b);
}
```

8. Solution

```
public static void main(String[] args) throws Exception {
  double a, b, y;

  a = Double.parseDouble(cin.nextLine());
  b = Double.parseDouble(cin.nextLine());

  y = 0;
  if (a > 0) {
    y = y + 7;
  }
  else {
    System.out.println("Hello Zeus");
    System.out.println(Math.abs(a));
  }
  System.out.println(y);
}
```

9. Solution

```
public static void main(String[] args) throws Exception {
  String os;

  System.out.print("What is your tablet's OS? ");
  os = cin.nextLine();

  if (os.equals("iOS") == true) {
    System.out.println("Apple");
  }
  else if (os.equals("Android") == true) {
    System.out.println("Google");
  }
  else if (os.equals("Windows") == true) {
    System.out.println("Microsoft");
  }
}
```

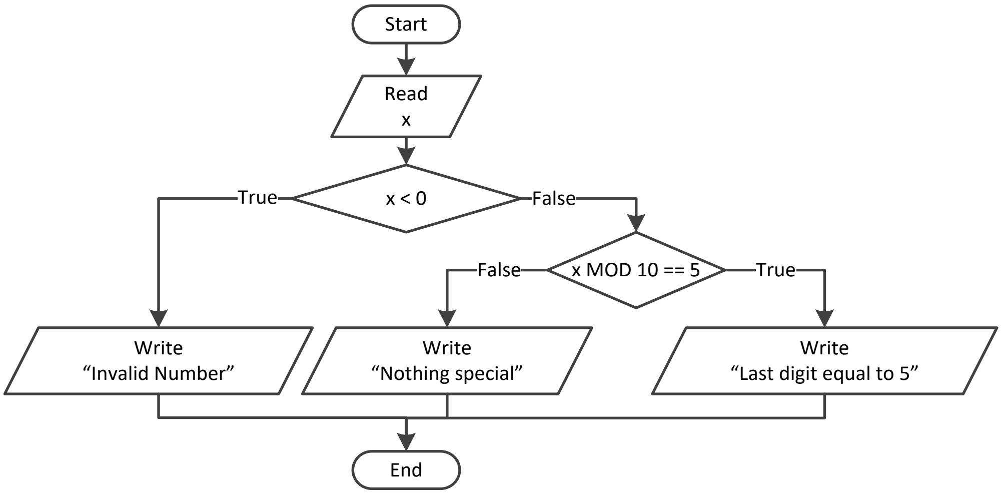
Chapter 23

23.7 Review Exercises

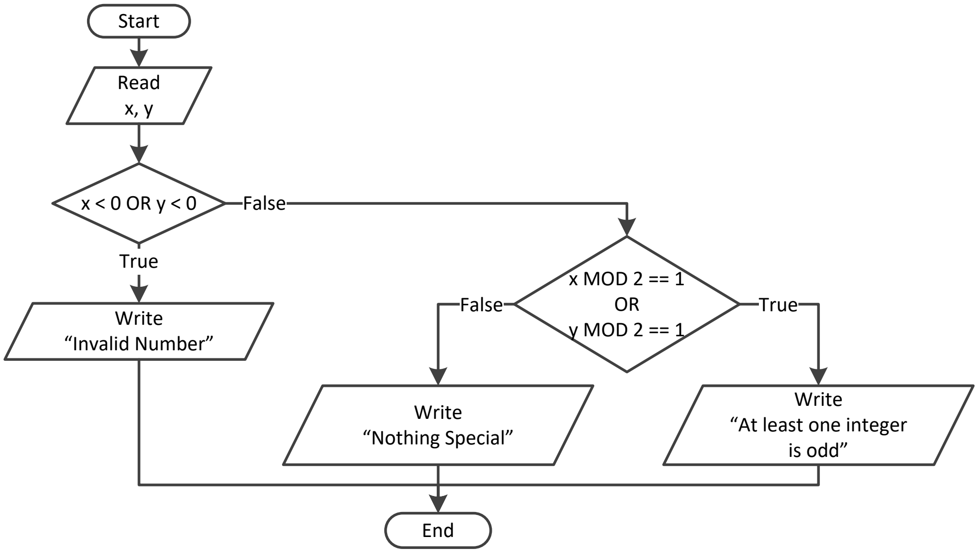
1. Solution

```
public static void main(String[] args) throws Exception {
  double x;

  System.out.print("Enter a non-negative number: ");
  x = Double.parseDouble(cin.nextLine());
  if (x < 0) {
    System.out.println("Error! You entered a negative value");
  }
  else {
    System.out.println("The square root of " + x + " is " + Math.sqrt(x));
  }
}
```

2. Solution

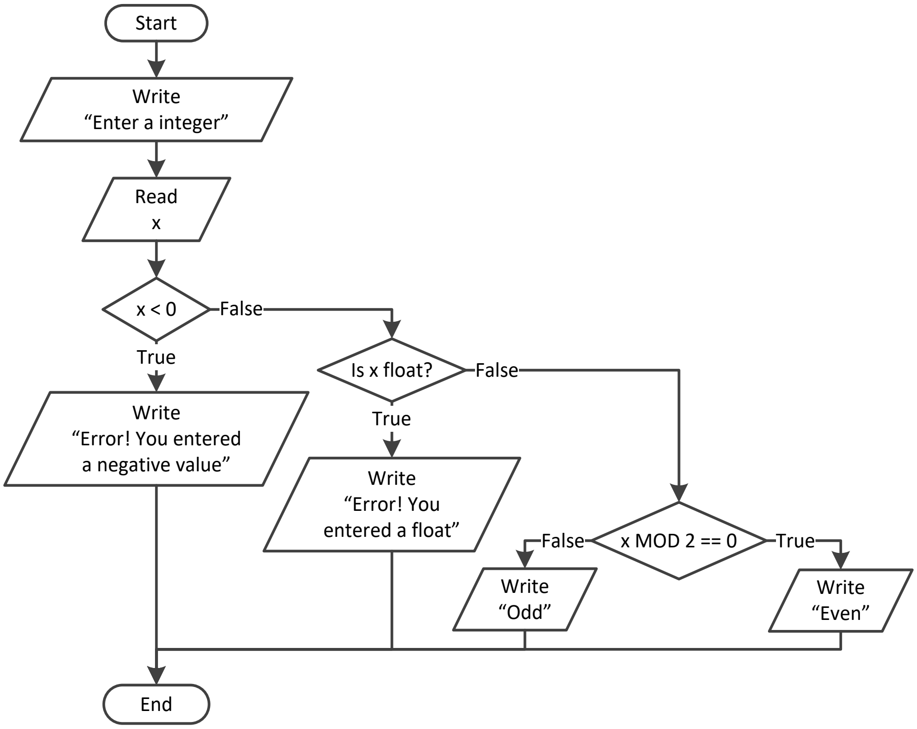


3. *Solution*



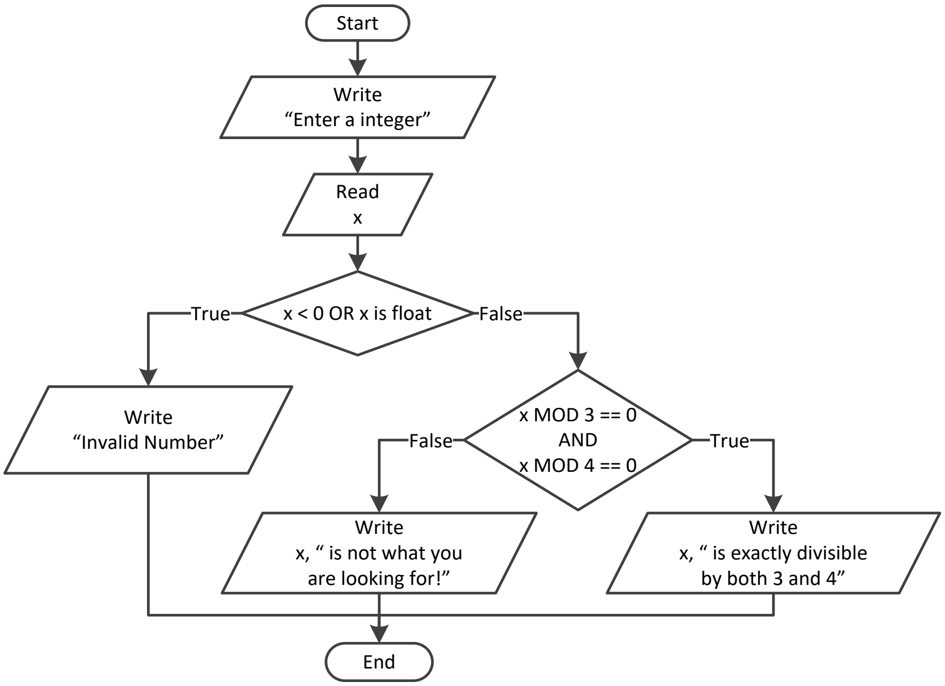
```
public static void main(String[] args) throws Exception {
  int x, y;

  x = Integer.parseInt(cin.nextLine());
  y = Integer.parseInt(cin.nextLine());

  if (x < 0 || y < 0) {
    System.out.println("Invalid Number");
  }
  else {
    if (x % 2 == 1 || y % 2 == 1) {
      System.out.println("At least one integer is odd");
    }
    else {
      System.out.println("Nothing Special");
    }
  }
}
```

4. Solution



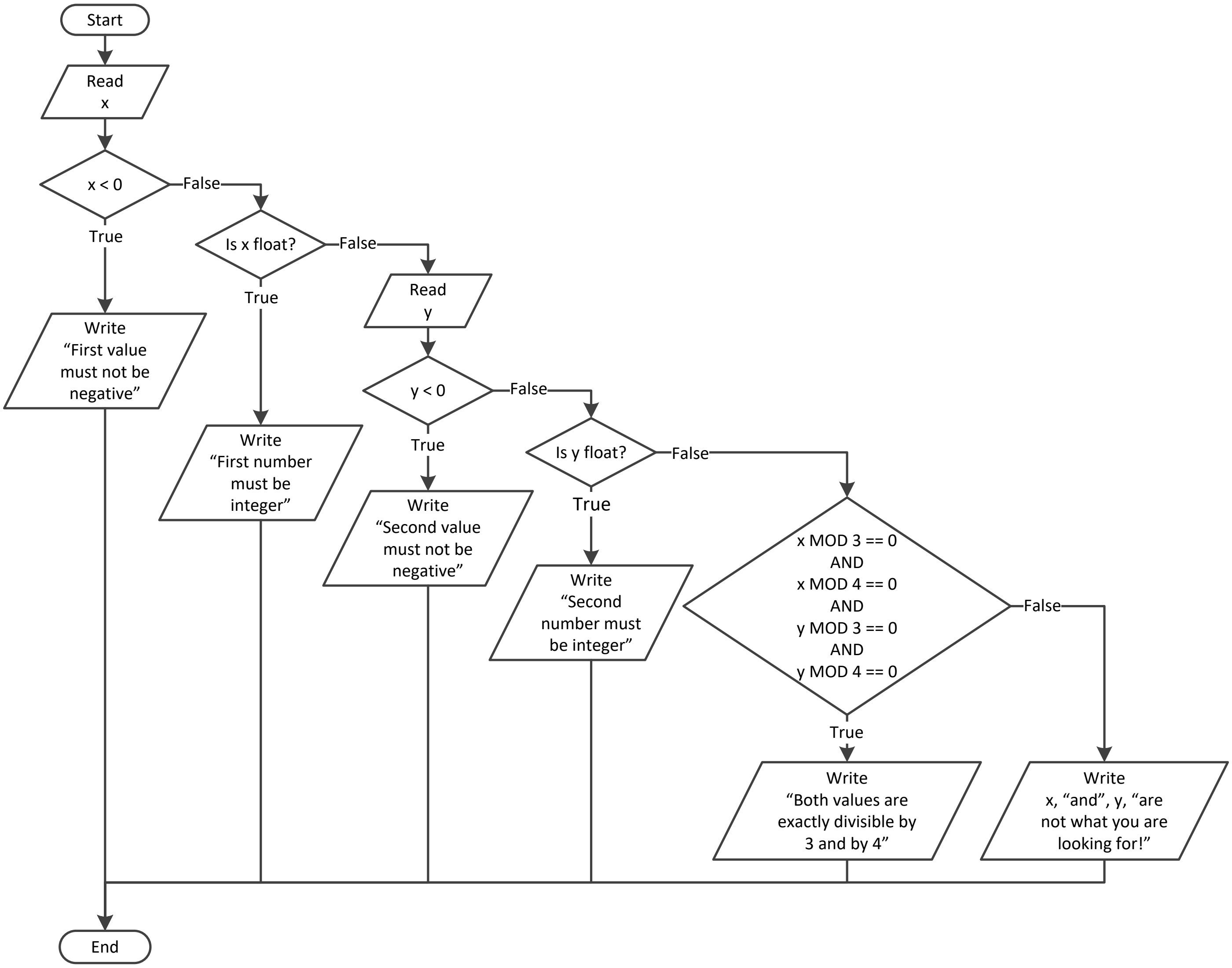
```
public static void main(String[] args) throws Exception {
  double x;

  System.out.print("Enter a non-negative number: ");
  x = Double.parseDouble(cin.nextLine());
  if (x < 0) {
    System.out.println("Error! You entered a negative value");
  }
  else if (x != (int)x) {
    System.out.println("Error! You entered a float");
  }
  else if (x % 2 == 0) {
    System.out.println("Even");
  }
  else {
    System.out.println("Odd");
  }
}
```

5. Solution



```
public static void main(String[] args) throws Exception {
  double x;

  System.out.print("Enter an integer: ");
  x = Double.parseDouble(cin.nextLine());

  if (x < 0 || x != (int)x) {
    System.out.println("Invalid Number");
  }
  else if (x % 3 == 0 && x % 4 == 0) {
    System.out.println(x + " is exactly divisible by both 3 and 4");
  }
  else {
    System.out.println(x + " is not what you are looking for!");
  }
}
```

6. Solution


Start
Read x
x < 0
False
True
Is x float?
False
True
Read y
Write "First value must not be negative"
y < 0
False
Write "First number must be integer"
True
Is y float?
False
Write "Second value must not be negative"
True
Write "Second number must be integer"
x MOD 3 == 0 AND x MOD 4 == 0 AND y MOD 3 == 0 AND y MOD 4 == 0
False
True
Write "Both values are exactly divisible by 3 and by 4"
Write x, "and", y, "are not what you are looking for!"
End

```
public static void main(String[] args) throws Exception {
  double x, y;

  x = Double.parseDouble(cin.nextLine());

  if (x < 0) {
    System.out.println("First value must be not be negative");
  }
  else {
    if (x != (int)x) {
        System.out.println("First number must be integer");
    }
    else {
      y = Double.parseDouble(cin.nextLine());
      if (y < 0) {
        System.out.println("Second value must be not be negative");
      }
      else {
        if (y != (int)y) {
          System.out.println("Second number must be integer");
        }
        else {
          if (x % 3 == 0 && x % 4 == 0 && y % 3 == 0 && y % 4 == 0 ) {
            System.out.println("Both values are exactly divisible by 3 and by 4");
          }
          else {
            System.out.println("Nothing Special");
          }
        }
      }
    }
  }
}
```

7. Solution

```
public static void main(String[] args) throws Exception {
  int choice;
  double t;

  System.out.println("1. Convert Kelvin to Fahrenheit");
  System.out.println("2. Convert Fahrenheit to Kelvin");
  System.out.println("3. Convert Fahrenheit to Celsius");
  System.out.println("4. Convert Celsius to Fahrenheit");

  System.out.print("Enter a choice: ");
  choice = Integer.parseInt(cin.nextLine());
  System.out.print("Enter a temperature: ");
  t = Double.parseDouble(cin.nextLine());

  if (choice < 1 || choice > 4) {
    System.out.println("Wrong choice");
  }
  else {
    switch (choice) {
      case 1:
        if (t < 0) {  //Absolute zero in Kelvin
          System.out.println("Wrong temperature");
        }
        else {
          System.out.println(1.8 * t - 459.67);
        }
        break;
      case 2:
        if (t < -459.67) {  //Absolute zero in Fahrenheit
          System.out.println("Wrong temperature");
        }
        else {
          System.out.println((t + 459.57) / 1.8);
        }
        break;
      case 3:
        if (t < -459.67) {  //Absolute zero in Fahrenheit
          System.out.println("Wrong temperature");
        }
        else {
          System.out.println(5.0 / 9 * (t - 32));
        }
        break;
      case 4:
        if (t < -273.15) {  //Absolute zero in Celcius
          System.out.println("Wrong temperature");
        }
        else {
          System.out.println(9.0 / 5 * t + 32);
        }
        break;
    }
  }
}
```

8. Solution

```
public static void main(String[] args) throws Exception {
  String op, message;
  int a, b;

  System.out.print("Enter 1st integer: ");
  a = Integer.parseInt(cin.nextLine());
  System.out.print("Enter type of operation: ");
  op = cin.nextLine().toUpperCase();
  System.out.print("Enter 2nd integer: ");
  b = Integer.parseInt(cin.nextLine());

  message = "The result of " + a + " " + op + " " + b + " equals ";

  switch (op) {
    case "+":
      message += a + b;  //Concatenate
      break;
    case "-":
      message += a - b;  //Concatenate
      break;
    case "*":
      message += a * b;  //Concatenate
      break;
    case "/":
      if (b == 0) {
        message = "Infinite";  //Replace
      }
      else {
        message += (double)a / b;  //Concatenate
      }
      break;
    case "DIV":
      if (b == 0) {
        message = "Infinite";  //Replace
      }
      else {
        message += (int)(a / b);  //Concatenate
      }
      break;
    case "MOD":
      if (b == 0) {
        message = "Infinite";  //Replace
      }
      else {
        message += a % b;  //Concatenate
      }
      break;
    case "POWER":
      message += Math.pow(a, b);  //Concatenate
      break;
  }
  System.out.println(message);
}
```

9. Solution

```
public static void main(String[] args) throws Exception {
  String op, message;
  int a, b;

  System.out.print("Enter 1st integer: ");
  a = Integer.parseInt(cin.nextLine());
  System.out.print("Enter type of operation: ");
  op = cin.nextLine().toUpperCase();
  System.out.print("Enter 2nd integer: ");
  b = Integer.parseInt(cin.nextLine());

  message = "The result of " + a + " " + op + " " + b + " equals ";

  switch (op) {
    case "+":
      message += a + b;  //Concatenate
      break;
    case "-":
      message += a - b;  //Concatenate
      break;
    case "*":
      message += a * b;  //Concatenate
      break;
    case "/":
      if (b == 0) {
        message = "Infinite";  //Replace
      }
      else {
        message += (double)a / b;  //Concatenate
      }
      break;
    case "DIV":
      if (b == 0) {
        message = "Infinite";  //Replace
      }
      else {
        message += (int)(a / b);  //Concatenate
      }
      break;
    case "MOD":
      if (b == 0) {
        message = "Infinite";  //Replace
      }
      else {
        message += a % b;  //Concatenate
      }
      break;
    case "POWER":
      message += Math.pow(a, b);  //Concatenate
      break;
    default:
      message = "Error: Invalid operator";  //Replace
  }
  System.out.println(message);
}
```

10. Solution

```
public static void main(String[] args) throws Exception {
  int a1, a2, a3, maximum, minimum;
  String maxName, minName, n1, n2, n3;

  System.out.print("Enter the age of the first person: ");
  a1 = Integer.parseInt(cin.nextLine());
  System.out.print("Enter the name of the first person: ");
  n1 = cin.nextLine();
  System.out.print("Enter the age of the second person: ");
  a2 = Integer.parseInt(cin.nextLine());
  System.out.print("Enter the name of the second person: ");
  n2 = cin.nextLine();
  System.out.print("Enter the age of the third person: ");
  a3 = Integer.parseInt(cin.nextLine());
  System.out.print("Enter the name of the third person: ");
  n3 = cin.nextLine();
  minimum = a1;
  minName = n1;
  if (a2 < minimum) {
    minimum = a2;
    minName = n2;
  }
  if (a3 < minimum) {
    minimum = a3;
    minName = n3;
  }

  maximum = a1;
  maxName = n1;
  if (a2 > maximum) {
    maximum = a2;
    maxName = n2;
  }
  if (a3 > maximum) {
    maximum = a3;
    maxName = n3;
  }

  System.out.println(minName + " " + maxName);
}
```

11. Solution

```
public static void main(String[] args) throws Exception {
  String artistName;
  int score1, score2, score3, score4, score5, minimum, maximum, totalScore;

  System.out.print("Enter artist's name: ");
  artistName = cin.nextLine();
  System.out.print("Enter score No 1: ");
  score1 = Integer.parseInt(cin.nextLine());
  System.out.print("Enter score No 2: ");
  score2 = Integer.parseInt(cin.nextLine());
  System.out.print("Enter score No 3: ");
  score3 = Integer.parseInt(cin.nextLine());
  System.out.print("Enter score No 4: ");
  score4 = Integer.parseInt(cin.nextLine());
  System.out.print("Enter score No 5: ");
  score5 = Integer.parseInt(cin.nextLine());

  minimum = score1;
  if (score2 < minimum) {
    minimum = score2;
  }
  if (score3 < minimum) {
    minimum = score3;
  }
  if (score4 < minimum) {
    minimum = score4;
  }
  if (score5 < minimum) {
    minimum = score5;
  }

  maximum = score1;
  if (score2 > maximum) {
    minimum = score2;
  }
  if (score3 > maximum) {
    minimum = score3;
  }
  if (score4 > maximum) {
    minimum = score4;
  }
  if (score5 > maximum) {
    minimum = score5    ;
  }

  totalScore = score1 + score2 + score3 + score4 + score5 - minimum - maximum;
  System.out.println(artistName + " received " + totalScore + " points");
}
```

12. Solution

```
public static void main(String[] args) throws Exception {
  int age1, age2, age3, maximum, middle, minimum;

  System.out.print("Enter age for person No1:");
  age1 = Integer.parseInt(cin.nextLine());
  System.out.print("Enter age for person No2:");
  age2 = Integer.parseInt(cin.nextLine());
  System.out.print("Enter age for person No3:");
  age3 = Integer.parseInt(cin.nextLine());

  minimum = age1;
  if (age2 < minimum) {
    minimum = age2;
  }
  if (age3 < minimum) {
    minimum = age3;
  }
  maximum = age1;
  if (age2 > maximum) {
    maximum = age2;
  }
  if (age3 > maximum) {
    maximum = age3;
  }
  middle = age1 + age2 + age3 - minimum - maximum;
  System.out.println(middle);
}
```

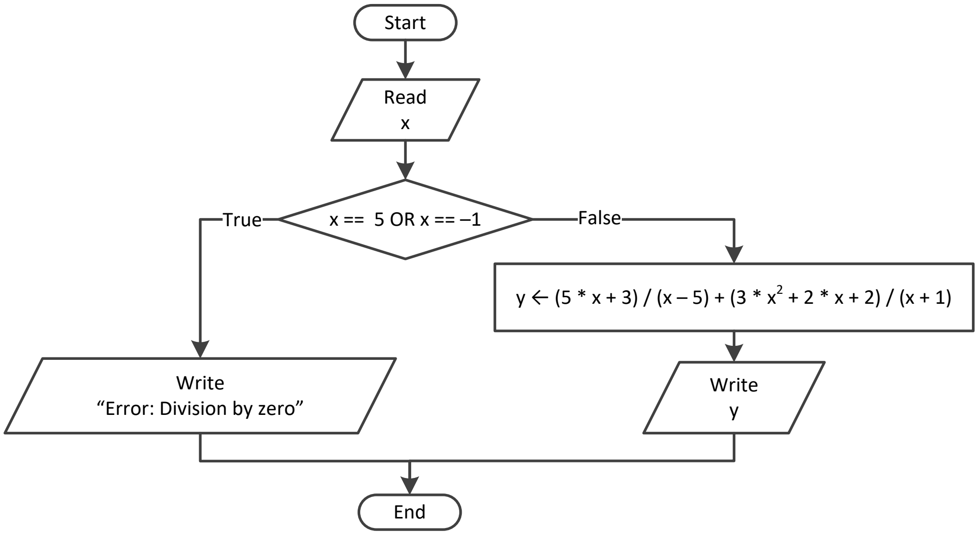
13. Solution

```
public static void main(String[] args) throws Exception {
  int a1, a2, a3, maximum, minimum, middle;
  String maxName, minName, n1, n2, n3;

  System.out.print("Enter the age of the first person: ");
  a1 = Integer.parseInt(cin.nextLine());
  System.out.print("Enter the name of the first person: ");
  n1 = cin.nextLine();
  System.out.print("Enter the age of the second person: ");
  a2 = Integer.parseInt(cin.nextLine());
  System.out.print("Enter the name of the second person: ");
  n2 = cin.nextLine();
  System.out.print("Enter the age of the third person: ");
  a3 = Integer.parseInt(cin.nextLine());
  System.out.print("Enter the name of the third person: ");
  n3 = cin.nextLine();

  minimum = a1;
  minName = n1;
  if (a2 < minimum) {
    minimum = a2;
    minName = n2;
  }
  if (a3 < minimum) {
    minimum = a3;
    minName = n3;
  }

  maximum = a1;
  maxName = n1;
  if (a2 > maximum) {
    maximum = a2;
    maxName = n2;
  }
  if (a3 > maximum) {
    maximum = a3;
    maxName = n3;
  }

  middle = a1 + a2 + a3 - minimum - maximum;

  if (Math.abs(maximum - middle) < Math.abs(minimum - middle)) {
    System.out.println(maxName);
  }
  else {
    System.out.println(minName);
  }
}
```

14. Solution

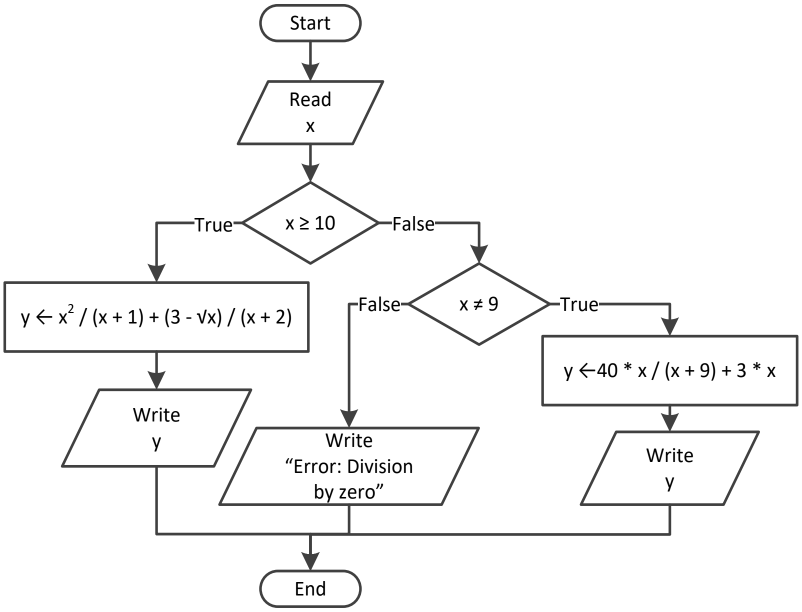
```
public static void main(String[] args) throws Exception {
  String title1, title2, title3, minName;
  double price1, price2, price3, minimum, amount;

  price1 = Double.parseDouble(cin.nextLine());
  title1 = cin.nextLine();
  price2 = Double.parseDouble(cin.nextLine());
  title2 = cin.nextLine();
  price3 = Double.parseDouble(cin.nextLine());
  title3 = cin.nextLine();

  minimum = price1;
  minName = title1;
  if (price2 < minimum) {
    minimum = price2;
    minName = title2;
  }
  if (price3 < minimum) {
    minimum = price3;
    minName = title3;
  }

  amount = price1 + price2 + price3 - minimum;
  System.out.println("You need to pay: $" + amount);
  System.out.println("Title provided for free: " + minName);
  System.out.println("You saved: $" + minimum);
}
```

15. Solution


Start
Read
x
x == 5 OR x == –1
True
False
$y \leftarrow (5 * x + 3) / (x – 5) + (3 * x^2 + 2 * x + 2) / (x + 1)$
Write
“Error: Division by zero”
Write
y
End

```
public static void main(String[] args) throws Exception {
  double x, y;

  x = Double.parseDouble(cin.nextLine());

  if (x == 5 || x == -1) {
    System.out.println("Error: Division by zero");
  }
  else {
    y = (5 * x + 3) / (x - 5) + (3 * Math.pow(x, 2) + 2 * x + 2) / (x + 1);
    System.out.println(y);
  }
}
```

16. Solution


Start
Read x
x ≥ 10
True
False
y ← x² / (x + 1) + (3 - √x) / (x + 2)
False
x ≠ 9
True
y ←40 * x / (x + 9) + 3 * x
Write y
Write "Error: Division by zero"
Write y
End

```
public static void main(String[] args) throws Exception {
  double x, y;

  x = Double.parseDouble(cin.nextLine());
  if (x >= 10) {
    y = Math.pow(x, 2) / (x + 1) + (3 - Math.sqrt(x)) / (x + 2);
    System.out.println(y);
  }
  else if (x != 9) {
      y = 40 * x / (x + 9) + 3 * x;
      System.out.println(y);
  }
  else {
    System.out.println("Error: Division by zero");
  }
}
```

17. Solution

```
public static void main(String[] args) throws Exception {
  double x, y;

  x = Double.parseDouble(cin.nextLine());
  if (x < 0 ) {
    y = 40 * x / (x - 5) + 3;
    System.out.println(y);
  }
  else if (x == 0 || x == 3) {
    System.out.println("Error: Division by zero!");
  }
  else {
    y = (7 + x) / (x - 3) + (3 - x) / x;
    System.out.println(y);
  }
}
```

18. Solution

```
public static void main(String[] args) throws Exception {
  double x, y;

  x = Double.parseDouble(cin.nextLine());
  if (x <= -15 || x > 25) {
    y = x - 1;
    System.out.println(y);
  }
  else if (x <= -10) {
    y = x / Math.sqrt(x + 30) + Math.pow(8 + x, 2) / (x + 1);
    System.out.println(y);
  }
  else if (x <= 0) {
    y = Math.abs(40 * x) / (x - 8);
    System.out.println(y);
  }
  else {
    if (x == 9) {
      System.out.println("Error: Division by zero");
    }
    else if (x < 9) {
      System.out.println("Error: Invalid square root");
    }
    else {
      y = 3 * x / Math.sqrt(x - 9);
      System.out.println(y);
    }
  }
}
```

19. Solution

```
public static void main(String[] args) throws Exception {
  int digit1, digit2, digit3, r, total, x;
  double xDbl;

  System.out.print("Enter a three-digit integer: ");
  xDbl = Double.parseDouble(cin.nextLine());

  if (xDbl != (int)xDbl) {
    System.out.println("Error! You must enter an integer");
  }
  else if (xDbl < 100 || xDbl > 999) {
    System.out.println("Entered integer is not a three-digit integer");
  }
  else {
    x = (int)xDbl;

    digit1 = (int)(x / 100);
    r = (int)x % 100;

    digit2 = (int)(r / 10);
    digit3 = r % 10;

    total = (int)(Math.pow(digit1, 3) + Math.pow(digit2, 3) + Math.pow(digit3, 3));

    if (total == x) {
      System.out.println("You entered an Armstrong number!");
    }
    else {
      System.out.println("You entered a non-Armstrong number!");
    }
  }
}
```

20. Solution

```
public static void main(String[] args) throws Exception {
  int d, m, y;

  System.out.print("Enter day 1 - 31: ");
  d = Integer.parseInt(cin.nextLine());
  System.out.print("Enter month 1 - 12: ");
  m = Integer.parseInt(cin.nextLine());
  System.out.print("Enter year: ");
  y = Integer.parseInt(cin.nextLine());

  if (m == 2) {
    if (y % 4 == 0 && y % 100 != 0 || y % 400 == 0) {
      System.out.println(29 - d);
    }
    else {
      System.out.println(28 - d);
    }
  }
  else if (m == 4 || m == 6 || m == 9 || m == 11) {
    System.out.println(30 - d);
  }
  else {
    System.out.println(31 - d);
  }
}
```

21. Solution

```
public static void main(String[] args) throws Exception {
  String word, word1, word2;

  word = cin.nextLine();

  //Using substring() instead of charAt() method is more convenient in this case
  word1 = word.substring(0, 1).toUpperCase() +
          word.substring(1, 2).toLowerCase() +
          word.substring(2, 3).toUpperCase() +
          word.substring(3, 4).toLowerCase() +
          word.substring(4, 5).toUpperCase() +
          word.substring(5, 6).toLowerCase();

  word2 = word.substring(0, 1).toLowerCase() +
          word.substring(1, 2).toUpperCase() +
          word.substring(2, 3).toLowerCase() +
          word.substring(3, 4).toUpperCase() +
          word.substring(4, 5).toLowerCase() +
          word.substring(5, 6).toUpperCase();

  if (word.equals(word1) || word.equals(word2)) {
    System.out.println("Word is okay!");
  }
  else {
    System.out.println("Word is not okay");
  }
}
```

22. Solution

```
public static void main(String[] args) throws Exception {
  int q;
  double discount, payment;

  System.out.print("Enter quantity: ");
  q = Integer.parseInt(cin.nextLine());
  if (q < 3) {
    discount = 0;
  }
  else if (q < 6) {
    discount = 10;
  }
  else if (q < 10) {
    discount = 15;
  }
  else if (q < 14) {
    discount = 20;
  }
  else if (q < 20) {
    discount = 27;
  }
  else {
    discount = 30;
  }

  payment = q * 10 - q * 10 * discount / 100.0;

  System.out.println("You got a discount of " + discount + "%");
  System.out.println("You must pay $" + payment);
}
```

23. Solution

```
static final double VAT = 0.19;

public static void main(String[] args) throws Exception {
  double amount, discount, payment;

  System.out.print("Enter a before-tax amount: : ");
  amount = Double.parseDouble(cin.nextLine());

  if (amount < 0) {
    System.out.println("Error! You entered a negative value");
  }
  else {
    if (amount < 50) {
      discount = 0;
    }
    else if (amount < 100) {
      discount = 1;
    }
    else if (amount < 250) {
      discount = 2;
    }
    else {
      discount = 3;
    }
    amount = amount - amount * discount / 100;
    payment = amount + amount * VAT;

    System.out.println("You got a discount of " + discount + "%");
    System.out.println("You must pay $" + payment);
  }
}
```

24. Solution

```
public static void main(String[] args) throws Exception {
  int a, h, w;
  double bmi;

  System.out.print("Enter age: ");
  a = Integer.parseInt(cin.nextLine());
  if (a < 18) {
    System.out.println("Invalid age");
  }
  else {
    System.out.print("Enter weight in pounds: ");
    w = Integer.parseInt(cin.nextLine());
    System.out.print("Enter height in inches: ");
    h = Integer.parseInt(cin.nextLine());

    bmi = w * 703 / Math.pow(h ,2);

    if (bmi < 15) {
      System.out.println("Very severely underweight");
    }
    else if (bmi < 16) {
      System.out.println("Severely underweight");
    }
    else if (bmi < 18.5) {
      System.out.println("Underweight");
    }
    else if (bmi < 25) {
      System.out.println("Normal");
    }
    else if (bmi < 30) {
      System.out.println("Overweight");
    }
    else if (bmi < 35) {
      System.out.println("Severely overweight");
    }
    else {
      System.out.println("Very severely overweight");
    }
  }
}
```

25. Solution

```
static final double TAX_RATE = 0.10;

public static void main(String[] args) throws Exception {
  int water;
  double total;

  System.out.print("Enter water consumption (in cubic feet): ");
  water = Integer.parseInt(cin.nextLine());

  if (water < 0) {
    System.out.println("Error! You entered a negative value");
  }
  else {
    if (water <= 10) {
      total = water * 3;
    }
    else if (water <= 20) {
      total = 10 * 3 + (water - 10) * 5;
    }
    else if (water <= 35) {
      total = 10 * 3 + 10 * 5 + (water - 20) * 7;
    }
    else {
      total = 10 * 3 + 10 * 5 + 15 * 7 + (water - 35) * 9;
    }

    total = total + total * TAX_RATE;
    System.out.println("Total amount to pay (taxes included): " + total);
  }
}
```

26. Solution

```
public static void main(String[] args) throws Exception {
  int children;
  double income, tax;

  System.out.print("Enter taxable income: ");
  income = Double.parseDouble(cin.nextLine());
  System.out.print("Enter number of children: ");
  children = Integer.parseInt(cin.nextLine());

  if (income <= 8000) {
    tax = income * 0.10;
  }
  else if (income <= 30000) {
    tax = 8000 * 0.10 + (income - 8000) * 0.15;
  }
  else if (income <= 70000) {
    tax = 8000 * 0.10 + 22000 * 0.15 + (income - 30000) * 0.25;
  }
  else {
    tax = 8000 * 0.10 + 22000 * 0.15 + 40000 * 0.25 + (income - 70000) * 0.30;
  }

  if (children > 0) {
    tax = tax - tax * 0.02;
  }
  System.out.println("Tax: " + tax);
}
```

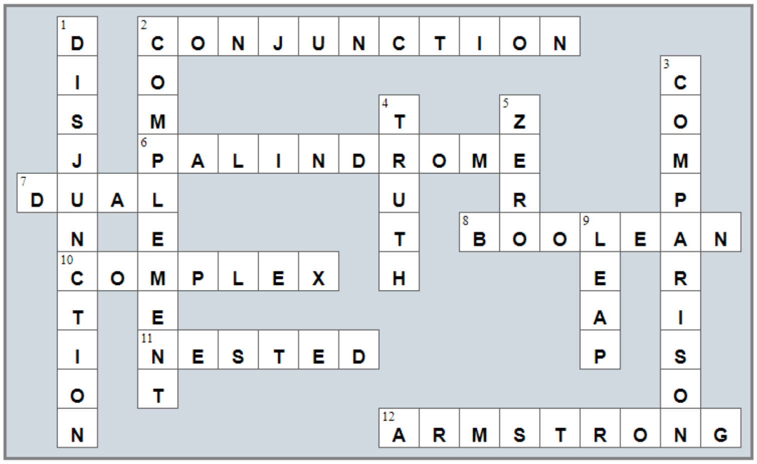
27. Solution

```
public static void main(String[] args) throws Exception {
  double wind;

  System.out.print("Enter wind speed (in miles/hour): ");
  wind = Double.parseDouble(cin.nextLine());

  if (wind < 0) {
    System.out.println("Error! You entered a negative value");
  }
  else {
    if (wind < 1) {
      System.out.println("Beaufort: 0\nCalm");
    }
    else if (wind < 4) {
      System.out.println("Beaufort: 1\nLight air");
    }
    else if (wind < 8) {
      System.out.println("Beaufort: 2\nLight breeze");
    }
    else if (wind < 13) {
      System.out.println("Beaufort: 3\nGentle breeze");
    }
    else if (wind < 18) {
      System.out.println("Beaufort: 4\nModerate breeze");
    }
    else if (wind < 25) {
      System.out.println("Beaufort: 5\nFresh breeze");
    }
    else if (wind < 31) {
      System.out.println("Beaufort: 6\nStrong breeze");
    }
    else if (wind < 39) {
      System.out.println("Beaufort: 7\nModerate gale");
    }
    else if (wind < 47) {
      System.out.println("Beaufort: 8\nGale");
    }
    else if (wind < 55) {
      System.out.println("Beaufort: 9\nStrong gale");
    }
    else if (wind < 64) {
      System.out.println("Beaufort: 10\nStorm");
    }
    else if (wind < 74) {
      System.out.println("Beaufort: 11\nViolent storm");
    }
    else {
      System.out.println("Beaufort: 12\nHurricane force");
    }

    if (wind < 13) {
      System.out.println("It's Fishing Day!!!");
    }
  }
}
```

Review in "Decision Control Structures"

Review Crossword Puzzle

1.



Chapter 24

24.3 Review Questions: True/False

1. true
2. true
3. false
4. false
5. true

Chapter 25

25.4 Review Questions: True/False

1. true
2. false
3. false
4. false
5. false
6. false
7. true
8. false
9. false
10. false
11. true
12. false
13. false
14. true
15. false

25.5 Review Questions: Multiple Choice

1. c
2. c
3. a
4. b
5. d
6. b
7. c
8. b
9. b
10. d
11. a
12. d

25.6 Review Exercises

1. *Solution*

```
public static void main(String[] args) throws Exception {
  int i;

  i = 3;
  do {
    System.out.println(i);
    i--;
  } while (i > 0);   //Alternatively you can use the logical operator !=
  System.out.println("The end");
}
```

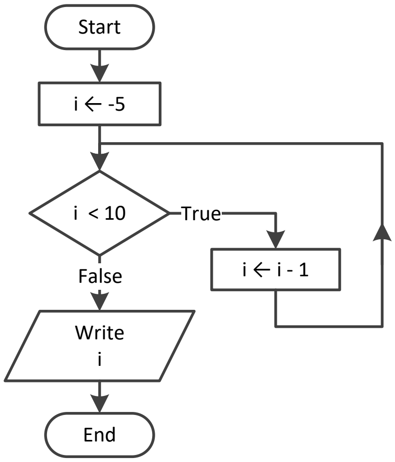
2. *Solution*

Step	Statement	i	x
1	`i = 3`	**3**	?
2	`x = 0`	3	**0**
3	`while (i >= 0)`	true	
4	`i--`	**2**	0
5	`x += i`	2	**2**
6	`while (i >= 0)`	true	
7	`i--`	**1**	2
8	`x += i`	1	**3**

9	`while (i >= 0)`	true	
10	`i--`	**0**	3
11	`x += i`	0	**3**
12	`while (i >= 0)`	true	
13	`i--`	**−1**	3
14	`x += i`	−1	**2**
15	`while (i >= 0)`	false	
16	`System.out.println(x)`	It displays: 2	

It performs 4 iterations

3. Solution



Step	Statement	Notes	i
1	`i = -5`		**−5**
2	`while (i < 10)`	true	
3	`i--`		**−6**
4	`while (i < 10)`	true	
5	`i--`		**−7**
6	`while (i < 10)`	true	
7	`i--`		**−8**
8	…	**…**	**…**
9	…	**…**	**…**

It performs an infinite number of iterations

4. Solution

Step	Statement	a	b	c	d
1	`a = 2`	**2**	?	?	?
2	`while (a <= 10)`	true			

3	b = a + 1	2	**3**	?	?
4	c = b * 2	2	3	**6**	?
5	d = c - b + 1	2	3	6	**4**
6	d == 4	true			
7	System.out.println(b + ", " + c)	It displays: 3, 6			
8	a += 4	**6**	3	6	4
9	while (a <= 10)	true			
10	b = a + 1	6	**7**	6	4
11	c = b * 2	6	7	**14**	4
12	d = c - b + 1	6	7	14	**8**
13	d == 4	false			
14	d == 5	false			
15	d == 8	true			
16	System.out.println(a + ", " + b)	It displays: 6, 7			
17	a += 4	**10**	7	14	8
18	while (a <= 10)	true			
19	b = a + 1	10	**11**	14	8
20	c = b * 2	10	11	**22**	8
21	d = c - b + 1	10	11	22	**12**
22	d == 4	false			
23	d == 5	false			
24	d == 8	false			
25	System.out.println(a + ", " + b + ", " + d)	It displays: 10, 11, 12			
26	a += 4	**14**	11	22	12
27	while (a <= 10)	false			

5. Solution

Step	Statement	a	b	c	d	x
1	a = 1	**1**	?	?	?	?
2	b = 1	1	**1**	?	?	?
3	c = 0	1	1	**0**	?	?
4	d = 0	1	1	0	**0**	?
5	while (b < 2)	true				
6	x = a + b	1	1	0	0	**2**
7	if (x % 2 != 0)	false				
8	d = d + 1	1	1	0	**1**	2
9	a = b	**1**	1	0	1	2

10	b = c	1	**0**	0	1	2
11	c = d	1	0	**1**	1	2
12	while (b < 2)	true				
13	x = a + b	1	0	1	1	**1**
14	if (x % 2 != 0)	true				
15	c = c + 1	1	0	**2**	1	1
16	a = b	**0**	0	2	1	1
17	b = c	0	**2**	2	1	1
18	c = d	0	2	**1**	1	1
19	while (b < 2)	false				

6. Solution

i. −1

ii. 9

iii. 0.25

iv. −7

v. Any value between 17 and 32

vi. 1.4

7. Solution

Step	Statement	x	y
1	y = 5	?	**5**
2	x = 38	**38**	5
3	y *= 2	38	**10**
4	x++	**39**	10
5	System.out.println(y)	It displays: 10	
6	while (y < x)	true	
7	y *= 2	39	**20**
8	x++	**40**	20
9	System.out.println(y)	It displays: 20	
10	while (y < x)	true	
11	y *= 2	40	**40**
12	x++	**41**	40
13	System.out.println(y)	It displays: 40	
14	while (y < x)	true	
15	y *= 2	41	**80**
16	x++	**42**	80
17	System.out.println(y)	It displays: 80	

18	`while (y < x)`	false

8. Solution

Step	Statement	Notes	x
1	`x = 1`		**1**
2	`if (x % 2 == 0)`	false	
3	`x += 3`		**4**
4	`System.out.println(x)`	It displays: 4	
5	`while (x < 12)`	true	
6	`if (x % 2 == 0)`	true	
7	`x++`		**5**
8	`System.out.println(x)`	It displays: 5	
9	`while (x < 12)`	true	
10	`if (x % 2 == 0)`	false	
11	`x += 3`		**8**
12	`System.out.println(x)`	It displays: 8	
13	`while (x < 12)`	true	
14	`if (x % 2 == 0)`	true	
15	`x++`		**9**
16	`System.out.println(x)`	It displays: 9	
17	`while (x < 12)`	true	
18	`if (x % 2 == 0)`	false	
19	`x += 3`		**12**
20	`System.out.println(x)`	It displays: 12	
21	`while (x < 12)`	false	

9. Solution

Step	Statement	x	y
1	`y = 2`	?	**2**
2	`x = 0`	**0**	2
3	`y = Math.pow (y, 2)`	0	**4**
4	`if (x < 256)`	true	
5	`x = x + y`	**4**	
6	`System.out.println(x + ", " + y)`	It displays: 4, 4	
7	`while (y < 65535)`	true	
8	`y = Math.pow (y, 2)`	4	**16**
9	`if (x < 256)`	true	

10	x = x + y	**20**	16
11	System.out.println(x + ", " + y)	It displays: 20, 16	
12	while (y < 65535)	true	
13	y = Math.pow (y, 2)	20	**256**
14	if (x < 256)	true	
15	x = x + y	**276**	256
16	System.out.println(x + ", " + y)	It displays: 276, 256	
17	while (y < 65535)	true	
18	y = Math.pow (y, 2)	276	**65536**
19	if (x < 256)	false	
20	System.out.println(x + ", " + y)	It displays: 276, 65536	
21	while (y < 65535)	false	

10. Solution

Step	Statement	a	b	c	d	x
1	a = 2	**2**	?	?	?	?
2	b = 4	2	**4**	?	?	?
3	c = 0	2	4	**0**	?	?
4	d = 0	2	4	0	**0**	?
5	x = a + b	2	4	0	0	**6**
6	if (x % 2 != 0)	false				
7	else if (d % 2 == 0)	true				
8	d = d + 5	2	4	0	**5**	6
9	a = b	**4**	4	0	5	6
10	b = d	4	**5**	0	5	6
11	while (c < 11)	true				
12	x = a + b	4	5	0	5	**9**
13	if (x % 2 != 0)	true				
14	c = c + 5	4	5	**5**	5	9
15	a = b	**b**	5	5	5	9
16	b = d	5	**5**	5	5	9
17	while (c < 11)	true				
18	x = a + b	5	5	5	5	**10**

19	`if (x % 2 != 0)`	false				
20	`else if (d % 2 == 0)`	false				
21	`c = c + 3`	5	5	**8**	5	10
22	`a = b`	**5**	5	8	5	10
23	`b = d`	5	**5**	8	5	10
24	`while (c < 11)`	true				
25	`x = a + b`	5	5	8	5	**10**
26	`if (x % 2 != 0)`	false				
27	`else if (d % 2 == 0)`	false				
28	`c = c + 3`	5	5	**11**	5	10
29	`a = b`	**5**	5	11	5	10
30	`b = d`	5	**5**	11	5	10
31	`while (c < 11)`	false				

11. Solution

i. -1
ii. 18
iii. 0.5
iv. -20
v. 128
vi. 11.25

12. Solution

i. 4
ii. -2
iii. 2
iv. 10

13. Solution

```
public static void main(String[] args) throws Exception {
  double a, total;
  int i, n;

  n = Integer.parseInt(cin.nextLine());
  total = 0

  i = 1;
  while (i <= n) {
    a = Double.parseDouble(cin.nextLine());
    total = total + a;
    i++;
  }

  System.out.println(total);
  if (n > 0) {
    System.out.println(total / n);
  }
}
```

14. Solution

```
public static void main(String[] args) throws Exception {
  int a, i, n, p;
  int count = 0;

  n = Integer.parseInt(cin.nextLine());
  p = 1;

  i = 1;
  while (i <= n) {
    a = Integer.parseInt(cin.nextLine());
    if (a % 2 == 0) {
      p = p * a;
      count++;
    }
    i++;
  }

  if (count > 0) {
    System.out.println(p);
  }
  else {
    System.out.println("You entered no even integers ");
  }
}
```

15. Solution

```
public static void main(String[] args) throws Exception {
  int a, i, total;

  total = 0;

  i = 1;
  while (i <= 100) {
    a = Integer.parseInt(cin.nextLine());
    if (a % 10 == 0) {
      total = total + a;
    }
    i++;
  }
  System.out.println(total);
}
```

16. Solution

```
public static void main(String[] args) throws Exception {
  int a, i, total;

  total = 0;

  i = 1;
  while (i <= 20) {
    a = Integer.parseInt(cin.nextLine());
    if (a >= 100 && a <= 999) {
      total = total + a;
    }
    i++;
  }
  System.out.println(total);
}
```

17. Solution

```
public static void main(String[] args) throws Exception {
  double a, p;

  p = 1;

  a = Double.parseDouble(cin.nextLine());
  while (a != 0) {
    p = p * a;
    a = Double.parseDouble(cin.nextLine());
  }
  System.out.println(p);
}
```

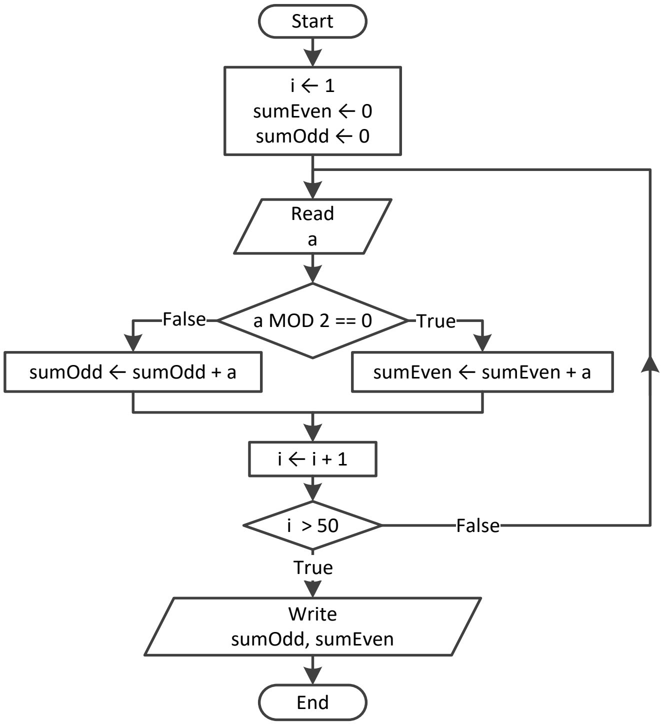
Step	Statement	a	p
1	`p = 1`	?	**1.0**
2	`a = Double.parseDouble(cin.nextLine())`	**3.0**	1.0
3	`while (a != 0)`	true	
4	`p = p * a`	3.0	**3.0**
5	`a = Double.parseDouble(cin.nextLine())`	**2.0**	3.0
6	`while (a != 0)`	true	
7	`p = p * a`	2.0	**6.0**
8	`a = Double.parseDouble(cin.nextLine())`	**9.0**	6.0
9	`while (a != 0)`	true	
10	`p = p * a`	9.0	**54.0**
11	`a = Double.parseDouble(cin.nextLine())`	**0.0**	54.0

12	`while (a != 0)`	false
13	`System.out.println(p)`	It displays: 54.0

18. Solution

```
public static void main(String[] args) throws Exception {
  int years;
  double population;

  population = 30000;

  years = 0;
  while (population <= 100000) {
    population += population * 0.03;
    years++;
  }
  System.out.println(years);
}
```

19. Solution



```
public static void main(String[] args) throws Exception {
  int a, i, sumEven, sumOdd;

  i = 1;
  sumEven = 0;
  sumOdd = 0;
  do {
    a = Integer.parseInt(cin.nextLine());
    if (a % 2 == 0) {
      sumEven += a;
    }
    else {
      sumOdd += a;
    }
    i++;
  } while (i <= 50);
  System.out.println(sumEven + " " + sumOdd);
}
```

20. Solution

```
public static void main(String[] args) throws Exception {
  int a, i, n, p;

  n = Integer.parseInt(cin.nextLine());
  i = 1;
  p = 1;
  do {
    a = Integer.parseInt(cin.nextLine());
    if (a < 0) {
      p *= a;
    }
    i++;
  } while (i <= n);
  System.out.println(Math.abs(p));
}
```

21. Solution

```
public static void main(String[] args) throws Exception {
  int a, i, p;

  i = 1;
  p = 1;
  do {
    System.out.print("Enter an integer: ");
    a = Integer.parseInt(cin.nextLine());
    if (a >= 500 && a <= 599) {
      p *= a;
    }
    i++;
  } while (i <= 5);
  System.out.println(p);
}
```

22. Solution

```
public static void main(String[] args) throws Exception {
  double population;
  int years;

  population = 50000;

  years = 0;
  do {
    population -= population * 0.10;
    years++;
  } while (population >= 20000);
  System.out.println(years);
}
```

Chapter 26

26.3 Review Questions: True/False

1. true
2. true
3. false
4. false
5. false
6. true
7. false
8. true
9. false
10. false
11. false
12. false

26.4 Review Questions: Multiple Choice

1. c
2. d
3. d
4. b
5. a
6. b
7. a
8. b
9. c
10. b
11. d
12. d
13. c
14. c

26.5 Review Exercises

1. Solution

Step	Statement	a	b	j
1	`a = 0`	**0**	?	?
2	`b = 0`	0	**0**	?
3	`j = 0`	0	0	**0**
4	`j <= 8`	true		
5	`if (j < 5)`	true		
6	`b++`	0	**1**	0
7	`j += 2`	0	1	**2**
8	`j <= 8`	true		
9	`if (j < 5)`	true		
10	`b++`	0	**2**	2
11	`j += 2`	0	2	**4**
12	`j <= 8`	true		
13	`if (j < 5)`	true		
14	`b++`	0	**3**	4
15	`j += 2`	0	3	**6**
16	`j <= 8`	true		
17	`if (j < 5)`	false		
18	`a += j - 1`	**5**	3	6

19	`j += 2`	5	3	**8**
20	`j <= 8`	true		
21	`if (j < 5)`	false		
22	`a += j - 1`	**12**	3	8
23	`j += 2`	12	3	**10**
24	`j <= 8`	false		
25	`System.out.println(a + ", " + b)`	It displays: 12, 3		

2. Solution

For input value of 10

Step	Statement	a	b	j
1	`a = Integer.parseInt(cin.nextLine())`	**10**	?	?
2	`b = a`	10	**10**	?
3	`j = a - 5`	10	10	**5**
4	`j <= a`	true		
5	`if (j % 2 != 0)`	true		
6	`b = a + j + 5`	10	**20**	5
7	`j += 2`	10	20	**7**
8	`j <= a`	true		
9	`if (j % 2 != 0)`	true		
10	`b = a + j + 5`	10	**22**	7
11	`j += 2`	10	22	**9**
12	`j <= a`	true		
13	`if (j % 2 != 0)`	true		
14	`b = a + j + 5`	10	**24**	9
15	`j += 2`	10	24	**11**
16	`j <= a`	false		
17	`System.out.println(b)`	It displays: 24		

For input value of 21

Step	Statement	a	b	j
1	`a = Integer.parseInt(cin.nextLine())`	**21**	?	?
2	`b = a`	21	**21**	?
3	`j = a - 5`	21	21	**16**
4	`j <= a`	true		
5	`if (j % 2 != 0)`	false		
6	`b = a + j + 5`	21	**5**	16
7	`j += 2`	21	5	**18**

8	`j <= a`	true		
9	`if (j % 2 != 0)`	false		
10	`b = a + j + 5`	21	**3**	18
11	`j += 2`	21	3	**20**
12	`j <= a`	true		
13	`if (j % 2 != 0)`	false		
14	`b = a + j + 5`	21	**1**	20
15	`j += 2`	21	1	**22**
16	`j <= a`	false		
17	`System.out.println(b)`	It displays: 1		

3. Solution

For input value of 12

Step	Statement	a	x	y	j
1	`a = Integer.parseInt(cin.nextLine())`	**12**	?	?	?
2	`j = 2`	12	?	?	**2**
3	`j <= a - 1`	true			
4	`x = j * 3 + 3`	12	**9**	?	2
5	`y = j * 2 + 10`	12	9	**14**	2
6	`if (y - x > 0 || x > 30)`	true			
7	`y *= 2`	12	9	**28**	2
8	`x += 4`	12	**13**	28	2
9	`System.out.println(x + ", " + y)`	It displays: 13, 28			
10	`j += 3`	12	13	28	**5**
11	`j <= a - 1`	true			
12	`x = j * 3 + 3`	12	**18**	28	5
13	`y = j * 2 + 10`	12	18	**20**	5
14	`if (y - x > 0 || x > 30)`	true			
15	`y *= 2`	12	18	**40**	5
16	`x += 4`	12	**22**	40	5
17	`System.out.println(x + ", " + y)`	It displays: 22, 40			
18	`j += 3`	12	22	40	**8**
19	`j <= a - 1`	true			
20	`x = j * 3 + 3`	12	**27**	40	8
21	`y = j * 2 + 10`	12	27	**26**	8
22	`if (y - x > 0 || x > 30)`	false			
23	`x += 4`	12	**31**	26	8

24	`System.out.println(x + ", " + y)`	It displays: 31, 26			
25	`j += 3`	12	31	26	**11**
26	`j <= a - 1`	true			
27	`x = j * 3 + 3`	12	**36**	26	11
28	`y = j * 2 + 10`	12	36	**32**	11
29	`if (y - x > 0 || x > 30)`	true			
30	`y *= 2`	12	36	**64**	11
31	`x += 4`	12	**40**	64	11
32	`System.out.println(x + ", " + y)`	It displays: 40, 64			
33	`j += 3`	12	40	64	**14**
34	`j <= a - 1`	false			

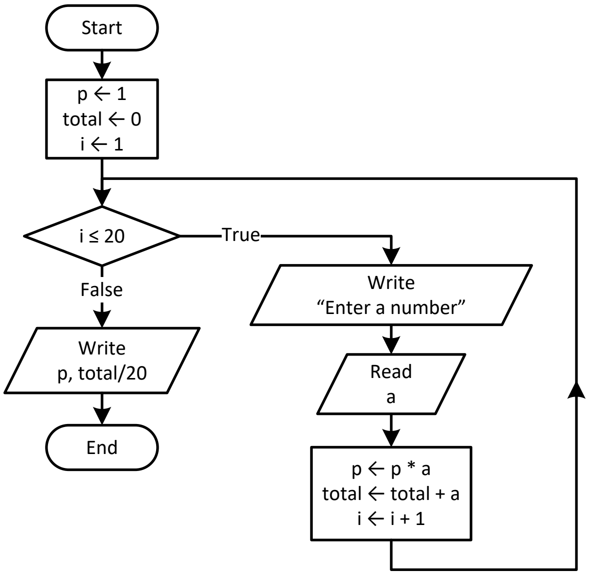
4. Solution

i. 9
ii. Any value greater than or equal to 2 and less than 2.5 (2 ≤ x < 2.5)
iii. −7 (or −6)
iv. −1

5. Solution

It displays: sueZ

6. Solution



```java
public static void main(String[] args) throws Exception {
  double a, p, total;
  int i;

  p = 1;
  total = 0;
  for (i = 1 ; i <= 20; i++) {
    System.out.print("Enter a number: ");
    a = Double.parseDouble(cin.nextLine());
    p = p * a;
    total = total + a;
  }
  System.out.println(p);
  System.out.println(total / 20);
}
```

7. Solution

```
public static void main(String[] args) throws Exception {
  double i;

  for (i = 0 ; i <= 360; i += 0.5) {
    System.out.println(Math.sin(i * Math.PI / 180));
  }
}
```

8. Solution

```
public static void main(String[] args) throws Exception {
  int deg, i;

  System.out.print("Enter degrees: ");
  deg = Integer.parseInt(cin.nextLine());
  for (i = 0 ; i <= deg; i++) {
    System.out.println(Math.cos(i * Math.PI / 180));
  }
}
```

9. Solution

```
public static void main(String[] args) throws Exception {
  int i, s;

  s = 0;
  for (i = 1; i <= 99; i += 2) {
    s += i;
  }
  System.out.println(s);
}
```

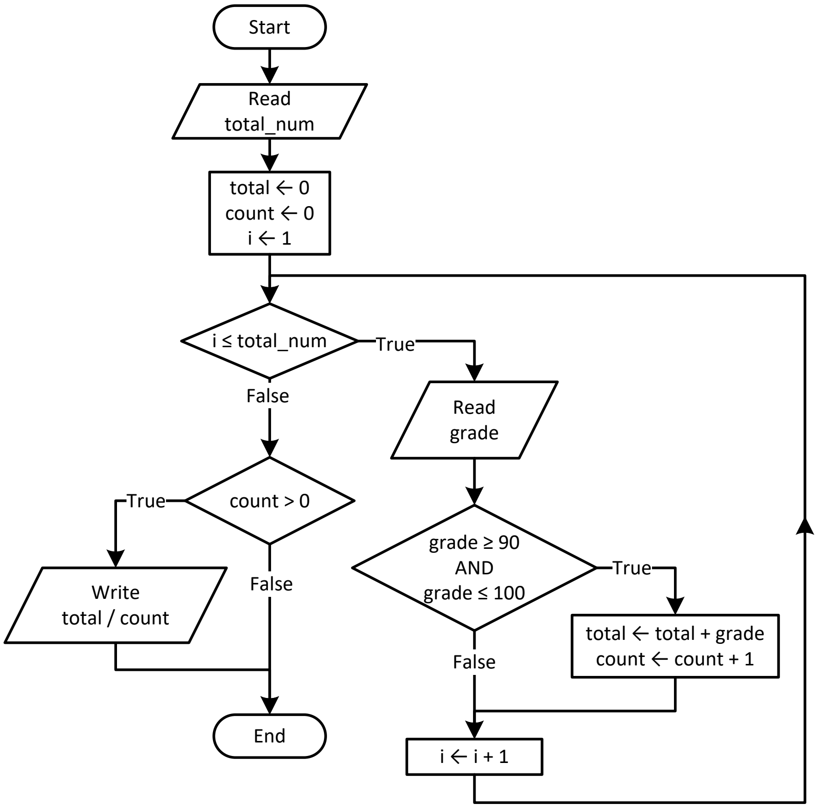
10. Solution

```
public static void main(String[] args) throws Exception {
  int i, n;
  double p;

  n = Integer.parseInt(cin.nextLine());
  p = 1;
  for (i = 2; i <= 2 * n; i += 2) {
    p *= Math.pow(i, i - 1);
  }
  System.out.println(p);
}
```

11. Solution

```
public static void main(String[] args) throws Exception {
  int i, offset, s;

  s = 0;
  i = 1;
  offset = 0;
  while (i <= 191) {
    s += i;
    offset++;
    i += offset;
  }
  System.out.println(s);
}
```

12. Solution

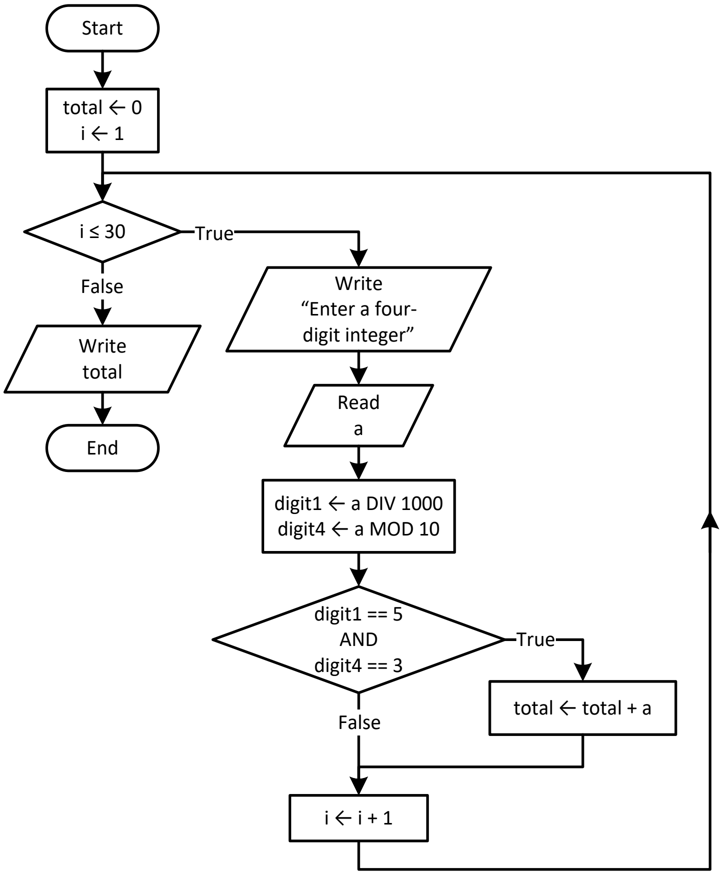


```
public static void main(String[] args) throws Exception {
  int count, grade, i, totalNum, total;

```

```
    totalNum = Integer.parseInt(cin.nextLine());
    total = 0;
    count = 0;
    for (i = 1; i <= totalNum; i++) {
      grade = Integer.parseInt(cin.nextLine());
      if (grade >= 90 && grade <= 100) {
        total += grade;
        count++;
      }
    }
    if (count > 0) {
      System.out.println(total / (double)count);
    }
  }
```

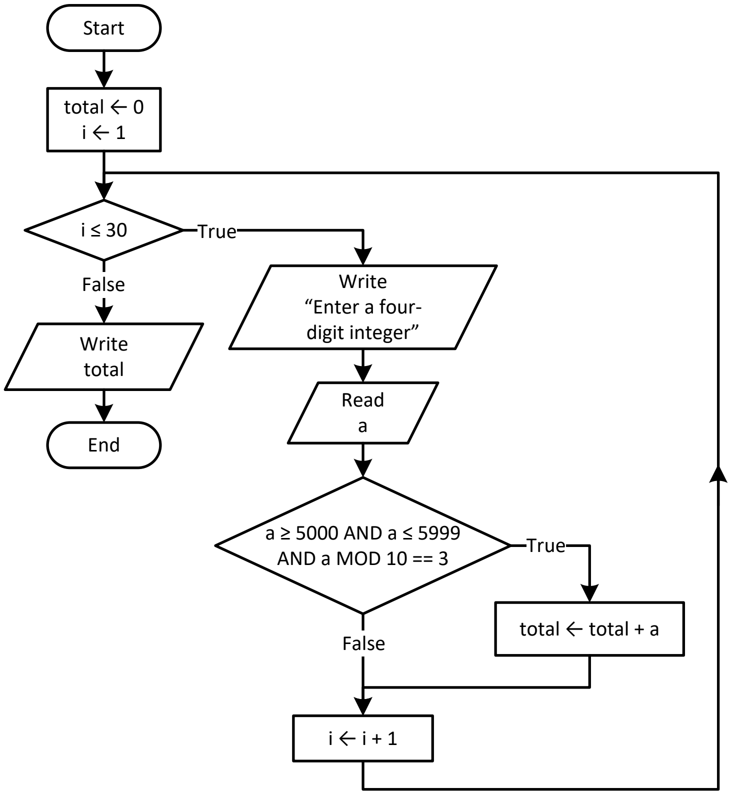
13. Solution

First approach



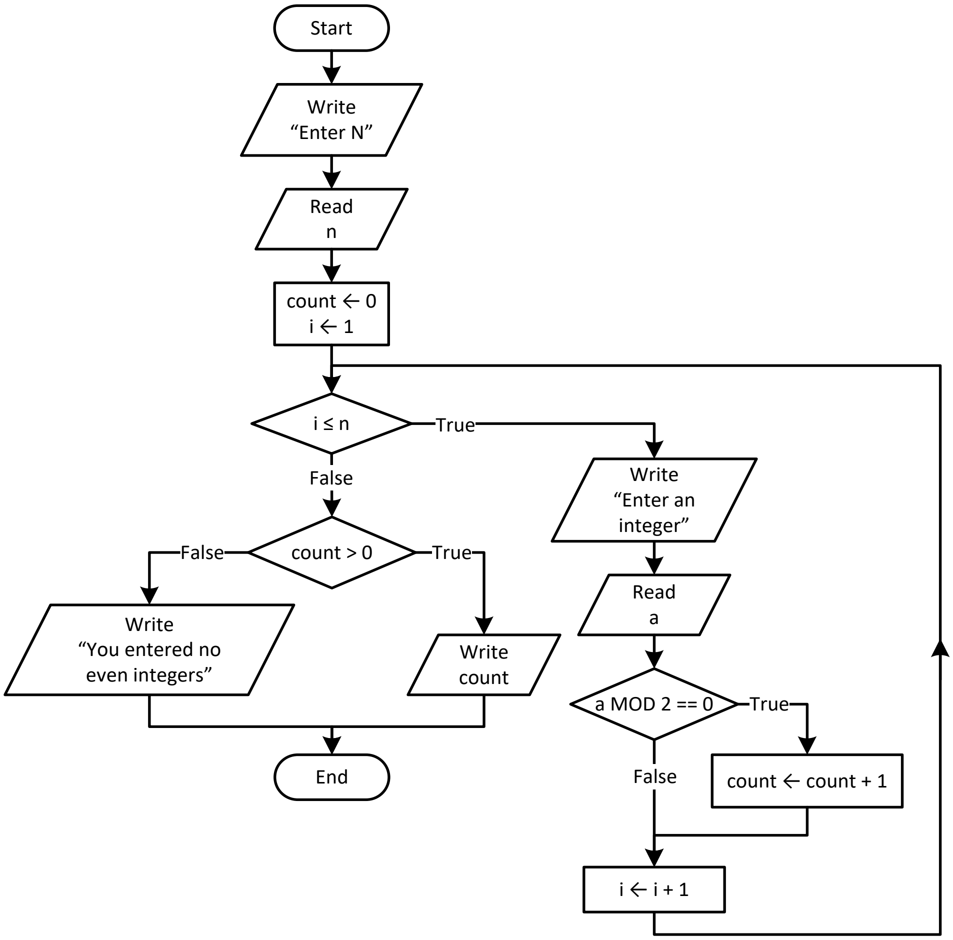
```
public static void main(String[] args) throws Exception {
  int a, digit1, digit4, i, total;

  total = 0;
  for (i = 1; i <= 30; i++) {
    System.out.print("Enter a four-digit integer: ");
    a = Integer.parseInt(cin.nextLine());
    digit1 = (int)(a / 1000);
    digit4 = a % 10;
    if (digit1 == 5 && digit4 == 3) {
      total += a;
    }
  }
  System.out.println(total);
}
```

Second approach



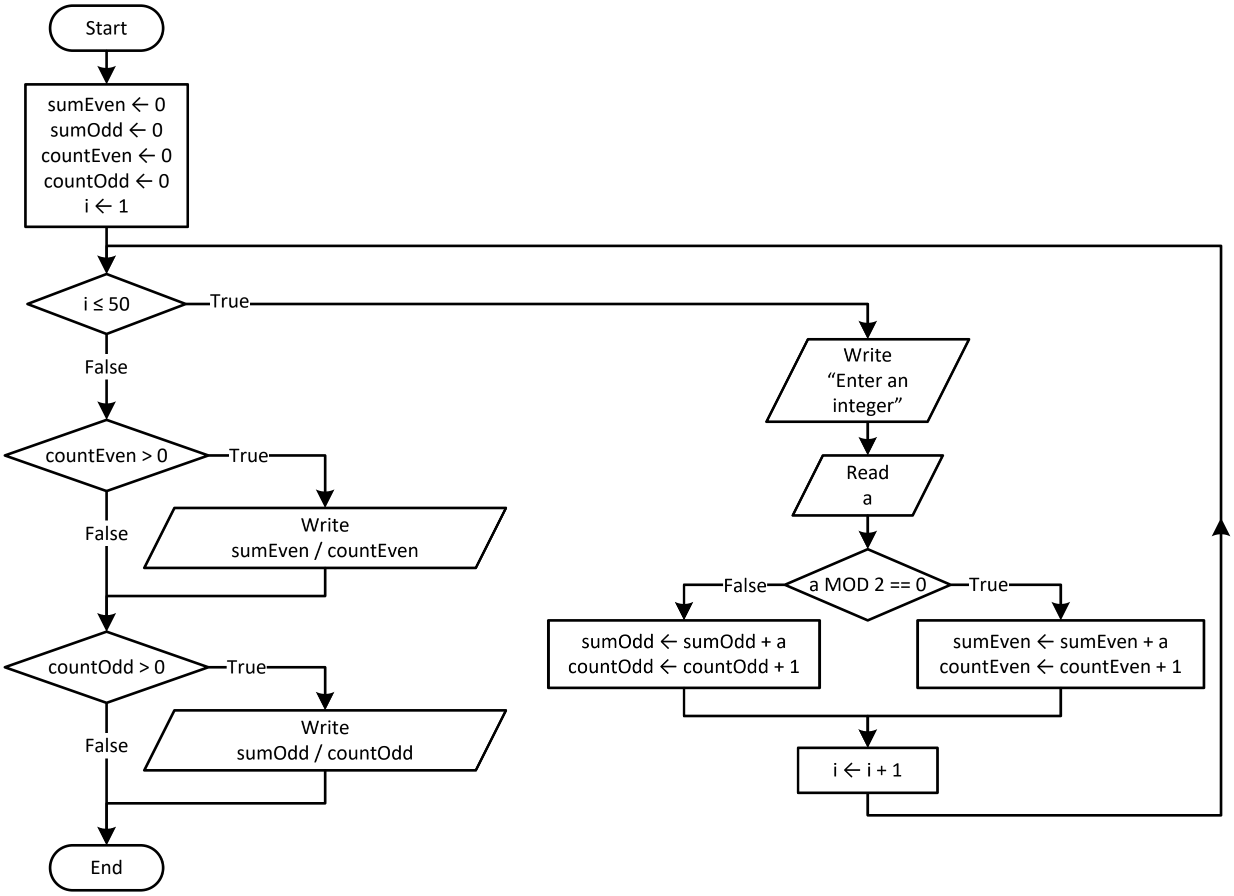
```
public static void main(String[] args) throws Exception {
  int a, i, total;

  total = 0;
  for (i = 1; i <= 30; i++) {
    System.out.print("Enter a four-digit integer: ");
    a = Integer.parseInt(cin.nextLine());
    if (a >= 5000 && a <= 5999 && a % 10 == 3) {
      total += a;
    }
  }
  System.out.println(total);
}
```

14. Solution



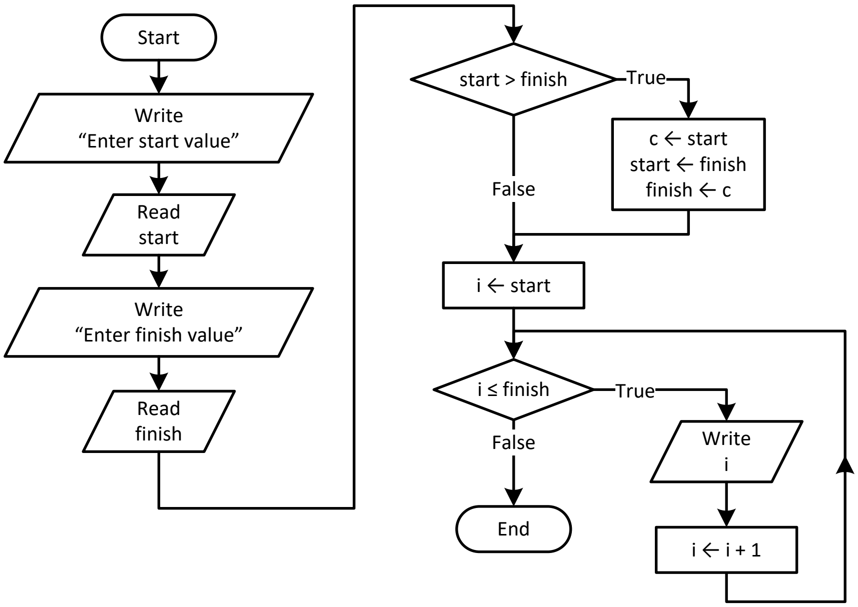
```
public static void main(String[] args) throws Exception {
  int a, count, i, n;

  System.out.print("Enter N: ");
  n = Integer.parseInt(cin.nextLine());
  count = 0;
  for (i = 1; i <= n; i++) {
    System.out.print("Enter an integer: ");
    a = Integer.parseInt(cin.nextLine());
    if (a % 2 == 0) {
      count++;
    }
  }
  if (count > 0) {
    System.out.println(count);
  }
  else {
    System.out.println("You entered no even integers");
  }
}
```

15. Solution



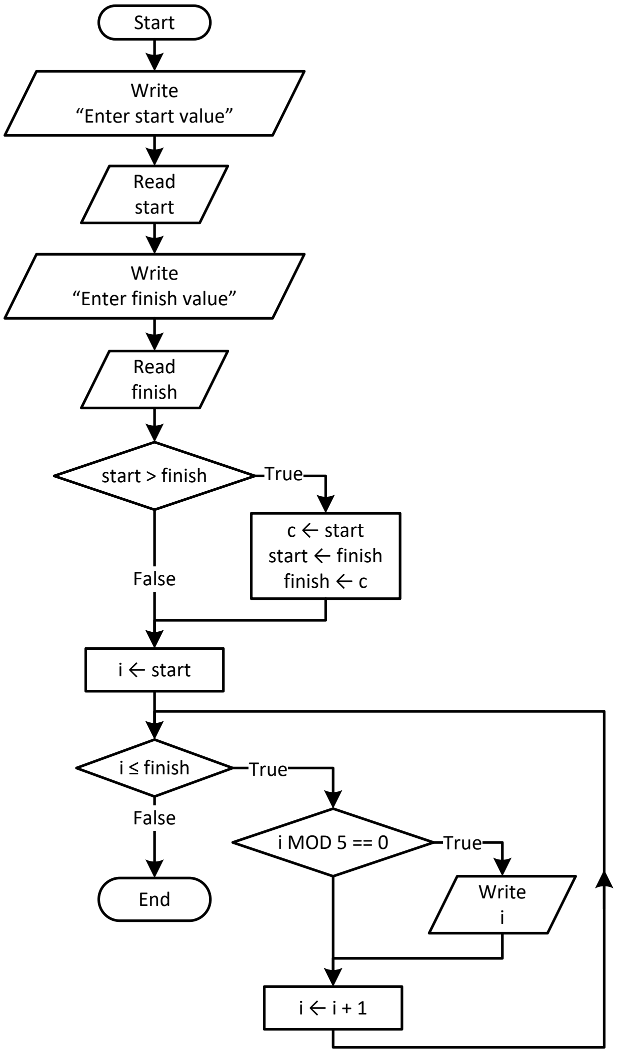
```
public static void main(String[] args) throws Exception {
  int a, countEven, countOdd, i, sumEven, sumOdd;

  sumEven = 0;
  sumOdd = 0;
  countEven = 0;
  countOdd = 0;
  for (i = 1; i <= 50; i++) {
    System.out.print("Enter an integer: ");
    a = Integer.parseInt(cin.nextLine());
    if (a % 2 == 0) {
      sumEven += a;
      countEven++;
    }
    else {
      sumOdd += a;
      countOdd++;
    }
  }
  if (countEven > 0) {
    System.out.println(sumEven / (double)countEven);
  }
  if (countOdd > 0) {
    System.out.println(sumOdd / (double)countOdd);
  }
}
```

16. Solution



```
public static void main(String[] args) throws Exception {
  int c, finish, i, start;

  System.out.print("Enter start value: ");
  start = Integer.parseInt(cin.nextLine());
  System.out.print("Enter finish value: ");
  finish = Integer.parseInt(cin.nextLine());

  if (start > finish) {
    c = start;
    start = finish;
    finish = c;
  }

  for (i = start; i <= finish; i++) {
    System.out.println(i);
  }
}
```

17. Solution



```
public static void main(String[] args) throws Exception {
  int c, finish, i, start;

  System.out.print("Enter start value: ");
  start = Integer.parseInt(cin.nextLine());
  System.out.print("Enter finish value: ");
  finish = Integer.parseInt(cin.nextLine());

  if (start > finish) {
    c = start;
    start = finish;
    finish = c;
  }

  for (i = start; i <= finish; i++) {
    if (i % 5 == 0) {
      System.out.println(i);
    }
  }
}
```

18. Solution

First approach

```
public static void main(String[] args) throws Exception {
  int exp, i;
  double p, b;

  System.out.print("Enter a value for base: ");
  b = Double.parseDouble(cin.nextLine());
  System.out.print("Enter an integer for exponent: ");
  exp = Integer.parseInt(cin.nextLine());

  p = 1;
  if (exp >= 0) {
    for (i = 1; i <= exp; i++) {
      p *= b;
    }
  }
  else {
    for (i = 1; i <= -exp; i++) {
      p *= 1 / b;
    }
  }
  System.out.println(p);
}
```

Second approach

```
public static void main(String[] args) throws Exception {
  int exp, i;
  double p, b;

  System.out.print("Enter a value for base: ");
  b = Double.parseDouble(cin.nextLine());
  System.out.print("Enter an integer for exponent: ");
  exp = Integer.parseInt(cin.nextLine());

  p = 1;
  for (i = 1; i <= Math.abs(exp); i++) {
    p *= b;
  }
  if (exp < 0) {
    p = 1 / p;
  }
  System.out.println(p);
}
```

19. Solution

```
public static void main(String[] args) throws Exception {
  int count, i, words;
  String msg, character;

  System.out.print("Enter a message: ");
  msg = cin.nextLine();

  count = 0;
  for (i = 0; i <= msg.length() - 1; i++) {
    character = "" + msg.charAt(i);
    if (character.equals(" ")) {
      count++;
    }
  }
  words = count + 1;

  System.out.println("The message entered contains " + words + " words");
}
```

20. Solution

```
public static void main(String[] args) throws Exception {
  int characters, count, i, words;
  String msg, character;

  System.out.print("Enter a message: ");
  msg = cin.nextLine();

  characters = msg.length();
  count = 0;
  for (i = 0; i <= characters - 1; i++) {
    character = "" + msg.charAt(i);
    if (character.equals(" ")) {
      count++;
    }
  }

  words = count + 1;
  System.out.print("The average number of letters in each word is ");
  System.out.println((characters - count) / (double)words);
}
```

21. Solution

```
public static void main(String[] args) throws Exception {
  String message;
  char character;
  String consonants = "BCDFGHJKLMNPQRSTVWZYX";
  int i, count;

  System.out.print("Enter an English message: ");
  message = cin.nextLine().toUpperCase();
  count = 0;
  for (i = 0; i <= message.length() - 1; i++) {
    character = message.charAt(i);

    if (consonants.indexOf(character) != -1) { //If character is found in consonants
      count++;
    }
  }
  System.out.println("Consonants: " + count);
}
```

22. Solution

```
public static void main(String[] args) throws Exception {
  String message;
  char character;
  String vowels = "AEIOU";
  String consonants = "BCDFGHJKLMNPQRSTVWZYX";
  String digits = "0123456789";
  int i, countv, countc, countd;

  System.out.print("Enter an English message: ");
  message = cin.nextLine().toUpperCase();

  countv = countc = countd = 0;
  for (i = 0; i <= message.length() - 1; i++) {
    character = message.charAt(i);

    if (vowels.indexOf(character) != -1) { //If character is found in vowels
      countv++;
    }
    else if (consonants.indexOf(character) != -1) { //If character is found in consonants
      countc++;
    }
    else if (digits.indexOf(character) != -1) { //If character is found in digits
      countd++;
    }
  }
  System.out.println("Vowels: " + countv);
  System.out.println("Consonants: " + countc);
  System.out.println("Digits: " + countd);
}
```

Chapter 27

27.3 Review Questions: True/False

1. true
2. true
3. false
4. true
5. true
6. false
7. true
8. true
9. true
10. true

27.4 Review Questions: Multiple Choice

1. b
2. a
3. c
4. a
5. b

27.5 Review Exercises

1. Solution

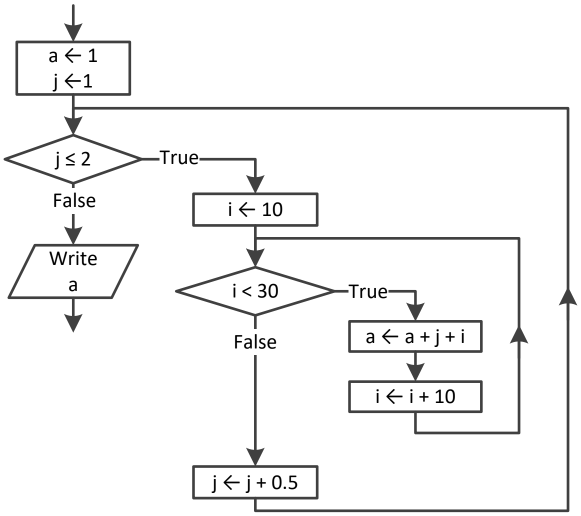
i. 10

ii. A value greater than or equal to 4.5 and less than 5.0 (4.5 ≤ x < 5.0)

iii. −7 (or −8)

iv. 138 (or 139)

2. Solution



Step	Statement	a	i	j
1	`a = 1`	**1**	?	?
2	`j = 1`	1	?	**1**
3	`j <= 2`	true		
4	`i = 10`	1	**10**	1
5	`i < 30`	true		

6	`a = a + j + i`	**12**	10	1
7	`i += 10`	12	**20**	1
8	`i < 30`	true		
9	`a = a * j + i`	**33**	20	1
10	`i += 10`	33	**30**	1
11	`i < 30`	false		
12	`j += 0.5`	33	30	**1.5**
13	`j <= 2`	true		
14	`i = 10`	33	**10**	1.5
15	`i < 30`	true		
16	`a = a + j + i`	**44.5**	10	1.5
17	`i += 10`	44.5	**20**	1.5
18	`i < 30`	true		
19	`a = a * j + i`	**66**	20	1.5
20	`i += 10`	66	**30**	1.5
21	`i < 30`	false		
22	`j += 0.5`	66	30	**2**
23	`j <= 2`	true		
24	`i = 10`	66	**10**	2
25	`i < 30`	true		
26	`a = a + j + i`	**78**	10	2
27	`i += 10`	78	**20**	2
28	`i < 30`	true		
29	`a = a * j + i`	**100**	20	2
30	`i += 10`	100	**30**	2
31	`i < 30`	false		
32	`j += 0.5`	100	30	**2.5**
33	`j <= 2`	false		
34	`System.out.println(a)`	It displays: 100		

3. Solution

Step	Statement	s	i	j
1	`s = 0`	**0**	?	?
2	`i = 1`	0	**1**	?
3	`i <= 4`	true		
4	`j = 3`	0	1	**3**
5	`j >= i`	true		

6	s = s + i * j	**3**	1	3
7	j--	3	1	**2**
8	j >= i	true		
9	s = s + i * j	**5**	1	2
10	j--	5	1	**1**
11	j >= i	true		
12	s = s + i * j	**6**	1	1
13	j--	6	1	**0**
14	j >= i	false		
15	i++	6	**2**	0
16	i <= 4	true		
17	j = 3	6	2	**3**
18	j >= i	true		
19	s = s + i * j	**12**	2	3
20	j--	12	2	**2**
21	j >= i	true		
22	s = s + i * j	**16**	2	2
23	j--	16	2	**1**
24	j >= i	false		
25	i++	16	**3**	1
26	i <= 4	true		
27	j = 3	16	3	**3**
28	j >= i	true		
29	s = s + i * j	**25**	3	3
30	j--	25	3	**2**
31	j >= i	false		
32	i++	25	**4**	2
33	i <= 4	true		
34	j = 3	25	4	**3**
35	j >= i	false		
36	i++	25	**5**	3
37	i <= 4	false		
38	System.out.println(s)	It displays: 25		

The statement `s = s + i * j` is executed 6 times

4. Solution

For input value of "NO"

Step	Statement	s	y	i	ans
1	`s = 1`	**1**	?	?	?
2	`y = 25`	1	**25**	?	?
3	`i = 1`	1	25	**1**	?
4	`i <= 3`	true			
5	`s = s + y`	**26**	25	1	?
6	`y -= 5`	26	**20**	1	?
7	`i++`	26	20	**2**	?
8	`i <= 3`	true			
9	`s = s + y`	**46**	20	2	?
10	`y -= 5`	46	**15**	2	?
11	`i++`	46	15	**3**	?
12	`i <= 3`	true			
13	`s = s + y`	**61**	15	3	?
14	`y -= 5`	61	**10**	3	?
15	`i++`	61	10	**4**	?
16	`i <= 3`	false			
17	`ans = cin.nextLine()`	61	10	4	**“NO”**
18	`while (ans.equals("YES"))`	false			
19	`System.out.println(s)`	It displays: 61			

For input values of “YES”, “NO”

Step	Statement	s	y	i	ans
1	`s = 1`	**1**	?	?	?
2	`y = 25`	1	**25**	?	?
3	`i = 1`	1	25	**1**	?
4	`i <= 3`	true			
5	`s = s + y`	**26**	25	1	?
6	`y -= 5`	26	**20**	1	?
7	`i++`	26	20	**2**	?
8	`i <= 3`	true			
9	`s = s + y`	**46**	20	2	?
10	`y -= 5`	46	**15**	2	?
11	`i++`	46	15	**3**	?
12	`i <= 3`	true			
13	`s = s + y`	**61**	15	3	?
14	`y -= 5`	61	**10**	3	?
15	`i++`	61	10	**4**	?

16	`i <= 3`	false			
17	`ans = cin.nextLine()`	61	10	4	**“YES”**
18	`while (ans.equals("YES"))`	true			
19	`i = 1`	61	10	**1**	“YES”
20	`i <= 3`	true			
21	`s = s + y`	**71**	10	1	“YES”
22	`y -= 5`	71	**5**	1	“YES”
23	`i++`	71	5	**2**	“YES”
24	`i <= 3`	true			
25	`s = s + y`	**76**	5	2	“YES”
26	`y -= 5`	76	**0**	2	“YES”
27	`i++`	76	0	**3**	“YES”
28	`i <= 3`	true			
29	`s = s + y`	**76**	0	3	“YES”
30	`y -= 5`	76	**−5**	3	“YES”
31	`i++`	76	−5	**4**	“YES”
32	`i <= 3`	false			
33	`ans = cin.nextLine()`	76	−5	4	**“NO”**
34	`while (ans.equals("YES"))`	false			
35	`System.out.println(s)`	It displays: 76			

For input values of “YES”, “YES”, “NO”

Step	Statement	s	y	i	ans
1	`s = 1`	**1**	?	?	?
2	`y = 25`	1	**25**	?	?
3	`i = 1`	1	25	**1**	?
4	`i <= 3`	true			
5	`s = s + y`	**26**	25	1	?
6	`y -= 5`	26	**20**	1	?
7	`i++`	26	20	**2**	?
8	`i <= 3`	true			
9	`s = s + y`	**46**	20	2	?
10	`y -= 5`	46	**15**	2	?
11	`i++`	46	15	**3**	?
12	`i <= 3`	true			
13	`s = s + y`	**61**	15	3	?
14	`y -= 5`	61	**10**	3	?
15	`i++`	61	10	**4**	?

16	`i <= 3`	false			
17	`ans = cin.nextLine()`	61	10	4	**“YES”**
18	`while (ans.equals("YES"))`	true			
19	`i = 1`	61	10	**1**	“YES”
20	`i <= 3`	true			
21	`s = s + y`	**71**	10	1	“YES”
22	`y -= 5`	71	**5**	1	“YES”
23	`i++`	71	5	**2**	“YES”
24	`i <= 3`	true			
25	`s = s + y`	**76**	5	2	“YES”
26	`y -= 5`	76	**0**	2	“YES”
27	`i++`	76	0	**3**	“YES”
28	`i <= 3`	true			
29	`s = s + y`	**76**	0	3	“YES”
30	`y -= 5`	76	**–5**	3	“YES”
31	`i++`	76	–5	**4**	“YES”
32	`i <= 3`	false			
33	`ans = cin.nextLine()`	76	–5	4	**“YES”**
34	`while (ans.equals("YES"))`	true			
35	`i = 1`	76	–5	**1**	“YES”
36	`i <= 3`	true			
37	`s = s + y`	**71**	–5	1	“YES”
38	`y -= 5`	71	**–10**	1	“YES”
39	`i++`	71	–10	**2**	“YES”
40	`i <= 3`	true			
41	`s = s + y`	**61**	–10	2	“YES”
42	`y -= 5`	61	**–15**	2	“YES”
43	`i++`	61	–15	**3**	“YES”
44	`i <= 3`	true			
45	`s = s + y`	**46**	–15	3	“YES”
46	`y -= 5`	46	**–20**	3	“YES”
47	`i++`	46	–20	**4**	“YES”
48	`i <= 3`	false			
49	`ans = cin.nextLine()`	46	–20	4	**“NO”**
50	`while (ans.equals("YES"))`	false			
51	`System.out.println(s)`	It displays: 46			

5. Solution

```
public static void main(String[] args) throws Exception {
  int hour, minutes;

  for (hour = 0; hour <= 23; hour++) {
    for (minutes = 0; minutes <= 59; minutes++) {
      System.out.println(hour + "\t" + minutes);
    }
  }
}
```

6. Solution

```
public static void main(String[] args) throws Exception {
  int i, j;

  for (i = 5; i >= 1; i--) {
    for (j = 1; j <= i; j++) {
      System.out.print(i + " ");
    }
    System.out.println();
  }
}
```

7. Solution

```
public static void main(String[] args) throws Exception {
  int i, j;

  for (i = 0; i <= 5; i++) {
    for (j = 0; j <= i; j++) {
      System.out.print(j + " ");
    }
    System.out.println();
  }
}
```

8. Solution

```
public static void main(String[] args) throws Exception {
  int i, j;

  for (i = 1; i <= 4; i++) {
    for (j = 1; j <= 10; j++) {
      System.out.print("* ");
    }
    System.out.println();
  }
}
```

9. Solution

```
public static void main(String[] args) throws Exception {
  int i, j, y;

  System.out.print("Enter an integer between 3 and 20: ");
  y = Integer.parseInt(cin.nextLine());

  for (i = 1; i <= y; i++) {
    for (j = 1; j <= y; j++) {
      System.out.print("* ");
    }
    System.out.println();
  }
}
```

10. Solution

```
public static void main(String[] args) throws Exception {
  int i, j, y;

  System.out.print("Enter an integer between 3 and 20: ");
  y = Integer.parseInt(cin.nextLine());

  for (j = 1; j <= y; j++) {
    System.out.print("* ");
  }
  System.out.println();

  for (i = 1; i <= y - 2; i++) {
    System.out.print("* ");
    for (j = 1; j <= y - 2; j++) {
      System.out.print("  ");
    }
    System.out.println("* ");
  }

  for (j = 1; j <= y; j++) {
    System.out.print("* ");
  }
}
```

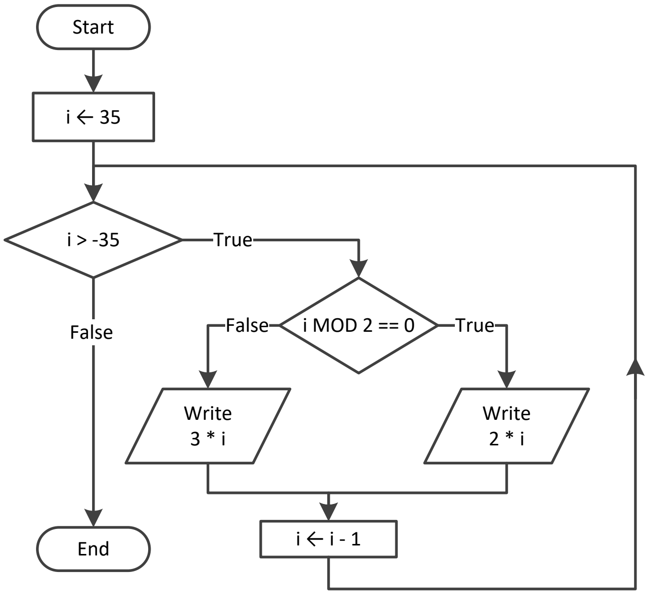
11. Solution

```
public static void main(String[] args) throws Exception {
  int i, j;

  for (i = 1; i <= 5; i++) {
    for (j = 1; j <= i; j++) {
      System.out.print("* ");
    }
    System.out.println();
  }

  for (i = 4; i >= 1; i--) {
    for (j = 1; j <= i; j++) {
      System.out.print("* ");
    }
    System.out.println();
  }
}
```

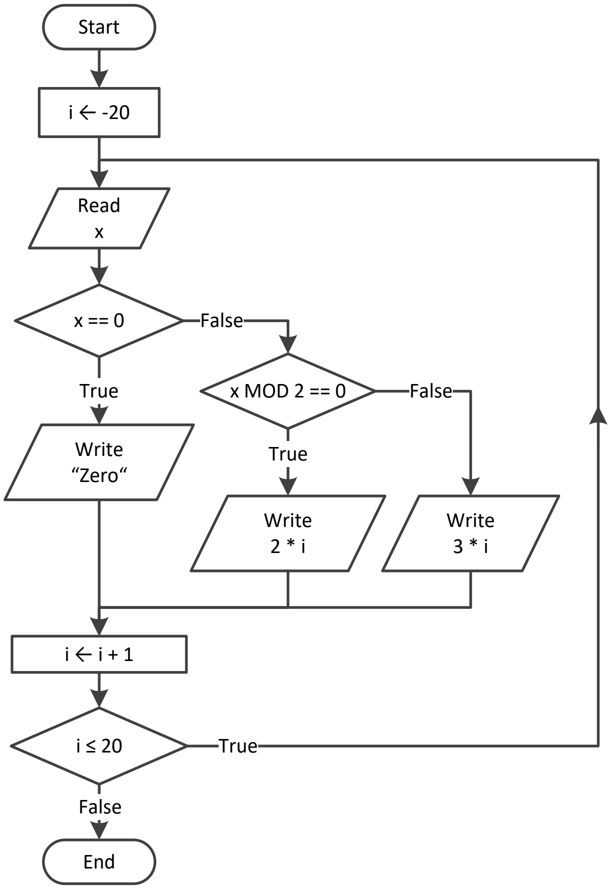
Chapter 28

28.4 Review Exercises

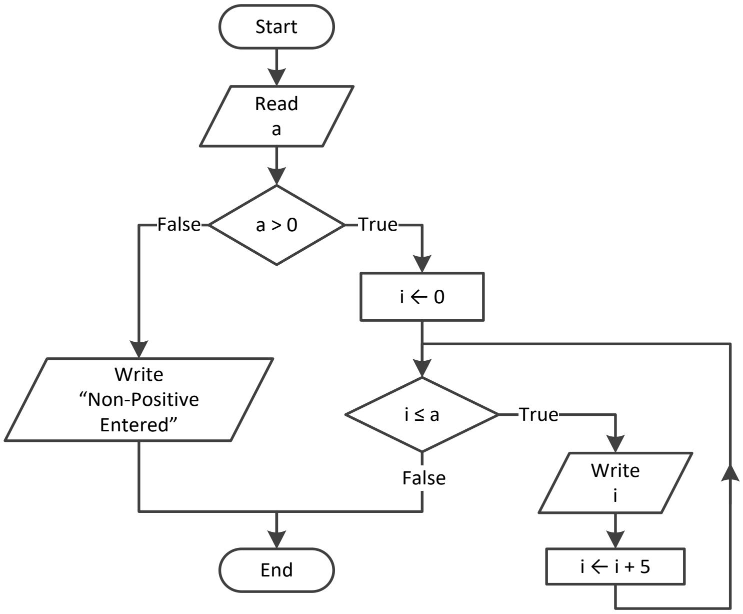
1. Solution



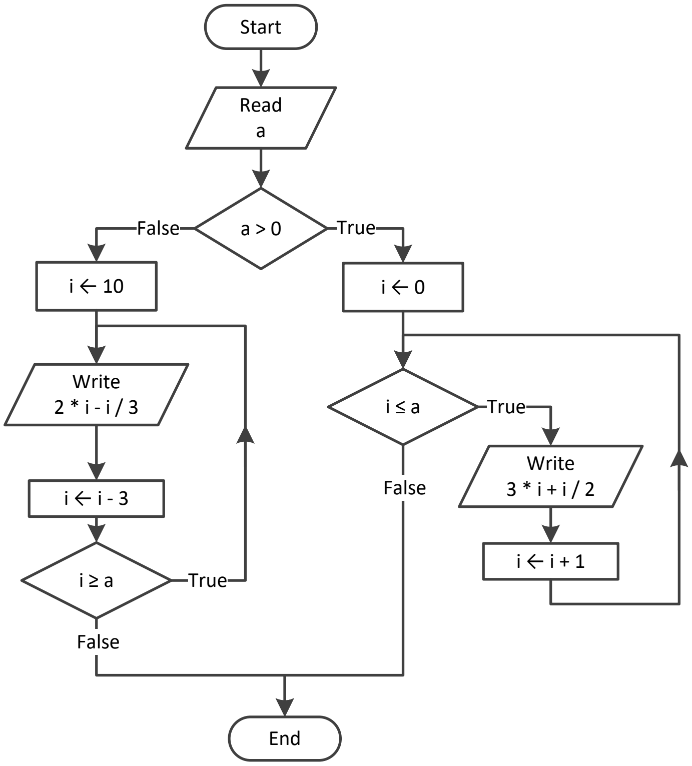
2. Solution



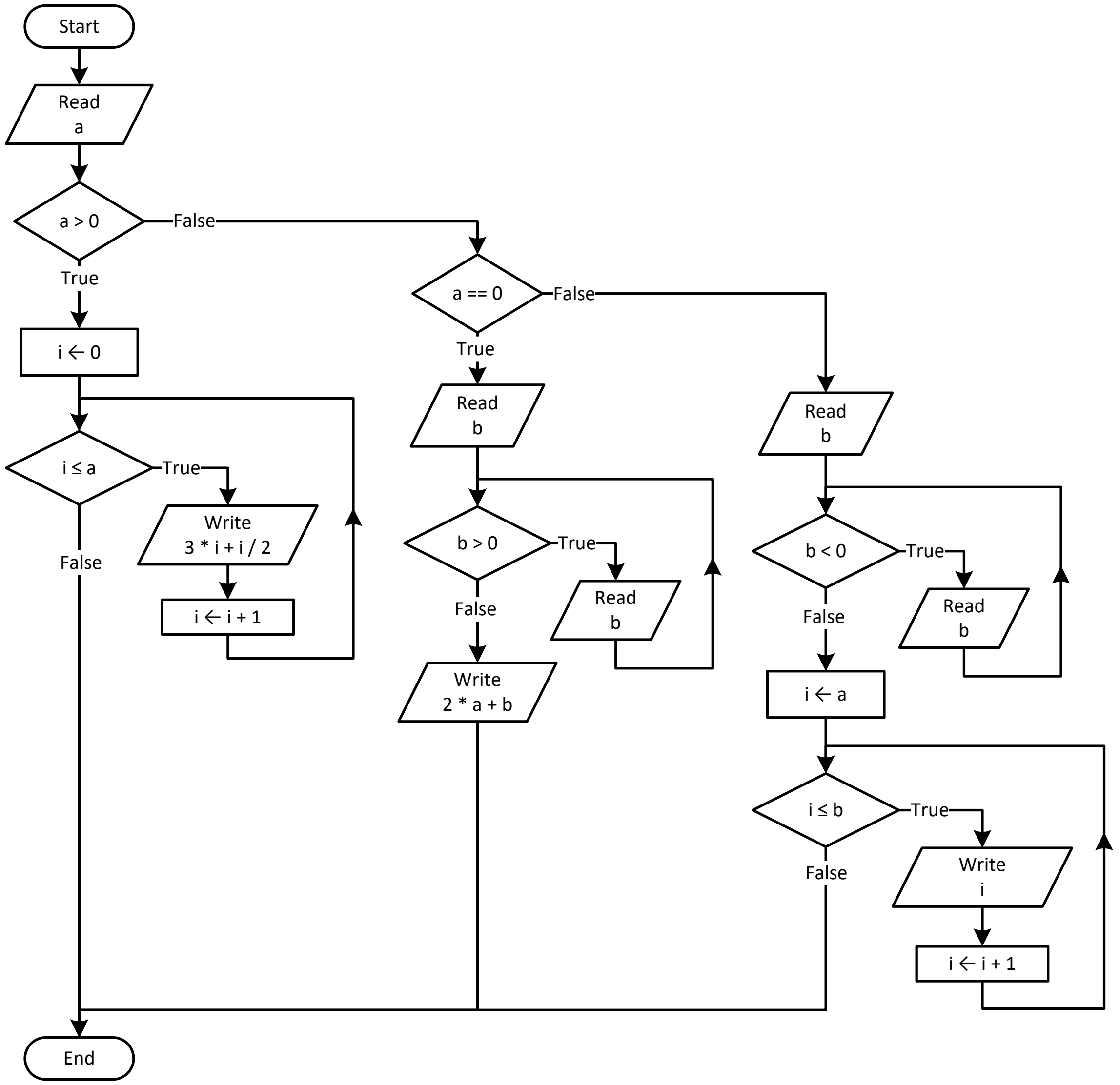
3. Solution



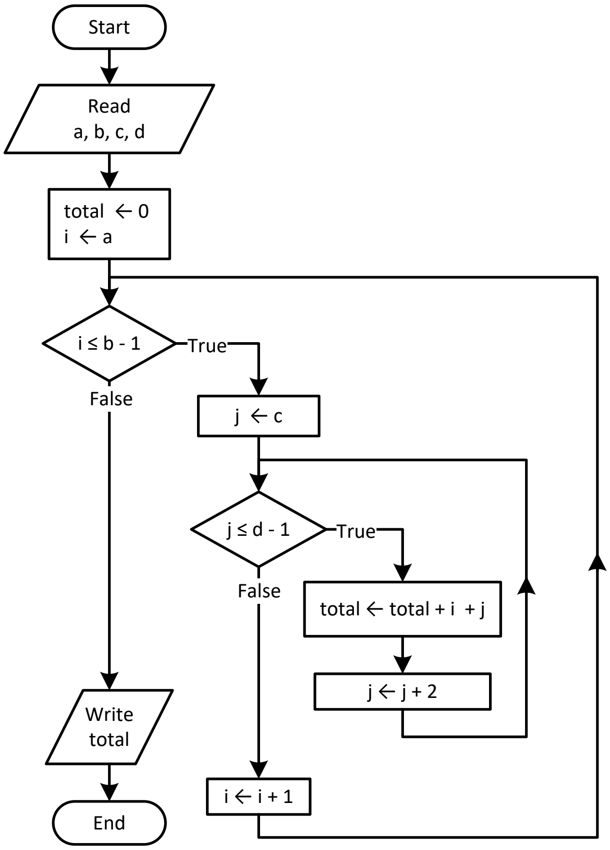
4. Solution


Start
Read
a
a > 0
False
True
i ← 10
i ← 0
Write
2 * i - i / 3
i ← i - 3
i ≥ a
True
False
i ≤ a
True
False
Write
3 * i + i / 2
i ← i + 1
End

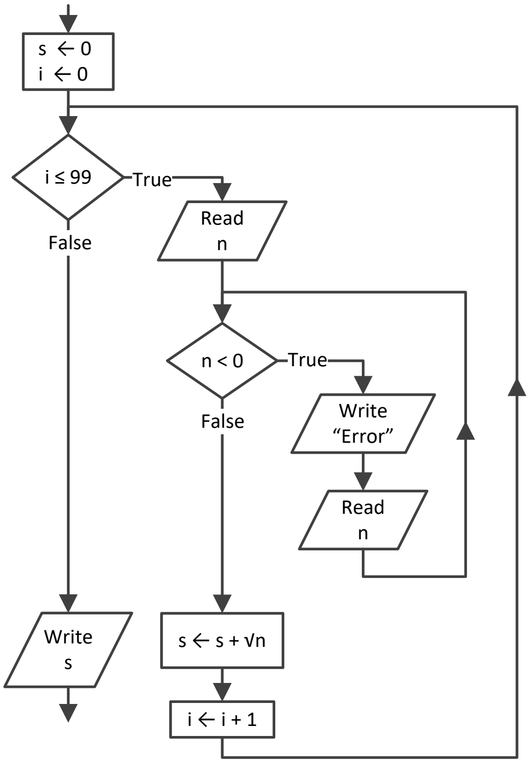
5. Solution


Start
Read a
a > 0
False
True
i ← 0
i ≤ a
True
Write 3 * i + i / 2
i ← i + 1
False
a == 0
False
True
Read b
b > 0
True
Read b
False
Write 2 * a + b
Read b
b < 0
True
Read b
False
i ← a
i ≤ b
True
Write i
i ← i + 1
False
End

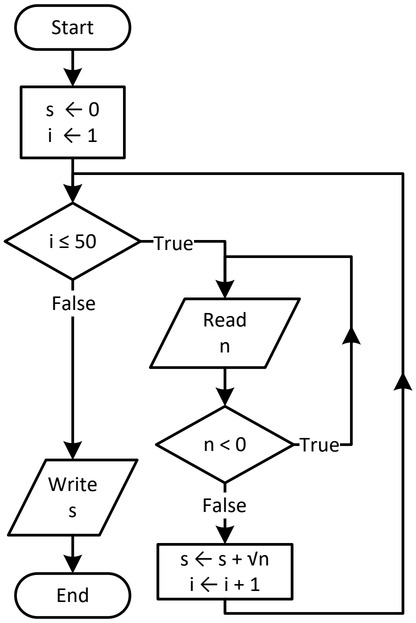
6. Solution


Start
Read
a, b, c, d
total ← 0
i ← a
i ≤ b - 1
True
False
j ← c
j ≤ d - 1
True
False
total ← total + i + j
j ← j + 2
i ← i + 1
Write
total
End

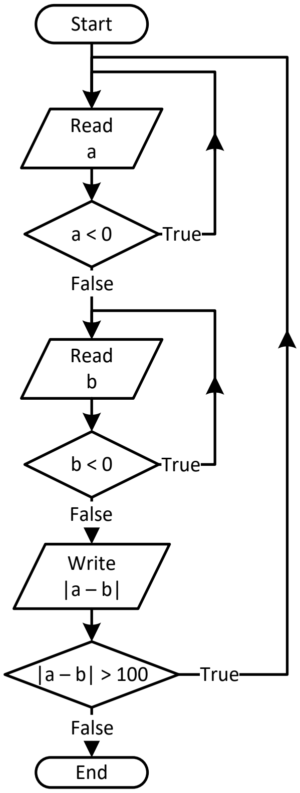
7. Solution



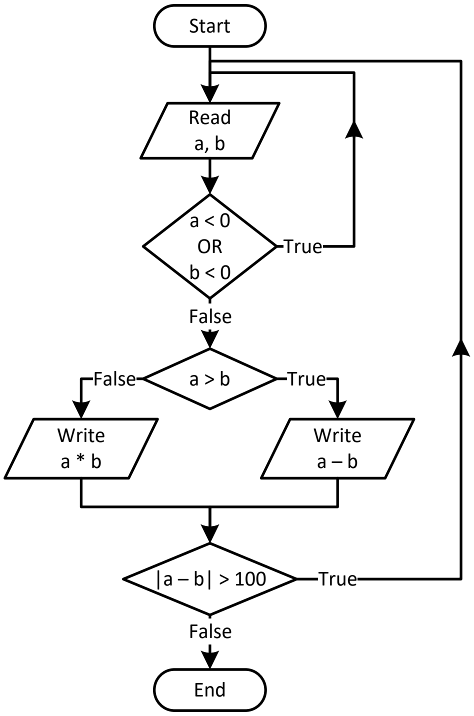
8. Solution



9. Solution



10. Solution



11. Solution

```
public static void main(String[] args) throws Exception {
  int a, i;

  i = 0;
  a = Integer.parseInt(cin.nextLine());
  do {
    if (i % 2 != 0) {
      System.out.println(i);
    }
    i += 5;
  } while (i < a);
}
```

12. Solution

```
public static void main(String[] args) throws Exception {
  int a, b, i;

  a = Integer.parseInt(cin.nextLine());
  while (a != -1) {
    do {
      b = Integer.parseInt(cin.nextLine());
    } while (b <= a);
    for (i = a; i <= b; i++) {
      System.out.println(i);
    }
    a = Integer.parseInt(cin.nextLine());
  }
}
```

13. Solution

```
public static void main(String[] args) throws Exception {
  int i;
  double P, S, a;

  i = 1;
  S = 0;
  P = 1;
  a = 0;

  while (true) {
    if (i < 45) {
      S += a;
    }
    else {
      P *= a;
    }
    i++;
    if (i >= 90) break;
    a = Double.parseDouble(cin.nextLine());
  }

  System.out.println(S + " " + P);
}
```

Chapter 29

29.8 Review Questions: True/False

1. false
2. false
3. false
4. true
5. true
6. false
7. false
8. false
9. true
10. true
11. false
12. false
13. false
14. true

29.9 Review Questions: Multiple Choice

1. c
2. d
3. b
4. a
5. c
6. c
7. c

29.10 Review Exercises

1. Solution

```
countNames = 0;
countNotJohns = 0;
~~name = "";~~
System.out.print("Enter a name: ");
name = cin.nextLine();
while (!name.equals("STOP")) {
  ~~System.out.print("Enter a name: ");~~
  ~~name = cin.nextLine();~~
  countNames++;
  if (!name.equals("John")) {
    countNotJohns++;
  }
  System.out.print("Enter a name: ");
  name = cin.nextLine();
}
System.out.println("Total names entered: " + countNames);
System.out.println("Names other than John entered: " + countNotJohns);
```

2. Solution

First approach

```
public static void main(String[] args) throws Exception {
  String text, character;
  boolean found;
  int i;

  System.out.print("Enter a text: ");
  text = cin.nextLine();

  found = false;
  for (i = 0; i <= text.length() - 1; i++) {
    character = "" + text.charAt(i);
    if (character.equals(" ")) {
      found = true;
      break;
    }
  }

  if (!found) {
    System.out.println("One Single Word");
  }
  else {
    System.out.println("Complete Sentence");
  }
}
```

Second approach

```
public static void main(String[] args) throws Exception {
  String text;

  System.out.print("Enter a text: ");
  text = cin.nextLine();

  if (text.indexOf(" ") == -1) {
    System.out.println("One Single Word");
  }
  else {
    System.out.println("Complete Sentence");
  }
}
```

3. Solution

First approach

```
public static void main(String[] args) throws Exception {
  String sentence, character;
  boolean found;
  int i;
  String digits = "0123456789";

  System.out.print("Enter a text: ");
  sentence = cin.nextLine();

  found = false;
  for (i = 0; i <= sentence.length() - 1; i++) {
    character = "" + sentence.charAt(i);
    if (digits.indexOf(character) != -1) {
      found = true;
      break;
    }
  }
  if (found) {
    System.out.println("The sentence contains a number");
  }
}
```

Second approach

```
public static void main(String[] args) throws Exception {
  String sentence;
  boolean found;
  int i;
  String digit;

  System.out.print("Enter a text: ");
  sentence = cin.nextLine();

  found = false;
  for (i = 0; i <= 9; i++) {
    digit = "" + i;
    if (sentence.indexOf(digit) != -1) {
      found = true;
      break;
    }
  }

  if (found) {
    System.out.println("The sentence contains a number");
  }
}
```

4. Solution

```
System.out.println("Printing all integers from 1 to 100");
i = 1;
while (i < 101) {
  System.out.println(i);
  i++;
}
```

5. Solution

```
System.out.println("Printing odd integers from 1 to 99");
i = 1;
while (i < 100) {
  System.out.println(i);
  i += 2;
}
```

6. Solution

```
s = 0;
i = 1;
count = 100;
do {
  number = Double.parseDouble(cin.nextLine());
  s = s + number;
  i++;
} while (i <= count);
average = s / count;
System.out.println(average);
```

7. Solution

```
int i, denom;
double s;

s = 0;

denom = 1;
for (i = 1; i <= 100; i++) {
  denom *= i;
}

for (i = 1; i <= 100; i++) {
  s += i / (double)denom;
}
System.out.println(s);
```

8. Solution

```
public static void main(String[] args) throws Exception {
  int i, j;

  for (i = 1; i <= 4; i++) {
    for (j = 1; j <= 4; j++) {
      System.out.println(i + " x " + j + " = " + (i * j));
    }
  }
}
```

9. Solution

```
public static void main(String[] args) throws Exception {
  int i, j;

  System.out.print("\t|\t");
  for (i = 1; i <= 12; i++) {
    System.out.print(i + "\t");
  }
  System.out.println();

  for (i = 1; i <= 12; i++) {
    System.out.print("---------");
  }
  System.out.println();

  for (i = 1; i <= 12; i++) {
    System.out.print(i + "\t|\t");
    for (j = 1; j <= 12; j++) {
      System.out.print(i * j + "\t");
    }
    System.out.println();
  }
}
```

10. Solution

```
public static void main(String[] args) throws Exception {
  int i, j, n;

  System.out.print("Enter an integer: ");
  n = Integer.parseInt(cin.nextLine());

  System.out.print("\t|\t");
  for (i = 1; i <= n; i++) {
    System.out.print(i + "\t");
  }
  System.out.println();

  for (i = 1; i <= n; i++) {
    System.out.print("---------");
  }
  System.out.println();

  for (i = 1; i <= n; i++) {
    System.out.print(i + "\t|\t");
    for (j = 1; j <= n; j++) {
      System.out.print(i * j + "\t");
    }
    System.out.println();
  }
}
```

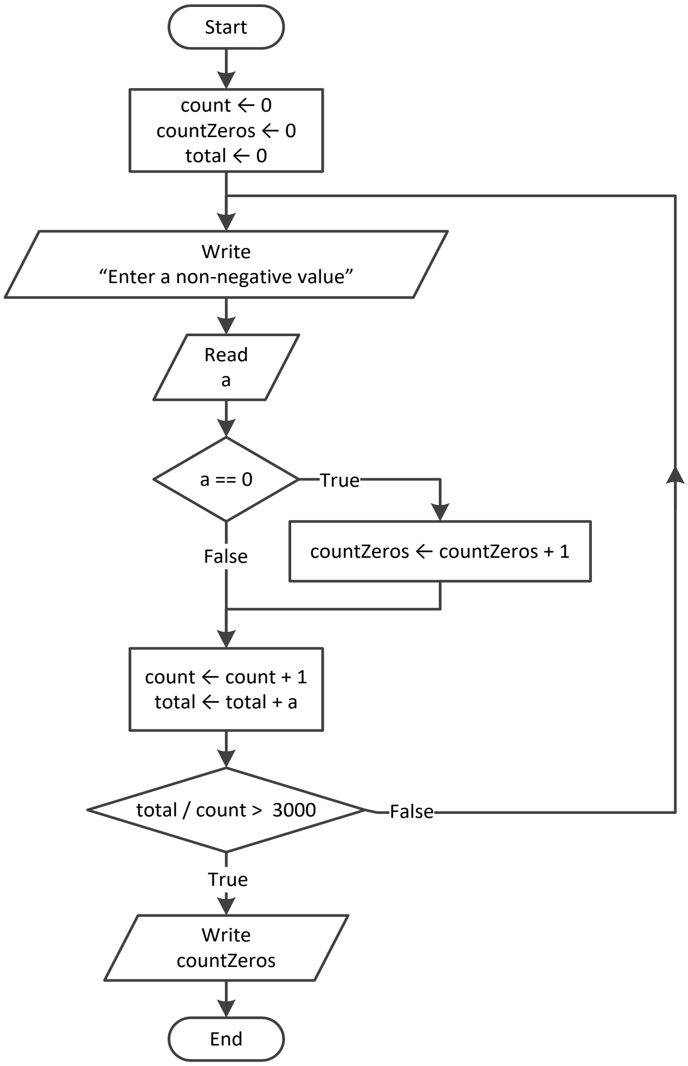
Chapter 30

30.7 Review Questions: True/False

1. true
2. false
3. true
4. false
5. false
6. false
7. true

30.8 Review Exercises

1. Solution



```
public static void main(String[] args) throws Exception {
  int count, countZeros;
  double a, total;

  count = 0;
  countZeros = 0;
  total = 0;
  do {
    System.out.print("Enter a non-negative value: ");
    a = Double.parseDouble(cin.nextLine());
    if (a == 0) {
      countZeros++;
    }
    count++;
    total += a;
  } while (total / count <= 3000);
  System.out.println(countZeros);
}
```

2. Solution

First approach

```
public static void main(String[] args) throws Exception {
  int a, d1, d2, d3, d4, i, r;

  System.out.print("Enter an integer between 1 and 20: ");
  a = Integer.parseInt(cin.nextLine());
  for (i = 1000; i <= 9999; i++) {
    d4 = i % 10;
    r = (int)(i / 10);
    d3 = r % 10;
    r = (int)(r / 10);
    d2 = r % 10;
    d1 = (int)(r / 10);
    if (d1 + d2 + d3 + d4 < a) {
      System.out.println(i);
    }
  }
}
```

Second approach

```
public static void main(String[] args) throws Exception {
  int a, d1, d2, d3, d4;

  System.out.print("Enter an integer between 1 and 20: ");
  a = Integer.parseInt(cin.nextLine());
  for (d1 = 1; d1 <= 9; d1++) {
    for (d2 = 0; d2 <= 9; d2++) {
      for (d3 = 0; d3 <= 9; d3++) {
        for (d4 = 0; d4 <= 9; d4++) {
          if (d1 + d2 + d3 + d4 < a) {
            System.out.println(d1 * 1000 + d2 * 100 + d3 * 10 + d4);
          }
        }
      }
    }
  }
}
```

3. Solution

First approach

```
public static void main(String[] args) throws Exception {
  int d1, d2, d3, d4, i, r;

  for (i = 1000; i <= 9999; i++) {
    d4 = i % 10;
    r = (int)(i / 10);
    d3 = r % 10;
    r = (int)(r / 10);
    d2 = r % 10;
    d1 = (int)(r / 10);
    if (d1 > d2 && d2 == d3 && d3 < d4) {
      System.out.println(i);
    }
  }
}
```

Second approach

```
public static void main(String[] args) throws Exception {
  int d1, d2, d3, d4;

  for (d1 = 1; d1 <= 9; d1++) {
    for (d2 = 0; d2 <= 9; d2++) {
      for (d3 = 0; d3 <= 9; d3++) {
        for (d4 = 0; d4 <= 9; d4++) {
          if (d1 > d2 && d2 == d3 && d3 < d4) {
            System.out.println(d1 * 1000 + d2 * 100 + d3 * 10 + d4);
          }
        }
      }
    }
  }
}
```

4. Solution

First approach

```
public static void main(String[] args) throws Exception {
  int x, count;

  System.out.print("Enter an integer: ");
  x = Integer.parseInt(cin.nextLine());

  count = 0;

  while (x != 0) {
    count++;
    x = (int)(x / 10);
  }
  System.out.println(count);
}
```

Second approach

```
public static void main(String[] args) throws Exception {
  int x, count;

  System.out.print("Enter an integer: ");
  x = Integer.parseInt(cin.nextLine());

  //Convert the absolute value of x to string and get its length
  count = String.valueOf(Math.abs(x)).length();  //Or you can do the following:
                                                 //count = ("" + Math.abs(x)).length();

  System.out.println(count);
}
```

5. Solution

```
x = Integer.parseInt(cin.nextLine());
while (x != 1 && x != 0) {
  System.out.println("Error");
  x = Integer.parseInt(cin.nextLine());
}
```

6. Solution

```
do {
  gender = cin.nextLine().toUpperCase();
} while (!gender.equals("M") && !gender.equals("F") && !gender.equals("O"));
```

7. Solution

```
public static void main(String[] args) throws Exception {
  int count;
  double x, y;

  System.out.print("Enter a non-negative number: ");
  x = Double.parseDouble(cin.nextLine());
  count = 0;
  while (x < 0) {
    count++;
    if (count == 2) break;

    System.out.println("Error: Invalid number!");
    System.out.print("Enter a non-negative number: ");
    x = Double.parseDouble(cin.nextLine());
  }

  if (count < 2) {
    y = Math.sqrt(x);
    System.out.println(y);
  }
  else {
    System.out.println("Dude, you are dumb!");
  }
}
```

8. Solution

```
public static void main(String[] args) throws Exception {
  String answer;
  double area, r;

  do {
    System.out.print("Enter the length of a radius: ");
    r = Double.parseDouble(cin.nextLine());
    while (r <= 0) {
      System.out.print("Invalid radius. Enter the length of a radius: ");
      r = Double.parseDouble(cin.nextLine());
    }

    area = Math.PI * Math.pow(r, 2);
    System.out.println("The area is: " + area);

    System.out.print("Would you like to repeat? ");
    answer = cin.nextLine();
  } while (answer.toUpperCase().equals("YES"));

}
```

9. Solution

```
public static void main(String[] args) throws Exception {
  int i;
  double maximum, total, t;

  maximum = -460;
  total = 0;
  for (i = 1; i <= 31; i++) {
    System.out.print("Enter temperature for day " + i + ": ");
    t = Double.parseDouble(cin.nextLine());
    while (t < -459.67) {
      System.out.println("Error! Wrong temperature.");
      System.out.print("Enter temperature for day " + i + ": ");
      t = Double.parseDouble(cin.nextLine());
    }

    total += t;
    if (t > maximum) {
      maximum = t;
    }
  }
  System.out.println(total / 31 + " " + maximum);
}
```

10. Solution

```
public static void main(String[] args) throws Exception {
  int hour, maxHour, maxMinutes, minHour, minMinutes, minutes;
  double level, maximum, minimum;

  level = Double.parseDouble(cin.nextLine());
  if (level != 9999) {
    hour = Integer.parseInt(cin.nextLine());
    minutes = Integer.parseInt(cin.nextLine());

    maximum = level;
    maxHour = hour;
    maxMinutes = minutes;

    minimum = level;
    minHour = hour;
    minMinutes = minutes;

    level = Double.parseDouble(cin.nextLine());
    while (level != 9999) {
      hour = Integer.parseInt(cin.nextLine());
      minutes = Integer.parseInt(cin.nextLine());

      if (level > maximum) {
        maximum = level;
        maxHour = hour;
        maxMinutes = minutes;
      }

      if (level < minimum) {
        minimum = level;
        minHour = hour;
        minMinutes = minutes;
      }

      level = Double.parseDouble(cin.nextLine());
    }

    System.out.println(maximum + ", " + maxHour + ", " + maxMinutes);
    System.out.println(minimum + ", " + minHour + ", " + minMinutes);
  }
}
```

11. Solution

```
public static void main(String[] args) throws Exception {
  String alphabet;
  int number, total;

  System.out.print("Enter an integer: ");
  number = Integer.parseInt(cin.nextLine());

  do {
    total = 0;
    while (number > 0) {
      total += number % 10;
      number = (int)(number / 10);
    }

    if (total > 26) {
      number = total;
    }
  } while (total > 26);

  alphabet = "ABCDEFGHIJKLMNOPQRSTUVWXYZ";
  System.out.print("The name of the person who might be thinking ");
  System.out.println("of you starts with a(an): " + alphabet.charAt(total - 1));
}
```

12. Solution

```
public static void main(String[] args) throws Exception {
  int x, y;

  for (x = -100; x <= 100; x++) {
    for (y = -100; y <= 100; y++) {
      if (5 * x + 3 * Math.pow(y, 2) == 0) {
        System.out.println(x + ", " + y);
      }
    }
  }
}
```

13. Solution

```
public static void main(String[] args) throws Exception {
  int x, y, z;

  for (x = -10; x <= 10; x++) {
    for (y = -10; y <= 10; y++) {
      for (z = -10; z <= 10; z++) {
        if ((x + y) / 2.0 + 3.0 * Math.pow(z, 2) / (x + 3 * y + 45) == x / 3.0) {
          System.out.println(x + ", " + y + ", " + z);
        }
      }
    }
  }
}
```

14. Solution

```
public static void main(String[] args) throws Exception {
  int m1, m2, m3, s;

  m1 = Integer.parseInt(cin.nextLine());
  m2 = Integer.parseInt(cin.nextLine());
  m3 = Integer.parseInt(cin.nextLine());

  s = 0;
  while (m2 != 0) {
    if (m2 % 2 != 0) {
      s += m1;
    }
    m1 *= 2;
    m2 = (int)(m2 / 2);
  }

  m1 = s;
  m2 = m3;

  s = 0;
  while (m2 != 0) {
    if (m2 % 2 != 0) {
      s += m1;
    }
    m1 *= 2;
    m2 = (int)(m2 / 2);
  }

  System.out.println(s);
}
```

15. Solution

```
public static void main(String[] args) throws Exception {
  double a;
  int x, numberOfDivisors, i;

  a = Double.parseDouble(cin.nextLine());
  while (a <= 0 || a != (int)a) {
    System.out.println("Error! You must enter a positive integer");
    a = Double.parseDouble(cin.nextLine());
  }
  x = (int)a;

  numberOfDivisors = 2;
  for (i = 2; i <= (int)(x / 2); i++) {
    if (x % i == 0) {
      numberOfDivisors++;
    }
  }
  System.out.println(numberOfDivisors);
}
```

16. Solution

```
public static void main(String[] args) throws Exception {
  int x, numberOfDivisors, i;

  System.out.print("Enter an integer greater than 1: ");
  x = Integer.parseInt(cin.nextLine());
  while (x <= 1) {
    System.out.println("Error!");
    System.out.print("Enter an integer greater than 1: ");
    x = Integer.parseInt(cin.nextLine());
  }

  numberOfDivisors = 2;
  for (i = 2; i <= (int)(x / 2); i++) {
    if (x % i == 0) {
      numberOfDivisors++;
      break;
    }
  }

  if (numberOfDivisors == 2) {
    System.out.println("Number " + x + " is prime");
  }
}
```

17. Solution

```
public static void main(String[] args) throws Exception {
  int start, finish, c, x, y;
  double z;

  System.out.print("Enter an positive integer: ");
  start = Integer.parseInt(cin.nextLine());
  System.out.print("Enter a second positive integer: ");
  finish = Integer.parseInt(cin.nextLine());

  if (start > finish) {
    c = start;
    start = finish;
    finish = c;
  }

  for (x = start; x <= finish; x++) {
    for (y = x; y <= finish; y++) {
      z = Math.sqrt(x * x + y * y);
      //If result is integer and less than or equal to finish, display x, y, z
      if (z == (int)z && z <= finish) {
        System.out.println(x + " " + y + " " + (int)z);
      }
    }
  }
}
```

18. Solution

```
public static void main(String[] args) throws Exception {
  int a, b, c, i, numberOfDivisors, x;

  System.out.print("Enter an integer greater than 1: ");
  a = Integer.parseInt(cin.nextLine());
  while (a < 2) {
    System.out.print("Wrong number. Please enter an integer greater than 1: ");
    a = Integer.parseInt(cin.nextLine());
  }

  System.out.print("Enter a second integer greater than 1: ");
  b = Integer.parseInt(cin.nextLine());
  while (b < 2) {
    System.out.print("Wrong number. Please enter a second integer greater than 1: ");
    b = Integer.parseInt(cin.nextLine());
  }

  if (a > b) {
    c = a;
    a = b;
    b = c;
  }

  for (x = a; x <= b; x++) {
    numberOfDivisors = 2;
    i = 2;
    while (i <= (int)(x / 2) && numberOfDivisors == 2) {
      if (x % i == 0) {
        numberOfDivisors++;
      }
      i++;
    }
    if (numberOfDivisors == 2) {
      System.out.println("Number " + x + " is prime");
    }
  }
}
```

19. Solution

```
public static void main(String[] args) throws Exception {
  double y;
  int x, i, total;
  System.out.print("Enter a positive integer: ");
  y = Double.parseDouble(cin.nextLine());
  while (y <= 0 || y != (int)y) {
    System.out.print("Wrong number! Enter a positive integer: ");
    y = Double.parseDouble(cin.nextLine());
  }
  x = (int)y;

  total = 0;
  for (i = 1; i <= x - 1; i++) {
    if (x % i == 0) {
      total += i;
    }
  }

  if (total == x) {
    System.out.println("Number " + x + " is a perfect number");
  }
  else {
    System.out.println("Number " + x + " is not a perfect number");
  }
}
```

20. Solution

```
public static void main(String[] args) throws Exception {
  double y;
  int a, b, c, x, j, total;

  System.out.print("Enter a positive integer: ");
  y = Double.parseDouble(cin.nextLine());
  while (y <= 0 || y != (int)y) {
    System.out.print("Wrong number! Enter a positive integer: ");
    y = Double.parseDouble(cin.nextLine());
  }
  a = (int)y;

  System.out.print("Enter a second positive integer: ");
  y = Double.parseDouble(cin.nextLine());
  while (y <= 0 || y != (int)y) {
    System.out.print("Wrong number! Enter a second positive integer: ");
    y = Double.parseDouble(cin.nextLine());
  }
  b = (int)y;

  if (a > b) {
    c = a;
    a = b;
    b = c;
  }

  for (x = a; x <= b + 1 - 1; x++) {
    total = 0;
    for (j = 1; j <= x - 1; j++) {
      if (x % j == 0) {
        total += j;
      }
    }

    if (total == x) {
      System.out.println("Number " + x + " is a perfect number");
    }
  }
}
```

21. Solution

```
public static void main(String[] args) throws Exception {
  int a, b, c, d1, d2, d3, d4, r, x;

  System.out.print("Enter a positive four-digit integer: ");
  a = Integer.parseInt(cin.nextLine());
  while (a < 1000 || a > 9999) {
    System.out.print("Wrong number. Please enter a positive four-digit integer: ");
    a = Integer.parseInt(cin.nextLine());
  }

  System.out.print("Enter a second positive four-digit integer: ");
  b = Integer.parseInt(cin.nextLine());
  while (b < 1000 || b > 9999) {
    System.out.print("Wrong number. Please enter a second positive four-digit integer: ");
    b = Integer.parseInt(cin.nextLine());
  }

  if (a > b) {
    c = a;
    a = b;
    b = c;
  }

  for (x = a; x <= b; x++) {
    d4 = x % 10;
    r = (int)(x / 10);
    d3 = r % 10;
    r = (int)(r / 10);
    d2 = r % 10;
    d1 = (int)(r / 10);

    if (d1 == d4 && d2 == d3) {
      System.out.println(x);
    }
  }
}
```

22. Solution

```
public static void main(String[] args) throws Exception {
  int i;

  for (i = 0; i <= 30; i++) {
    System.out.println(Math.pow(2, i));
  }
}
```

23. Solution

```
public static void main(String[] args) throws Exception {
  int i, offset;

  offset = 10;
  i = 1;
  while (i <= 401) {
    System.out.println(i);
    i += offset;
    offset += 2;
  }
}
```

24. Solution

```
public static void main(String[] args) throws Exception {
  int i;

  for (i = 1; i <= 100; i++) {
    System.out.println(-i + "\n" + i);
  }
}
```

25. Solution

First approach

```
public static void main(String[] args) throws Exception {
  int i, offset, value;

  value = 0;
  for (i = 1; i <= 8; i++) {
    offset = (int)Math.pow(10, i - 1);
    value += offset;
    System.out.println(value);
  }
}
```

Second approach

```
public static void main(String[] args) throws Exception {
  int i;
  String value;
  value = "1";
  for (i = 1; i <= 8; i++) {
    System.out.println(value);
    value += "1";
  }
}
```

26. Solution

```
public static void main(String[] args) throws Exception {
  int a, fib, fibPrevious, fibPrevious2, i;

  a = Integer.parseInt(cin.nextLine());

  fibPrevious2 = 0;
  fibPrevious = 1;
  fib = 1;
  for (i = 1; i <= a; i++) {
    System.out.println(fibPrevious2);
    fib = fibPrevious + fibPrevious2;
    fibPrevious2 = fibPrevious;
    fibPrevious = fib;
  }
}
```

27. Solution

```
public static void main(String[] args) throws Exception {
  int a, fib, fibPrev, fibPrevPrev;

  a = Integer.parseInt(cin.nextLine());

  fibPrevPrev = 0;
  fibPrev = 1;
  fib = 1;
  while (fib < a) {
    System.out.println(fib);
    fib = fibPrev + fibPrevPrev;
    fibPrevPrev = fibPrev;
    fibPrev = fib;
  }
}
```

28. Solution

```
public static void main(String[] args) throws Exception {
  int denominator, i, n, nominator;
  double y;

  System.out.print("Enter a positive integer: ");
  n = Integer.parseInt(cin.nextLine());
  while (n <= 0) {
    System.out.print("Wrong number. Please enter a positive integer: ");
    n = Integer.parseInt(cin.nextLine());
  }

  nominator = 0;
  for (i = 2; i <= 2 * n; i += 2) {
    nominator += i;
  }

  denominator = 1;
  for (i = 1; i <= n; i++) {
    denominator *= i;
  }

  y = nominator / (double)denominator;
  System.out.println(y);
}
```

29. Solution

```
public static void main(String[] args) throws Exception {
  int i, n, nominator, sign;
  double y;

  System.out.print("Enter a positive integer: ");
  n = Integer.parseInt(cin.nextLine());
  while (n <= 0) {
    System.out.print("Wrong number. Please enter a positive integer: ");
    n = Integer.parseInt(cin.nextLine());
  }

  nominator = 0;
  sign = 1;
  for (i = 1; i <= 2 * n + 1; i += 2) {
    nominator += sign * i;
    sign = -sign;
  }

  y = nominator / (double)n;
  System.out.println(y);
}
```

30. Solution

```
public static void main(String[] args) throws Exception {
  int i, n, sign;
  double y;

  System.out.print("Enter an integer greater than 2: ");
  n = Integer.parseInt(cin.nextLine());
  while (n <= 2) {
    System.out.print("Wrong number. Please enter an integer greater than 2: ");
    n = Integer.parseInt(cin.nextLine());
  }

  y = 0.5;  //This is equal to the first two terms: 1 - 1 / 2

  sign = 1;
  for (i = 3; i <= n; i += 2) {
    y += sign / (double)i;
    sign = -sign;
  }

  System.out.println(y);
}
```

31. Solution

```
public static void main(String[] args) throws Exception {
  int i, n;
  double y;

  System.out.print("Enter a positive integer: ");
  n = Integer.parseInt(cin.nextLine());
  while (n <= 0) {
    System.out.print("Wrong number. Please enter a positive integer: ");
    n = Integer.parseInt(cin.nextLine());
  }

  y = 0;
  for (i = 1; i <= n; i++) {
    y += 1 / Math.pow(i, n - i + 1);
  }

  System.out.println(y);
}
```

32. Solution

```
public static void main(String[] args) throws Exception {
  int factorial, i, n;

  System.out.print("Enter a non-negative integer: ");
  n = Integer.parseInt(cin.nextLine());

  factorial = 1;
  for (i = 1; i <= n; i++) {
    factorial *= i;
  }

  System.out.println(factorial);
}
```

Please note that this Java code operates properly for all non-negative integers, including zero.

33. Solution

First approach

```
static final double ACCURACY = 0.00001;

public static void main(String[] args) throws Exception {
  int i, j;
  double factorial, exponentialPrevious, exponential, x;

  x = Double.parseDouble(cin.nextLine());

  exponential = 0;
  i = 0;
  do {
    exponentialPrevious = exponential;

    factorial = 1;
    for (j = 1; j <= i; j++) {
      factorial *= j;
    }

    exponential += Math.pow(x, i) / factorial;

    i++;
  } while (Math.abs(exponential - exponentialPrevious) > ACCURACY);

  System.out.println("e(" + x  +") ~= " + exponential);
}
```

Second approach

```
static final double ACCURACY = 0.00001;

public static void main(String[] args) throws Exception {
  int i;
  double factorial, exponentialPrevious, exponential, x;

  x = Double.parseDouble(cin.nextLine());

  exponential = 1;
  i = 1;
  factorial = 1;
  do {
    exponentialPrevious = exponential;

    factorial *= i;

    exponential += Math.pow(x, i) / factorial;

    i++;
  } while (Math.abs(exponential - exponentialPrevious) > ACCURACY);

  System.out.println("e(" + x + ") ~= " + exponential);
}
```

34. Solution

First approach

```
static final double ACCURACY = 0.00001;

public static void main(String[] args) throws Exception {
  int i, j, sign;
  double factorial;
  double sinus, sinusPrevious, x;

  x = Double.parseDouble(cin.nextLine());

  sign = 1;
  sinus = 0;
  i = 1;
  do {
    sinusPrevious = sinus;

    factorial = 1;
    for (j = 1; j <= i; j++) {
      factorial *= j;
    }

    sinus += sign * Math.pow(x, i) / factorial;

    sign = -sign;
    i += 2;
  } while (Math.abs(sinus - sinusPrevious) > ACCURACY);

  System.out.println("sin(" + x + ") ~= " + sinus);
}
```

Second approach

```
static final double ACCURACY = 0.00001;

public static void main(String[] args) throws Exception {
  int i, sign;
  double factorial;
  double sinus, sinusPrevious, x;

  x = Double.parseDouble(cin.nextLine());

  sign = -1;
  sinus = x;
  i = 3;
  factorial = 1;
  do {
    sinusPrevious = sinus;

    factorial *= i * (i - 1);

    sinus += sign * Math.pow(x, i) / factorial;

    sign = -sign;
    i += 2;
  } while (Math.abs(sinus - sinusPrevious) > ACCURACY);

  System.out.println("sin(" + x + ") ~= " + sinus);
}
```

35. Solution

First approach

```
static final double ACCURACY = 0.00001;

public static void main(String[] args) throws Exception {
  int i, j, sign;
  double factorial;
  double cosinus, cosinusPrevious, x;

  x = Double.parseDouble(cin.nextLine());

  sign = 1;
  cosinus = 0;
  i = 0;
  do {
    cosinusPrevious = cosinus;

    factorial = 1;
    for (j = 1; j <= i; j++) {
      factorial *= j;
    }

    cosinus += sign * Math.pow(x, i) / factorial;

    sign = -sign;
    i += 2;
  } while (Math.abs(cosinus - cosinusPrevious) > ACCURACY);

  System.out.println("cos(" + x + ") ~= " + cosinus);
}
```

Second approach

```
static final double ACCURACY = 0.00001;

public static void main(String[] args) throws Exception {
  int i, sign;
  double factorial;
  double cosinus, cosinusPrevious, x;

  x = Double.parseDouble(cin.nextLine());

  sign = -1;
  cosinus = 1;
  i = 2;
  factorial = 1;
  do {
    cosinusPrevious = cosinus;

    factorial *= i * (i - 1);

    cosinus += sign * Math.pow(x, i) / factorial;

    sign = -sign;
    i += 2;
  } while (Math.abs(cosinus - cosinusPrevious) > ACCURACY);

  System.out.println("cos(" + x + ") ~= " + cosinus);
}
```

36. Solution

```
public static void main(String[] args) throws Exception {
  int a, b, c, i;
  boolean failure;

  String alphabet = "abcdefghijklmnopqrstuvwxyz";

  do {
    System.out.print("Enter an integer between 1 and 26: ");
    a = Integer.parseInt(cin.nextLine());

    failure = false;
    if (a < 1) {
      System.out.println("Please enter positive integers!");
      failure = true;
    }
    else if (a > 26) {
      System.out.println("Please enter a value less than or equal to 26!");
      failure = true;
    }
  } while (failure);

  do {
    System.out.print("Enter an integer between 1 and 26: ");
    b = Integer.parseInt(cin.nextLine());

    failure = false;
    if (b < 1) {
      System.out.println("Please enter positive integers!");
      failure = true;
    }
    else if (b > 26) {
      System.out.println("Please enter a value less than or equal to 26!");
      failure = true;
    }
  } while (failure);

  if (a > b) {
    c = a;
    a = b;
    b = c;
  }

  for (i = a; i <= b; i++) {
    System.out.print(alphabet.charAt(i - 1));
  }
}
```

37. Solution

```
public static void main(String[] args) throws Exception {
  int attempts, guess, secretNumber;

  secretNumber = 1 + (int)(Math.random() * 100);

  attempts = 1;
  System.out.print("Enter a guess: ");
  guess = Integer.parseInt(cin.nextLine());
  while (guess != secretNumber) {
    if (guess > secretNumber) {
      System.out.println("Your guess is bigger than my secret number. Try again.");
    }
    else {
      System.out.println("Your guess is smaller than my secret number. Try again.");
    }
    attempts++;
    System.out.print("Enter a guess: ");
    guess = Integer.parseInt(cin.nextLine());
  }
  System.out.println("You found it!");
  System.out.println("Attempts: " + attempts);
}
```

38. Solution

```
public static void main(String[] args) throws Exception {
  int attempts = 0, firstPlayerAttempts = 0, guess, i, secretNumber;

  for (i = 1; i <= 2; i++) {
    secretNumber = 1 + (int)(Math.random() * 100);

    attempts = 1;
    System.out.print("Enter a guess: ");
    guess = Integer.parseInt(cin.nextLine());
    while (guess != secretNumber) {
      if (guess > secretNumber) {
        System.out.println("Your guess is bigger than my secret number. Try again.");
      }
      else {
        System.out.println("Your guess is smaller than my secret number. Try again.");
      }
      attempts++;
      System.out.print("Enter a guess: ");
      guess = Integer.parseInt(cin.nextLine());
    }
    System.out.println("You found it!");
    System.out.println("Attempts: " + attempts);

    if (i == 1) {
      firstPlayerAttempts = attempts;
    }
  }

  if (firstPlayerAttempts < attempts) {
    System.out.println("First player wins!");
  }
  else if (firstPlayerAttempts > attempts) {
    System.out.println("Second player wins!");
  }
  else {
    System.out.println("It's a draw");
  }
}
```

39. Solution

```
public static void main(String[] args) throws Exception {
  int choice, diagonal;

  do {
    System.out.println("1. 4/3 TV Screen");
    System.out.println("2. 16/9 TV Screen");
    System.out.println("3. Exit");
    System.out.print("Enter a choice: ");
    choice = Integer.parseInt(cin.nextLine());

    if (choice == 1) {
      System.out.print("Enter diagonal: ");
      diagonal = Integer.parseInt(cin.nextLine());
      System.out.println("Width: " + (diagonal * 0.8));
      System.out.println("Height: " + (diagonal * 0.6));
    }
    else if (choice == 2) {
      System.out.print("Enter diagonal: ");
      diagonal = Integer.parseInt(cin.nextLine());
      System.out.println("Width: " + (diagonal * 0.87));
      System.out.println("Height: " + (diagonal * 0.49));
    }
  } while (choice != 3);
}
```

40. Solution

```
public static void main(String[] args) throws Exception {
  int countA, countABoys, countB, countCdefGirls, grade;
  int i, maximum, minimum, n, total, totalA, totalABoys, totalB;
  String gender;

  System.out.print("Enter total number of students: ");
  n = Integer.parseInt(cin.nextLine());
  while (n <= 0) {
    System.out.print("Wrong number. Please enter total number of students: ");
    n = Integer.parseInt(cin.nextLine());
  }

  total = 0;
  totalA = 0;
  countA = 0;
  totalB = 0;
  countB = 0;
  totalABoys = 0;
  countABoys = 0;
  countCdefGirls = 0;

  maximum = -1;
  minimum = 101;

  for (i = 1; i <= n; i++) {
    System.out.print("Enter grade for student No " + i + ": ");
    grade = Integer.parseInt(cin.nextLine());
    while (grade < 0 || grade > 100) {
      System.out.print("Wrong grade. Please enter grade for student No " + i + ": ");
      grade = Integer.parseInt(cin.nextLine());
    }

    System.out.print("Enter gender for student No " + i + ": ");
    gender = cin.nextLine().toUpperCase();
    while (!gender.equals("M") && !gender.equals("F") && !gender.equals("O")) {
      System.out.print("Wrong gender. Please enter gender for student No " + i + ": ");
      gender = cin.nextLine().toUpperCase();
    }
    if (grade >= 90 && grade <= 100) {
      totalA += grade;
      countA++;
      if (gender.equals("M")) {
        totalABoys += grade;
        countABoys++;
      }
    }
    else if (grade >= 80 && grade <= 89) {
      totalB += grade;
      countB++;
    }
    else {
      if (gender.equals("F")) {
        countCdefGirls++;
      }
    }

    if (grade > maximum) {
      maximum = grade;
    }

    if (grade < minimum) {
      minimum = grade;
    }

    total += grade;
  }

  if (countA > 0) {
    System.out.print("The average value of those who got an 'A' is: ");
    System.out.println(totalA / (double)countA);
  }
  if (countB > 0) {
    System.out.print("The average value of those who got a 'B' is: ");
    System.out.println(totalB / (double)countB);
  }
  if (countABoys > 0) {
    System.out.print("The average value of boys who got an 'A' is: ");
    System.out.println(totalABoys / (double)countABoys);
  }
  System.out.println("The total number of girls that got less than 'B' is: " + countCdefGirls);
  System.out.println("The highest grade is: " + maximum);
  System.out.println("The lowest grade is: " + minimum);
  System.out.println("The average grade of the whole class is: " + total / (double)n);
}
```

41. Solution

```
public static void main(String[] args) throws Exception {
  double amount, discount;
  String answer;

  do {
    System.out.print("Enter amount: ");
    amount = Double.parseDouble(cin.nextLine());
    while (amount <= 0) {
      System.out.print("Wrong amount. Please enter amount: ");
      amount = Double.parseDouble(cin.nextLine());
    }

    if (amount < 20) {
      discount = 0;
    }
    else if (amount < 50) {
      discount = 3;
    }
    else if (amount < 100) {
      discount = 5;
    }
    else {
      discount = 10;
    }

    System.out.println("Discount: " + discount + "%");
    System.out.println("Amount to pay (discount included): " + (amount - amount * discount / 100));

    System.out.print("Would you like to repeat? ");
    answer = cin.nextLine().toUpperCase();
  } while (answer.equals("YES"));
}
```

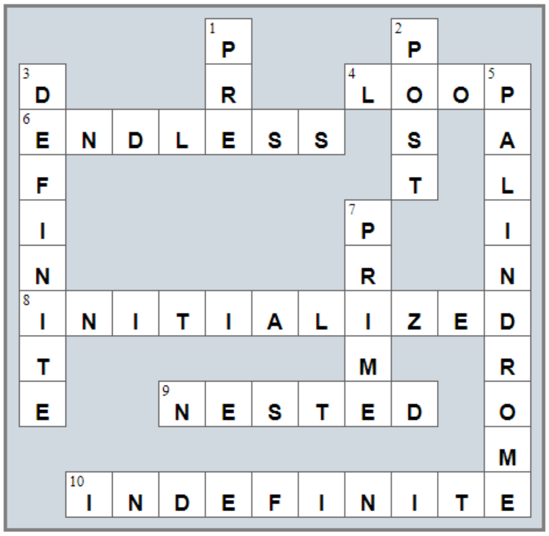
42. Solution

```
static final double TAX_RATE = 0.25;

public static void main(String[] args) throws Exception {
  int kwh;
  double t;

  System.out.print("Enter number of Kilowatt-hours consumed: ");
  kwh = Integer.parseInt(cin.nextLine());
  while (kwh < 0 && kwh != -1) {
    System.out.print("Wrong value. Please enter number of Kilowatt-hours consumed: ");
    kwh = Integer.parseInt(cin.nextLine());
  }

  while (kwh != -1) {
    if (kwh <= 400) {
      t = kwh * 0.11;
    }
    else if (kwh <= 1500) {
      t = 400 * 0.11 + (kwh - 400) * 0.22;
    }
    else if (kwh <= 3500) {
      t = 400 * 0.11 + 1100 * 0.22 + (kwh - 1500) * 0.25;
    }
    else {
      t = 400 * 0.11 + 1100 * 0.22 + 2000 * 0.25 + (kwh - 3500) * 0.50;
    }

    t += t * TAX_RATE;
    System.out.println("Total amount to pay (taxes included): " + t);

    System.out.print("Enter number of Kilowatt-hours consumed: ");
    kwh = Integer.parseInt(cin.nextLine());
    while (kwh < 0 && kwh != -1) {
      System.out.print("Wrong value. Please enter number of Kilowatt-hours consumed: ");
      kwh = Integer.parseInt(cin.nextLine());
    }
  }
}
```

Review in “Loop Control Structures”

Review Crossword Puzzle

1.



Chapter 31

31.13 Review Questions: True/False

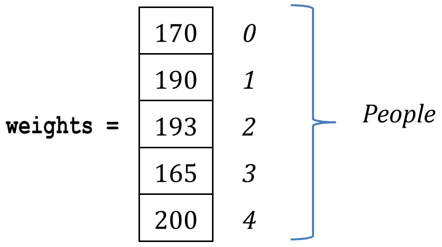
1. true
2. true
3. false
4. false
5. false
6. true
7. false
8. true
9. false
10. true
11. true
12. true
13. false
14. false
15. false
16. true
17. false
18. true
19. true
20. false
21. true
22. false
23. true
24. false
25. true
26. false
27. false
28. true
29. false
30. true
31. true
32. false
33. false
34. true
35. true
36. true
37. false
38. false
39. true

31.14 Review Questions: Multiple Choice

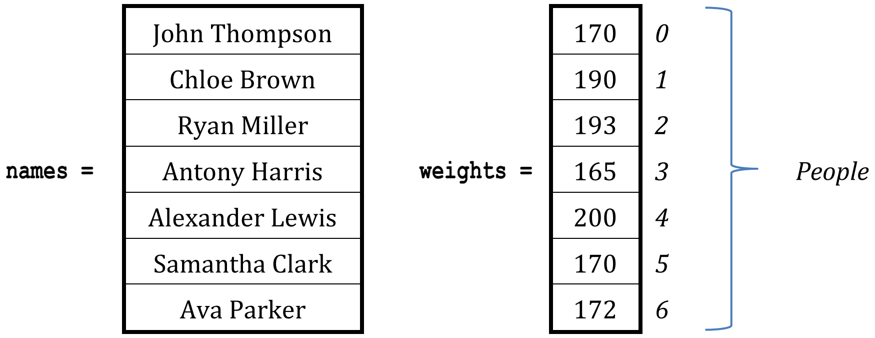
1. b
2. a
3. c
4. b
5. d
6. b
7. d
8. d
9. c
10. a
11. b
12. a
13. b
14. b

31.15 Review Exercises

1. Solution

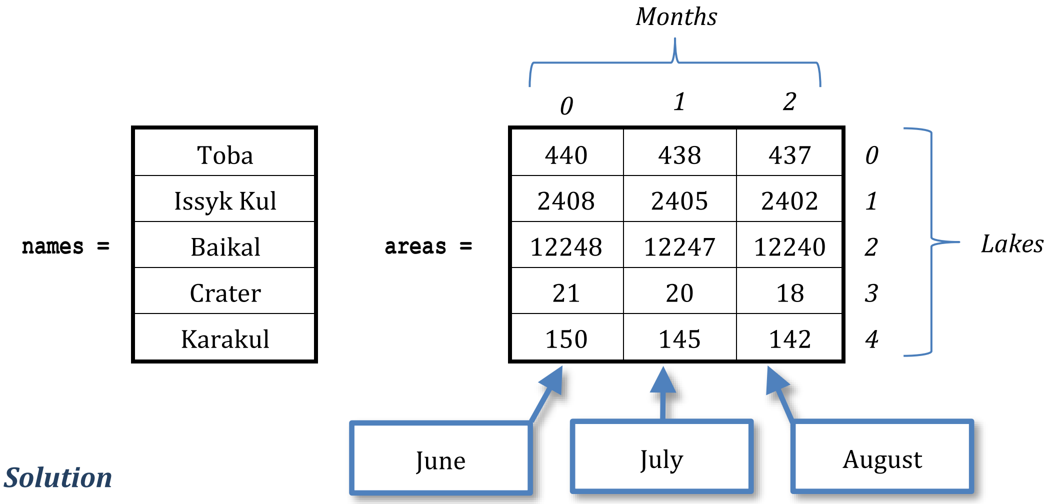


2. Solution



names	weights	
John Thompson	170	0
Chloe Brown	190	1
Ryan Miller	193	2
Antony Harris	165	3
Alexander Lewis	200	4
Samantha Clark	170	5
Ava Parker	172	6

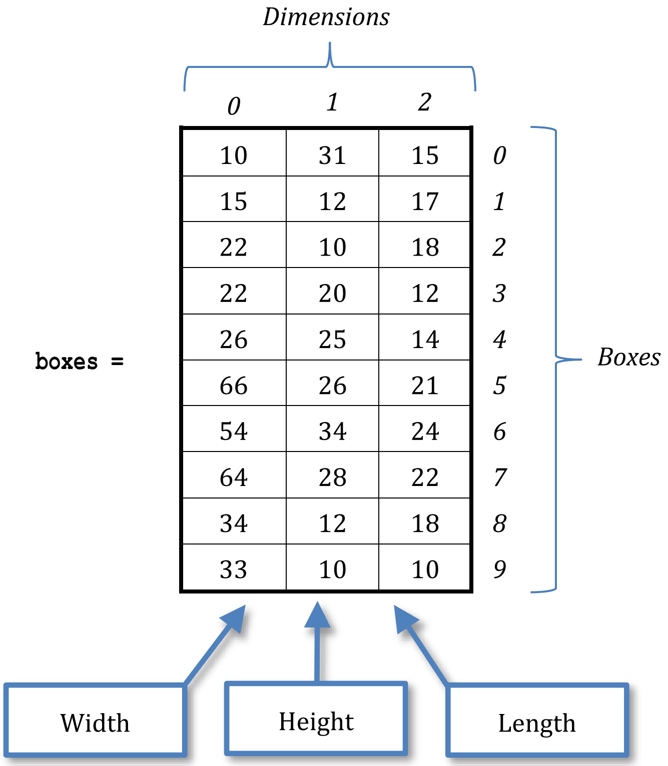
3. Solution



names
Toba
Issyk Kul
Baikal
Crater
Karakul

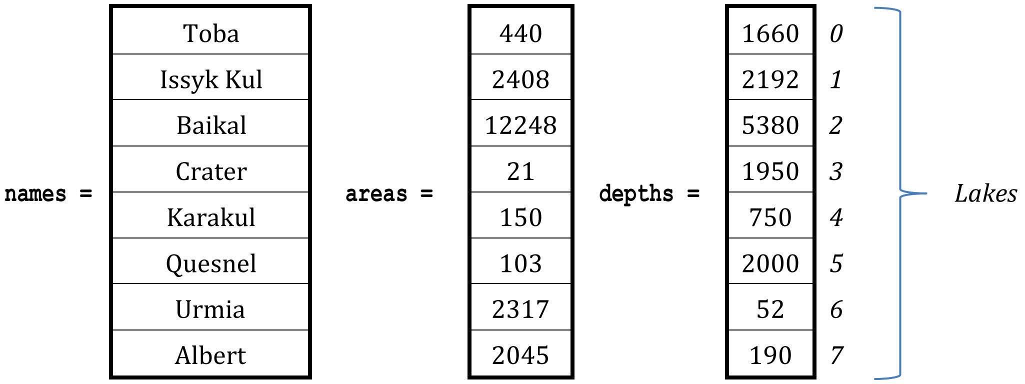
areas	0	1	2
0	440	438	437
1	2408	2405	2402
2	12248	12247	12240
3	21	20	18
4	150	145	142

4. Solution



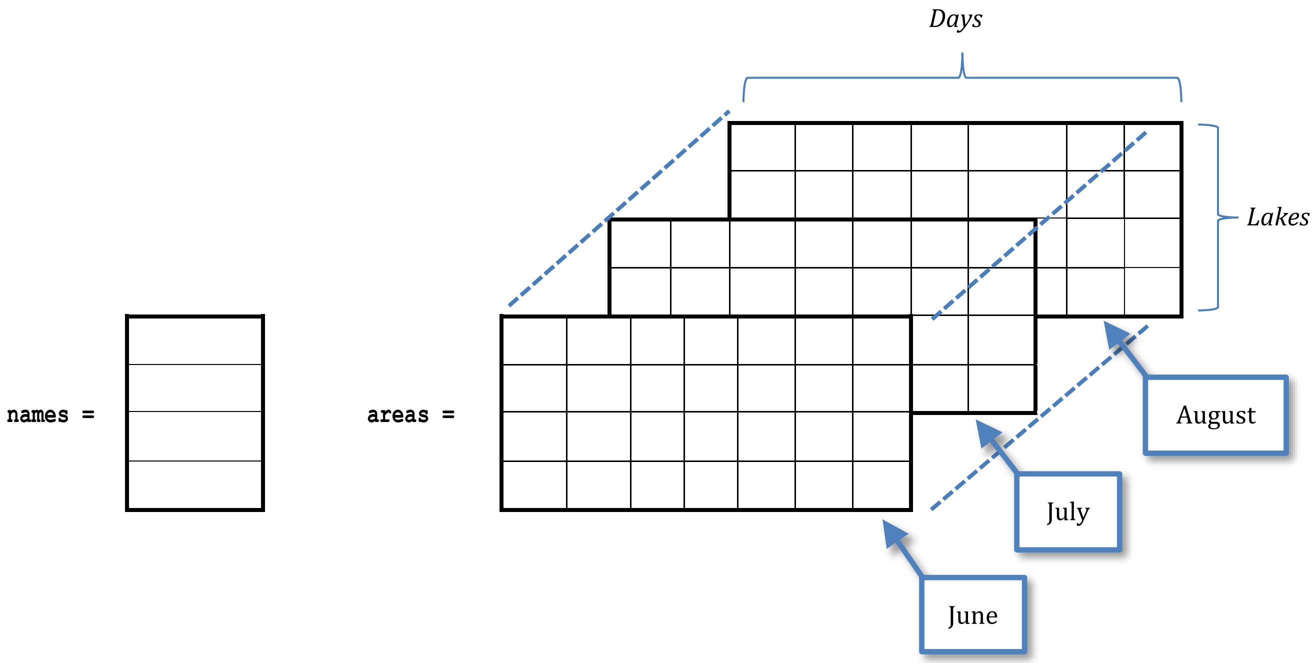
boxes	0	1	2
0	10	31	15
1	15	12	17
2	22	10	18
3	22	20	12
4	26	25	14
5	66	26	21
6	54	34	24
7	64	28	22
8	34	12	18
9	33	10	10

5. Solution



names =	areas =	depths =	
Toba	440	1660	*0*
Issyk Kul	2408	2192	*1*
Baikal	12248	5380	*2*
Crater	21	1950	*3*
Karakul	150	750	*4*
Quesnel	103	2000	*5*
Urmia	2317	52	*6*
Albert	2045	190	*7*

6. Solution



7. Solution

Step	Statement	x	a[0]	a[1]	a[2]
1	`int[] a = new int[3]`	?	?	?	?
2	`a[2] = 1`	?	?	?	**1**
3	`x = 0`	**0**	?	?	1
4	`a[x + a[2]] = 4`	0	?	**4**	1
5	`a[x] = a[x + 1] * 4`	0	**16**	4	1

8. Solution

Step	Statement	x	a[0]	a[1]	a[2]	a[3]	a[4]
1	`int[] a = new int[5]`	?	?	?	?	?	?
2	`a[1] = 5`	?	?	**5**	?	?	?
3	`x = 0`	**0**	?	5	?	?	?
4	`a[x] = 4`	0	**4**	5	?	?	?
5	`a[a[0]] = a[x + 1] % 3`	0	4	5	?	?	**2**
6	`a[a[0] / 2] = 10`	0	4	5	**10**	?	2
7	`x += 2`	**2**	4	5	10	?	2
8	`a[x + 1] = a[x] + 9`	2	4	5	10	**19**	2

9. Solution

For input value of 3

Step	Statement	x	a[0]	a[1]	a[2]	a[3]
1	`int[] a = new int[4]`	?	?	?	?	?
2	`a[1] = Integer.parseInt(cin.nextLine())`	?	?	**3**	?	?
3	`x = 0`	**0**	?	3	?	?
4	`a[x] = 3`	0	**3**	3	?	?
5	`a[a[0]] = a[x + 1] % 2`	0	3	3	?	**1**
6	`a[a[0] % 2] = 10`	0	3	**10**	?	1
7	`x++`	**1**	3	10	?	1
8	`a[x + 1] = a[x] + 9`	1	3	10	**19**	1

For input value of 4

Step	Statement	x	a[0]	a[1]	a[2]	a[3]
1	`int[] a = new int[4]`	?	?	?	?	?
2	`a[1] = Integer.parseInt(cin.nextLine())`	?	?	**4**	?	?
3	`x = 0`	**0**	?	4	?	?
4	`a[x] = 3`	0	**3**	4	?	?
5	`a[a[0]] = a[x + 1] % 2`	0	3	4	?	**0**
6	`a[a[0] % 2] = 10`	0	3	**10**	?	0
7	`x++`	**1**	3	10	?	0
8	`a[x + 1] = a[x] + 9`	1	3	10	**19**	0

For input value of 1

Step	Statement	x	a[0]	a[1]	a[2]	a[3]
1	`int[] a = new int[4]`	?	?	?	?	?
2	`a[1] = Integer.parseInt(cin.nextLine())`	?	?	**1**	?	?
3	`x = 0`	**0**	?	1	?	?

4	a[x] = 3	0	**3**	1	?	?
5	a[a[0]] = a[x + 1] % 2	0	3	1	?	**3**
6	a[a[0] % 2] = 10	0	3	**10**	?	3
7	x++	**1**	3	10	?	3
8	a[x + 1] = a[x] + 9	1	3	10	**19**	3

10. Solution

For input value of 100

Step	Statement	x	a[0]	a[1]	a[2]	a[3]
1	int[] a = new int[4]	?	?	?	?	?
2	a[1] = Integer.parseInt(cin.nextLine())	?	?	**100**	?	?
3	x = 0	**0**	?	100	?	?
4	a[x] = 3	0	**3**	100	?	?
5	a[a[0]] = a[x + 1] % 10	0	3	100	?	**0**
6	if (a[3] > 5)	false				
7	a[2] = 3	0	3	100	**3**	0

For input value of 108

Step	Statement	x	a[0]	a[1]	a[2]	a[3]
1	int[] a = new int[4]	?	?	?	?	?
2	a[1] = Integer.parseInt(cin.nextLine())	?	?	**108**	?	?
3	x = 0	**0**	?	108	?	?
4	a[x] = 3	0	**3**	108	?	?
5	a[a[0]] = a[x + 1] % 10	0	3	108	?	**8**
6	if (a[3] > 5)	true				
7	a[a[0] % 2] = 9	0	3	**9**	?	8
8	x += 1	**1**	3	9	?	8
9	a[x + 1] = a[x] + 9	1	3	9	**18**	8

For input value of 1

Step	Statement	x	a[0]	a[1]	a[2]	a[3]
1	int[] a = new int[4]	?	?	?	?	?
2	a[1] = Integer.parseInt(cin.nextLine())	?	?	**1**	?	?
3	x = 0	**0**	?	1	?	?
4	a[x] = 3	0	**3**	1	?	?
5	a[a[0]] = a[x + 1] % 10	0	3	1	?	**1**
6	if (a[3] > 5)	false				
7	a[2] = 3	0	3	1	**3**	1

11. Solution

Step	Statement	x	y	a[0]	a[1]	a[2]
1	int[] a = new int[3]	?	?	?	?	?
2	x = 4	**4**	?	?	?	?
3	y = x - 1	4	**3**	?	?	?

4, 5	if (x > y)
	  a[0] = 1;
	else
	  a[0] = y;
		4	3	**1**	?	?

6	a[1] = x + 3	4	3	1	**7**	?
7	y = y - 1	4	**2**	1	7	?
8	a[y] = (x + 5) % 2	4	2	1	7	**1**

12. Solution

Step	Statement	i	a[0]	a[1]	a[2]	a[3]	a[4]	a[5]
1	int[] a = {17, 12, 45, 12, 12, 49}	?	**17**	**12**	**45**	**12**	**12**	**49**
2	i = 0;	**0**	17	12	45	12	12	49
3	i <= 5	true						
4	if (a[i] == 12)	false						
5	a[i]++	0	**18**	12	45	12	12	49
6	i++	**1**	18	12	45	12	12	49
7	i <= 5	true						
8	if (a[i] == 12)	true						
9	a[i]--	1	18	**11**	45	12	12	49
10	i++	**2**	18	11	45	12	12	49
11	i <= 5	true						
12	if (a[i] == 12)	false						
13	a[i]++	2	18	11	**46**	12	12	49
14	i++	**3**	18	11	46	12	12	49
15	i <= 5	true						
16	if (a[i] == 12)	true						
17	a[i]--	3	18	11	46	**11**	12	49
18	i++	**4**	18	11	46	11	12	49
19	i <= 5	true						
20	if (a[i] == 12)	true						
21	a[i]--	4	18	11	46	11	**11**	49
22	i++	**5**	18	11	46	11	11	49
23	i <= 5	true						

24	`if (a[i] == 12)`	false						
25	`a[i]++`	5	18	11	46	11	11	**50**
26	`i++`	**6**	18	11	46	11	11	50
27	`i <= 5`	false						

13. Solution

Step	Statement	i	a[0]	a[1]	a[2]	a[3]	a[4]	a[5]
1	`int[] a = {10, 15, 12, 23, 22, 19}`	?	**10**	**15**	**12**	**23**	**22**	**19**
2	`i = 1`	**1**	10	15	12	23	22	19
3	`i <= 4`	true						
4	`a[i] = a[i + 1] + a[i - 1]`	1	10	**22**	12	23	22	19
5	`i++`	**2**	10	22	12	23	22	19
6	`i <= 4`	true						
7	`a[i] = a[i + 1] + a[i - 1]`	2	10	22	**45**	23	22	19
8	`i++`	**3**	10	22	45	23	22	19
9	`i <= 4`	true						
10	`a[i] = a[i + 1] + a[i - 1]`	3	10	22	45	**67**	22	19
11	`i++`	**4**	10	22	45	67	22	19
12	`i <= 4`	true						
13	`a[i] = a[i + 1] + a[i - 1]`	4	10	22	45	67	**86**	19
14	`i++`	**5**	10	22	45	67	86	19
15	`i <= 4`	false						

14. Solution

It displays:

Navajo
Cherokee
Sioux

15. Solution

```
static final int ELEMENTS = 100;

public static void main(String[] args) throws Exception {
  int i;

  double[] a = new double[ELEMENTS];
  for (i = 0; i <= ELEMENTS - 1; i++) {
    a[i] = Double.parseDouble(cin.nextLine());
  }

  for (i = 0; i <= ELEMENTS - 1; i++) {
    System.out.println(Math.pow(a[i], 3));
  }
}
```

16. Solution

```
static final int ELEMENTS = 80;

public static void main(String[] args) throws Exception {
  int i;

  double[] a = new double[ELEMENTS];
  for (i = 0; i <= ELEMENTS - 1; i++) {
    a[i] = Double.parseDouble(cin.nextLine());
  }

  for (i = 0; i <= ELEMENTS - 1; i++) {
    a[i] = Math.pow(a[i], 2);
  }

  for (i = ELEMENTS - 1; i >= 0; i--) {
    System.out.println(a[i]);
  }
}
```

17. Solution

```
static final int ELEMENTS = 90;

public static void main(String[] args) throws Exception {
  int i;

  int[] a = new int[ELEMENTS];
  for (i = 0; i <= ELEMENTS - 1; i++) {
    a[i] = Integer.parseInt(cin.nextLine());
  }

  for (i = ELEMENTS - 1; i >= 0; i--) {
    if (a[i] % 5 == 0) {
      System.out.println(a[i]);
    }
  }
}
```

18. Solution

```
static final int ELEMENTS = 50;

public static void main(String[] args) throws Exception {
  int i;

  int[] a = new int[ELEMENTS];
  for (i = 0; i <= ELEMENTS - 1; i++) {
    a[i] = Integer.parseInt(cin.nextLine());
  }

  for (i = 0; i <= ELEMENTS - 1; i++) {
    if (a[i] % 2 == 0 || a[i] > 10) {
      System.out.println(a[i]);
    }
  }
}
```

19. Solution

```
static final int ELEMENTS = 30;

public static void main(String[] args) throws Exception {
  int i;
  double total;

  double[] a = new double[ELEMENTS];
  for (i = 0; i <= ELEMENTS - 1; i++) {
    a[i] = Double.parseDouble(cin.nextLine());
  }

  total = 0;
  for (i = 0; i <= ELEMENTS - 1; i++) {
    if (a[i] > 0) {
      total += a[i];
    }
  }
  System.out.println(total);
}
```

20. Solution

```
static final int ELEMENTS = 50;

public static void main(String[] args) throws Exception {
  int i, total;

  int[] a = new int[ELEMENTS];
  for (i = 0; i <= ELEMENTS - 1; i++) {
    a[i] = Integer.parseInt(cin.nextLine());
  }

  total = 0;
  for (i = 0; i <= ELEMENTS - 1; i++) {
    if (a[i] >= 10 && a[i] <= 99) {
      total += a[i];
    }
  }
  System.out.println(total);
}
```

21. Solution

```
static final int ELEMENTS = 40;

public static void main(String[] args) throws Exception {
  int i;
  double sumNeg, sumPos;

  double[] a = new double[ELEMENTS];
  for (i = 0; i <= ELEMENTS - 1; i++) {
    a[i] = Double.parseDouble(cin.nextLine());
  }

  sumPos = 0;
  sumNeg = 0;
  for (i = 0; i <= ELEMENTS - 1; i++) {
    if (a[i] > 0 ) {
      sumPos += a[i];
    }
    else if (a[i] < 0) {
      sumNeg += a[i];
    }
  }
  System.out.println(sumPos + ", " + sumNeg);
}
```

22. Solution

```
static final int ELEMENTS = 20;

public static void main(String[] args) throws Exception {
  int i;
  double total;

  double[] a = new double[ELEMENTS];
  for (i = 0; i <= ELEMENTS - 1; i++) {
    a[i] = Double.parseDouble(cin.nextLine());
  }

  total = 0;
  for (i = 0; i <= ELEMENTS - 1; i++) {
    total += a[i];
  }
  System.out.println(total / ELEMENTS);
}
```

23. Solution

```
static final int ELEMENTS = 50;

public static void main(String[] args) throws Exception {
  int i;
  int[] a = new int[ELEMENTS];
  for (i = 0; i <= ELEMENTS - 1; i++) {
    System.out.print("Enter an integer: ");
    a[i] = Integer.parseInt(cin.nextLine());
  }

  for (i = 0; i <= ELEMENTS - 1; i++) {
    if (a[i] < 20) {
      System.out.println(a[i]);
    }
  }
}
```

24. Solution

```
static final int ELEMENTS = 60;

public static void main(String[] args) throws Exception {
  int i;

  double[] a = new double[ELEMENTS];
  for (i = 0; i <= ELEMENTS - 1; i++) {
    System.out.print("Enter a number: ");
    a[i] = Double.parseDouble(cin.nextLine());
  }

  for (i = 0; i <= ELEMENTS - 1; i += 2) {
    System.out.println(a[i]);
  }
}
```

25. Solution

```
static final int ELEMENTS = 20;

public static void main(String[] args) throws Exception {
  int i;
  double total;

  double[] a = new double[ELEMENTS];
  for (i = 0; i <= ELEMENTS - 1; i++) {
    System.out.print("Enter a number: ");
    a[i] = Double.parseDouble(cin.nextLine());
  }

  total = 0;
  for (i = 0; i <= ELEMENTS - 1; i += 2) {
    total += a[i];
  }
  System.out.println(total);
}
```

26. Solution

```
static final int ELEMENTS = 100;
```

```
public static void main(String[] args) throws Exception {
  int i;
  int[] a = new int[ELEMENTS];
  for (i = 0; i <= ELEMENTS - 1; i++) {
    a[i] = i + 1;
  }
…
```

27. Solution

First approach

```
static final int ELEMENTS = 100;

public static void main(String[] args) throws Exception {
  int i, k;
  int[] a = new int[ELEMENTS];
  k = 2;
  for (i = 0; i <= ELEMENTS - 1; i++) {
    a[i] = k;
    k += 2;
  }
…
```

Second approach

```
static final int ELEMENTS = 100;

public static void main(String[] args) throws Exception {
  int i;
  int[] a = new int[ELEMENTS];
  for (i = 0; i <= ELEMENTS - 1; i++) {
    a[i] = (i + 1) * 2;
  }
…
```

28. Solution

```
public static void main(String[] args) throws Exception {
  int i, n;

  System.out.print("Enter N: ");
  n = Integer.parseInt(cin.nextLine());
  while (n < 1) {
    System.out.print("Error! Value must be greater than or equal to 1");
    System.out.print("Enter N: ");
    n = Integer.parseInt(cin.nextLine());
  }

  int[] a = new int[n];
  for (i = 1; i <= n; i++) {
    a[i - 1] = (int)Math.pow(i, 2);
  }

  for (i = 0; i <= n - 1; i++) {
    System.out.println(a[i]);
  }
}
```

29. Solution

```
static final int ELEMENTS = 10;

public static void main(String[] args) throws Exception {
  int i;

  double[] a = new double[ELEMENTS];
  for (i = 1; i <= ELEMENTS - 1; i++) {
    System.out.print("Enter a number: ");
    a[i] = Double.parseDouble(cin.nextLine());
  }

  for (i = 0; i <= ELEMENTS - 1; i++) {
    if (a[i] == (int)a[i]) {
      System.out.println(i);
    }
  }
}
```

30. Solution

```
static final int ELEMENTS = 50;

public static void main(String[] args) throws Exception {
  int i, count;

  double[] a = new double[ELEMENTS];
  for (i = 1; i <= ELEMENTS - 1; i++) {
    System.out.print("Enter a number: ");
    a[i] = Double.parseDouble(cin.nextLine());
  }

  count = 0;
  for (i = 0; i <= ELEMENTS - 1; i++) {
    if (a[i] < 0) {
      count++;
    }
  }
  System.out.println(count);
}
```

31. Solution

```
static final int WORDS = 50;

public static void main(String[] args) throws Exception {
  int i;

  String[] a = new String[WORDS];
  for (i = 0; i <= WORDS - 1; i++) {
    a[i] = cin.nextLine();
  }

  for (i = 0; i <= WORDS - 1; i++) {
    if (a[i].length() >= 10 ) {
      System.out.println(a[i]);
    }
  }
}
```

32. Solution

```
static final int ELEMENTS = 30;

public static void main(String[] args) throws Exception {
  int i, k;

  String[] words = new String[ELEMENTS];
  for (i = 0; i <= ELEMENTS - 1; i++) {
    words[i] = cin.nextLine();
  }

  int[] lengthLimits = {0, 5, 10, 20};

  for (k = 1; k <= 3; k++) {
    for (i = 0; i <= ELEMENTS - 1; i++) {
      if (words[i].length() >= lengthLimits[k - 1] && words[i].length() < lengthLimits[k]) {
        System.out.println(words[i]);
      }
    }
  }
}
```

33. Solution

```
static final int WORDS = 40;

public static void main(String[] args) throws Exception {
  int count, i, j;

  String[] a = new String[WORDS];
  for (i = 0; i <= WORDS - 1; i++) {
    System.out.print("Enter a word: ");
    a[i] = cin.nextLine();
  }

  for (i = 0; i <= WORDS - 1; i++) {
    count = 0;
    for (j = 0; j <= a[i].length() - 1; j++) {
      if (a[i].substring(j, j + 1).equals("w")) {
        count++;
      }
    }
    if (count >= 2) {
      System.out.println(a[i]);
    }
  }
}
```

34. Solution

```
public static void main(String[] args) throws Exception {
  String roman;
  int number, digit1, digit2;

  System.out.print("Enter a number between 1 and 99: ");
  number = Integer.parseInt(cin.nextLine());

  digit1 = (int)(number / 10);
  digit2 = number % 10;

  HashMap<Integer, String> number2romanOnes = new HashMap<>(
    Map.of(1, "I", 2, "II", 3, "III", 4, "IV", 5, "V", 6, "VI", 7, "VII", 8, "VIII", 9, "IX")
  );

  HashMap<Integer, String> number2romanTens = new HashMap<>(
    Map.of(1, "X", 2, "XX", 3, "XXX", 4, "XL", 5, "L", 6, "LX", 7, "LXX", 8, "LXXX", 9, "XC")
  );

  roman = number2romanTens.get(digit1) + number2romanOnes.get(digit2);
  System.out.println(roman);
}
```

Chapter 32

32.7 Review Questions: True/False

1. false
2. true
3. false
4. false
5. false
6. true
7. false
8. true
9. true
10. true
11. true
12. true
13. false
14. true
15. true
16. true
17. true
18. true
19. false
20. true
21. true
22. true
23. false
24. true
25. true
26. true
27. false

32.8 Review Questions: Multiple Choice

1. b
2. b
3. c
4. a
5. d
6. a
7. d
8. c
9. c
10. c
11. b

32.9 Review Exercises

1. Solution

Step	Statement	x	a
1	`int[][] a = new int[2][3]`	?	? ? ? ? ? ?
2	`a[0][2] = 1`	?	? ? **1** ? ? ?
3	`x = 0`	**0**	? ? 1 ? ? ?
4	`a[0][x] = 9`	0	**9** ? 1 ? ? ?
5	`a[0][x + a[0][2]] = 4`	0	9 **4** 1 ? ? ?
6	`a[a[0][2]][2] = 19`	0	9 4 1 ? ? **19**
7	`a[a[0][2]][x + 1] = 13`	0	9 4 1 ? **13** 19
8	`a[a[0][2]][x] = 15`	0	9 4 1 **15** 13 19

2. Solution

Step	Statement	i	j	a
1	`int[][] a = new int[2][3]`	?	?	? ? ? ? ? ?
2	`i = 0`	**0**	?	? ? ? ? ? ?
3	`i <= 1`	true		
4	`j = 0`	0	**0**	? ? ? ? ? ?

5	j <= 2	true		
6	a[i][j] = (i + 1) * 5 + j	0	0	**5** ? ? ? ? ?
7	j++	0	**1**	5 ? ? ? ? ?
8	j <= 2	true		
9	a[i][j] = (i + 1) * 5 + j	0	1	5 **6** ? ? ? ?
10	j++	0	**2**	5 6 ? ? ? ?
11	j <= 2	true		
12	a[i][j] = (i + 1) * 5 + j	0	2	5 6 **7** ? ? ?
13	j++	0	**3**	5 6 7 ? ? ?
14	j <= 2	false		
15	i++	**1**	3	5 6 7 ? ? ?
16	i <= 1	true		
17	j = 0	1	**0**	5 6 7 ? ? ?
18	j <= 2	true		
19	a[i][j] = (i + 1) * 5 + j	1	0	5 6 7 **10** ? ?
20	j++	1	**1**	5 6 7 10 ? ?
21	j <= 2	true		
22	a[i][j] = (i + 1) * 5 + j	1	1	5 6 7 10 **11** ?
23	j++	1	**2**	5 6 7 10 11 ?

24	`j <= 2`	true		
25	`a[i][j] = (i + 1) * 5 + j`	1	2	5 6 7 10 11 **12**
26	`j++`	1	**3**	5 6 7 10 11 12
27	`j <= 2`	false		
28	`i++`	**2**	3	5 6 7 10 11 12
29	`i <= 1`	false		

3. Solution

Step	Statement	i	j	a
1	`int[][] a = new int[3][3]`	?	?	? ? ? ? ? ? ? ? ?
2	`j = 0`	?	**0**	? ? ? ? ? ? ? ? ?
3	`j <= 2`	True		
4	`i = 0`	0	**0**	? ? ? ? ? ? ? ? ?
5	`i <= 2`	True		
6	`a[i][j] = (i + 1) * 2 + j * 4`	0	0	**2** ? ? ? ? ? ? ? ?
7	`i++`	**1**	0	2 ? ? ? ? ? ? ? ?
8	`i <= 2`	True		
9	`a[i][j] = (i + 1) * 2 + j * 4`	1	0	2 ? ? **4** ? ? ? ? ?

10	`i++`	**2**	0	2 ? ? 4 ? ? ? ? ?
11	`i <= 2`	True		
12	`a[i][j] = (i + 1) * 2 + j * 4`	2	0	2 ? ? 4 ? ? **6** ? ?
13	`i++`	**3**	0	2 ? ? 4 ? ? 6 ? ?
14	`i <= 2`	False		
15	`j++`	3	**1**	2 ? ? 4 ? ? 6 ? ?
16	`j <= 2`	True		
17	`i = 0`	**0**	1	2 ? ? 4 ? ? 6 ? ?
18	`i <= 2`	True		
19	`a[i][j] = (i + 1) * 2 + j * 4`	0	1	2 **6** ? 4 ? ? 6 ? ?
20	`i++`	**1**	1	2 6 ? 4 ? ? 6 ? ?
21	`i <= 2`	True		
22	`a[i][j] = (i + 1) * 2 + j * 4`	1	1	2 6 ? 4 **8** ? 6 ? ?
23	`i++`	**2**	1	2 6 ? 4 8 ? 6 ? ?
24	`i <= 2`	True		
25	`a[i][j] = (i + 1) * 2 + j * 4`	2	1	2 6 ? 4 8 ? 6 **10** ?

26	`i++`	**3**	1	2 6 ? 4 8 ? 6 10 ?
27	`i <= 2`	False		
28	`j++`	3	**2**	2 6 ? 4 8 ? 6 10 ?
29	`j <= 2`	True		
30	`i = 0`	**0**	2	2 6 ? 4 8 ? 6 10 ?
31	`i <= 2`	True		
32	`a[i][j] = (i + 1) * 2 + j * 4`	0	2	2 6 **10** 4 8 ? 6 10 ?
33	`i++`	**1**	2	2 6 10 4 8 ? 6 10 ?
34	`i <= 2`	True		
35	`a[i][j] = (i + 1) * 2 + j * 4`	1	2	2 6 10 4 8 **12** 6 10 ?
36	`i++`	**2**	2	2 6 10 4 8 12 6 10 ?
37	`i <= 2`	True		
38	`a[i][j] = (i + 1) * 2 + j * 4`	2	2	2 6 10 4 8 12 6 10 **14**
39	`i++`	**3**	2	2 6 10 4 8 12 6 10 14
40	`i <= 2`	False		
41	`j++`	3	**3**	2 6 10 4 8 12 6 10 14

42	`j <= 2`	False

4. Solution

For input value of 5

0	5	10
0	6	12

For input value of 9

0	9	18
0	10	20

For input value of 3

0	3	6
0	4	8

5. Solution

For input value of 13

0	3	3
0	17	18

For input value of 10

0	10	3
0	11	15

For input value of 8

3	3	3
11	12	13

6. Solution

19	5	31
28	6	20

7. Solution

26	29
37	34
59	49

8. Solution

i. −1 15 22 25 12 16 7 9 1

ii. 7 9 1 25 12 16 −1 15 22

iii. 22 15 −1 16 12 25 1 9 7

iv. 1 9 7 16 12 25 22 15 −1

v. −1 25 7 15 12 9 22 16 1

vi. 7 25 −1 9 12 15 1 16 22

vii. 22 16 1 15 12 9 −1 25 7

viii. 1 16 22 9 12 15 7 25 −1

9. Solution

```
static final int ROWS = 10;
static final int COLUMNS = 15;

public static void main(String[] args) throws Exception {
  int i, j;

  int[][] a = new int[ROWS][COLUMNS];
  for (i = 0; i <= ROWS - 1; i++) {
    for (j = 0; j <= COLUMNS - 1; j++) {
      a[i][j] = Integer.parseInt(cin.nextLine());
    }
  }

  for (i = 0; i <= ROWS - 1; i++) {
    for (j = 0; j <= COLUMNS - 1; j++) {
      if (a[i][j] % 2 != 0) {
        System.out.println(i + ", " + j);
      }
    }
  }
}
```

10. Solution

```
static final int ROWS = 10;
static final int COLUMNS = 6;

public static void main(String[] args) throws Exception {
  int i, j;

  double[][] a = new double[ROWS][COLUMNS];
  for (i = 0; i <= ROWS - 1; i++) {
    for (j = 0; j <= COLUMNS - 1; j++) {
      a[i][j] = Double.parseDouble(cin.nextLine());
    }
  }

  for (i = 0; i <= ROWS - 1; i++) {
    for (j = 0; j <= COLUMNS - 1; j += 2) {
      System.out.println(a[i][j]);
    }
  }
}
```

11. Solution

```
static final int ROWS = 12;
static final int COLUMNS = 8;

public static void main(String[] args) throws Exception {
  int i, j;
  double total;

  double[][] a = new double[ROWS][COLUMNS];
  for (i = 0; i <= ROWS - 1; i++) {
    for (j = 0; j <= COLUMNS - 1; j++) {
      a[i][j] = Double.parseDouble(cin.nextLine());
    }
  }

  total = 0;
  for (i = 1; i <= ROWS - 1; i += 2) {
    for (j = 0; j <= COLUMNS - 1; j += 2) {
      total += a[i][j];
    }
  }
  System.out.println(total);
}
```

12. Solution

```
static final int N = 8 ;

public static void main(String[] args) throws Exception {
  int i, j, k;
  double sumAntidiagonal, sumDiagonal;

  double[][] a = new double[N][N];
  for (i = 0; i <= N - 1; i++) {
    for (j = 0; j <= N - 1; j++) {
      a[i][j] = Double.parseDouble(cin.nextLine());
    }
  }

  sumDiagonal = 0;
  sumAntidiagonal = 0;
  for (k = 0; k <= N - 1; k++) {
    sumDiagonal += a[k][k];
    sumAntidiagonal += a[k][N - k - 1];
  }
  System.out.println(sumDiagonal / N + ", " + sumAntidiagonal / N);
}
```

13. Solution

```
static final int N = 5;

public static void main(String[] args) throws Exception {
  int i, j;

  int[][] a = new int[N][N];
  for (i = 0; i <= N - 1; i++) {
    for (j = 0; j <= N - 1; j++) {
      if (i == N - j - 1) {
        a[i][j] = 5;
      }
      else if (i > N - j - 1) {
        a[i][j] = 88;
      }
      else {
        a[i][j] = 11;
      }
    }
  }

  for (i = 0; i <= N - 1; i++) {
    for (j = 0; j <= N - 1; j++) {
      System.out.print(a[i][j] + "\t");
    }
    System.out.println();
  }
}
```

14. Solution

```
static final int N = 5;

public static void main(String[] args) throws Exception {
  int i, j;

  int[][] a = new int[N][N];
  for (i = 0; i <= N - 1; i++) {
    for (j = 0; j <= N - 1; j++) {
      if (i == N - j - 1) {
        a[i][j] = 5;
      }
      else if (i > N - j - 1) {
        a[i][j] = 88;
      }
      else {
        a[i][j] = 11;
      }
      if (i == j) {
        a[i][j] = 0;
      }
    }
  }

  for (i = 0; i <= N - 1; i++) {
    for (j = 0; j <= N - 1; j++) {
      System.out.print(a[i][j] + "\t");
    }
    System.out.println();
  }
}
```

15. Solution

```
static final int ROWS = 5;
static final int COLUMNS = 4;

public static void main(String[] args) throws Exception {
  int i, j;

  double[][] a = new double[ROWS][COLUMNS];
  for (i = 0; i <= ROWS - 1; i++) {
    for (j = 0; j <= COLUMNS - 1; j++) {
      a[i][j] = Double.parseDouble(cin.nextLine());
    }
  }

  for (i = 0; i <= ROWS - 1; i++) {
    for (j = 0; j <= COLUMNS - 1; j++) {
      if (a[i][j] == (int)(a[i][j])) {
        System.out.println(i + ", " + j);
      }
    }
  }
}
```

16. Solution

```
static final int ROWS = 10;
static final int COLUMNS = 4;

public static void main(String[] args) throws Exception {
  int count, i, j;

  double[][] a = new double[ROWS][COLUMNS];
  for (i = 0; i <= ROWS - 1; i++) {
    for (j = 0; j <= COLUMNS - 1; j++) {
      a[i][j] = Double.parseDouble(cin.nextLine());
    }
  }
  count = 0;
  for (i = 0; i <= ROWS - 1; i++) {
    for (j = 0; j <= COLUMNS - 1; j++) {
      if (a[i][j] < 0) {
        count++;
      }
    }
  }
  System.out.println(count);
}
```

17. Solution

```
static final int ROWS = 3;
static final int COLUMNS = 4;

public static void main(String[] args) throws Exception {
  int i, j;

  String[][] a = new String[ROWS][COLUMNS];
  for (i = 0; i <= ROWS - 1; i++) {
    for (j = 0; j <= COLUMNS - 1; j++) {
      a[i][j] = cin.nextLine();
    }
  }

  for (i = 0; i <= ROWS - 1; i++) {
    for (j = 0; j <= COLUMNS - 1; j++) {
      System.out.print(a[i][j] + " ");
    }
  }
}
```

18. Solution

```
static final int ROWS = 20;
static final int COLUMNS = 14;

public static void main(String[] args) throws Exception {
  int i, j;

  String[][] a = new String[ROWS][COLUMNS];
  for (i = 0; i <= ROWS - 1; i++) {
    for (j = 0; j <= COLUMNS - 1; j++) {
      a[i][j] = cin.nextLine();
    }
  }

  for (i = 0; i <= ROWS - 1; i++) {
    for (j = 0; j <= COLUMNS - 1; j++) {
      if (a[i][j].length() < 5) {
        System.out.println(a[i][j]);
      }
    }
  }
}
```

19. Solution

First approach

```
static final int ROWS = 20;
static final int COLUMNS = 14;

public static void main(String[] args) throws Exception {
  int i, j, k;

  String[][] a = new String[ROWS][COLUMNS];
  for (i = 0; i <= ROWS - 1; i++) {
    for (j = 0; j <= COLUMNS - 1; j++) {
      a[i][j] = cin.nextLine();
    }
  }

  int[] lengthLimits = {5, 10, 20};

  for (k = 0; k <= 2; k++) {
    for (i = 0; i <= ROWS - 1; i++) {
      for (j = 0; j <= COLUMNS - 1; j++) {
        if (a[i][j].length() < lengthLimits[k]) {
          System.out.println(a[i][j]);
        }
      }
    }
  }
}
```

Second approach

```
static final int ROWS = 20;
static final int COLUMNS = 14;

public static void main(String[] args) throws Exception {
  int i, j, k;

  String[][] a = new String[ROWS][ COLUMNS];
  for (i = 0; i <= ROWS - 1; i++) {
    for (j = 0; j <= COLUMNS - 1; j++) {
      a[i][j] = cin.nextLine();
    }
  }

  for (k = 0; k <= 2; k++) {
    for (i = 0; i <= ROWS - 1; i++) {
      for (j = 0; j <= COLUMNS - 1; j++) {
        if (a[i][j].length() < 5 * Math.pow(2, k)) {
          System.out.println(a[i][j]);
        }
      }
    }
  }
}
```

Chapter 33

33.8 Review Questions: True/False

1. true
2. false
3. false
4. false
5. false
6. false
7. true
8. true
9. false
10. false
11. true
12. true
13. true

33.9 Review Questions: Multiple Choice

1. a
2. b
3. c
4. d
5. b
6. a
7. a
8. a

33.10 Review Exercises

1. Solution

```
static final int STUDENTS = 15;
static final int TESTS = 5;

public static void main(String[] args) throws Exception {
  int i, j;

  int[][] grades = new int[STUDENTS][TESTS];
  for (i = 0; i <= STUDENTS - 1; i++) {
    for (j = 0; j <= TESTS - 1; j++) {
      grades[i][j] = Integer.parseInt(cin.nextLine());
    }
  }

  double[] average = new double[STUDENTS];
  for (i = 0; i <= STUDENTS - 1; i++) {
    average[i] = 0;
    for (j = 0; j <= TESTS - 1; j++) {
      average[i] += grades[i][j];
    }
    average[i] /= TESTS;
  }

  for (i = 0; i <= STUDENTS - 1; i++) {
    System.out.print("Student No " + (i + 1) + ": ");

    if (average[i] < 60) {
      System.out.println("E/F");
    }
    else if (average[i] < 70) {
      System.out.println("D");
    }
    else if (average[i] < 80) {
      System.out.println("C");
    }
    else if (average[i] < 90) {
      System.out.println("B");
    }
    else {
      System.out.println("A");
    }
  }
}
```

2. Solution

```
static final int OBJECTS = 5;
static final int FALLS = 10;

public static void main(String[] args) throws Exception {
  int i, j, total;

  int[][] g = new int[OBJECTS][FALLS];
  for (i = 0; i <= OBJECTS - 1; i++) {
    for (j = 0; j <= FALLS - 1; j++) {
      g[i][j] = Integer.parseInt(cin.nextLine());
    }
  }

  for (i = 0; i <= OBJECTS - 1; i++) {
    total = 0;
    for (j = 0; j <= FALLS - 1; j++) {
      total += g[i][j];
    }
    System.out.println("Average g for object No " + (i + 1) + ": " + (total / (double)FALLS));
  }

  for (j = 0; j <= FALLS - 1; j++) {
    total = 0;
    for (i = 0; i <= OBJECTS - 1; i++) {
      total += g[i][j];
    }
    System.out.println("Average g for fall No " + (j + 1) + ": " + (total / (double)OBJECTS));
  }

  total = 0;
  for (i = 0; i <= OBJECTS - 1; i++) {
    for (j = 0; j <= FALLS - 1; j++) {
      total += g[i][j];
    }
  }
  System.out.println("Overall average g: " + (total / (double)(OBJECTS * FALLS)));
}
```

3. Solution

```
static final int PLAYERS = 15;
static final int MATCHES = 12;

public static void main(String[] args) throws Exception {
  int i, j, total;

  int[][] points = new int[PLAYERS][MATCHES];
  for (i = 0; i <= PLAYERS - 1; i++) {
    for (j = 0; j <= MATCHES - 1; j++) {
      points[i][j] = Integer.parseInt(cin.nextLine());
    }
  }

  for (i = 0; i <= PLAYERS - 1; i++) {
    total = 0;
    for (j = 0; j <= MATCHES - 1; j++) {
      total += points[i][j];
    }
    System.out.println("Total number of points for player No " +(i + 1) + ": " + total);
  }

  for (j = 0; j <= MATCHES - 1; j++) {
    total = 0;
    for (i = 0; i <= PLAYERS - 1; i++) {
      total += points[i][j];
    }
    System.out.println("Total number of points for match No " + (j + 1) + ": " + total);
  }
}
```

4. Solution

```
static final int CITIES = 20;
static final int HOURS = 24;

public static void main(String[] args) throws Exception {
  int i, j;
  double total;

  double[][] temperatures = new double[CITIES][HOURS];
  for (i = 0; i <= CITIES - 1; i++) {
    for (j = 0; j <= HOURS - 1; j++) {
      temperatures[i][j] = Integer.parseInt(cin.nextLine());
    }
  }
  for (j = 0; j <= HOURS - 1; j++) {
    total = 0;
    for (i = 0; i <= CITIES - 1; i++) {
      total += temperatures[i][j];
    }
    if (total / CITIES < 10) {
      System.out.println("Hour: " + (j + 1));
    }
  }
}
```

5. Solution

```
static final int PLAYERS = 24;
static final int MATCHES = 10;

public static void main(String[] args) throws Exception {
  int i, j, total;

  String[] names = new String[PLAYERS];
  int[][] goals = new int[PLAYERS][MATCHES];
  for (i = 0; i <= PLAYERS - 1; i++) {
    names[i] = cin.nextLine();
    for (j = 0; j <= MATCHES - 1; j++) {
      goals[i][j] = Integer.parseInt(cin.nextLine());
    }
  }

  for (i = 0; i <= PLAYERS - 1; i++) {
    total = 0;
    for (j = 0; j <= MATCHES - 1; j++) {
      total += goals[i][j];
    }
    System.out.println(names[i] + ": " + (total / (double)MATCHES));
  }

  for (j = 0; j <= MATCHES - 1; j++) {
    total = 0;
    for (i = 0; i <= PLAYERS - 1; i++) {
      total += goals[i][j];
    }
    System.out.println("Match No " + (j + 1) + ": " + total);
  }
}
```

6. Solution

```
static final int STUDENTS = 12;
static final int LESSONS = 6;
```

```
public static void main(String[] args) throws Exception {
  int i, j, total;

  String[] names = new String[STUDENTS];
  int[][] grades = new int[STUDENTS][LESSONS];
  for (i = 0; i <= STUDENTS - 1; i++) {
    names[i] = cin.nextLine();
    for (j = 0; j <= LESSONS - 1; j++) {
      grades[i][j] = Integer.parseInt(cin.nextLine());
    }
  }

  double[] average = new double[STUDENTS];
  for (i = 0; i <= STUDENTS - 1; i++) {
    total = 0;
    for (j = 0; j <= LESSONS - 1; j++) {
      total += grades[i][j];
    }
    average[i] = total / (double)LESSONS;
    System.out.println(names[i] + ": " + average[i]);
  }

  for (j = 0; j <= LESSONS - 1; j++) {
    total = 0;
    for (i = 0; i <= STUDENTS - 1; i++) {
      total += grades[i][j];
    }
    System.out.println(total / (double)STUDENTS);
  }

  for (i = 0; i <= STUDENTS - 1; i++) {
    if (average[i] < 60) {
      System.out.println(names[i]);
    }
  }

  for (i = 0; i <= STUDENTS - 1; i++) {
    if (average[i] > 89) {
      System.out.println(names[i] + " Bravo!");
    }
  }
}
```

7. Solution

```
static final int ARTISTS = 15;
static final int JUDGES = 5;

public static void main(String[] args) throws Exception {
  int i, j, total;
  String[] judgeNames = new String[JUDGES];
  for (j = 0; j <= JUDGES - 1; j++) {
    System.out.print("Enter name for judge No " + (j + 1) + ": ");
    judgeNames[j] = cin.nextLine();
  }

  String[] artistNames = new String[ARTISTS];
  String[] songTitles = new String[ARTISTS];
  int[][] score = new int[ARTISTS][JUDGES];
  for (i = 0; i <= ARTISTS - 1; i++) {
    System.out.print("Enter name for artist No " + (i + 1) + ": ");
    artistNames[i] = cin.nextLine();
    System.out.print("Enter song title for artist " + artistNames[i] + ": ");
    songTitles[i] = cin.nextLine();
    for (j = 0; j <= JUDGES - 1; j++) {
      System.out.print("Enter score for artist: " + artistNames[i]);
      System.out.print(" gotten from judge " + judgeNames[j] + ": ");
      score[i][j] = Integer.parseInt(cin.nextLine());
    }
  }

  for (i = 0; i <= ARTISTS - 1; i++) {
    total = 0;
    for (j = 0; j <= JUDGES - 1; j++) {
      total += score[i][j];
    }
    System.out.println(artistNames[i] + ", " + songTitles[i] + ": " + total);
  }

  for (j = 0; j <= JUDGES - 1; j++) {
    total = 0;
    for (i = 0; i <= ARTISTS - 1; i++) {
      total += score[i][j];
    }
    System.out.println(judgeNames[j] + ": " + total / (double)ARTISTS);
  }
}
```

8. Solution

```
static final int PEOPLE = 30;
static final int MONTHS = 12;

public static void main(String[] args) throws Exception {
  int i, j, sumHeights, sumWeights;
  double averageHeight, averageWeight;

  int[][] weights = new int[PEOPLE][MONTHS];
  int[][] heights = new int[PEOPLE][MONTHS];
  for (i = 0; i <= PEOPLE - 1; i++) {
    for (j = 0; j <= MONTHS - 1; j++) {
      weights[i][j] = Integer.parseInt(cin.nextLine());
      heights[i][j] = Integer.parseInt(cin.nextLine());
    }
  }

  for (i = 0; i <= PEOPLE - 1; i++) {
    sumWeights = 0;
    sumHeights = 0;
    for (j = 0; j <= MONTHS - 1; j++) {
      sumWeights += weights[i][j];
      sumHeights += heights[i][j];
    }
    averageWeight = sumWeights / (double)MONTHS;
    averageHeight = sumHeights / (double)MONTHS;
    System.out.println(averageWeight + ", " + averageHeight);
    System.out.println(averageWeight * 702 / Math.pow(averageHeight, 2));
  }

  for (i = 0; i <= PEOPLE - 1; i++) {
    System.out.println(weights[i][4] * 702 / Math.pow(heights[i][4], 2));
    System.out.println(weights[i][7] * 702 / Math.pow(heights[i][7], 2));
  }
}
```

9. Solution

```
static final double VAT = 0.19;
static final int CONSUMERS = 1000;

public static void main(String[] args) throws Exception {
  int consumed, i;
  double payment, total;

  int[][] meterReading = new int[CONSUMERS][2];
  for (i = 0; i <= CONSUMERS - 1; i++) {
    meterReading[i][0] = Integer.parseInt(cin.nextLine());
    meterReading[i][1] = Integer.parseInt(cin.nextLine());
  }

  total = 0;
  for (i = 0; i <= CONSUMERS - 1; i++) {
    consumed = meterReading[i][1] - meterReading[i][0];
    System.out.println(consumed);
    payment = consumed * 0.07;
    payment += VAT * payment;
    System.out.println(payment);

    total += consumed;
  }

  System.out.println(total + ", " + (total * 0.07 + total * 0.07 * VAT));
}
```

10. Solution

```
static final int CURRENCIES = 4;
static final int DAYS = 5;

public static void main(String[] args) throws Exception {
  int i, j;
  double average, total, usd;

  System.out.print("Enter an amount in US dollars: ");
  usd = Double.parseDouble(cin.nextLine());

  String[] currency = {"British Pounds Sterling", "Euros", "Canadian Dollars", "Australian Dollars"};

  double[][] rate = {
    {1.420, 1.421, 1.432, 1.431, 1.441},
    {1.043, 1.056, 1.038, 1.022, 1.029},
    {0.757, 0.764, 0.760, 0.750, 0.749},
    {0.620, 0.625, 0.629, 0.636, 0.639}
  };

  for (i = 0; i <= CURRENCIES - 1; i++) {
    total = 0;
    for (j = 0; j <= DAYS - 1; j++) {
      total += rate[i][j];
    }
    average = total / DAYS;
    System.out.println(usd + " US dollars = " + (usd / average) + " " + currency[i]);
  }
}
```

11. Solution

```
static final int EMPLOYEES = 10;
static final int DAYS = 5;

public static void main(String[] args) throws Exception {
  int i, j;
  double totalGrossPay, grossPay, payRate, total;

  String[] days = {"Monday", "Tuesday", "Wednesday", "Thursday", "Friday"};

  payRate = Double.parseDouble(cin.nextLine());

  String[] names = new String[EMPLOYEES];
  int[][] hoursWorkedPerDay = new int[EMPLOYEES][DAYS];
  for (i = 0; i <= EMPLOYEES - 1; i++) {
    names[i] = cin.nextLine();
    for (j = 0; j <= DAYS - 1; j++) {
      hoursWorkedPerDay[i][j] = Integer.parseInt(cin.nextLine());
    }
  }

  int[] hoursWorkedPerWeek = new int[EMPLOYEES];
  for (i = 0; i <= EMPLOYEES - 1; i++) {
    hoursWorkedPerWeek[i] = 0;
    for (j = 0; j <= DAYS - 1; j++) {
      hoursWorkedPerWeek[i] += hoursWorkedPerDay[i][j];
    }
    if (hoursWorkedPerWeek[i] > 40) {
      System.out.println(names[i]);
    }
  }

  totalGrossPay = 0;
  for (i = 0; i <= EMPLOYEES - 1; i++) {
    if (hoursWorkedPerWeek[i] <= 40) {
      grossPay = payRate * hoursWorkedPerWeek[i];
    }
    else {
      grossPay = payRate * 40 + 1.5 * payRate * (hoursWorkedPerWeek[i] - 40);
    }
    totalGrossPay += grossPay;
    System.out.println(names[i] + ", " + (grossPay / 5));
  }

  System.out.println(totalGrossPay);

  for (i = 0; i <= EMPLOYEES - 1; i++) {
    if (hoursWorkedPerWeek[i] > 40) {
      for (j = 0; j <= DAYS - 1; j++) {
        if (hoursWorkedPerDay[i][j] > 8) {
          System.out.println(names[i] + ", " + days[j] + " Overtime!");
        }
      }
    }
  }

  for (j = 0; j <= DAYS - 1; j++) {
    total = 0;
    for (i = 0; i <= EMPLOYEES - 1; i++) {
      if (hoursWorkedPerDay[i][j] <= 8) {
        grossPay = payRate * hoursWorkedPerDay[i][j];
      }
      else {
        grossPay = payRate * 8 + 1.5 * payRate * (hoursWorkedPerDay[i][j] - 8);
      }
      total += grossPay;
    }
```

```
    System.out.println(days[j] + ", " + total);
  }
}
```

12. Solution

```
static final int ROWS = 3;
static final int COLUMNS = 4;

public static void main(String[] args) throws Exception {
  int i, j, k;

  int[][] a = {
    {9, 9, 2, 6},
    {4, 1, 10, 11},
    {12, 15, 7, 3}
  };

  int[] b = new int[ROWS * COLUMNS];
  k = 0;
  for (i = 0; i <= ROWS - 1; i++) {
    for (j = 0; j <= COLUMNS - 1; j++) {
      b[k++] = a[i][j];
    }
  }

  for (k = 0; k <= b.length - 1; k++) {
    System.out.print(b[k] + " ");
  }
}
```

13. Solution

```
static final int ROWS = 3;
static final int COLUMNS = 3;

public static void main(String[] args) throws Exception {
  int i, j, k;

  int[] a = {16, 12, 3, 5, 6, 9, 18, 19, 20};

  int[][] b = new int[ROWS][COLUMNS];
  k = 0;
  for (i = ROWS - 1; i >= 0; i--) {
    for (j = 0; j <= COLUMNS - 1; j++) {
      b[i][j] = a[k++];
    }
  }

  for (i = 0; i <= ROWS - 1; i++) {
    for (j = 0; j <= COLUMNS - 1; j++) {
      System.out.print(b[i][j] + "\t");
    }
    System.out.println();
  }
}
```

Chapter 34

34.7 Review Questions: True/False

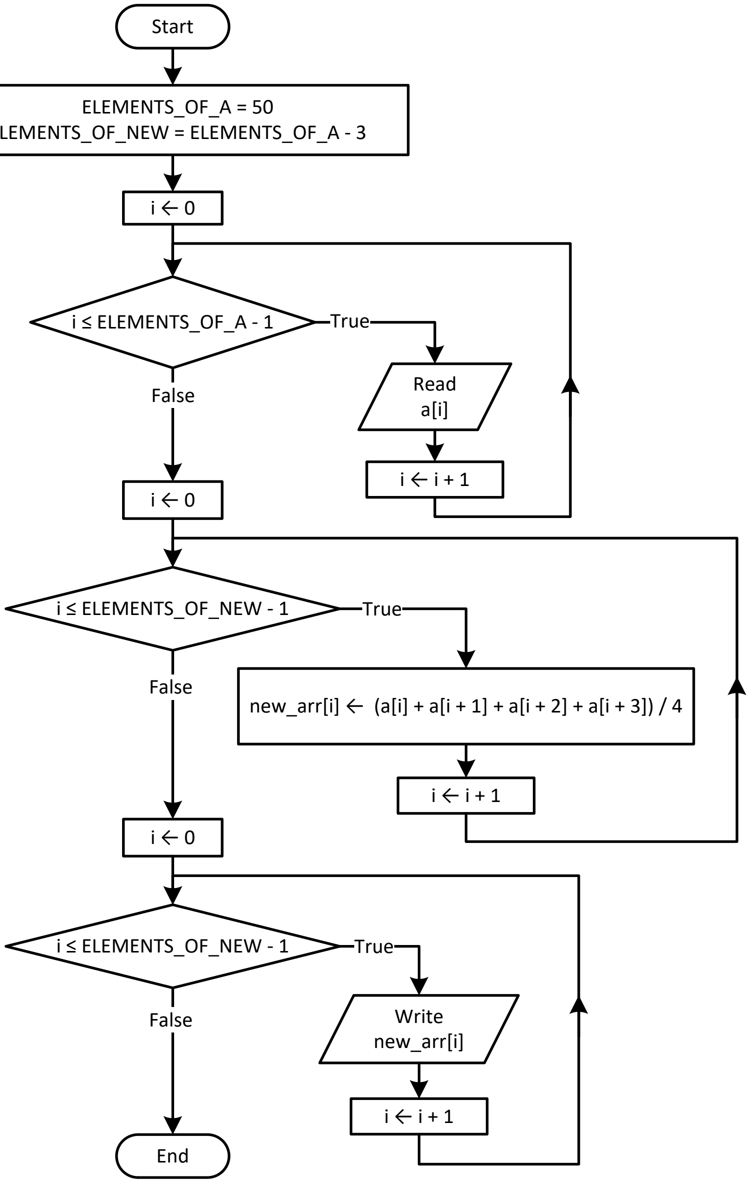
1. true
2. false
3. true
4. true
5. true
6. true
7. true
8. false
9. true
10. false
11. false
12. true
13. false
14. false
15. false
16. true
17. true
18. true
19. false
20. false
21. true
22. true
23. true
24. false
25. true
26. false
27. false
28. false
29. true
30. true
31. true
32. false
33. true
34. false
35. true
36. true
37. false
38. true
39. true
40. false

34.8 Review Exercises

1. Solution

```
for (i = 0; i <= ROWS - 1; i++) {
  for (j = 0; j <= COLUMNS - 1; j++) {
    a[i][j] = Double.parseDouble(cin.nextLine());
    while (a[i][j] == 0) {
      System.out.println("Error");
      a[i][j] = Double.parseDouble(cin.nextLine());
    }
  }
}
```

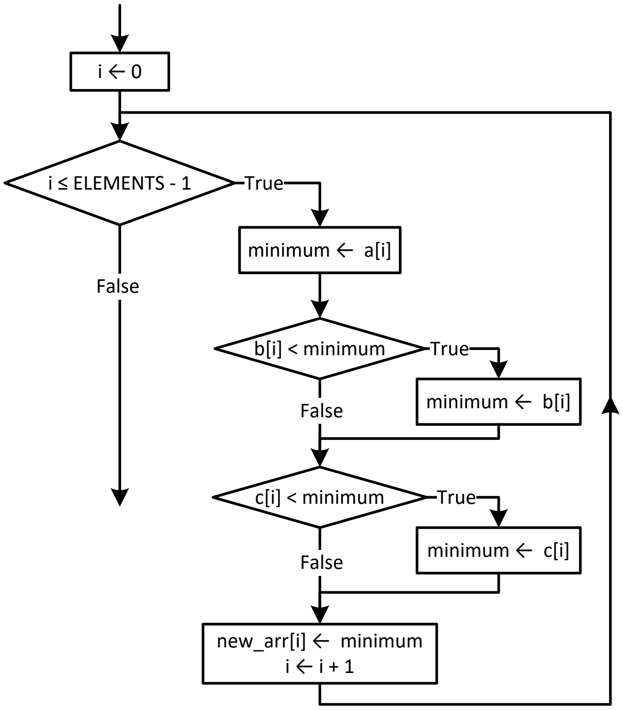
2. Solution



```
static final int ELEMENTS_OF_A = 50;
static final int ELEMENTS_OF_NEW = ELEMENTS_OF_A - 3;

public static void main(String[] args) throws Exception {
  int i;

  double[] a = new double[ELEMENTS_OF_A];
  for (i = 0; i <= ELEMENTS_OF_A - 1; i++) {
    a[i] = Double.parseDouble(cin.nextLine());
  }

  double[] newArr = new double[ELEMENTS_OF_NEW];
  for (i = 0; i <= ELEMENTS_OF_NEW - 1; i++) {
    newArr[i] = (a[i] + a[i + 1] + a[i + 2] + a[i + 3]) / 4;
  }

  for (i = 0; i <= ELEMENTS_OF_NEW - 1; i++) {
    System.out.println(newArr[i] + "\t");
  }
}
```

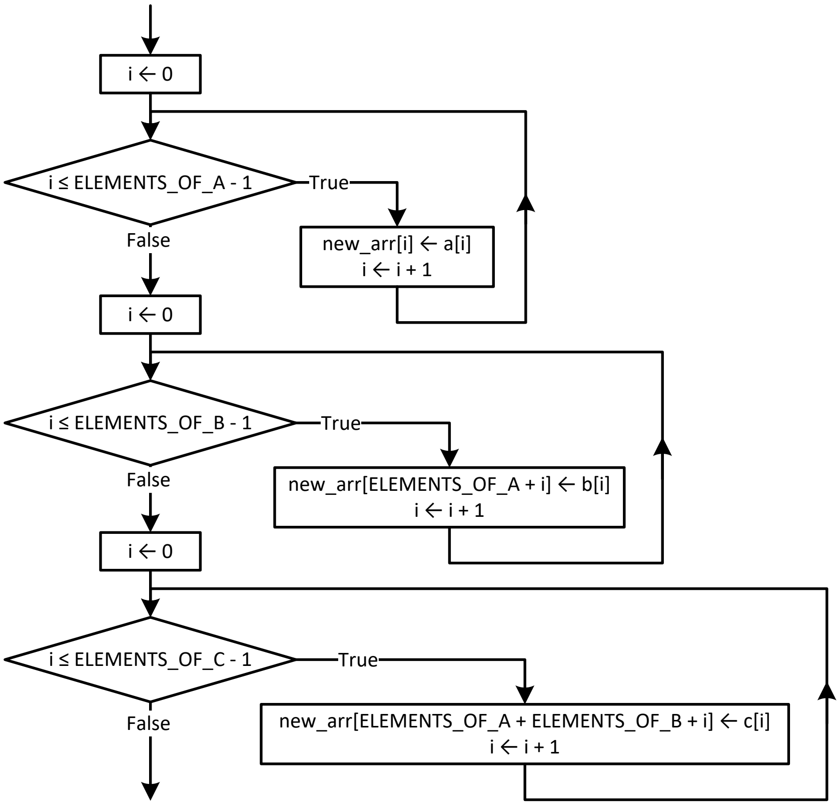
3. Solution

```
static final int ELEMENTS = 15;

public static void main(String[] args) throws Exception {
  int i;
  double minimum

  double[] a = new double[ELEMENTS];
  for (i = 0; i <= ELEMENTS - 1; i++) {
    a[i] = Double.parseDouble(cin.nextLine());
  }
  double[] b = new double[ELEMENTS];
  for (i = 0; i <= ELEMENTS - 1; i++) {
    b[i] = Double.parseDouble(cin.nextLine());
  }
  double[] c = new double[ELEMENTS];
  for (i = 0; i <= ELEMENTS - 1; i++) {
    c[i] = Double.parseDouble(cin.nextLine());
  }

  double[] newArr = new double[ELEMENTS];
  for (i = 0; i <= ELEMENTS - 1; i++) {
    minimum = a[i];
    if (b[i] < minimum) {
      minimum = b[i];
    }
    if (c[i] < minimum) {
      minimum = c[i];
    }
    newArr[i] = minimum;
  }

  for (i = 0; i <= ELEMENTS - 1; i++) {
    System.out.println(newArr[i]);
  }
}
```



4. Solution

```
static final int ELEMENTS_OF_A = 10;
static final int ELEMENTS_OF_B = 5;
static final int ELEMENTS_OF_C = 15;
static final int ELEMENTS_OF_NEW = ELEMENTS_OF_A + ELEMENTS_OF_B + ELEMENTS_OF_C;

public static void main(String[] args) throws Exception {
  int i;

  double[] a = new double[ELEMENTS_OF_A];
  for (i = 0; i <= ELEMENTS_OF_A - 1; i++) {
    a[i] = Double.parseDouble(cin.nextLine());
  }
  double[] b = new double[ELEMENTS_OF_B];
  for (i = 0; i <= ELEMENTS_OF_B - 1; i++) {
    b[i] = Double.parseDouble(cin.nextLine());
  }
  double[] c = new double[ELEMENTS_OF_C];
  for (i = 0; i <= ELEMENTS_OF_C - 1; i++) {
    c[i] = Double.parseDouble(cin.nextLine());
  }

  double[] newArr = new double[ELEMENTS_OF_NEW];
  for (i = 0; i <= ELEMENTS_OF_C - 1; i++) {
    newArr[i] = c[i];
  }
  for (i = 0; i <= ELEMENTS_OF_B - 1; i++) {
    newArr[ELEMENTS_OF_C + i] = b[i];
  }
  for (i = 0; i <= ELEMENTS_OF_A - 1; i++) {
    newArr[ELEMENTS_OF_B + ELEMENTS_OF_C + i] = a[i];
  }

  //Display array new
  for (i = 0; i <= ELEMENTS_OF_NEW - 1; i++) {
    System.out.print(newArr[i] + "\t");
  }
}
```



5. Solution

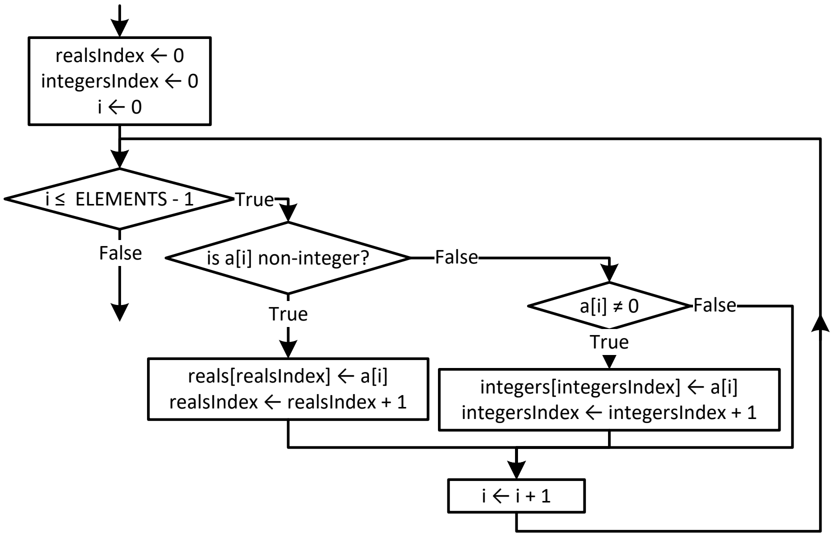
```
static final int COLUMNS = 4;

public static void main(String[] args) throws Exception {
  int i, j;

  //Create arrays a and b
  int[][] a = {
    {10, 11, 12, 85},
    {3, 1, 5, 10},
    {-1, 2, -5, -10}
  };
  int[][] b = {
    {10, 11, 16, 33},
    {11, 13, 5, 55},
    {-1, -2, -4, 44},
    {55, 33, 77, 12},
    {-110, 120, 132, 43}
  };

  //Create array newArr
  int[][] newArr = new int[a.length + b.length][COLUMNS];
  for (i = 0; i <= a.length - 1; i++) {
    for (j = 0; j <= COLUMNS - 1; j++) {
      newArr[i][j] = a[i][j];
    }
  }
  for (i = 0; i <= b.length - 1; i++) {
    for (j = 0; j <= COLUMNS - 1; j++) {
      newArr[a.length + i][j] = b[i][j];
    }
  }

  //Display array newArr
  for (i = 0; i <= newArr.length - 1; i++) {
    for (j = 0; j <= COLUMNS - 1; j++) {
      System.out.print(newArr[i][j] + "\t");
    }
    System.out.println();
  }
}
```

6. Solution

```
static final int COLUMNS_OF_A = 10;
static final int COLUMNS_OF_B = 15;
static final int COLUMNS_OF_C = 20;
static final int ROWS = 5;
static final int COLUMNS = COLUMNS_OF_A + COLUMNS_OF_B + COLUMNS_OF_C;

public static void main(String[] args) throws Exception {
  int i, j;

  double[][] a = new double[ROWS][COLUMNS_OF_A];
  for (i = 0; i <= ROWS - 1; i++) {
    for (j = 0; j <= COLUMNS_OF_A - 1; j++) {
      a[i][j] = Double.parseDouble(cin.nextLine());
    }
  }

  double[][] b = new double[ROWS][COLUMNS_OF_B];
  for (i = 0; i <= ROWS - 1; i++) {
    for (j = 0; j <= COLUMNS_OF_B - 1; j++) {
      b[i][j] = Double.parseDouble(cin.nextLine());
    }
  }
  double[][] c = new double[ROWS][COLUMNS_OF_C];
  for (i = 0; i <= ROWS - 1; i++) {
    for (j = 0; j <= COLUMNS_OF_C - 1; j++) {
      c[i][j] = Double.parseDouble(cin.nextLine());
    }
  }

  double[][] newArr = new double[ROWS][COLUMNS];
  for (i = 0; i <= ROWS - 1; i++) {
    for (j = 0; j <= COLUMNS_OF_A - 1; j++) {
      newArr[i][j] = a[i][j];
    }
  }
  for (i = 0; i <= ROWS - 1; i++) {
    for (j = 0; j <= COLUMNS_OF_B - 1; j++) {
      newArr[i][COLUMNS_OF_A + j] = b[i][j];
    }
  }
  for (i = 0; i <= ROWS - 1; i++) {
    for (j = 0; j <= COLUMNS_OF_C - 1; j++) {
      newArr[i][COLUMNS_OF_A + COLUMNS_OF_B + j] = c[i][j];
    }
  }

  for (i = 0; i <= ROWS - 1; i++) {
    for (j = 0; j <= COLUMNS - 1; j++) {
      System.out.print(newArr[i][j] + "\t");
    }
    System.out.println();
  }
}
```

7. Solution

```
static final int ELEMENTS = 50;

public static void main(String[] args) throws Exception {
  int i, integersIndex, realsIndex;

  double[] a = new double[ELEMENTS];
  for (i = 0; i <= ELEMENTS - 1; i++) {
    a[i] = Double.parseDouble(cin.nextLine());
  }

  double[] reals = new double[ELEMENTS];
  int[] integers = new int[ELEMENTS];
  realsIndex = 0;
  integersIndex = 0;
  for (i = 0; i <= ELEMENTS - 1; i++) {
    if (a[i] != (int)(a[i])) {
      reals[realsIndex] = a[i];
      realsIndex++;
    }
    else if (a[i] != 0) {
      integers[integersIndex] = (int)a[i];
      integersIndex++;
    }
  }

  for (i = 0; i <= realsIndex - 1; i++) {
    System.out.print(reals[i] + "\t");
  }

  System.out.println();
  for (i = 0; i <= integersIndex - 1; i++) {
    System.out.print(integers[i] + "\t");
  }
}
```



8. Solution

```
static final int ELEMENTS = 50;

public static void main(String[] args) throws Exception {
  int digit1, digit2, digit3, i, k, r;

  int[] a = new int[ELEMENTS];
  for (i = 0; i <= ELEMENTS - 1; i++) {
    a[i] = Integer.parseInt(cin.nextLine());
  }

  int[] b = new int[ELEMENTS];
  k = 0;
  for (i = 0; i <= ELEMENTS - 1; i++) {
    digit3 = a[i] % 10;
    r = (int)(a[i] / 10);
    digit2 = r % 10;
    digit1 = (int)(r / 10);

    if (digit1 < digit2 && digit2 < digit3) {
      b[k] = a[i];
      k++;
    }
  }

  for (i = 0; i <= k - 1; i++) {
    System.out.print(b[i] + "\t");
  }
}
```

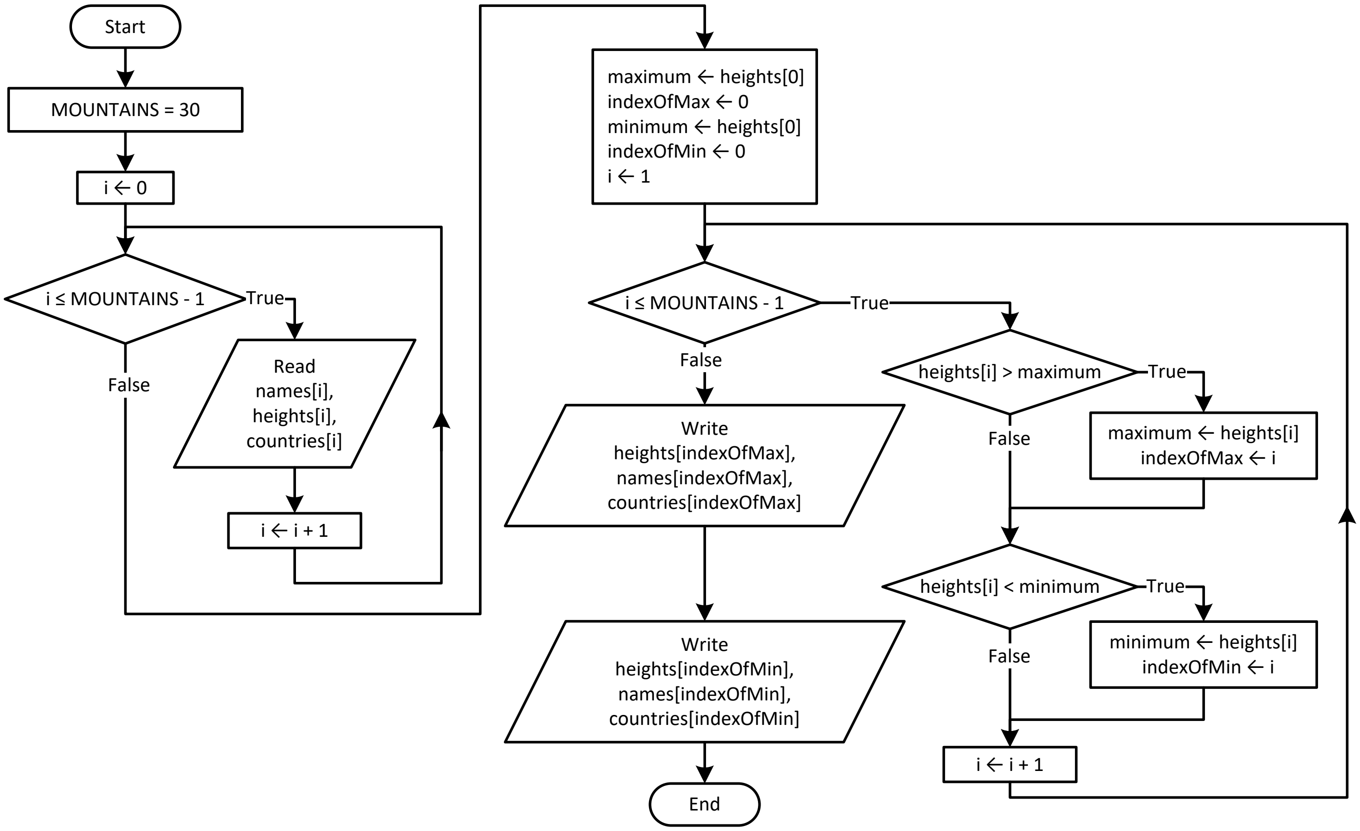
9. Solution

```
static final int PRODUCTS = 10;
static final int CITIZENS = 200;

public static void main(String[] args) throws Exception {
  int countB, i, j, maximum;

  String[] prodNames = new String[PRODUCTS];
  String[][] answers = new String[PRODUCTS][CITIZENS];
  for (i = 0; i <= PRODUCTS - 1; i++) {
    prodNames[i] = cin.nextLine();
    for (j = 0; j <= CITIZENS - 1; j++) {
      answers[i][j] = cin.nextLine();
      while (answers[i][j].compareTo("A") < 0 || answers[i][j].compareTo("D") > 0) {
        System.out.println("Error! ");
        answers[i][j] = cin.nextLine();
      }
    }
  }

  int[] countA = new int[PRODUCTS];
  for (i = 0; i <= PRODUCTS - 1; i++) {
    countA[i] = 0;
    for (j = 0; j <= CITIZENS - 1; j++) {
      if (answers[i][j].equals("A")) {
        countA[i]++;
      }
    }
    System.out.println(prodNames[i] + ", " + countA[i]);
  }

  for (j = 0; j <= CITIZENS - 1; j++) {
    countB = 0;
    for (i = 0; i <= PRODUCTS - 1; i++) {
      if (answers[i][j].equals("B")) {
        countB++;
      }
    }
    System.out.println(countB);
  }

  maximum = countA[0];
  for (i = 1; i <= PRODUCTS - 1; i++) {
    if (countA[i] > maximum) {
      maximum = countA[i];
    }
  }
  for (i = 0; i <= PRODUCTS - 1; i++) {
    if (countA[i] == maximum) {
      System.out.println(prodNames[i]);
    }
  }
}
```

10. Solution

```
static final int US_CITIES = 20;
static final int CANADIAN_CITIES = 20;

public static void main(String[] args) throws Exception {
  int i, j, minJ;
  double minimum;

  String[] usNames = new String[US_CITIES];
  for (i = 0; i <= US_CITIES - 1; i++) {
    System.out.print("Enter name for US city No " + (i + 1) + ": ");
    usNames[i] = cin.nextLine();
  }

  String[] canadianNames = new String[CANADIAN_CITIES];
  for (j = 0; j <= CANADIAN_CITIES - 1; j++) {
    System.out.print("Enter name for Canadian city No " + (j + 1) + ": ");
    canadianNames[j] = cin.nextLine();
  }

  double[][] distances = new double[US_CITIES][CANADIAN_CITIES];
  for (i = 0; i <= US_CITIES - 1; i++) {
    for (j = 0; j <= CANADIAN_CITIES - 1; j++) {
      System.out.print("Enter distance between " + usNames[i] + " and " + canadianNames[j] + ": ");
      distances[i][j] = Double.parseDouble(cin.nextLine());
    }
  }

  for (i = 0; i <= US_CITIES - 1; i++) {
    minimum = distances[i][0];
    minJ = 0;
  for (j = 1; j <= CANADIAN_CITIES - 1; j++) {
   if (distances[i][j] < minimum) {
    minimum = distances[i][j];
    minJ = j;
   }
  }
  System.out.println("Closest Canadian city to " + usNames[i] + " is " + canadianNames[minJ]);
 }
}
```

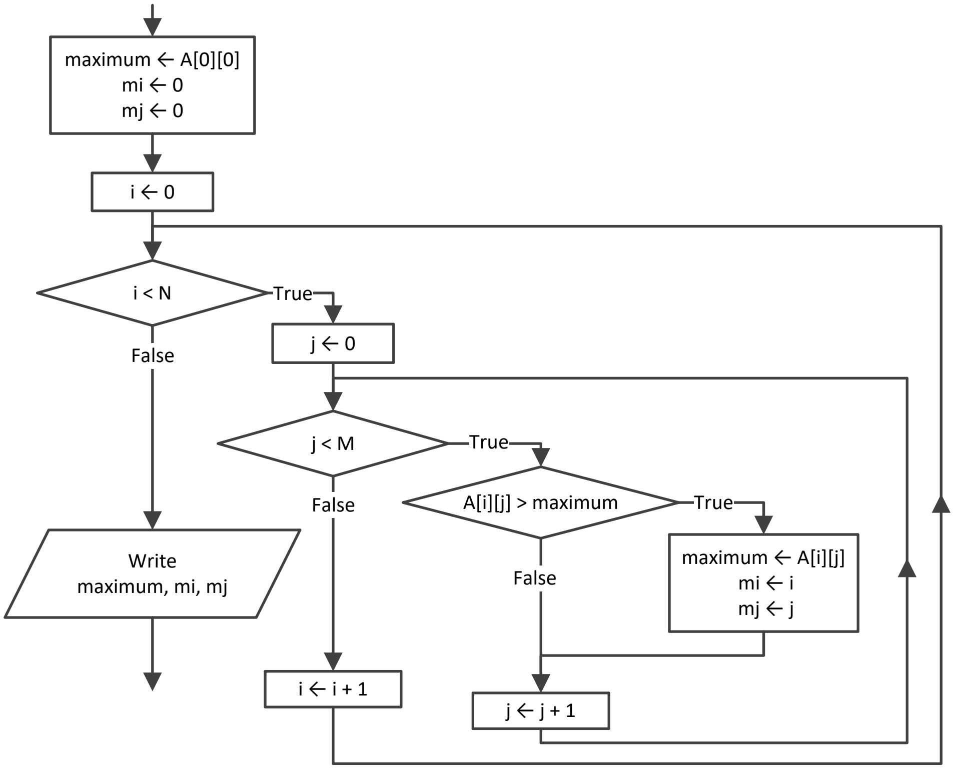
11. Solution



```
static final int MOUNTAINS = 30;

public static void main(String[] args) throws Exception {
 int i, indexOfMax, indexOfMin;
 double maximum, minimum;

 String[] names = new String[MOUNTAINS];
 double[] heights = new double[MOUNTAINS];
 string[] countries = new string[MOUNTAINS];
 for (i = 0; i <= MOUNTAINS - 1; i++) {
  names[i] = cin.nextLine();
  heights[i] = Double.parseDouble(cin.nextLine());
  countries[i] = cin.nextLine();
 }
```

```
  maximum = heights[0];
  indexOfMax = 0;
  minimum = heights[0];
  indexOfMin = 0;
  for (i = 1; i <= MOUNTAINS - 1; i++) {
    if (heights[i] > maximum) {
      maximum = heights[i];
      indexOfMax = i;
    }
    if (heights[i] < minimum) {
      minimum = heights[i];
      indexOfMin = i;
    }
  }

  System.out.println(heights[indexOfMax] +", "+ names[indexOfMax] +", "+ countries[indexOfMax]);
  System.out.println(heights[indexOfMin] +", "+ names[indexOfMin] +", "+ countries[indexOfMin]);
}
```

12. Solution



13. Solution

```
static final int TEAMS = 26;
static final int GAMES = 15;

public static void main(String[] args) throws Exception {
  int i, j, m_i, maximum;

  String[] names = new String[TEAMS];
  String[][] results = new String[TEAMS][GAMES];
  for (i = 0; i <= TEAMS - 1; i++) {
    names[i] = cin.nextLine();
    for (j = 0; j <= GAMES - 1; j++) {
      results[i][j] = cin.nextLine();
    }
  }

  int[] points = new int[TEAMS];
  for (i = 0; i <= TEAMS - 1; i++) {
    points[i] = 0;
    for (j = 0; j <= GAMES - 1; j++) {
      if (results[i][j].equals("W")) {
        points[i] += 3;
      }
      else if (results[i][j].equals("T")) {
        points[i] += 1;
      }
    }
  }

  maximum = points[0];
  m_i = 0;
  for (i = 1; i <= TEAMS - 1; i++) {
    if (points[i] > maximum) {
      maximum = points[i];
      m_i = i;
    }
  }

  System.out.println(names[m_i]);
}
```

14. Solution

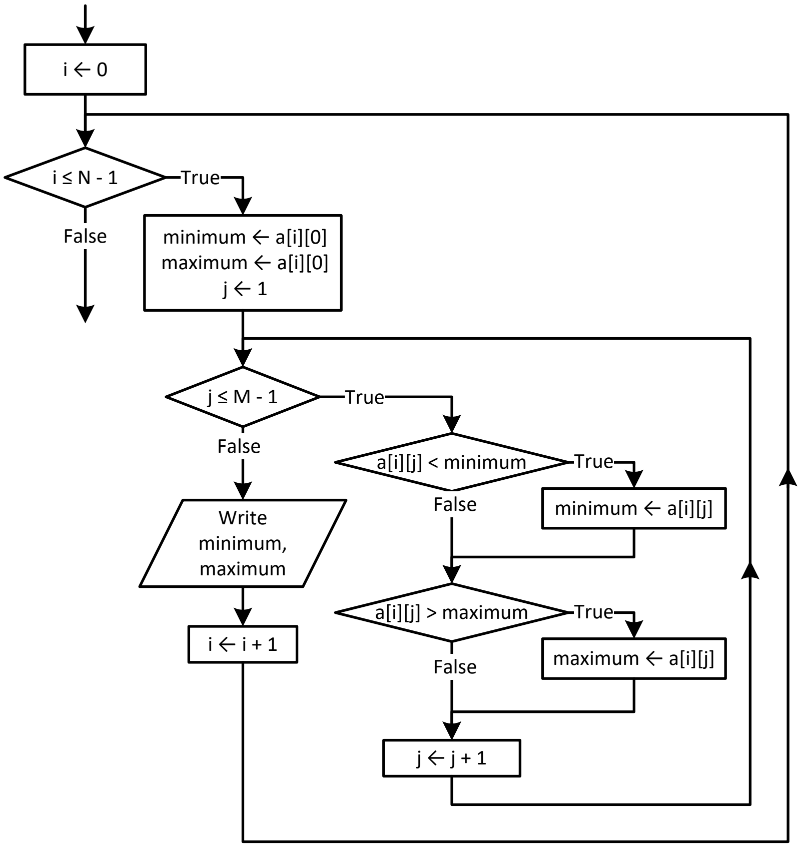
```
static final int OBJECTS = 10;
static final int FALLS = 20;

public static void main(String[] args) throws Exception {
  int i, j;
  double maxi, mini;

  double[][] heights = new double[OBJECTS][FALLS];
  double[][] times = new double[OBJECTS][FALLS];
  for (i = 0; i <= OBJECTS - 1; i++) {
    for (j = 0; j <= FALLS - 1; j++) {
      heights[i][j] = Double.parseDouble(cin.nextLine());
      times[i][j] = Double.parseDouble(cin.nextLine());
    }
  }

  double[][] g = new double[OBJECTS][FALLS];
  for (i = 0; i <= OBJECTS - 1; i++) {
    for (j = 0; j <= FALLS - 1; j++) {
      g[i][j] = 2 * heights[i][j] / Math.pow(times[i][j], 2);
    }
  }

  double[] minimum = new double[OBJECTS];
  double[] maximum = new double[OBJECTS];
  for (i = 0; i <= OBJECTS - 1; i++) {
    minimum[i] = g[i][0];
    maximum[i] = g[i][0];
    for (j = 1; j <= FALLS - 1; j++) {
      if (g[i][j] < minimum[i]) {
        minimum[i] = g[i][j];
      }
      if (g[i][j] > maximum[i]) {
        maximum[i] = g[i][j];
      }
    }
  }

  for (i = 0; i <= OBJECTS - 1; i++) {
    System.out.println(minimum[i] + ", " + maximum[i]);
  }

  maxi = maximum[0];
  mini= minimum[0];
  for (i = 1; i <= OBJECTS - 1; i++) {
    if (maximum[i] > maxi) {
      maxi = maximum[i];
    }
    if (minimum[i] < mini) {
      mini = minimum[i];
    }
  }

  System.out.println(mini + ", " + maxi);
}
```

15. Solution

```
static final int STATIONS = 10;
static final int DAYS = 365;

public static void main(String[] args) throws Exception {
  int i, j, m_i;
  double minimum;
```

```
 String[] names = new String[STATIONS];
 double[][] co2 = new double[STATIONS][DAYS];
 for (i = 0; i <= STATIONS - 1; i++) {
  names[i] = cin.nextLine();
  for (j = 0; j <= DAYS - 1; j++) {
   co2[i][j] = Double.parseDouble(cin.nextLine());
  }
 }

 double[] average = new double[STATIONS];
 for (i = 0; i <= STATIONS - 1; i++) {
  average[i] = 0;
  for (j = 0; j <= DAYS - 1; j++) {
   average[i] += co2[i][j];
  }
  average[i] /= DAYS;
 }

 minimum = average[0];
 m_i = 0;
 for (i = 1; i <= STATIONS - 1; i++) {
  if (average[i] < minimum) {
   minimum = average[i];
   m_i = i;
  }
 }
 System.out.println(names[m_i]);
}
```

16. Solution



17. Solution

First approach

```
static final int ROWS = 20;
static final int COLUMNS = 30;

public static void main(String[] args) throws Exception {
  int i, j;

  double[][] b = new double[ROWS][COLUMNS];
  for (i = 0; i <= ROWS - 1; i++) {
    for (j = 0; j <= COLUMNS - 1; j++) {
      b[i][j] = Double.parseDouble(cin.nextLine());
    }
  }

  double[] minimum = new double[COLUMNS];
  double[] maximum = new double[COLUMNS];
  for (j = 0; j <= COLUMNS - 1; j++) {
    minimum[j] = b[0][j];
    maximum[j] = b[0][j];
    for (i = 1; i <= ROWS - 1; i++) {
      if (b[i][j] < minimum[j]) {
        minimum[j] = b[i][j];
      }
      if (b[i][j] > maximum[j]) {
        maximum[j] = b[i][j];
      }
    }
  }

  for (j = 0; j <= COLUMNS - 1; j++) {
    System.out.println(minimum[j] + " " + maximum[j]);
  }
}
```

Second approach

```
static final int ROWS = 20;
static final int COLUMNS = 30;

public static void main(String[] args) throws Exception {
  int i, j;
  double minimum, maximum;

  double[][] b = new double[ROWS][COLUMNS];
  for (i = 0; i <= ROWS - 1; i++) {
    for (j = 0; j <= COLUMNS - 1; j++) {
      b[i][j] = Double.parseDouble(cin.nextLine());
    }
  }

  for (j = 0; j <= COLUMNS - 1; j++) {
    minimum = b[0][j];
    maximum = b[0][j];
    for (i = 1; i <= ROWS - 1; i++) {
      if (b[i][j] < minimum) {
        minimum = b[i][j];
      }
      if (b[i][j] > maximum) {
        maximum = b[i][j];
      }
    }
    System.out.println(minimum + " " + maximum);
  }
}
```

18. Solution

```
static final int TEAMS = 20;
static final int GAMES = 10;

public static void main(String[] args) throws Exception {
  int i, j, m, n, temp;
  boolean swaps;
```

```
String tempStr;

String[] names = new String[TEAMS];
String[][] results = new String[TEAMS][GAMES];
for (i = 0; i <= TEAMS - 1; i++) {
  System.out.print("Enter team name: ");
  names[i] = cin.nextLine();
  for (j = 0; j <= GAMES - 1; j++) {
    System.out.print("Enter result for team " + names[i] + " for game No " + (j + 1) + ": ");
    results[i][j] = cin.nextLine();
    while (!results[i][j].equals("W") && !results[i][j].equals("L") && !results[i][j].equals("T")) {
      System.out.print("Error! Enter only value W, L, or T: ");
      results[i][j] = cin.nextLine();
    }
  }
}

int[] points = new int[TEAMS];
for (i = 0; i <= TEAMS - 1; i++) {
  points[i] = 0;
  for (j = 0; j <= GAMES - 1; j++) {
    if (results[i][j].equals("W")) {
      points[i] += 3;
    }
    else if (results[i][j].equals("T")) {
      points[i] += 1;
    }
  }
}

for (m = 1; m <= 3; m++) {   //Perfom only three passes
  swaps = false;
  for (n = TEAMS - 1; n >= m; n--) {
    if (points[n] > points[n - 1]) {
      temp = points[n];
      points[n] = points[n - 1];
      points[n - 1] = temp;

      tempStr = names[n];
      names[n] = names[n - 1];
      names[n - 1] = tempStr;

      swaps = true;
    }
  }
  if (!swaps) break;
}

System.out.println("Gold: " + names[0]);
System.out.println("Silver: " + names[1]);
System.out.println("Bronze: " + names[2]);
```

```
}
```

19. Solution

```
static final int PEOPLE = 50;

public static void main(String[] args) throws Exception {
  int i, m, n;
  double temp;
  String tempStr;

  String[] names = new String[PEOPLE];
  double[] heights = new double[PEOPLE];
  for (i = 0; i <= PEOPLE - 1; i++) {
    System.out.print("Enter name for person No. " + (i + 1) + ": ");
    names[i] = cin.nextLine();
    System.out.print("Enter height for person No. " + (i + 1) + ": ");
    heights[i] = Double.parseDouble(cin.nextLine());
  }

  for (m = 1; m <= PEOPLE - 1; m++) {
    for (n = PEOPLE - 1; n >= m; n--) {
      if (heights[n] > heights[n - 1]) {
        temp = heights[n];
        heights[n] = heights[n - 1];
        heights[n - 1] = temp;

        tempStr = names[n];
        names[n] = names[n - 1];
        names[n - 1] = tempStr;
      }
      else if (heights[n] == heights[n - 1]) {
        if (names[n].compareTo(names[n - 1]) < 0) {
          tempStr = names[n];
          names[n] = names[n - 1];
          names[n - 1] = tempStr;
        }
      }
    }
  }

  for (i = 0; i <= PEOPLE - 1; i++) {
    System.out.println(heights[i] + "\t" + names[i]);
  }
}
```

20. Solution

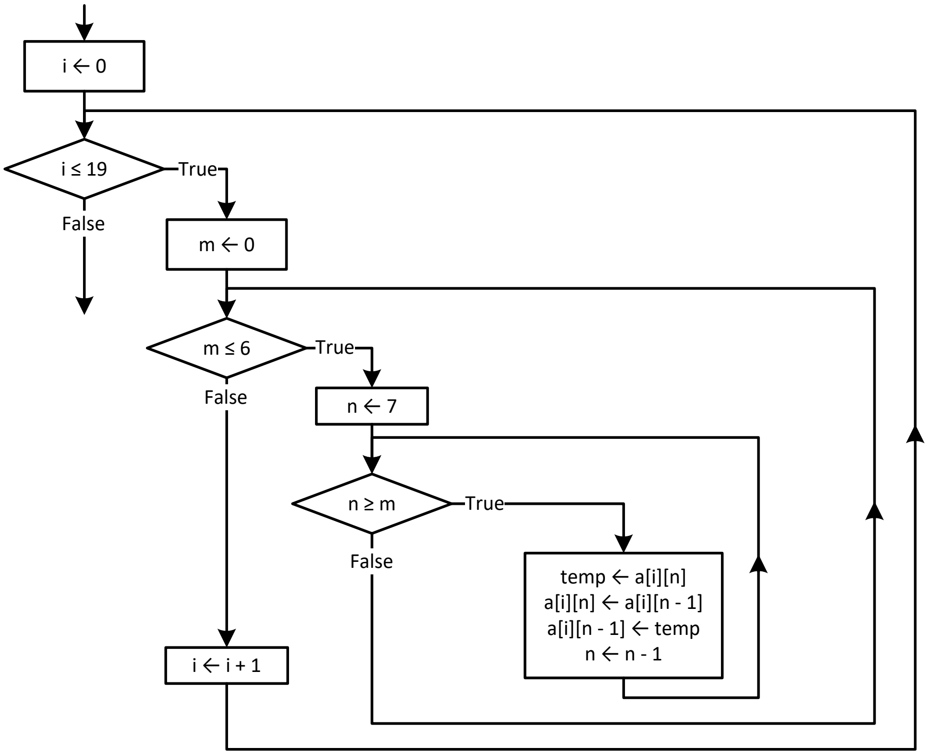
```
static final int PEOPLE = 50;

public static void main(String[] args) throws Exception {
  String tempStr;
```

```
int i, m, n;

String[] firstNames = new String[PEOPLE];
String[] lastNames = new String[PEOPLE];
String[] fatherNames = new String[PEOPLE];

for (i = 0; i <= PEOPLE - 1; i++) {
  System.out.print("Enter first name for person No." + (i + 1) + ": ");
  firstNames[i] = cin.nextLine();
  System.out.print("Enter last name for person No." + (i + 1) + ": ");
  lastNames[i] = cin.nextLine();
  System.out.print("Enter father's name for person No." + (i + 1) + ": ");
  fatherNames[i] = cin.nextLine();
}

for (m = 1; m <= PEOPLE - 1; m++) {
  for (n = PEOPLE - 1; n >= m; n--) {
    if (lastNames[n].compareTo(lastNames[n - 1]) < 0) {
      tempStr = lastNames[n];
      lastNames[n] = lastNames[n - 1];
      lastNames[n - 1] = tempStr;

      tempStr = firstNames[n];
      firstNames[n] = firstNames[n - 1];
      firstNames[n - 1] = tempStr;

      tempStr = fatherNames[n];
      fatherNames[n] = fatherNames[n - 1];
      fatherNames[n - 1] = tempStr;
    }
    else if (lastNames[n].equals(lastNames[n - 1])) {
      if (firstNames[n].compareTo(firstNames[n - 1]) < 0) {
        tempStr = firstNames[n];
        firstNames[n] = firstNames[n - 1];
        firstNames[n - 1] = tempStr;

        tempStr = fatherNames[n];
        fatherNames[n] = fatherNames[n - 1];
        fatherNames[n - 1] = tempStr;
      }
      else if (firstNames[n].equals(firstNames[n - 1])) {
        if (fatherNames[n].compareTo(fatherNames[n - 1]) < 0) {
          tempStr = fatherNames[n];
          fatherNames[n] = fatherNames[n - 1];
          fatherNames[n - 1] = tempStr;
        }
      }
    }
  }
}

for (i = 0; i <= PEOPLE - 1; i++) {
  System.out.println(lastNames[i] + "\t" + firstNames[i] + "\t" + fatherNames[i]);
  }
}
```

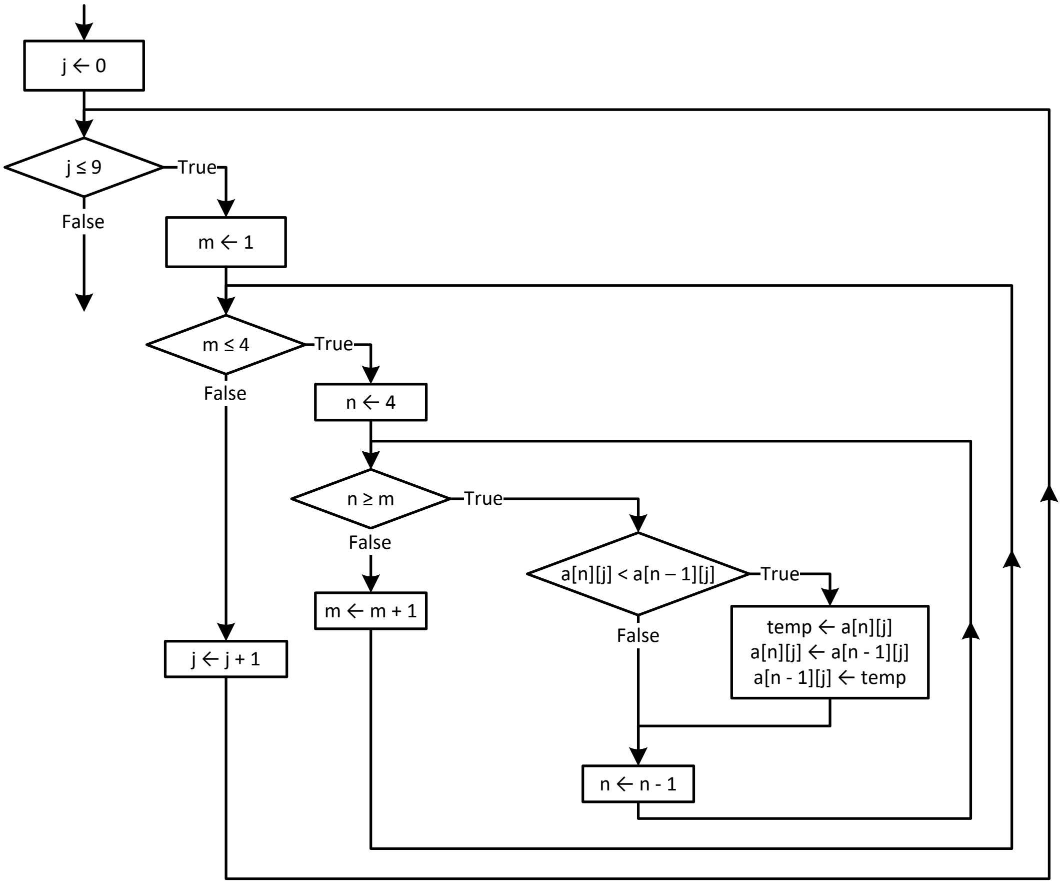
21. Solution

```
static final int ARTISTS = 12;
static final int JUDGES = 10;

public static void main(String[] args) throws Exception {
  int i, j, m, maximum, minimum, n, temp;
  String tempStr;

  String[] artistNames = new String[ARTISTS];
  int[][] score = new int[ARTISTS][JUDGES];
  for (i = 0; i <= ARTISTS - 1; i++) {
    System.out.print("Enter name for artist No " + (i + 1) + ": ");
    artistNames[i] = cin.nextLine();
    for (j = 0; j <= JUDGES - 1; j++) {
      System.out.print("Enter score for artist: " + artistNames[i]);
      System.out.print(" gotten from judge No " + (j + 1) + ": ");
      score[i][j] = Integer.parseInt(cin.nextLine());
    }
  }

  int[] total = new int[ARTISTS];
  for (i = 0; i <= ARTISTS - 1; i++) {
    total[i] = 0;
    for (j = 1; j <= JUDGES - 1; j++) {
      total[i] += score[i][j];
    }
  }

  for (i = 0; i <= ARTISTS - 1; i++) {
    minimum = score[i][0];
    maximum = score[i][0];
    for (j = 1; j <= JUDGES - 1; j++) {
      if (score[i][j] < minimum) {
        minimum = score[i][j];
      }
      if (score[i][j] > maximum) {
        maximum = score[i][j];
      }
    }
    total[i] = total[i] - minimum - maximum;
    System.out.println(total[i]);
  }

  for (m = 1; m <= ARTISTS - 1; m++) {
    for (n = ARTISTS - 1; n >= m; n--) {
      if (total[n] > total[n - 1]) {
        temp = total[n];
        total[n] = total[n - 1];
        total[n - 1] = temp;

        tempStr = artistNames[n];
        artistNames[n] = artistNames[n - 1];
        artistNames[n - 1] = tempStr;
      }
      else if (total[n] == total[n - 1]) {
        if (artistNames[n].compareTo(artistNames[n - 1]) < 0) {
          tempStr = artistNames[n];
          artistNames[n] = artistNames[n - 1];
          artistNames[n - 1] = tempStr;
        }
      }
    }
  }

  for (i = 0; i <= ARTISTS - 1; i++) {
    System.out.println(artistNames[i] + ", " + total[i]);
  }
}
```

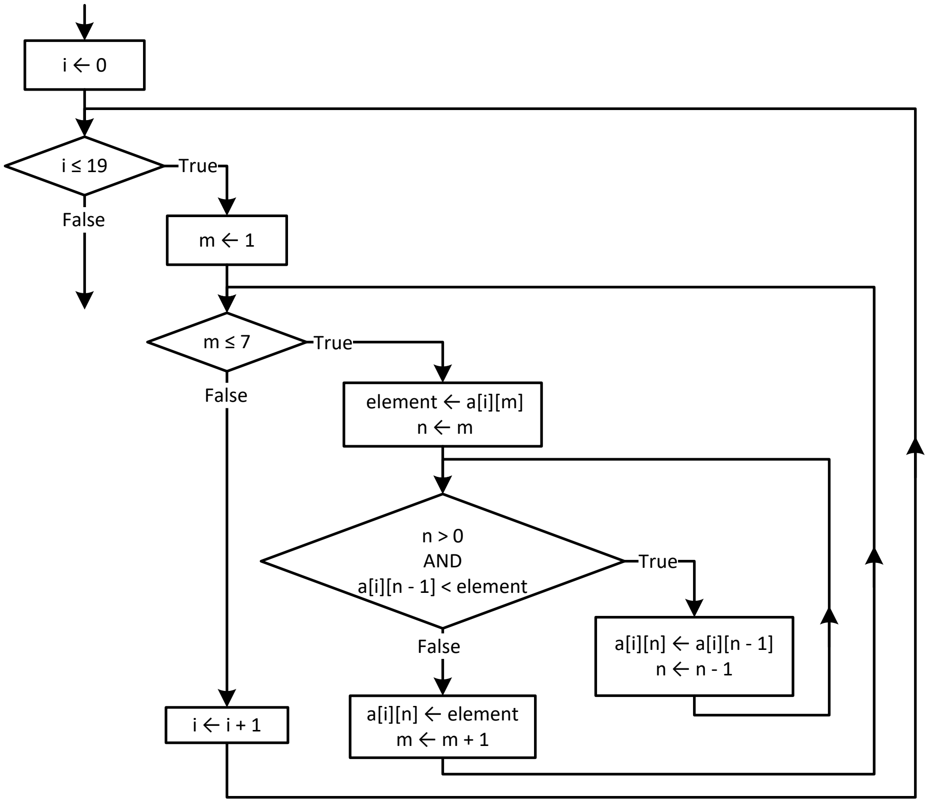
22. Solution



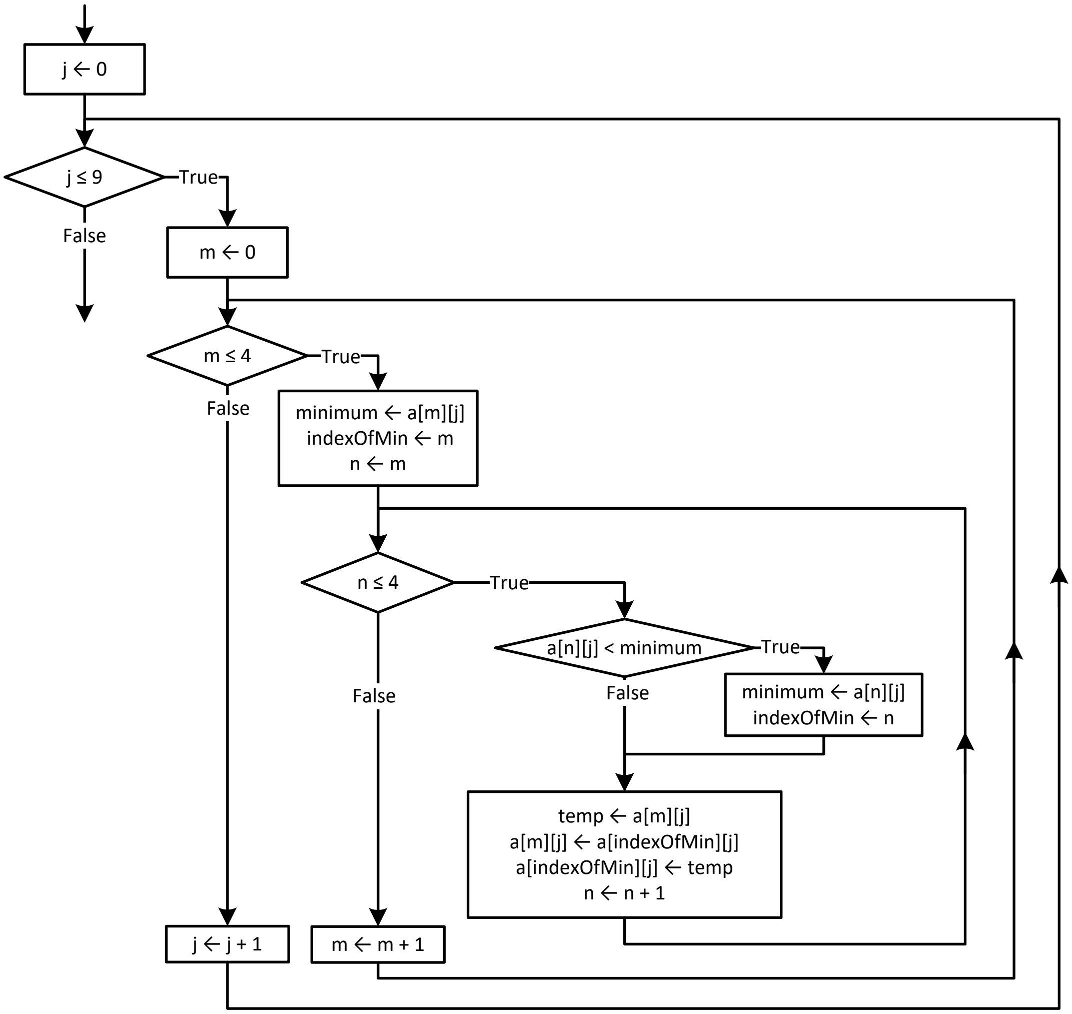
23. Solution


j ← 0
j ≤ 9
True
False
m ← 1
m ≤ 4
True
False
n ← 4
n ≥ m
True
False
a[n][j] < a[n – 1][j]
True
False
temp ← a[n][j]
a[n][j] ← a[n - 1][j]
a[n - 1][j] ← temp
m ← m + 1
j ← j + 1
n ← n - 1

24. Solution


i ← 0
i ≤ 19
True
False
m ← 1
m ≤ 7
True
False
element ← a[i][m]
n ← m
n > 0
AND
a[i][n - 1] < element
True
False
a[i][n] ← a[i][n - 1]
n ← n - 1
a[i][n] ← element
m ← m + 1
i ← i + 1

25. Solution



26. Solution

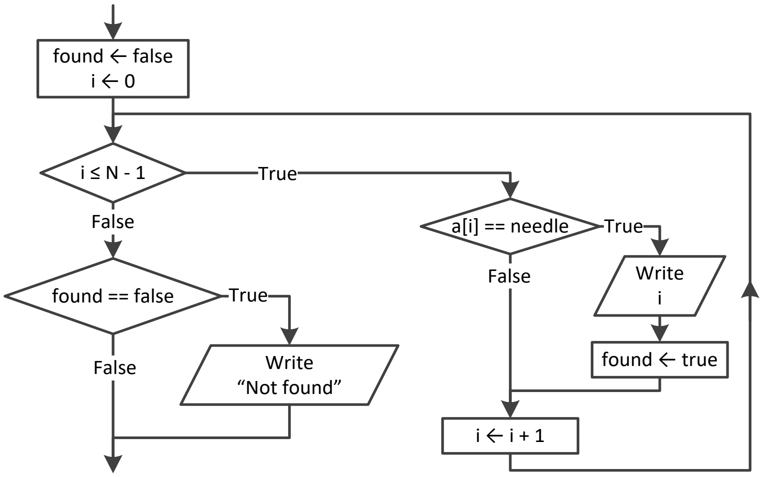
```
static final int PEOPLE = 10;
static final int PUZZLES = 8;

public static void main(String[] args) throws Exception {
  int i, indexOfMin, j, m, n, hours, minutes, seconds, iTemp;
  double minimum, dTemp;
  String tempStr;

  String[] names = new String[PEOPLE];
  int[][] times = new int[PEOPLE][PUZZLES];
  for (i = 0; i <= PEOPLE - 1; i++) {
    names[i] = cin.nextLine();
    for (j = 0; j <= PUZZLES - 1; j++) {
      hours = Integer.parseInt(cin.nextLine());
      minutes = Integer.parseInt(cin.nextLine());
      seconds = Integer.parseInt(cin.nextLine());
      times[i][j] = hours * 3600 + minutes * 60 + seconds;
    }
  }

  for (i = 0; i <= PEOPLE - 1; i++) {
    for (m = 0; m <= PUZZLES - 1; m++) {
      minimum = times[i][m];
      indexOfMin = m;
      for (n = m; n <= PUZZLES - 1; n++) {
        if (times[i][n] < minimum) {
          minimum = times[i][n];
          indexOfMin = n;
        }
      }
      iTemp = times[i][m];
      times[i][m] = times[i][indexOfMin];
      times[i][indexOfMin] = iTemp;
    }
  }

  for (i = 0; i <= PEOPLE - 1; i++) {
    System.out.println(names[i]);
    for (j = 0; j <= 2; j++) {
      System.out.println(times[i][j]);
    }
  }

  double[] average = new double[PEOPLE];
  for (i = 0; i <= PEOPLE - 1; i++) {
    average[i] = 0;
    for (j = 0; j <= PUZZLES - 1; j++) {
      average[i] += times[i][j];
    }
    average[i] /= PUZZLES;
  }

  for (m = 0; m <= 2; m++) {  //Perform only 3 iterations
    minimum = average[m];
    indexOfMin = m;
    for (n = m; n <= PEOPLE - 1; n++) {
      if (average[n] < minimum) {
        minimum = average[n];
        indexOfMin = n;
      }
    }
    dTemp = average[m];
    average[m] = average[indexOfMin];
    average[indexOfMin] = dTemp;

    tempStr = names[m];
    names[m] = names[indexOfMin];
```

```
    names[indexOfMin] = tempStr;
  }

  System.out.println(names[0] + ", " + names[1] + ", " + names[2]);
}
```

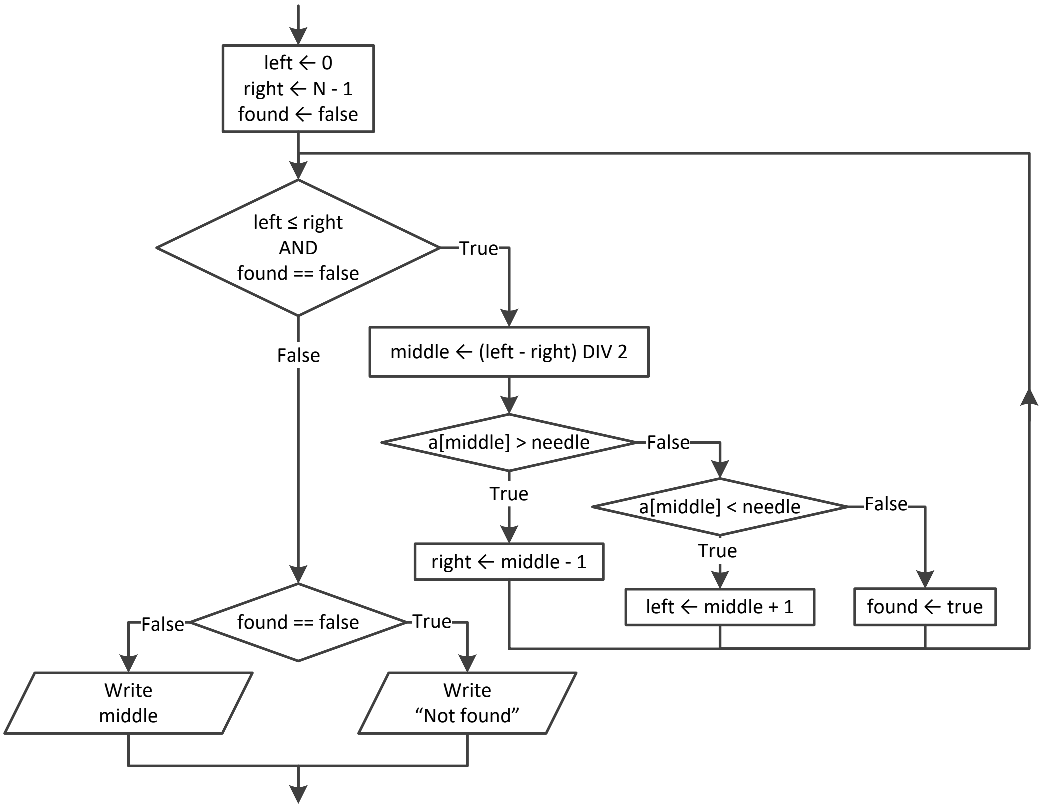
27. Solution

```
static final int AREAS = 5;
static final int HOURS = 48;

public static void main(String[] args) throws Exception {
  int i, j, m, m_i, m_j, n;
  double maximum, element1;
  String element2;

  String[] names = new String[AREAS];
  double[][] CO2 = new double[AREAS][HOURS];
  for (i = 0; i <= AREAS - 1; i++) {
    names[i] = cin.nextLine();
    for (j = 0; j <= HOURS - 1; j++) {
      CO2[i][j] = Double.parseDouble(cin.nextLine());
    }
  }

  double[] averagePerHour = new double[AREAS];
  for (i = 0; i <= AREAS - 1; i++) {
    averagePerHour[i] = 0;
    for (j = 0; j <= HOURS - 1; j++) {
      averagePerHour[i] += CO2[i][j];
    }
    averagePerHour[i] /= HOURS;
  }

  for (i = 0; i <= AREAS - 1; i++) {
    System.out.println(names[i] + ", " + averagePerHour[i]);
  }

  double[] averagePerCity = new double[HOURS];
  for (j = 0; j <= HOURS - 1; j++) {
    averagePerCity[j] = 0;
    for (i = 0; i <= AREAS - 1; i++) {
      averagePerCity[j] += CO2[i][j];
    }
    averagePerCity[j] /= AREAS;
  }

  for (j = 0; j <= HOURS - 1; j++) {
    System.out.println(averagePerCity[j]);
  }
  maximum = averagePerCity[0];
  m_j = 0;
  for (j = 1; j <= HOURS - 1; j++) {
    if (averagePerCity[j] > maximum) {
      maximum = averagePerCity[j];
      m_j = j;
    }
  }
  System.out.println(m_j);

  maximum = CO2[0][0];
  m_i = 0;
  m_j = 0;
  for (i = 0; i <= AREAS - 1; i++) {
    for (j = 0; j <= HOURS - 1; j++) {
      if (CO2[i][j] > maximum) {
        maximum = CO2[i][j];
        m_i = i;
        m_j = j;
      }
    }
  }
  System.out.println(m_j + ", " + names[m_i]);

  for (m = 1; m <= AREAS - 1; m++) {
    element1 = averagePerHour[m];
    element2 = names[m];

    n = m;
    while (n > 0 && averagePerHour[n - 1] < element1) {
      averagePerHour[n] = averagePerHour[n - 1];
      names[n] = names[n - 1];
      n--;
    }

    averagePerHour[n] = element1;
    names[n] = element2;
  }

  System.out.println(names[0] + ", " + names[1]  + ", " +  names[2]);
}
```

28. Solution



29. Solution



30. Solution

```
static final int TEAMS = 20;
static final int WEEKS = 12;

public static void main(String[] args) throws Exception {
  int i, j;
  String needle;
  boolean found;

  String[] names = new String[TEAMS];
  String[][] results = new String[TEAMS][WEEKS];
  for (i = 0; i <= TEAMS - 1; i++) {
    System.out.print("Enter name for team No. " + (i + 1) + ": ");
    names[i] = cin.nextLine();
    for (j = 0; j <= WEEKS - 1; j++) {
      System.out.print("Enter result for");
      System.out.print(" week No. " + (j + 1) + " for " + names[i] + ": ");
      results[i][j] = cin.nextLine();
    }
  }

  //Get value to search and convert it to uppercase
  System.out.print("Enter a result to search: ");
  needle = cin.nextLine().toUpperCase();

  for (i = 0; i <= TEAMS - 1; i++) {
    found = false;
    System.out.println("Found results for " + names[i]);
    for (j = 0; j <= WEEKS - 1; j++) {
      if (results[i][j].toUpperCase().equals(needle)) {
        System.out.println("Week " + (j + 1));
        found = true;
      }
    }

    if (!found) {
      System.out.println("No results!");
    }
  }
}
```

31. Solution

```
static final int TEAMS = 10;
static final int GAMES = 16;

public static void main(String[] args) throws Exception {
  int i, j, total;
  String needle;

  String[] names = new String[TEAMS];
  int[][] goalsScored = new int[TEAMS][GAMES];
  int[][] goalsLetIn = new int[TEAMS][GAMES];
  for (i = 0; i <= TEAMS - 1; i++) {
    System.out.print("Enter team name: ");
    names[i] = cin.nextLine();
    for (j = 0; j <= GAMES - 1; j++) {
      System.out.print("Enter goals scored: ");
      goalsScored[i][j] = Integer.parseInt(cin.nextLine());
      while (goalsScored[i][j] < 0) {
        System.out.print("Error! Enter goals scored: ");
        goalsScored[i][j] = Integer.parseInt(cin.nextLine());
      }

      System.out.print("Enter goals let in: ");
      goalsLetIn[i][j] = Integer.parseInt(cin.nextLine());
      while (goalsLetIn[i][j] < 0) {
        System.out.print("Error! Enter goals let in: ");
        goalsLetIn[i][j] = Integer.parseInt(cin.nextLine());
      }
    }
  }

  System.out.print("Enter a team to search: ");
  needle = cin.nextLine();

  i = 0;
  while (i < TEAMS - 1 && !names[i].equals(needle)) {
    i++;
  }

  if (!names[i].equals(needle)) {
    System.out.println("This team does not exist");
  }
  else {
    total = 0;
    for (j = 0; j <= GAMES - 1; j++) {
      if (goalsScored[i][j] > goalsLetIn[i][j]) {
        total += 3;
      }
      else if (goalsScored[i][j] == goalsLetIn[i][j]) {
        total += 1;
      }
    }
    System.out.println(total);
  }
}
```

32. Solution

```
static final int CLASS1 = 20;
static final int CLASS2 = 25;

public static void main(String[] args) throws Exception {
  int i, left, m, middle, n, right;
  String temp, needle;
  boolean found;

```

```
System.out.println("Class 1");
String[] names1 = new String[CLASS1];
for (i = 0; i <= CLASS1 - 1; i++) {
  System.out.print("Enter name: ");
  names1[i] = cin.nextLine();
}
System.out.println("Class 2");
String[] names2 = new String[CLASS2];
for (i = 0; i <= CLASS2 - 1; i++) {
  System.out.print("Enter name: ");
  names2[i] = cin.nextLine();
}

//Bubble sort
for (m = 1; m <= CLASS1 - 1; m++) {
  for (n = CLASS1 - 1; n >= m; n--) {
    if (names1[n].compareTo(names1[n - 1]) < 0) {
      temp = names1[n];
      names1[n] = names1[n - 1];
      names1[n] = temp;
    }
  }
}
for (m = 1; m <= CLASS2 - 1; m++) {
  for (n = CLASS2 - 1; n >= m; n--) {
    if (names2[n].compareTo(names2[n - 1]) < 0) {
      temp = names2[n];
      names2[n] = names2[n - 1];
      names2[n] = temp;
    }
  }
}

System.out.println("\nClass 1");
for (i = 0; i <= CLASS1 - 1; i++) {
  System.out.println(names1[i]);
}
System.out.println("\nClass 2");
for (i = 0; i <= CLASS2 - 1; i++) {
  System.out.println(names2[i]);
}

System.out.print("Enter a name to search: ");
needle = cin.nextLine();

left = 0;
right = CLASS1 - 1;
found = false;
while (left <= right && !found) {
  middle = (int)((left + right) / 2);
```

```
    if (needle.compareTo(names1[middle]) < 0) {
      right = middle - 1;
    }
    else if (needle.compareTo(names1[middle]) > 0) {
      left = middle + 1;
    }
    else {
      found = true;
    }
  }

  if (found) {
    System.out.println("Student found in Class No 1");
  }
  else {
    left = 0;
    right = CLASS2 - 1;
    while (left <= right && !found) {
      middle = (int)((left + right) / 2);

      if (needle.compareTo(names2[middle]) < 0) {
        right = middle - 1;
      }
      else if (needle.compareTo(names2[middle]) > 0) {
        left = middle + 1;
      }
      else {
        found = true;
      }
    }

    if (found) {
      System.out.println("Student found in Class No 2");
    }
    else {
      System.out.println("Student not found in either class");
    }
  }
}
```

33. Solution

```
System.out.print("Enter username: ");
usr = cin.nextLine().toUpperCase();
System.out.print("Enter password: ");
pwd = cin.nextLine().toUpperCase();

i = 0;
while (i < 99 && !usernames[i].toUpperCase().equals(usr)) {
  i++;
}
```

```
if (usernames[i].toUpperCase().equals(usr) && passwords[i].toUpperCase().equals(pwd)) {
  System.out.println("Login OK!");
}
else {
  System.out.println("Login Failed!");
}
```

34. Solution

```
System.out.print("Enter a value to search: ");
valueStr = cin.nextLine();

found = false;

for (i = 0; i <= 999; i++) {
  if (names[i].equals(valueStr)) {
    System.out.println(SSNs[i]);
    found = true;
  }
}


if (!found) {
  value = Integer.parseInt(valueStr);
  i = 0;
  while (i < 999 && !SSNs[i].equals(value)) {
    i++;
  }

  if (SSNs[i].equals(value)) {
    found = true;
    System.out.println(names[i]);
  }
}

if (!found) {
  System.out.println("This value does not exist");
}
```

35. Solution

```
static final int STUDENTS = 12;
static final int LESSONS = 6;

public static void main(String[] args) throws Exception {
  int i, j;
  boolean found, failure;

  int[][] grades = new int[STUDENTS][LESSONS];
  for (i = 0; i <= STUDENTS - 1; i++) {
    for (j = 0; j <= LESSONS - 1; j++) {
      do {
        grades[i][j] = Integer.parseInt(cin.nextLine());
        failure = false;
        if (grades[i][j] < 0) {
          System.out.println("Error! You entered a negative value");
          failure = true;
        }
        else if (grades[i][j] > 100) {
          System.out.println("Error! You entered a value grater than 100");
          failure = true;
        }
      } while (failure);
    }
  }

  double[] average = new double[STUDENTS];
  for (i = 0; i <= STUDENTS - 1; i++) {
    average[i] = 0;
    for (j = 0; j <= LESSONS - 1; j++) {
      average[i] += grades[i][j];
    }
    average[i] /= LESSONS;
  }

  found = false;
  for (i = 0; i <= STUDENTS - 1; i++) {
    if (average[i] < 70) {
      found = true;
      break;
    }
  }

  if (found) {
    System.out.println("There is at least one student that has an average value below 70");
  }
}
```

36. Solution

```
public static void main(String[] args) throws Exception {
  HashMap<String, String> morseAlphabet = new HashMap<>();
  String word, letter;
  int i;

  morseAlphabet.put("A", ".-");
  morseAlphabet.put("B", "-...");
  morseAlphabet.put("C", "-.-.");
  morseAlphabet.put("D", "-..");
  morseAlphabet.put("E", ".");
  morseAlphabet.put("F", "..-.");
  morseAlphabet.put("G", "--.");
  morseAlphabet.put("H", "....");
  morseAlphabet.put("I", "..");
  morseAlphabet.put("J", ".---");
  morseAlphabet.put("K", "-.-");
  morseAlphabet.put("L", ".-..");
  morseAlphabet.put("M", "--");
  morseAlphabet.put("N", "-.");
  morseAlphabet.put("O", "---");
  morseAlphabet.put("P", ".--.");
  morseAlphabet.put("Q", "--.-");
  morseAlphabet.put("R", ".-.");
  morseAlphabet.put("S", "...");
  morseAlphabet.put("T", "-");
  morseAlphabet.put("U", "..-");
  morseAlphabet.put("V", "...-");
  morseAlphabet.put("W", ".--");
  morseAlphabet.put("X", "-..-");
  morseAlphabet.put("Y", "-.--");
  morseAlphabet.put("Z", "--..");
  morseAlphabet.put(" ", "/");

  System.out.print("Enter an English message: ");
  word = cin.nextLine();

  for (i = 0; i <= word.length() - 1; i++) {
    letter = "" + word.charAt(i);
    System.out.print(morseAlphabet.get(letter.toUpperCase()) + " ");
  }
}
```

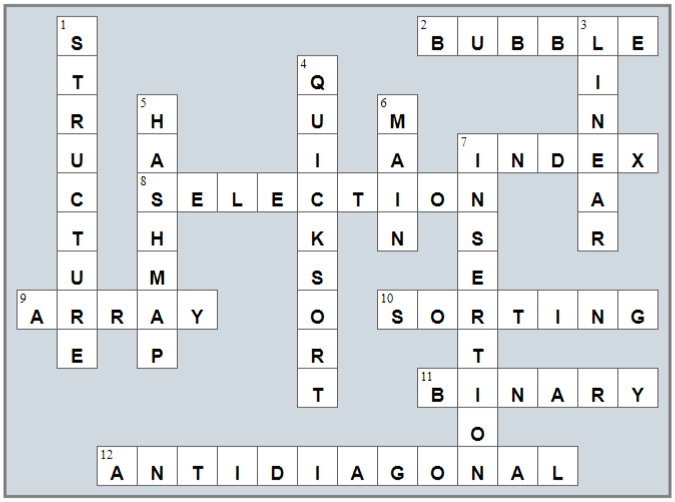
37. Solution

```
public static void main(String[] args) throws Exception {
  int countSpaces, countExistingLetters, countNonExistingLetters;
  int countUserProvidedCharacters, countNonAlphabeticCharacters;
  int i;
  String sentence, letter;
  String alphabet = "ABCDEFGHIJKLMNOPQRSTUVWXYZ";

  //Create a hashmap to store the frequencies of each English letter with initial
  //frequencies all set to zero.
  HashMap<String, Integer> lettersFrequency = new HashMap<>();
  for (i = 0; i < alphabet.length(); i++) {
    letter = "" + alphabet.charAt(i);
    lettersFrequency.put(letter, 0);
  }

  System.out.print("Enter an English sentence: ");
  sentence = cin.nextLine();

  //Iterate through the characters of the user-provided sentence and if it is a letter,
  //update (increase) the corresponding frequency count in the lettersFrequency hashmap.
  //Also count number of space characters and existing letters
  countSpaces = 0;
  countExistingLetters = 0;
  for (i = 0; i < sentence.length(); i++) {
    letter = ("" + sentence.charAt(i)).toUpperCase();
    if (lettersFrequency.containsKey(letter)) {
      lettersFrequency.put(letter, lettersFrequency.get(letter) + 1);
      countExistingLetters++;
    }
    else if (letter.equals(" ")) {
      countSpaces++;
    }
  }

  //Display the frequency of each existing letter
  for (String key : lettersFrequency.keySet()) {
    if (lettersFrequency.get(key) > 0) {
      System.out.println(key + ": " + lettersFrequency.get(key));
    }
  }

  //Count and display all non existing letters
  countNonExistingLetters = 0;
  for (String key : lettersFrequency.keySet()) {
    if (lettersFrequency.get(key) == 0) {
      countNonExistingLetters += 1;
      System.out.println(key);
    }
  }

  //Display percentage of letters that do not exist in relation to the letters of the English alphabet
  System.out.println(countNonExistingLetters * 100.0 / 26 + "%");

  //Display percentage of non-alphabetic characters in relation to the characters of
  //the user-provided sentence (excluding space characters)
  countUserProvidedCharacters = sentence.length() - countSpaces;
  countNonAlphabeticCharacters = countUserProvidedCharacters - countExistingLetters;
  System.out.println(countNonAlphabeticCharacters * 100.0 / countUserProvidedCharacters + "%");
}
```

Review in “Data Structures in Java”

Review Crossword Puzzle

1.



Chapter 35

35.4 Review Questions: True/False

1. true
2. true
3. false
4. false
5. true
6. true
7. true
8. true
9. true
10. true
11. false
12. true

Chapter 36

36.8 Review Questions: True/False

1. true
2. true
3. false
4. true
5. true
6. false
7. true
8. false
9. true
10. false
11. true
12. true
13. true
14. true
15. true
16. false
17. false
18. true
19. false
20. true
21. true
22. true
23. true
24. true
25. false
26. true
27. false
28. true
29. false
30. true
31. true
32. true
33. true
34. false

36.9 Review Exercises

1. Solution

```
static int findMax(int a, int b) {
  int maximum;
  if (a > b) {
    maximum = a;
  }
  else {
    maximum = b;
  }
  return maximum;
}
```

2. Solution

Step	Statement	Main Code		Method `sumDigits()`		
		s	i	a	d1	d2
1	`s = 0`	**0**	?			
2	`i = 25`	0	**25**			
3	`i <= 27`	true				
4	`s += sumDigits(i)`			**25**	?	?
5	`d1 = a % 10`			25	**5**	?

6	d2 = (int)(a / 10)			25	5	**2**
7	return d1 + d2	**7**	25			
8	i++	7	**26**			
9	i <= 27	true				
10	s += sumDigits(i)			**26**	?	?
11	d1 = a % 10			26	**6**	?
12	d2 = (int)(a / 10)			26	6	**2**
13	return d1 + d2	**15**	26			
14	i++	15	**27**			
15	i <= 27	true				
16	s += sumDigits(i)			**27**	?	?
17	d1 = a % 10			27	**7**	?
18	d2 = (int)(a / 10)			27	7	**2**
19	return d1 + d2	**24**	27			
20	i++	24	**28**			
21	i <= 27	false				
22	System.out.println(s)	It displays: 24				

3. Solution

Step	Statement	Main Code		Method sss()		
		s	i	a	total	k
1	i = 1	?	**1**			
2	s = 0	**0**	1			
3	while(i < 6)	true				
4	if (i % 2 == 1)	true				
5	s += 1	**1**	1			
6	i++	1	**2**			
7	while(i < 6)	true				
8	if (i % 2 == 1)	false				
9	s += sss(i)			**2**	?	?
10	total = 0			2	**0**	?
11	k = 1			2	0	**1**
12	k <= a			true		
13	total += k			2	**1**	1
14	k++			2	1	**2**
15	k <= a			true		
16	total += k			2	**3**	2

17	k++			2	3	**3**
18	k <= a			false		
19	return total	**4**	2			
20	i++	4	**3**			
21	while(i < 6)	true				
22	if (i % 2 == 1)	true				
23	s += 1	**5**	3			
24	i++	5	**4**			
25	while(i < 6)	true				
26	if (i % 2 == 1)	false				
27	s += sss(i)			**4**	?	?
28	total = 0			4	**0**	?
29	k = 1			4	0	**1**
30	k <= a			true		
31	total += k			4	**1**	1
32	k++			4	1	**2**
33	k <= a			true		
34	total += k			4	**3**	2
35	k++			4	3	**3**
36	k <= a			true		
37	total += k			4	**6**	4
38	k++			4	6	**4**
39	k <= a			true		
40	total += k			4	**10**	4
41	k++			4	10	**5**
42	k <= a			false		
43	return total	**15**	4			
44	i++	15	**5**			
45	while(i < 6)	true				
46	if (i % 2 == 1)	true				
47	s += 1	**16**	5			
48	i++	16	**6**			
49	while(i < 6)	false				
50	System.out.println(s)	It displays: 16				

4. Solution

Step	Statement	Main Code				Method `customDiv()`	
		k	m	a	x	b	d
1	`k = Integer.parseInt(cin.nextLine())`	**12**	?	?	?		
2	`m = 2`	12	**2**	?	?		
3	`a = 1`	12	2	**1**	?		
4	`while (a < 6)`	true					
5	`if (k % m != 0)`	false					
6	`x = a + m + customDiv(m, a)`					2	1
7	`return (int)((b + d) / 2)`	12	2	1	**4**		
8	`System.out.println(m + " " + a + " " + x)`	It displays: 2 1 4					
9	`a += 2`	12	2	**3**	4		
10	`m++`	12	**3**	3	4		
11	`while (a < 6)`	true					
12	`if (k % m != 0)`	false					
13	`x = a + m + customDiv(m, a)`					3	3
14	`return (int)((b + d) / 2)`	12	3	3	**9**		
15	`System.out.println(m + " " + a + " " + x)`	It displays: 3 3 9					
16	`a += 2`	12	3	**5**	9		
17	`m++`	12	**4**	5	9		
18	`while (a < 6)`	true					
19	`if (k % m != 0)`	false					
20	`x = a + m + customDiv(m, a)`					4	5
21	`return (int)((b + d) / 2)`	12	4	5	**13**		
22	`System.out.println(m + " " + a + " " + x)`	It displays: 4 5 13					
23	`a += 2`	12	4	**7**	13		
24	`m++`	12	**5**	7	13		
25	`while (a < 6)`	false					

5. Solution

Step	Statement	Main Code		void Method `display()`
		i	x	a
1	`i = 1`	**1**	?	
2	`i <= 5`	true		
3	`x = Integer.parseInt(cin.nextLine())`	1	**3**	

4	`display(x)`			**3**
5	`if (a % 2 == 0)`			false
6	`System.out.println(a + " is odd")`	It displays: 3 is odd		
7	`i++`	**2**	3	
8	`i <= 5`	true		
9	`x = Integer.parseInt(cin.nextLine())`	2	**7**	
10	`display(x)`			**7**
11	`if (a % 2 == 0)`			false
12	`System.out.println(a + " is odd")`	It displays: 7 is odd		
13	`i++`	**3**	7	
14	`i <= 5`	true		
15	`x = Integer.parseInt(cin.nextLine())`	3	**9**	
16	`display(x)`			**9**
17	`if (a % 2 == 0)`			false
18	`System.out.println(a + " is odd")`	It displays: 9 is odd		
19	`i++`	**4**	9	
20	`i <= 5`	true		
21	`x = Integer.parseInt(cin.nextLine())`	4	**2**	
22	`display(x)`			**2**
23	`if (a % 2 == 0)`			true
24	`System.out.println(a + " is even")`	It displays: 2 is even		
25	`i++`	**5**	2	
26	`i <= 5`	true		
27	`x = Integer.parseInt(cin.nextLine())`	5	**4**	
28	`display(x)`			**4**
29	`if (a % 2 == 0)`			true
30	`System.out.println(a + " is even")`	It displays: 4 is even		
31	`i++`	**6**	4	
32	`i <= 5`	false		

6. Solution

Step	Statement	Main Code		void Method `division()`	
		x	y	a	b
1	`x = 20`	**20**	?		
2	`y = 30`	20	**30**		
3	`while (x % y < 30)`	true			

4	`division(y, x)`			**30**	**20**
5	`b = (int)(b / a)`			30	**0**
6	`System.out.println(a * b)`	It displays: 0			
7	`x = 4 * y`	**120**	30		
8	`y++`	120	**31**		
9	`while (x % y < 30)`	true			
10	`division(y, x)`			**31**	**120**
11	`b = (int)(b / a)`			31	**3**
12	`System.out.println(a * b)`	It displays: 93			
13	`x = 4 * y`	**124**	31		
14	`y++`	124	**32**		
15	`while (x % y < 30)`	true			
16	`division(y, x)`			**32**	**124**
17	`b = (int)(b / a)`			32	**3**
18	`System.out.println(a * b)`	It displays: 96			
19	`x = 4 * y`	**128**	32		
20	`y++`	128	**33**		
21	`while (x % y < 30)`	true			
22	`division(y, x)`			**33**	**128**
23	`b = (int)(b / a)`			33	**3**
24	`System.out.println(a * b)`	It displays: 99			
25	`x = 4 * y`	**132**	33		
26	`y++`	132	**34**		
27	`while (x % y < 30)`	false			

7. *Solution*

Step	**Statement**	**Main Code**		**void Method `calculate()`**		
		i	**m**	**n**	**s**	**j**
1	`i = 1`	**1**	?			
2	`i <= 3`	true				
3	`m = Integer.parseInt(cin.nextLine())`	1	**2**			
4	`calculate(m)`			**2**	?	?
5	`s = 0`			2	**0**	?
6	`j = 2`			2	0	**2**
7	`j <= 2 * n`			true		
8	`s = s + Math.pow(j, 2)`			2	**4**	2

9	`j += 2`			2	4	**4**
10	`j <= 2 * n`			true		
11	`s = s + Math.pow(j, 2)`			2	**20**	4
12	`j += 2`			2	20	**6**
13	`j <= 2 * n`			false		
14	`System.out.println(s)`	It displays: 20				
15	`i++`	**2**	2			
16	`i <= 3`	true				
17	`m = Integer.parseInt(cin.nextLine())`	2	**3**			
18	`calculate(m)`			**3**	?	?
19	`s = 0`			3	**0**	?
20	`j = 2`			3	0	**2**
21	`j <= 2 * n`			true		
22	`s = s + Math.pow(j, 2)`			3	**4**	2
23	`j += 2`			3	4	**4**
24	`j <= 2 * n`			true		
25	`s = s + Math.pow(j, 2)`			3	**20**	4
26	`j += 2`			3	20	**6**
27	`j <= 2 * n`			true		
28	`s = s + Math.pow(j, 2)`			3	**56**	6
29	`j += 2`			3	56	**8**
30	`j <= 2 * n`			false		
31	`System.out.println(s)`	It displays: 56				
32	`i++`	**3**	3			
33	`i <= 3`	true				
34	`m = Integer.parseInt(cin.nextLine())`	3	**4**			
35	`calculate(m)`			**4**	?	?
36	`s = 0`			4	**0**	?
37	`j = 2`			4	0	**2**
38	`j <= 2 * n`			true		
39	`s = s + Math.pow(j, 2)`			4	**4**	2
40	`j += 2`			4	4	**4**
41	`j <= 2 * n`			true		
42	`s = s + Math.pow(j, 2)`			4	**20**	4
43	`j += 2`			4	20	**6**
44	`j <= 2 * n`			true		
45	`s = s + Math.pow(j, 2)`			4	**56**	6

46	`j += 2`			4	56	**8**
47	`j <= 2 * n`			true		
48	`s = s + Math.pow(j, 2)`			4	**120**	8
49	`j += 2`			4	120	**10**
50	`j <= 2 * n`			false		
51	`System.out.println(s)`	It displays: 120				
52	`i++`	**4**	4			
53	`i <= 3`	false				

8. Solution

```
static int findSum(int a, int b, int c) {
  return a + b + c;
}
```

9. Solution

```
static double findAvg(double a, double b, double c, double d) {
  return (a + b + c + d) / 4;
}
```

10. Solution

```
static double maximum(double a, double b, double c) {
  double m;

  m = a;
  if (b > m) {
    m = b;
  }
  if (c > m) {
    m = c;
  }
  return m;
}
```

11. Solution

```
static void displayMax(double a, double b, double c, double d, double e) {
  double m;

  m = a;
  if (b > m) {
    m = b;
  }
  if (c > m) {
    m = c;
  }
  if (d > m) {
    m = d;
  }
  if (e > m) {
    m = e;
  }
  System.out.println(m);
}
```

12. Solution

```
static double myRound(double x) {
  int digitToCheck;
  double returnValue;

  digitToCheck = (int)(x * 1000) % 10;
  if (digitToCheck >= 5) {
    returnValue = ((int)(x * 100) + 1) / 100.0;
  }
  else {
    returnValue = ((int)(x * 100)) / 100.0;
  }

  return returnValue;
}
```

13. Solution

```
static double findMin(double a, double b) {
  double minimum;

  minimum = a;
  if (b < minimum) {
    minimum = b;
  }
  return minimum;
}

public static void main(String[] args) throws Exception {
  double temp1, temp2, x1, x2, x3, x4;

  System.out.println("Enter four numbers: ");
  x1 = Double.parseDouble(cin.nextLine());
  x2 = Double.parseDouble(cin.nextLine());
  x3 = Double.parseDouble(cin.nextLine());
  x4 = Double.parseDouble(cin.nextLine());

  //First approach
  temp1 = findMin(x1, x2);
  temp2 = findMin(x3, x4);
  System.out.println(findMin(temp1, temp2));
  //Second approach
  System.out.println(findMin(findMin(x1, x2), findMin(x3, x4)));
}
```

14. Solution

```
static double KelvinToFahrenheit(double kelvin) {
  return 1.8 * kelvin - 459.67;
}

static double KelvinToCelsius(double kelvin) {
  return kelvin - 273.15;
}

public static void main(String[] args) throws Exception {
  double k;

  System.out.print("Enter a temperature in degrees Kelvin: ");
  k = Double.parseDouble(cin.nextLine());
  System.out.println("Fahrenheit: " + KelvinToFahrenheit(k));
  System.out.println("Celsius: " + KelvinToCelsius(k));
}
```

15. Solution

```
static String bmi(double w, double h) {
  double b;
  String returnValue;

  b = w * 703 / Math.pow(h ,2);
  if (b < 16) {
    returnValue = "You must add weight.";
  }
  else if (b < 18.5) {
    returnValue = "You should add some weight.";
  }
  else if (b < 25) {
    returnValue = "Maintain your weight.";
  }
  else if (b < 30) {
    returnValue = "You should lose some weight.";
  }
  else {
    returnValue = "You must lose weight.";
  }

  return returnValue;
}

public static void main(String[] args) throws Exception {
  double height, weight;
  int age;

  System.out.print("Enter your weight (in pounds): ");
  weight = Double.parseDouble(cin.nextLine());
  while (weight < 0) {
    System.out.print("Error! Enter your weight (in pounds): ");
    weight = Double.parseDouble(cin.nextLine());
  }

  System.out.print("Enter your age: ");
  age = Integer.parseInt(cin.nextLine());
  while (age < 18) {
    System.out.print("Error! Enter your age: ");
    age = Integer.parseInt(cin.nextLine());
  }

  System.out.print("Enter your height (in inches): ");
  height = Double.parseDouble(cin.nextLine());
  while (height < 0) {
    System.out.print("Error! Enter your height (in inches): ");
    height = Double.parseDouble(cin.nextLine());
  }

  System.out.println(bmi(weight, height));
}
```

16. Solution

```
static void numOfDays(int year, int month) {
  int days;

  switch (month) {
    case 4:
    case 6:
    case 9:
    case 11:
      days = 30;
      break;
    case 2:
      if (year % 4 == 0 && year % 100 != 0 || year % 400 == 0) {
        days = 29;
      }
      else {
        days = 28;
      }
      break;
    default:
      days = 31;
  }

  System.out.println(days);
}

public static void main(String[] args) throws Exception {
  int y, m;

  System.out.print("Enter a year: ");
  y = Integer.parseInt(cin.nextLine());
  for (m = 1; m <= 12; m++) {
    numOfDays(y, m);
  }
}
```

17. Solution

```
static int numOfDays(int year, int month) {
  int days;

  switch (month) {
    case 4:
    case 6:
    case 9:
    case 11:
      days = 30;
      break;
    case 2:
      if (year % 4 == 0 && year % 100 != 0 || year % 400 == 0) {
        days = 29;
      }
      else {
        days = 28;
      }
      break;
    default:
      days = 31;
  }

  return days;
}

public static void main(String[] args) throws Exception {
  int y, m1, m2, m, total;

  System.out.print("Enter a year: ");
  y = Integer.parseInt(cin.nextLine());
  System.out.print("Enter a month: ");
  m1 = Integer.parseInt(cin.nextLine());
  System.out.print("Enter a second month: ");
  m2 = Integer.parseInt(cin.nextLine());

  total = 0;
  for (m = m1; m <= m2; m++) {
    total += numOfDays(y, m);
  }
  System.out.println(total);
}
```

18. Solution

```
static void displayMenu() {
  System.out.println();
  System.out.println("1. Convert meters to miles");
  System.out.println("2. Convert miles to meters");
  System.out.println("3. Exit");
  System.out.print("Enter a choice: ");
}

static void metersToMiles(double meters) {
  System.out.println(meters + " meters equals " + (meters / 1609.344) + " miles");
}

static void milesToMeters(double miles) {
  System.out.println(miles + " miles equals " + (miles * 1609.344) + " meters");
}

public static void main(String[] args) throws Exception {
  int choice;
  double distance;

  displayMenu();
  choice = Integer.parseInt(cin.nextLine());
  while (choice != 3) {
    System.out.print("Enter distance: ");
    distance = Integer.parseInt(cin.nextLine());
    if (choice == 1) {
      metersToMiles(distance);
    }
    else {
      milesToMeters(distance);
    }

    displayMenu();
    choice = Integer.parseInt(cin.nextLine());
  }
}
```

19. Solution

```
static void amountToPay(int seconds) {
  double extra, tax, total, totalWithoutTax;

  if (seconds <= 600) {
    extra = 0;
  }
  else if (seconds <= 1200) {
    extra = (seconds - 600) * 0.01;
  }
  else {
    extra = 600 * 0.01 + (seconds - 1200) * 0.02;
  }

  totalWithoutTax = 10 + extra;
  tax = totalWithoutTax * 11 / 100;
  total = totalWithoutTax + tax;

  System.out.println("Total amount to pay: " + total);
}

public static void main(String[] args) throws Exception {
  int seconds;

  System.out.print("Enter number of seconds: ");
  seconds = Integer.parseInt(cin.nextLine());
  amountToPay(seconds);
}
```

Chapter 37

37.9 Review Questions: True/False

1. true
2. true
3. true
4. false
5. true
6. false
7. true
8. false
9. true
10. false
11. true
12. true
13. true
14. false
15. true
16. true
17. false
18. false
19. false
20. true
21. true
22. false
23. true
24. true
25. true

37.10 Review Exercises

1. Solution

It displays: 5

2. Solution

It displays: 14

3. Solution

It displays: 14

4. Solution

It displays: hellohellohello

5. Solution

It displays: 15

6. Solution

It displays: 11   4

7. Solution

It displays: 3

8. Solution

Within the method `getNumOfDigits()`, the corresponding element eventually becomes 0, and since the array `val` is passed to the method by reference, that zero also reflects back to the main code.

To resolve this issue, all you have to do is assign the value of the corresponding element to an auxiliary variable and let this variable become zero.

```
static final int ELEMENTS = 5;

static int getNumOfDigits(int[] x, int index) {
  int count = 0, auxVar;

  auxVar = x[index];

  while (auxVar != 0) {
    count++;
    auxVar = (int)(auxVar / 10);
  }
  return count;
}

public static void main(String[] args) throws Exception {
  int[] val = new int[ELEMENTS];
  int i;

  for (i = 0; i <= ELEMENTS - 1; i++) {
    val[i] = Integer.parseInt(cin.nextLine());
  }
  for (i = 0; i <= ELEMENTS - 1; i++) {
    System.out.print(getNumOfDigits(val, i) + " digits in number " + val[i]);
  }
}
```

9. Solution

```
static final int STUDENTS = 10;
static final int LESSONS = 5;

static void part1(String[] names, int[][] grades) {
  int i, j;

  for (i = 0; i <= STUDENTS - 1; i++) {
    System.out.print("Enter name for student No. " + (i + 1) + ": ");
    names[i] = cin.nextLine();
    for (j = 0; j <= LESSONS - 1; j++) {
      System.out.print("Enter grade for lesson No. " + (j + 1) + ": ");
      grades[i][j] = Integer.parseInt(cin.nextLine());
    }
  }
}

static double[] part2(int[][] grades) {
  double[] average = new double[STUDENTS];
  int i, j;

  for (i = 0; i <= STUDENTS - 1; i++) {
    average[i] = 0;
    for (j = 0; j <= LESSONS - 1; j++) {
      average[i] += grades[i][j];
    }
    average[i] /= LESSONS;
  }
  return average;
}

static void part3(double[] average, String[] names) {
  int m, n;
  double temp;
  String tempStr;

  for (m = 1; m <= STUDENTS - 1; m++) {
    for (n = STUDENTS - 1; n >= m; n--) {
      if (average[n] > average[n - 1]) {
        temp = average[n];
        average[n] = average[n - 1];
        average[n - 1] = temp;

        tempStr = names[n];
        names[n] = names[n - 1];
        names[n - 1] = tempStr;
      }
      else if (average[n] == average[n - 1]) {
        if (names[n].compareTo(names[n - 1]) < 0) {
          tempStr = names[n];
          names[n] = names[n - 1];
          names[n - 1] = tempStr;
        }
      }
    }
  }
}

public static void main(String[] args) throws Exception {
  int i;

  String[] names = new String[STUDENTS];
  int[][] grades = new int[STUDENTS][LESSONS];
  double[] average = new double[STUDENTS];

  part1(names, grades);

  average = part2(grades);

  part3(average, names);

  for (i = 0; i <= STUDENTS - 1; i++) {
    System.out.println(names[i] + "\t" + average[i]);
  }
```

```
}
```

10. Solution

```
static String part1() {
  String message;

  System.out.print("Enter a message: ");
  message = cin.nextLine().toLowerCase();
  return message;
}

static String part2(String message) {
  String letter, messageClean;
  int i;

  messageClean = "";
  for (i = 0; i <= message.length() - 1; i++) {
    letter = "" + message.charAt(i);
    if (!letter.equals(" ") && !letter.equals(",") &&
        !letter.equals(".") && !letter.equals("?")) {

      messageClean += letter;
    }
  }
  return messageClean;
}

static boolean part3(String messageClean) {
  int middlePos, i, j;
  boolean palindrome;
  String leftLetter, rightLetter;

  middlePos = (int)((messageClean.length() - 1) / 2);
  j = messageClean.length() - 1;
  palindrome = true;
  for (i = 0; i <= middlePos; i++) {
    leftLetter = "" + messageClean.charAt(i);
    rightLetter = "" + messageClean.charAt(j);
    if (!leftLetter.equals(rightLetter)) {
      palindrome = false;
      break;
    }
    j--;
  }
  return palindrome;
}

static boolean part4(String message) {
  String messageClean;
  boolean palindrome;
  messageClean = part2(message);
  palindrome = part3(messageClean);
  return palindrome;
}

public static void main(String[] args) throws Exception {
  String message;
  boolean palindrome;

  message = part1();
  palindrome = part4(message);
  if (palindrome) {
    System.out.println("The message is palindrome");
  }
}
```

11. Solution

```
public static void main(String[] args) throws Exception {
  int a, b, c, d, maximum;

  a = Integer.parseInt(cin.nextLine());
  b = Integer.parseInt(cin.nextLine());
  c = Integer.parseInt(cin.nextLine());
  d = Integer.parseInt(cin.nextLine());

  maximum = a;
  if (b > maximum) {
    maximum = b;
  }
  if (c > maximum) {
    maximum = c;
  }
  if (d > maximum) {
    maximum = d;
  }

  System.out.println(maximum);
}
```

12. Solution

```
static void f1(double a, double b, double c, double[] returningArray) {
  returningArray[0] = a + b + c;
  returningArray[1] = returningArray[0] / 3;
}
```

13. Solution

```
static double myRound(double x, int decimalPlaces) {
  double returnValue;
  int digitToCheck = (int)((x * Math.pow(10, decimalPlaces + 1))) % 10;
  if (digitToCheck >= 5) {
    returnValue = ((int)((x * Math.pow(10, decimalPlaces))) + 1) / Math.pow(10, decimalPlaces);
  }
  else {
    returnValue = ((int)(x * Math.pow(10, decimalPlaces))) / Math.pow(10, decimalPlaces);
  }
  return returnValue;
}

static double myRound(double x) {
  return myRound(x, 2);
}
```

14. Solution

```
static boolean getInput() {
  String answer;

  do {
    System.out.print("Enter Yes or No: ");
    answer = cin.nextLine().toUpperCase();
  } while (!answer.equals("YES") && !answer.equals("NO"));

  return answer.equals("YES");  //This returns true or false
}

static double findArea(double b, double h) {
  return b * h;
}

public static void main(String[] args) throws Exception {
  double b, h;

  do {
    System.out.print("Enter the base of the parallelogram: ");
    b = Double.parseDouble(cin.nextLine());
    System.out.print("Enter the height of the parallelogram: ");
    h = Double.parseDouble(cin.nextLine());

    System.out.println("Area = " + findArea(b, h));

    System.out.println("Would you like to repeat? ");
  } while (getInput());
}
```

15. Solution

```
static final int STUDENTS = 100;
static void getArrays(String[] names, int[] grades) {
  int i;

  for (i = 0; i <= STUDENTS - 1; i++) {
    System.out.print("Enter name: ");
    names[i] = cin.nextLine();
    System.out.print("Enter grade: ");
    grades[i] = Integer.parseInt(cin.nextLine());
  }
}

static double getAverage(int[] grades) {
  int i, total = 0;
  for (i = 0; i <= STUDENTS - 1; i++) {
    total += grades[i];
  }
  return total / (double)STUDENTS;
}

static void sortArrays(int[] grades, String[] names) {
  int m, n, elementGrds;
  String elementNms;

  for (m = 1; m <= STUDENTS - 1; m++) {
    elementGrds = grades[m];
    elementNms = names[m];

    n = m;
    while (n > 0 && grades[n - 1] > elementGrds) {
      grades[n] = grades[n - 1];
      names[n] = names[n - 1];
      n--;
    }

    grades[n] = elementGrds;
    names[n] = elementNms;
  }
}

public static void main(String[] args) throws Exception {
  int i;
  double average;

  String[] names = new String[STUDENTS];
  int[] grades = new int[STUDENTS];

  getArrays(names, grades);
  average = getAverage(grades);
  sortArrays(grades, names);
  for (i = 0; i <= STUDENTS - 1; i++) {
    if (grades[i] < average) {
      System.out.println(names[i]);
    }
  }
}
```

16. Solution

```
static final int JUDGES = 10;

static int[] getArray() {
  int[] score = new int[JUDGES];
  int i;

  for (i = 0; i <= JUDGES - 1; i++) {
    System.out.print("Judge No " + (i + 1) + ". Enter score: ");
    score[i] = Integer.parseInt(cin.nextLine());
  }
  return score;
}

static void findMinMax(int[] score, int[] results) {
  int i;

  int minimum = score[0];
  int maximum = score[0];
  for (i = 1; i <= JUDGES - 1; i++) {
    if (score[i] > maximum) {
      maximum = score[i];
    }
    if (score[i] < minimum) {
      minimum = score[i];
    }
  }
  results[0] = minimum;
  results[1] = maximum;
}

public static void main(String[] args) throws Exception {
  String name;
  int[] results = new int[2];
  int total, i, points;

  System.out.print("Enter artist's name: ");
  name = cin.nextLine();
  int[] score = getArray();
  findMinMax(score, results);

  total = 0;
  for (i = 0; i <= JUDGES - 1; i++) {
    total += score[i];
  }
  points = total - results[0] - results[1];
  System.out.println("Artist " + name + " got " + points + " points");
}
```

17. Solution

```
static int sumRecursive(int n) {
  if (n == 1) {
    return 1;
  }
  else {
    return sumRecursive(n - 1) + n;
  }
}

public static void main(String[] args) throws Exception {
  int num = Integer.parseInt(cin.nextLine());
  System.out.println(sumRecursive(num));
}
```

18. Solution

```
static double woc(int index) {
  if (index == 1) {
    return 1;
  }
  else {
    return 2 * woc(index - 1);
  }
}

public static void main(String[] args) throws Exception {
  double total;
  int i;

  total = 0;
  for (i = 1; i <= 64; i++) {
    total += woc(i);
  }
  System.out.println(total);
}
```

19. Solution

```
static int fib(int n) {
  if (n <= 1) {
    return n;
  }
  else {
    return fib(n - 1) + fib(n - 2);
  }
}

public static void main(String[] args) throws Exception {
  int num = Integer.parseInt(cin.nextLine());
  System.out.println(fib(num - 1));
}
```

20. Solution

```
static int tribonacci(int n) {
  if (n == 0) {
    return 0;
  }
  else if (n == 1 || n == 2) {
    return 1;
  }
  else {
    return tribonacci(n - 1) + tribonacci(n - 2) + tribonacci(n - 3);
  }
}
```

21. Solution

```
static double myPow(double n, int p) {
  if (p == 0)
    return 1;
  else if (p < 0)
    return 1 / (n * myPow(n, -p - 1));
  else
    return n * myPow(n, p - 1);
}
```

22. Solution

```
static double factorial(int value) {
  if (value == 1) {
    return 1;
  }
  else {
    return value * factorial(value - 1);
  }
}

static double myCos(double x, int i) {
  if (i == 0) {
    return 1;
  }
  else {
    return myCos(x, i - 4) + Math.pow(x, i) / factorial(i) - Math.pow(x, i - 2) / factorial(i - 2);
  }
}
```

```
//Overload
static double myCos(double x) {
  return myCos(x, 40);
}

public static void main(String[] args) throws Exception {
  System.out.println(myCos(Math.PI / 4));
}
```

Chapter 38

38.3 Review Exercises

1. Solution

```
static void displayMenu() {
  System.out.println("1. Convert USD to Euro (EUR)");
  System.out.println("2. Convert USD to British Pound Sterling (GBP)");
  System.out.println("3. Convert USD to Japanese Yen (JPY)");
  System.out.println("4. Convert USD to Canadian Dollar (CAD)");
  System.out.println("5. Exit");
  System.out.println("-------------------------");
  System.out.print("Enter a choice: ");
}

static double USD_to_EU(double value) {
  return value * 0.94;
}

static double USD_to_GBP(double value) {
  return value * 0.81;
}

static double USD_to_JPY(double value) {
  return value * 149.11;
}

static double USD_to_CAD(double value) {
  return value * 1.36;
}

public static void main(String[] args) throws Exception {
  int choice;
  double amount;

  displayMenu();
  choice = Integer.parseInt(cin.nextLine());
  while (choice != 5) {
    System.out.print("Enter an amount in US dollars: ");
    amount = Double.parseDouble(cin.nextLine());
    switch (choice) {
      case 1:
        System.out.println(amount + " USD = " + USD_to_EU(amount) + " Euro");
        break;
      case 2:
        System.out.println(amount + " USD = " + USD_to_GBP(amount) + " GBP");
        break;
      case 3:
        System.out.println(amount + " USD = " + USD_to_JPY(amount) + " JPY");
        break;
      case 4:
        System.out.println(amount + " USD = " + USD_to_CAD(amount) + " CAD");
        break;
    }

    displayMenu();
    choice = Integer.parseInt(cin.nextLine());
  }
}
```

2. Solution

```
static void displayMenu() {
  System.out.println("---------------------------------------------");
  System.out.println("1. Convert USD to Euro (EUR)");
  System.out.println("2. Convert USD to British Pound Sterling (GBP)");
  System.out.println("3. Convert EUR to USD");
  System.out.println("4. Convert EUR to GBP");
  System.out.println("5. Convert GBP to USD");
  System.out.println("6. Convert GBP to EUR");
  System.out.println("7. Exit");
  System.out.println("-------------------------");
  System.out.print("Enter a choice: ");
}

static double USD_to_EUR(double value) {
  return value * 0.94;
}

static double USD_to_GBP(double value) {
  return value * 0.81;
}

public static void main(String[] args) throws Exception {
  int choice;
  double amount;

  displayMenu();
  choice = Integer.parseInt(cin.nextLine());
  while (choice != 7) {
    System.out.print("Enter an amount: ");
    amount = Double.parseDouble(cin.nextLine());
    switch (choice) {
      case 1:
        System.out.println(amount + " USD = " + USD_to_EUR(amount) + " Euro");
        break;
      case 2:
        System.out.println(amount + " USD = " + USD_to_GBP(amount) + " GBP");
        break;
      case 3:
        System.out.println(amount + " EUR = " + 1 / USD_to_EUR(1 / amount) + " USD");
        break;
      case 4:
        System.out.println(amount + " EUR = " + USD_to_GBP(1 / USD_to_EUR(1 / amount)) + " GBP");
        break;
      case 5:
        System.out.println(amount + " GBP = " + 1 / USD_to_GBP(1 / amount) + " USD");
        break;
      case 6:
        System.out.println(amount + " GBP = " + USD_to_EUR(1 / USD_to_GBP(1 / amount)) + " EUR");
        break;
    }

    displayMenu();
    choice = Integer.parseInt(cin.nextLine());
  }
}
```

3. Solution

```
static final double ACCURACY = 0.000000001;

static double factorial(int n) {
  int i;

  double returnValue = 1;
  for (i = 1; i <= n; i++) {
    returnValue *= i;
  }
  return returnValue;
}

static double mySin(double x) {
  int i, sign;
  double sinus, sinusPrevious;
  sign = 1;
  sinus = 0;
  i = 1;
  do {
    sinusPrevious = sinus;
    sinus += sign * Math.pow(x, i) / factorial(i);

    sign = -sign;
    i += 2;
  } while (Math.abs(sinus - sinusPrevious) > ACCURACY);
  return sinus;
}

static double degreesToRad(double degrees) {
  return 2 * Math.PI * degrees / 360;
}

public static void main(String[] args) throws Exception {
  int i;

  for (i = 0; i <= 360; i++) {
    System.out.println("sin(" + i + ") ~= " + mySin(degreesToRad(i)));
  }
}
```

4. Solution

```
static boolean isLeap(int year) {
  boolean returnValue = false;
  if (year % 4 == 0 && year % 100 != 0 || year % 400 == 0) {
    returnValue = true;
  }
  return returnValue;
}

static int numOfDays(int year, int month) {
  int days;

  switch (month) {
    case 4:
    case 6:
    case 9:
    case 11:
      days = 30;
      break;
    case 2:
      if (isLeap(year)) {
        days = 29;
      }
      else {
        days = 28;
      }
      break;
    default:
      days = 31;
  }

  return days;
}

static boolean checkDate(int day, int month, int year) {
  boolean returnValue = true;
  if (month < 1 || month > 12) {
    returnValue = false;
  }
  else if (day < 1 || day > numOfDays(year, month)) {
    returnValue = false;
  }
  return returnValue;
}

public static void main(String[] args) throws Exception {
  int day, month, year, total, i;

  System.out.print("Enter day: ");
  day = Integer.parseInt(cin.nextLine());
  System.out.print("Enter month: ");
  month = Integer.parseInt(cin.nextLine());
  System.out.print("Enter year: ");
  year = Integer.parseInt(cin.nextLine());
  while (!checkDate(day, month, year)) {
    System.out.println("Error!");
    System.out.print("Enter day: ");
    day = Integer.parseInt(cin.nextLine());
    System.out.print("Enter month: ");
    month = Integer.parseInt(cin.nextLine());
    System.out.print("Enter year: ");
    year = Integer.parseInt(cin.nextLine());
  }

  total = 0;
  for (i = 1; i <= month - 1; i++) {
    total += numOfDays(year, i);
  }
  total += day;

  System.out.println(total);
}
```

5. Solution

```
static int dice() {
  return 1 + (int)(Math.random() * 6);
}

public static void main(String[] args) throws Exception {
  int dice1, dice2, i, player, total, totalPlayer1 = 0, totalPlayer2 = 0;
  String[] names = new String[2];

  System.out.print("Player1 - Enter name: ");
  names[0] = cin.nextLine();
  System.out.print("Player2 - Enter name: ");
  names[1] = cin.nextLine();

  for (player = 0; player <= 1; player++) {
    total = 0;
    for (i = 1; i <= 10; i++) {
      System.out.println(names[player] + ", hit enter to roll the dice!");
      cin.nextLine();  //This statement just waits the user to hit the enter key
      dice1 =  dice();
      dice2 =  dice();
      System.out.println(dice1 + "   " + dice2);
      total += dice1 + dice2;
    }
    if (player == 1) {
      totalPlayer1 = total;
    }
    else {
      totalPlayer2 = total;
    }
  }

  if (totalPlayer1 == totalPlayer2) {
    System.out.println("Tie!");
  }
  else if (totalPlayer1 > totalPlayer2) {
    System.out.println(names[0] + " wins");
  }
  else {
    System.out.println(names[1] + " wins");
  }
}
```

6. Solution

```
static final int GAS = 1;
static final int DIESEL = 2;
static final int HYBRID = 3;
static final double TAX_RATE = 0.10;
static final int CARS = 40;

static int getChoice() {
  System.out.println("1. Gas");
  System.out.println("2. Diesel");
  System.out.println("3. Hybrid");
  System.out.print("Enter type of the car: ");
  return Integer.parseInt(cin.nextLine());
}

static int getDays() {
  System.out.print("Enter total number of rental days: ");
  return Integer.parseInt(cin.nextLine());
}

static double getCharge(int carType, int rentalDays) {
  double charge;

  if (carType == GAS) {
    if (rentalDays <= 5) {
      charge = rentalDays * 24;
    }
    else if (rentalDays <= 8) {
      charge = 5 * 24 + (rentalDays - 5) * 22;
    }
    else {
      charge = 5 * 24 + 3 * 22 + (rentalDays - 8) * 18;
    }
  }
  else if (carType == DIESEL) {
    if (rentalDays <= 5) {
      charge = rentalDays * 28;
    }
    else if (rentalDays <= 8) {
      charge = 5 * 28 + (rentalDays - 5) * 25;
    }
    else {
      charge = 5 * 28 + 3 * 25 + (rentalDays - 8) * 21;
    }
  }
  else {
    if (rentalDays <= 5) {
      charge = rentalDays * 30;
    }
    else if (rentalDays <= 8) {
      charge = 5 * 30 + (rentalDays - 5) * 28;
    }
    else {
      charge = 5 * 30 + 3 * 28 + (rentalDays - 8) * 23;
    }
  }
  charge = charge * (1 + TAX_RATE); //This is equivalent to charge += charge * TAX_RATE;
  return charge;
}

public static void main(String[] args) throws Exception {
  int count, i;
  double charge, total;

  int[] rentedCarTypes = new int[CARS];
  int[] rentedDays = new int[CARS];

  for (i = 0; i <= CARS - 1; i++) {
    rentedCarTypes[i] = getChoice();
    rentedDays[i] = getDays();
  }

  total = 0;
  for (i = 0; i <= CARS - 1; i++) {
    charge = getCharge(rentedCarTypes[i], rentedDays[i]);
    System.out.println("Car No " + (i + 1) + ": " + charge);
    total += charge;
  }

  count = 0;
  for (i = 0; i <= CARS - 1; i++) {
    if (rentedCarTypes[i] == HYBRID) {
      count++;
    }
  }

  System.out.println("Hybrids rented: " + count);
  System.out.println("Net profit: " + total / (1 + TAX_RATE));
}
```

7. Solution

```
static final int CHANNELS = 10;
static final int DAYS = 7;
static final String[] dayNames = {
  "Monday", "Tuesday", "Wednesday", "Thursday", "Friday", "Saturday", "Sunday"
};

static void getData(String[] names, int[][] viewers) {
  int i, j;

  for (i = 0; i <= CHANNELS - 1; i++) {
    System.out.print("Enter name for channel No. " + (i + 1) + ": ");
    names[i] = cin.nextLine();
    for (j = 0; j <= DAYS - 1; j++) {
      System.out.print("Enter the number of viewers of the main news program on " + dayNames[j] +
                       " for channel " + names[i] + ": ");
      viewers[i][j] = Integer.parseInt(cin.nextLine());
    }
  }
}

static double getAverage(int[] a) {
  int total ,i;

  total = 0;
  for (i = 0; i <= 4; i++) {
    total += a[i];
  }
  return total / 5.0;
}

public static void main(String[] args) throws Exception {
  int i, j;
  double weekend;
  boolean increasing;

  String[] names = new String[CHANNELS];
  int[][] viewers = new int[CHANNELS][DAYS];
  getData(names, viewers);

  int[] temporaryArray = new int[5];
  for (i = 0; i <= CHANNELS - 1; i++) {
    for (j = 0; j <= 4; j++) {
      temporaryArray[j] = viewers[i][j];
    }
    weekend = (viewers[i][DAYS - 2] + viewers[i][DAYS - 1]) / 2;
    if (weekend >= 1.2 * getAverage(temporaryArray)) {
      System.out.println(names[i]);
    }
  }

  for (i = 0; i <= CHANNELS - 1; i++) {
    increasing = true;
    for (j = 1; j <= DAYS - 1; j++) {
      if (viewers[i][j] <= viewers[i][j - 1]) {
        increasing = false;
      }
    }
    if (increasing) {
      System.out.println(names[i]);
    }
  }
}
```

8. Solution

```
static final int CITIZENS = 300;

static void inputData(long[] SSNs, String[] answers) {
  int i;

  for (i = 0; i <= CITIZENS - 1; i++) {
    System.out.print("Enter SSN: ");
    SSNs[i] = Long.parseLong(cin.nextLine());
    System.out.print("Enter answer: ");
    answers[i] = cin.nextLine();
  }
}

static void sortArrays(long[] SSNs, String[] answers) {
  int m, n, indexOfMin;
  long minimum, temp;
  String tempStr;

  for (m = 0; m <= CITIZENS - 1; m++) {
    minimum = SSNs[m];
    indexOfMin = m;
    for (n = m; n <= CITIZENS - 1; n++) {
      if (SSNs[n] < minimum) {
        minimum = SSNs[n];
        indexOfMin = n;
      }
    }
    temp = SSNs[m];
    SSNs[m] = SSNs[indexOfMin];
    SSNs[indexOfMin] = temp;
    tempStr = answers[m];
    answers[m] = answers[indexOfMin];
    answers[indexOfMin] = tempStr;
  }
}

static int searchArray(long[] SSNs, long SSN) {
  int left, right, middle;
  boolean found;

  middle = -1;
  left = 0;
  right = CITIZENS - 1;
  found = false;
  while (left <= right && !found) {
    middle = (int)((left + right) / 2);

    if (SSN < SSNs[middle]) {
      right = middle - 1;
    }
    else if (SSN > SSNs[middle]) {
      left = middle + 1;
    }
    else {
      found = true;
    }
  }

  if (!found) {
    System.out.println("SSN not found!");
    return -1;
  }
  else {
    return middle;
  }
}

static int countAnswers(String[] answers, String answer) {
  int count, i;

  count = 0;
  for (i = 0; i <= CITIZENS - 1; i++) {
    if (answers[i].equals(answer)) {
      count++;
    }
  }
  return count;
}

public static void main(String[] args) throws Exception {
  long[] SSNs = new long[CITIZENS];
  long SSN;
  String[] answers = new String[CITIZENS];
  int index, count;
  String answer;

  do {
    inputData(SSNs, answers);
    sortArrays(SSNs, answers);

    System.out.print("Enter an SSN to search: ");
    SSN = Long.parseLong(cin.nextLine());

    index = searchArray(SSNs, SSN);
    if (index != -1) {
      answer = answers[index];
      System.out.println(answer);

      count = countAnswers(answers, answer);
      System.out.println(count * 100 / (double)CITIZENS);
    }
    System.out.print("Repeat? ");
    answer = cin.nextLine();
  } while (answer.equals("yes"));
}
```

9. *Solution*

```
static final int TEAMS = 8;
static final int GAMES = 12;

static void inputData(String[] names, String[][] results)  {
  int i, j;

  for (i = 0; i <= TEAMS - 1; i++) {
    System.out.print("Enter team name: ");
    names[i] = cin.nextLine();
    for (j = 0; j <= GAMES - 1; j++) {
      System.out.print("Enter result (W, L, T): ");
      results[i][j] = cin.nextLine();
    }
  }
}
```

```
static void displayResult(String[] names, String[][] results) {
  String result;
  int i, j;
  boolean found;

  System.out.print("Enter a result to search (W, L, T): ");
  result = cin.nextLine();
  for (i = 0; i <= TEAMS - 1; i++) {
    System.out.println("Team: " + names[i]);
    found = false;
    for (j = 0; j <= GAMES - 1; j++) {
      if (results[i][j].equals(result)) {
        System.out.println("Week: " + (j + 1));
        found = true;
      }
    }
    if (!found) {
      System.out.println("Nothing found");
    }
  }
}

static int findTeam(String[] names) {
  String name;
  int i, returnValue;

  System.out.print("Enter a name to search: ");
  name = cin.nextLine();

  i = 0;
  while (i < TEAMS - 1 && !names[i].equals(name)) {
    i++;
  }

  if (!names[i].equals(name)) {
    returnValue = -1;
  }
  else {
    returnValue = i;
  }
  return returnValue;
}

public static void main(String[] args) throws Exception {
  String[] names = new String[TEAMS];
  String[][] results = new String[TEAMS][GAMES];
  int j, index, total;

  inputData(names, results);
  displayResult(names, results);
  index = findTeam(names);
  while (index != -1) {
    total = 0;
    for (j = 0; j <= GAMES - 1; j++) {
      if (results[index][j].equals("W")) {
        total += 3;
      }
      else if (results[index][j].equals("T")) {
        total += 1;
      }
    }
    System.out.println("Points: " + total);
    index = findTeam(names);
  }

  if (index == -1) {
    System.out.println("Team not found");
  }
}
```

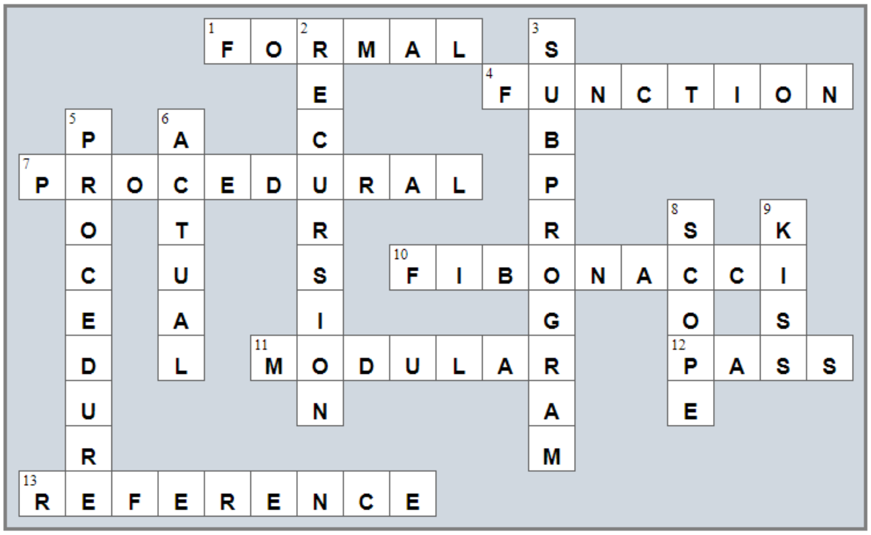
10. Solution

```
static boolean hasDuplicateDigits(int num) {
  int digit;

  //Initialize an array to store the count of each digit
  int[] digitCount = {0, 0, 0, 0, 0, 0, 0, 0, 0, 0};

  while (num > 0) {
    digit = num % 10; //Extract the last digit
    if (digitCount[digit] > 0) {
      return true; //If this digit has been seen before, return true
    }
    digitCount[digit]++; //Increment the count of this digit
    x = (int)(x / 10);   //Move to the next digit
  }

  return false; //No duplicate digits found
}

public static void main(String[] args) throws Exception {
  int num;

  System.out.print("Enter an integer: ");
  num = Integer.parseInt(cin.nextLine());
  while (num < 11) {
    System.out.print("Wrong number! Enter an integer greater than 10: ");
    num = Integer.parseInt(cin.nextLine());
  }

  if (hasDuplicateDigits(num)) {
    System.out.println("The integer contains duplicate digits");
  }
  else {
    System.out.println("The integer does not contain duplicate digits");
  }
}
```

Review in “Subprograms”

Review Crossword Puzzle

1.



Chapter 39

39.8 Review Questions: True/False

1. false
2. true
3. true
4. false
5. false
6. false
7. false
8. true
9. true
10. false
11. true
12. true
13. true
14. false
15. true
16. false
17. false

39.9 Review Exercises

1. Solution

```
class Geometry {
  public double rectangleArea(double b, double h) {
    return b * h;
  }

  public double triangleArea(double b, double h) {
    return b * h / 2;
  }
}

public class App {
  static Scanner cin = new Scanner(System.in);

  public static void main(String[] args) throws Exception {
    double sqrSide, rctnglBase, rctnglHeight, trnglBase, trnglHeight;
    Geometry gmtr = new Geometry();

    System.out.print("Enter square side: ");
    sqrSide = Double.parseDouble(cin.nextLine());

    System.out.print("Enter rectangle base:  ");
    rctnglBase = Double.parseDouble(cin.nextLine());
    System.out.print("Enter rectangle height: ");
    rctnglHeight = Double.parseDouble(cin.nextLine());

    System.out.print("Enter triangle base: ");
    trnglBase = Double.parseDouble(cin.nextLine());
    System.out.print("Enter triangle height: ");
    trnglHeight = Double.parseDouble(cin.nextLine());

    System.out.println(gmtr.rectangleArea(sqrSide, sqrSide));
    System.out.println(gmtr.rectangleArea(rctnglBase, rctnglHeight));
    System.out.println(gmtr.triangleArea(trnglBase, trnglHeight));
  }
}
```

2. Solution

```
class Pet {
  public String kind;
  public int legsNumber;

  public void startRunning() {
    System.out.println("Pet is running");
  }

  public void stopRunning() {
    System.out.println("Pet stopped");
  }
}

public class App {
  static Scanner cin = new Scanner(System.in);

  public static void main(String[] args) throws Exception {
    Pet pet1 = new Pet();
    pet1.kind = "dog";
    pet1.legsNumber = 4;

    Pet pet2 = new Pet();
    pet2.kind = "monkey";
    pet2.legsNumber = 2;

    pet1.startRunning();
    pet2.startRunning();
    pet1.stopRunning();
  }
}
```

3. Solution

```
class Pet {
  private String _kind;
  private int _legsNumber;

  //Define the constructor
  public Pet(String kind, int legsNumber) throws Exception {
    this.setKind(kind);
    this.setLegsNumber(legsNumber);
  }

  public String getKind() {
    return this._kind;
  }

  public void setKind(String value) throws Exception {
    if (!value.equals("")) {
      this._kind = value;
    }
    else {
      throw new Exception("Cannot be empty");
    }
  }

  public int getLegsNumber() {
    return this._legsNumber;
  }

  public void setLegsNumber(int value) throws Exception {
    if (value >= 0) {
      this._legsNumber = value;
    }
    else {
      throw new Exception("Cannot be negative");
    }
  }

  public void startRunning() {
    System.out.println("Pet is running");
  }

  public void stopRunning() {
    System.out.println("Pet stopped");
  }
}

public class App {
  static Scanner cin = new Scanner(System.in);

  public static void main(String[] args) throws Exception {
    Pet pet1 = new Pet("dog", 4);

    pet1.startRunning();
    pet1.stopRunning();

    pet1.setKind(""); //This will throw an error
    pet1.setLegsNumber(-1); //This will throw an error
  }
}
```

4. Solution

```
class Box {
  private double _width;
  private double _length;
  private double _height;

  //Define the constructor
  public Box(double w, double l, double h) {
    //Initialize fields
    this._width = w;
    this._length = l;
    this._height = h;
  }

  public void displayVolume() {
    System.out.println("Volume: " + (this._width * this._length * this._height));
  }

  public void displayDimensions() {
    System.out.println(this._width + " x " + this._length + " x " + this._height);
  }
}

public class App {
  static Scanner cin = new Scanner(System.in);
  static final int BOXES = 30;

  public static void main(String[] args) throws Exception {
    int i;
    double w, l, h;

    Box[] listOfObj = new Box[BOXES]; //create an array

    for (i = 0; i <= BOXES - 1; i++) {
      System.out.print("Enter width: ");
        w = Double.parseDouble(cin.nextLine());
        System.out.print("Enter length: ");
        l = Double.parseDouble(cin.nextLine());
        System.out.print("Enter height: ");
        h = Double.parseDouble(cin.nextLine());

        //Add each new object to the array
        listOfObj[i] = new Box(w, l, h);
    }

    for (i = 0; i <= BOXES - 1; i++) {
        listOfObj[i].displayDimensions();
        listOfObj[i].displayVolume();
    }
  }
}
```

5. Solution

```
class Box {
  private double _width;
  private double _length;
  private double _height;
```

```
//Define the constructor
public Box(double w, double l, double h) throws Exception {
    //Initialize fields (using the corresponding set methods)
    this.setWidth(w);
    this.setLength(l);
    this.setHeight(h);
}

//Define the getter
public double getWidth() {
  return this._width;
}

//Define the setter
public void setWidth(double value) throws Exception {
  if (value > 0) {
    this._width = value;
  }
  else {
    throw new Exception("Cannot be negative or zero");
  }
}

//Define the getter
public double getLength() {
  return this._length;
}

//Define the setter
public void setLength(double value) throws Exception {
  if (value > 0) {
    this._length = value;
  }
  else {
    throw new Exception("Cannot be negative or zero");
  }
}

//Define the getter
public double getHeight() {
  return this._height;
}

//Define the setter
public void setHeight(double value) throws Exception {
  if (value > 0) {
    this._height = value;
  }
  else {
    throw new Exception("Cannot be negative or zero");
    }
  }

  public void displayVolume() {
    System.out.println("Volume: " + (this.getWidth() * this.getLength() * this.getHeight()));
  }

  public void displayDimensions() {
    System.out.println(this.getWidth() + " x " + this.getLength() + " x " + this.getHeight());
  }
}

public class App {
  static Scanner cin = new Scanner(System.in);
  static final int BOXES = 30;

  public static void main(String[] args) throws Exception {
    int i;
    double w, l, h;

    Box[] listOfObj = new Box[BOXES]; //Create an array

    for (i = 0; i <= BOXES - 1; i++) {
      System.out.print("Enter width: ");
        w = Double.parseDouble(cin.nextLine());
        System.out.print("Enter length: ");
        l = Double.parseDouble(cin.nextLine());
        System.out.print("Enter height: ");
        h = Double.parseDouble(cin.nextLine());

        //Add each new object to the array
        listOfObj[i] = new Box(w, l, h);
    }

    for (i = 0; i <= BOXES - 1; i++) {
        listOfObj[i].displayDimensions();
        listOfObj[i].displayVolume();
    }
  }
}
```

6. Solution

```
class Cube {
  private double _edge;

  //Define the constructor
  public Cube(double edge) {
    this._edge = edge;
  }
  public void displayVolume() {
    System.out.println("Volume: " + Math.pow(this._edge, 3));
  }

  public void displayOneSurface() {
    System.out.println("One surface: " + Math.pow(this._edge, 2));
  }

  public void displayTotalSurface() {
    System.out.println("Total surface: " + 6 * Math.pow(this._edge, 2));
  }
}

public class App {
  static Scanner cin = new Scanner(System.in);

  public static void main(String[] args) throws Exception {
    double edge;

    System.out.print("Enter edge length of a cube: ");
    edge = Double.parseDouble(cin.nextLine());

    Cube cube1 = new Cube(edge);

    cube1.displayVolume();
    cube1.displayOneSurface();
    cube1.displayTotalSurface();
  }
}
```

7. Solution

```
class Cube {
  private double _edge;

  //Define the constructor
  public Cube(double edge) throws Exception {
    this.setEdge(edge);
  }

  //Define the getter
  public double getEdge() {
    return this._edge;
  }

  //Define the setter
  public void setEdge(double value) throws Exception {
    if (value > 0) {
      this._edge = value;
    }
    else {
      throw new Exception("Cannot be negative or zero");
    }
  }

  public void displayVolume() {
    System.out.println("Volume: " + Math.pow(this.getEdge(), 3));
  }

  public void displayOneSurface() {
    System.out.println("One surface: " + Math.pow(this.getEdge(), 2));
  }

  public void displayTotalSurface() {
    System.out.println("Total surface: " + 6 * Math.pow(this.getEdge(), 2));
  }
}

public class App {
  static Scanner cin = new Scanner(System.in);

  public static void main(String[] args) throws Exception {
    double edge;

    System.out.print("Enter edge length of a cube: ");
    edge = Double.parseDouble(cin.nextLine());

    Cube cube1 = new Cube(edge);

    cube1.displayVolume();
    cube1.displayOneSurface();
    cube1.displayTotalSurface();
  }
}
```

8. Solution

```
class Circle {
  private double _radius = -1;

  //Define the getter
  public double getRadius() throws Exception {
    if (this._radius > 0) {
      return this._radius;
    }
    else {
      throw new Exception("Radius is not set");
    }
  }

  //Define the setter
  public void setRadius(double value) throws Exception {
    if (value > 0) {
      this._radius = value;
    }
    else {
      throw new Exception("Cannot be negative or zero");
    }
  }

  public double getDiameter() throws Exception {
    return 2 * this.getRadius();
  }

  public double getArea() throws Exception {
    return 3.14 * Math.pow(this.getRadius(), 2);
  }

  public double getPerimeter() throws Exception {
      return 2 * 3.14 * this.getRadius();
  }
}

public class App {
  static Scanner cin = new Scanner(System.in);

  static void displayMenu() {
    System.out.println("1. Enter radius");
    System.out.println("2. Display radius");
    System.out.println("3. Display diameter");
    System.out.println("4. Display area");
    System.out.println("5. Display perimeter");
    System.out.println("6. Exit");
  }

  public static void main(String[] args) throws Exception {
    int choice;
    double radius;

    Circle circle1 = new Circle();

    do {
      displayMenu();
      System.out.print("Enter a choice: ");
      choice = Integer.parseInt(cin.nextLine());

      if (choice == 1) {
        System.out.print("Enter radius: ");
        radius = Double.parseDouble(cin.nextLine());
        circle1.setRadius(radius);
      }
      else if (choice == 2) {
        System.out.println("Radius: " + circle1.getRadius());
      }
      else if (choice == 3) {
        System.out.println("Diameter: " + circle1.getDiameter());
      }
      else if (choice == 4) {
        System.out.println("Area: " + circle1.getArea());
      }
      else if (choice == 5) {
        System.out.println("Perimeter: " + circle1.getPerimeter());
      }
    } while (choice != 6);
  }
}
```

9. Solution

```
class Info {
  private String _userText;

  //Define the getter
  public String getUserText() {
    return this._userText;
  }

  //Define the setter
  public void setUserText(String value) throws Exception {
    if (!value.equals("")) {
      this._userText = value;
    }
    else {
      throw new Exception("Cannot be set to empty");
    }
  }

  public int getSpacesCount() {
      int i, count = 0;
      String character;

      for (i = 0; i <= this.getUserText().length() - 1; i++) {
        character = "" + this.getUserText().charAt(i);
        if (character.equals(" ")) {
          count += 1;
        }
      }
      return count;
  }

  public int getWordsCount() {
      return this.getSpacesCount() + 1;
  }
  public int getVowelsCount() {
    int i, count = 0;
    String character;

    for (i = 0; i <= this.getUserText().length() - 1; i++) {
      character = "" + this.getUserText().toLowerCase().charAt(i);
      if ("aeiou".indexOf(character) > -1) {
        count += 1;
      }
    }
    return count;
  }

  public int getLettersCount() {
    return this.getUserText().length() - this.getSpacesCount();
  }
}

public class App {
  static Scanner cin = new Scanner(System.in);

  public static void main(String[] args) throws Exception {
    Info inf = new Info();

    System.out.print("Enter a text: ");
    inf.setUserText(cin.nextLine());

    System.out.println("Text: " + inf.getUserText());
    System.out.println("Spaces: " + inf.getSpacesCount());
    System.out.println("Words: " + inf.getWordsCount());
    System.out.println("Vowels: " + inf.getVowelsCount());
    System.out.println("Total number of letters: " + inf.getLettersCount());
  }
}
```

10. Solution

```
class EncryptDecrypt {
  static final String alphabet = " abcdefghijklmnopqrstuvwxyz";  //space is a valid character!
  private int _encrDecrKey = -1;

  //Define the getter
  public int getEncrDecrKey() throws Exception {
    if (this._encrDecrKey != -1) {
      return this._encrDecrKey;
    }
    else {
      throw new Exception("Key is not set");
    }
  }
  //Define the setter
  public void setEncrDecrKey(int value) throws Exception {
    if (value >= 1 && value <= 26) {
      this._encrDecrKey = value;
    }
    else {
      throw new Exception("Must be between 1 and 26");
    }
  }

  public String encrypt(String message) throws Exception {
    String character, returnValue = "";
    char newLetter;
    int i, index, newIndex;

    for (i = 0; i <= message.length() - 1; i++) {
      character = "" + message.charAt(i);
      index = alphabet.indexOf(character);
      newIndex = index + this.getEncrDecrKey();
      if (newIndex >= 27) {
        newIndex -= 27;
      }
      newLetter = alphabet.charAt(newIndex);
      returnValue += newLetter;
    }
    return returnValue;
  }

  public String decrypt(String encMessage) throws Exception {
    String character, returnValue = "";
    char newLetter;
    int i, index, newIndex;

    for (i = 0; i <= encMessage.length() - 1; i++) {
      character = "" + encMessage.charAt(i);
      index = alphabet.indexOf(character);
      newIndex = index - this.getEncrDecrKey();
      if (newIndex < 0) {
        newIndex += 27;
      }
      newLetter = alphabet.charAt(newIndex);
      returnValue += newLetter;
    }
    return returnValue;
  }
}

public class App {
  static Scanner cin = new Scanner(System.in);

  static void displayMenu() {
    System.out.println("1. Enter encryption/decryption key");
    System.out.println("2. Encrypt a message");
    System.out.println("3. Decrypt a message");
    System.out.println("4. Exit");
  }

  public static void main(String[] args) throws Exception {
    String text;
    int choice;

    EncryptDecrypt ed = new EncryptDecrypt();

    displayMenu();
    System.out.print("Enter a choice: ");
    choice = Integer.parseInt(cin.nextLine());
    while (choice != 4) {
      if (choice == 1) {
        System.out.print("Enter encryption/decryption key: ");
        ed.setEncrDecrKey(Integer.parseInt(cin.nextLine()));
      }
      else if (choice == 2) {
        System.out.print("Enter message to encrypt: ");
        text = cin.nextLine();
        System.out.println("Encrypted message: " + ed.encrypt(text));
      }
      else if (choice == 3) {
        System.out.print("Enter message to decrypt: ");
        text = cin.nextLine();
        System.out.println("Decrypted message: " + ed.decrypt(text));
      }

      displayMenu();
      System.out.print("Enter a choice: ");
      choice = Integer.parseInt(cin.nextLine());
    }
  }
}
```

11. Solution

```
class Vehicle {
  public int numberOfWheels;
  public String color;
  public double length, width, height;

  //Define the constructor
  public Vehicle(int numberOfWheels, String color, double length, double width, double height) {
    this.numberOfWheels = numberOfWheels;
    this.color = color;
    this.length = length;
    this.width = width;
    this.height = height;
  }

  public void startEngine() {
    System.out.println("The engine started");
  }

  public void stopEngine() {
    System.out.println("The engine stopped");
  }
}

class Car extends Vehicle {
  public int bootCapacity;

  //Define the constructor
  public Car(int numberOfWheels, String color, double length, double width, double height) {
    super(numberOfWheels, color, length, width, height);
    this.bootCapacity = 0;
  }

  public void turnWindshieldWipersOn() {
    System.out.println("The windshield wipers have been turned on!");
  }
}

class Motorcycle extends Vehicle {
  public boolean hasLuggage;

  //Define the constructor
  public Motorcycle(int numberOfWheels, String color, double length, double width, double height) {
    super(numberOfWheels, color, length, width, height);
    this.hasLuggage = false;
  }

  public void doAWheelie() {
    System.out.println("I am doing a wheelie!!!");
  }
}

public class App  {
  public static void main(String[] args) throws Exception {
    Car car1 = new Car(4, "Red", 5, 2, 1.5);
    car1.bootCapacity = 300;
    car1.startEngine();
    car1.turnWindshieldWipersOn();
    car1.stopEngine();

    Car car2 = new Car(4, "Green", 4.5, 2.2, 1.4);
    car2.bootCapacity = 400;
    car2.startEngine();
    car2.turnWindshieldWipersOn();
    car2.stopEngine();
    Motorcycle motorcycle1 = new Motorcycle(2, "Blue", 2, 0.9, 1.3);
    motorcycle1.hasLuggage = true;
    motorcycle1.startEngine();
    motorcycle1.doAWheelie();
    motorcycle1.stopEngine();
  }
}
```

12. Solution

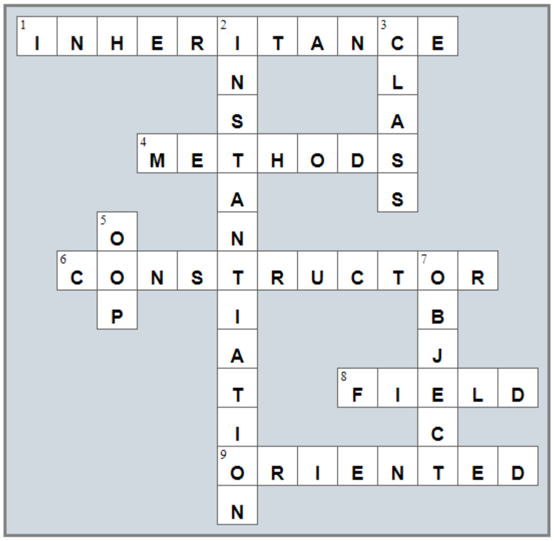
```
class SchoolMember {
  private String _name;
  private int _age;

  public SchoolMember(String name, int age) throws Exception {
    this.setName(name);
    this.setAge(age);
    System.out.println("A school member was initialized");
  }

  public String getName() {
    return this._name;
  }

  public void setName(String value) throws Exception {
    if (value != "") {
      this._name = value;
    }
    else {
      throw new Exception("Name cannot be empty");
    }
  }

  public int getAge() {
    return this._age;
  }

  public void setAge(int value) throws Exception {
    if (value > 0) {
      this._age = value;
    }
    else {
      throw new Exception("Age cannot be negative or zero");
    }
  }
}

class Teacher extends SchoolMember {
  private double _salary;

  public Teacher(String name, int age, double salary) throws Exception {
    super(name, age);
    this.setSalary(salary);
    System.out.println("A teacher was initialized");
  }

  public void displayValues() {
    System.out.println("Name: " + this.getName());
    System.out.println("Age: " + this.getAge());
    System.out.println("Salary: " + this.getSalary());
  }

  public double getSalary() {
    return this._salary;
  }

  public void setSalary(double value) throws Exception {
    if (value >= 0) {
      this._salary = value;
    }
    else {
      throw new Exception("Age cannot be negative");
    }
  }
}

class Student extends SchoolMember {
  private String _finalGrade;

  //Define the constructor
  public Student(String name, int age, String finalGrade) throws Exception {
    super(name, age);
    this.setFinalGrade(finalGrade);
    System.out.println("A student was initialized");
  }

  public void displayValues() {
    System.out.println("Name: " + this.getName());
    System.out.println("Age: " + this.getAge());
    System.out.println("Final grade: " + this.getFinalGrade());
  }

  public String getFinalGrade() {
    return this._finalGrade;
  }

  public void setFinalGrade(String value) throws Exception {
    if (value == "A" || value == "B" || value == "C" || value == "D" || value == "E" || value == "F") {
      this._finalGrade = value;
    }
    else {
      throw new Exception("Final grade must be in the range of 'A' to 'F'");
    }
  }
}
```

```
public class App {
  public static void main(String[] args) throws Exception {
    Teacher teacher1 = new Teacher("Mr. John Scott", 43, 35000);
    Teacher teacher2 = new Teacher("Mrs. Ann Carter", 5, 32000);

    Student student1 = new Student("Mark Nelson", 14, "A");
    Student student2 = new Student("Mary Morgan", 13, "B");

    teacher1.displayValues();
    teacher2.displayValues();
    student1.displayValues();
    student2.displayValues();
  }
}
```

Review in “Object Oriented Programming”

Review Crossword Puzzle

1.



Chapter 40

40.8 Review Questions: True/False

1. false
2. false
3. true
4. false
5. false
6. false
7. false
8. false
9. true
10. false
11. true
12. false
13. false
14. false
15. true
16. true
17. false
18. false
19. false
20. true
21. true
22. true

40.9 Review Exercises

1. *Solution*

```
static final String PATH = "c:/temp/";

public static void main(String[] args) throws Exception {
  String[] days = {"Sunday", "Monday", "Tuesday", "Wednesday", "Thursday", "Friday", "Saturday"};

  FileWriter f = new FileWriter(PATH + "days_of_week.txt");
  for (String d : days) {
    f.write(d + "\n");
  }
  f.close();
}
```

2. *Solution*

```
static final String PATH = "c:/temp/";

public static void main(String[] args) throws Exception {
  int i;
  String[] days = new String[7];

  Scanner f = new Scanner(Paths.get(PATH + "days_of_week.txt"));
  for (i = 0; i <= 6; i++) {
    days[i] = f.nextLine();
  }
  f.close();

  for (i = 6; i >= 0; i--) {
    System.out.println(days[i]);
  }
}
```

3. Solution

```
static final String PATH = "c:/temp/";

public static void main(String[] args) throws Exception {
  FileWriter f = new FileWriter(PATH + "days_of_week.txt", true);
  f.write("*** End of File ***\n");
  f.close();
}
```

4. Solution

```
static final String PATH = "c:/temp/";

public static void main(String[] args) throws Exception {
  int i;

  FileWriter f = new FileWriter(PATH + "randoms.txt");
  for (i = 0; i <= 49; i++) {
    f.write(1 + (int)(Math.random() * 100) + "\n");
  }
  f.close();
}
```

5. Solution

```
static final String PATH = "c:/temp/";

public static void main(String[] args) throws Exception {
  int i;
  FileWriter f;

  for (i = 1; i <= 10; i++) {
    f = new FileWriter(PATH + "file" + i + ".txt");
    f.write(100 + (int)(Math.random() * (10000 - 100 + 1)) + "\n");
    f.close();
  }
}
```

6. Solution

```
static final String PATH = "c:/temp/";

public static void main(String[] args) throws Exception {
  int i, j;
  FileWriter f = new FileWriter(PATH + "multiplication_table.txt");

  for (i = 1; i <= 10; i++) {
    for (j = 1; j <= 4; j++) {
      f.write(i + " x " + j + " = " + (i * j) + "\n");
    }
  }
  f.close();
}
```

7. Solution

```
static final String PATH = "c:/temp/";

public static void main(String[] args) throws Exception {
  Scanner f = new Scanner(Paths.get(PATH + "a_file.txt"));

  while (f.hasNextLine()) {
    System.out.println(f.nextLine().length());
  }
  f.close();
}
```

8. Solution

First approach

```
static final String PATH = "c:/temp/";

public static void main(String[] args) throws Exception {
  int i, j;
  String line;
  char character;
  Scanner f = new Scanner(Paths.get(PATH + "a_file.txt"));

  i = 1;
  while (f.hasNextLine()) {
    line = f.nextLine();
    for (j = 0; j < line.length(); j++) {
      character = line.charAt(j);
      if (",.!".indexOf(character) > -1) {
        System.out.println("There is a punctuation mark on line No " + i);
        break;
      }
    }
    i++;
  }

  f.close();
}
```

Second approach

```
static final String PATH = "c:/temp/";

public static void main(String[] args) throws Exception {
  int i;
  String line;
  Scanner f = new Scanner(Paths.get(PATH + "a_file.txt"));

  i = 1;
  while (f.hasNextLine()) {
    line = f.nextLine();
    if (line.indexOf(",") > -1 || line.indexOf(".") > -1 || line.indexOf("!") > -1) {
      System.out.println("There is a punctuation mark on line No " + i);
    }
    i++;
  }

  f.close();
}
```

Chapter 41

41.2 Review Exercises

1. *Solution*

First approach

```
static final String PATH = "c:/temp/";

public static void main(String[] args) throws Exception {
  int i, total, count, number;

  Scanner fin = new Scanner(Paths.get(PATH + "f_data41.2-1.txt"));
  String values = fin.nextLine();
  fin.close();

  total = 0;
  count = 0;
  for (i = 0; i < 10; i++) {
    number = Integer.parseInt(values.substring(i * 3, i * 3 + 2));
    if (number > 50) {
      total += number;
      count += 1;
    }
  }

  if (count > 0) {
    System.out.println(total / (double)count);
  }
}
```

Second approach

```
static final String PATH = "c:/temp/";

public static void main(String[] args) throws Exception {
  int i, total, count, number;

  Scanner fin = new Scanner(Paths.get(PATH + "f_data41.2-1.txt"));

  total = 0;
  count = 0;
  for (i = 0; i < 10; i++) {
    number = fin.nextInt();
    if (number > 50) {
      total += number;
      count += 1;
    }
  }

  fin.close();

  if (count > 0) {
    System.out.println(total / (double)count);
  }
}
```

2. Solution

```
static final String PATH = "c:/temp/";

public static void main(String[] args) throws Exception {
  int i, total, count, number;

  Scanner fin = new Scanner(Paths.get(PATH + "f_data41.2-2.txt"));
  String values = fin.nextLine();
  fin.close();

  total = 0;
  count = 0;
  i = 0;
  while (i < values.length() / 4) {
    number = Integer.parseInt(values.substring(i * 4, i * 4 + 3));
    if (number >= 300 && number <= 500) {
      total += number;
      count += 1;
    }
    i++;
  }

  if (count > 0) {
    System.out.println(total / (double)count);
  }
}
```

3. Solution

```
static final String PATH = "c:/temp/";

public static void main(String[] args) throws Exception {
  String maxName, minName, name, line;
  int maximum, minimum, grade, commaPosition;

  Scanner fin = new Scanner(Paths.get(PATH + "f_data41.2-3.txt"));

  //Read the first line
  line = fin.nextLine();

  commaPosition = line.indexOf(',');
  grade = Integer.parseInt(line.substring(0, commaPosition));
  name = line.substring(commaPosition + 1);

  maximum = minimum = grade;
  maxName = minName = name;

  //Read the rest of the lines
  while (fin.hasNextLine()) {
    line = fin.nextLine();
    commaPosition = line.indexOf(',');
    grade = Integer.parseInt(line.substring(0, commaPosition));
    name = line.substring(commaPosition + 1);

    if (grade > maximum) {
      maximum = grade;
      maxName = name;
    }
    if (grade < minimum) {
      minimum = grade;
      minName = name;
    }
  }

  fin.close();

  System.out.println(maxName);
  System.out.println(minName);
}
```

4. Solution

```
static final String PATH = "c:/temp/";

public static void main(String[] args) throws Exception {
  String description, maximumDescription, keyword, stringInfo1, stringInfo2;
  double width, length, height, volume, total;
  double maximum;

  System.out.print("Enter keyword to search: ");
  keyword = cin.nextLine().toLowerCase();

  Scanner fin = new Scanner(Paths.get(PATH + "f_data41.2-4.txt"));

  maximum = total = 0;
  maximumDescription = stringInfo1 = stringInfo2 = "";
  while (fin.hasNextDouble()) {
    width = fin.nextDouble();
    length = fin.nextDouble();
    height = fin.nextDouble();
    description = fin.nextLine().trim();

    if (description.toLowerCase().indexOf(keyword) != -1) {
      stringInfo1 += description + " - Dimensions: " + width + " x " + length + " x " + height + "\n";
    }

    volume = width * length * height / 1728;
    stringInfo2 += description + " - Volume = " + volume + " cubic feet\n";

    total += volume;

    if (volume > maximum) {
      maximum = volume;
      maximumDescription = description;
    }
  }

  fin.close();

  if (stringInfo1 != "") {
    System.out.println("Keyword ' " + keyword + "' found!");
    System.out.println(stringInfo1);
  }

  System.out.println("Volume of each item:");
  System.out.println(stringInfo2);

  System.out.println("Total volume: " + total);
  System.out.println("Greatest box: " + maximumDescription);
}
```

5. Solution

First approach

```
static final String PATH = "c:/temp/";

public static void main(String[] args) throws Exception {
  String filename1, filename2, content;

  System.out.print("Enter filename No 1: ");
  filename1 = cin.nextLine();
  if (!filename1.substring(filename1.length() - 4).equals(".txt")) {
    System.out.println("Wrong filename");
  }
  else {
    System.out.print("Enter filename No 2: ");
    filename2 = cin.nextLine();
    if (!filename2.substring(filename1.length() - 4).equals(".txt")) {
      System.out.println("Wrong filename");
    }
    else {
      Scanner fin;
      content = "";

      fin =  new Scanner(Paths.get(filename2));
      while (fin.hasNextLine()) {
        content += fin.nextLine() + "\n";
      }
      fin.close();

      fin = new Scanner(Paths.get(filename1));
      while (fin.hasNextLine()) {
        content += fin.nextLine() + "\n";
      }
      fin.close();
      FileWriter fout = new FileWriter("final.txt");
      fout.write(content);
      fout.close();
    }
  }
}
```

Second approach

```
static final String PATH = "c:/temp/";

public static void main(String[] args) throws Exception {
  String filename1, filename2, content;

  System.out.print("Enter filename No 1: ");
  filename1 = cin.nextLine();
  if (!filename1.substring(filename1.length() - 4).equals(".txt")) {
    System.out.println("Wrong filename");
  }
  else {
    System.out.print("Enter filename No 2: ");
    filename2 = cin.nextLine();
    if (!filename2.substring(filename1.length() - 4).equals(".txt")) {
      System.out.println("Wrong filename");
    }
    else {
      Scanner fin1 = new Scanner(Paths.get(filename1));
      Scanner fin2 = new Scanner(Paths.get(filename2));
      FileWriter fout = new FileWriter("final.txt");

      content = "";

      while (fin2.hasNextLine()) {
        content += fin2.nextLine() + "\n";
      }

      while (fin1.hasNextLine()) {
        content += fin1.nextLine() + "\n";
      }

      fout.write(content);

      fin1.close();
      fin2.close();
      fout.close();
    }
  }
}
```

6. Solution

```
static final String PATH = "c:/temp/";
static final int ELEMENTS = 15;

public static void main(String[] args) throws Exception {
  int i, m, n;
  double[] numbers = new double[ELEMENTS];
  double temp;

  Scanner fin = new Scanner(Paths.get(PATH + "f_data41.2-6.txt"));
  for (i = 0; i < ELEMENTS; i++) {
    numbers[i] = Double.parseDouble(fin.nextLine());
  }
  fin.close();

  for (m = 1; m <= ELEMENTS - 1; m++) {
    for (n = ELEMENTS - 1; n >= m; n--) {
      if (numbers[n] < numbers[n - 1]) {
        temp = numbers[n];
        numbers[n] = numbers[n - 1];
        numbers[n - 1] = temp;
      }
    }
  }

  FileWriter fout = new FileWriter(PATH + "f_data41.2-5.txt", true);
  fout.write("\n********* Sorted numbers ************\n");
  for (double number : numbers) {
    fout.write(number + "\n");
  }
  fout.close();
}
```

7. Solution

```
static final String PATH = "c:/temp/";
static final int NUMBER_OF_CITIES = 8;

public static void main(String[] args) throws Exception {
  int i;
  boolean onCityLine;
  double total, average, maximum;

  String[] cities = new String[NUMBER_OF_CITIES];
  double[] temperatures = new double[NUMBER_OF_CITIES];

  Scanner fin = new Scanner(Paths.get(PATH + "f_data41.2-6.txt"));

  //Split read values into two arrays (cities and temperatures)
  i = 0;
  onCityLine = true;
  while (fin.hasNextLine()) {
    if (onCityLine) {
      cities[i] = fin.nextLine();
    }
    else {
      temperatures[i++] = Double.parseDouble(fin.nextLine());
    }
    onCityLine = !onCityLine;  //true becomes false, and false becomes true
  }

  fin.close();

  total = 0;
  for (i = 0; i < NUMBER_OF_CITIES; i++) {
    total += temperatures[i];
  }

  average = total / NUMBER_OF_CITIES;
  System.out.println(average);

  //Find greatest temperature
  maximum = temperatures[0];
  for (i = 1; i <= NUMBER_OF_CITIES - 1; i++) {
    if (temperatures[i] > maximum) {
      maximum = temperatures[i];
    }
  }

  System.out.println("Highest temperature: " + maximum);
  for (i = 0; i < NUMBER_OF_CITIES; i++) {
    if (temperatures[i] == maximum) {
      System.out.println(cities[i]);
    }
  }
}
```

8. Solution

```
static final String PATH = "c:/temp/";

static String abbreviate(String word) {
  if (word.length() > 10) {
    return "" + word.charAt(0) + (word.length() - 2) + word.charAt(word.length() - 1);
  }
  else {
    return word;
  }
}

public static void main(String[] args) throws Exception {
  String line, word;
  int spaceIndex;
  Scanner fin = new Scanner(Paths.get(PATH + "f_data41.2-8.txt"));

  while (fin.hasNextLine()) {
    line = fin.nextLine();

    spaceIndex = line.indexOf(" ");  //Find the first space
    while ((int)spaceIndex != -1) {
      word = line.substring(0, spaceIndex);   //Get the word and
      line = line.substring(spaceIndex + 1);  //remove the word from line

      System.out.print(abbreviate(word) + " ");

      spaceIndex = line.indexOf(" ");
    }
    //Display the last word remained in the string line
    System.out.println(abbreviate(line));
  }

  fin.close();
}
```

9. Solution

```
static final String PATH = "c:/temp/";

static String pigLatinTranslator(String word) {
  int i, firstVowelIndex;
  String pigLatinWord, vowels = "aeiou";

  if (vowels.indexOf(word.charAt(0)) != -1) { //If first character is vowel
    pigLatinWord = word + "way";
  }
  else {
    //Find the index of the first vowel
    firstVowelIndex = -1;
    for (i = 0; i <= word.length() - 1; i++) {
      if (vowels.indexOf(word.charAt(i)) != -1) {
        firstVowelIndex = i;
        break;
      }
    }

    //If at least one vowel found
    if (firstVowelIndex != -1) {
      //Move the consonants to the end
      word = word.substring(firstVowelIndex) + word.substring(0, firstVowelIndex);
    }
    pigLatinWord = word + "ay";
  }
  return pigLatinWord;
}

public static void main(String[] args) throws Exception {
  String line, word;
  int spaceIndex;
  Scanner fin = new Scanner(Paths.get(PATH + "f_data41.2-9.txt"));
  FileWriter fout = new FileWriter(PATH + "pig_latin_translation.txt");

  while (fin.hasNextLine()) {
    line = fin.nextLine();
    spaceIndex = line.indexOf(" ");  //Find the first space
    while ((int)spaceIndex != -1) {
      word = line.substring(0, spaceIndex);   //Get the word and
      line = line.substring(spaceIndex + 1);  //remove the word from line

      fout.write(pigLatinTranslator(word) + " ");

      spaceIndex = line.indexOf(" ");
    }
    //Write the last word remained in the string line
    fout.write(pigLatinTranslator(line) + "\n");
  }

  fin.close();
  fout.close();
}
```

10. Solution

```
static final String PATH = "c:/temp/";
static final String X = " ABCDEFGHIJKLMNOPQRSTUVWXYZ";   //The space character remains as is
static final String Y = " JKWCTAMEDXSLFBYUNGRZOIQVHP";

public static void main(String[] args) throws Exception {
  String initialMessage, encryptedMessage;
  char letter;
  int i, j;

  System.out.print("Enter a message to encrypt: ");
  initialMessage = cin.nextLine().toUpperCase();

  encryptedMessage = "";
  for (i = 0; i < initialMessage.length(); i++) {
    letter = initialMessage.charAt(i);

    //Search for letter in const X
    for (j = 0; j < 27; j++) {
      if (letter == X.charAt(j)) {
        //Create encrypted message using letters from const Y
        encryptedMessage += Y.charAt(j);
        break;
      }
    }
  }

  FileWriter fout = new FileWriter(PATH + "encrypted.txt");
  fout.write(encryptedMessage);
  fout.close();
}
```

11. Solution

```
static final String PATH = "c:/temp/";
static final String X = " ABCDEFGHIJKLMNOPQRSTUVWXYZ";   //The space character remains as is
static final String Y = " JKWCTAMEDXSLFBYUNGRZOIQVHP";

public static void main(String[] args) throws Exception {
  String initialMessage, encryptedMessage;
  char letter;
  int i, j;

  Scanner fin = new Scanner(Paths.get(PATH + "encrypted.txt"));
  encryptedMessage = fin.nextLine();
  fin.close();

  initialMessage = "";
  for (i = 0; i < encryptedMessage.length(); i++) {
    letter = encryptedMessage.charAt(i);

    //Search for letter in const Y
    for (j = 0; j < 27; j++) {
      if (letter == Y.charAt(j)) {
        //Create decrypted message using letters from const X
        initialMessage += X.charAt(j);
        break;
      }
    }
  }

  FileWriter fout = new FileWriter(PATH + "decrypted.txt");
  fout.write(initialMessage);
  fout.close();
}
```

12. Solution

First approach

```
static void copyFile(String source, String destination) throws Exception {
  String x;

  Scanner fin = new Scanner(Paths.get(source));
  x = "";
  while (fin.hasNextLine()) {
    x += fin.nextLine() + "\n";
  }
  fin.close();

  FileWriter fout = new FileWriter(destination);
  fout.write(x);
  fout.close();
}
```

Second approach

```
static void copyFile(String source, String destination) throws Exception {
  Scanner fin = new Scanner(Paths.get(source));
  FileWriter fout = new FileWriter(destination);
  while (fin.hasNextLine()) {
    fout.write(fin.nextLine() + "\n");
  }

  fin.close();
  fout.close();
}
```

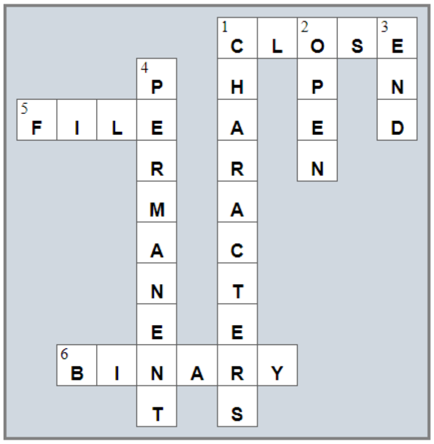
13. Solution

```
class Triangle {
  static final String PATH = "c:/temp/";

  private double _sideA, _sideB, _sideC;

  //Define the constructor
  public Triangle() throws Exception {
    Scanner fin = new Scanner(Paths.get(PATH + "f_data41.2-13.txt"));
    this._sideA = Double.parseDouble(fin.nextLine());
    this._sideB = Double.parseDouble(fin.nextLine());
    this._sideC = Double.parseDouble(fin.nextLine());
    fin.close();
  }

  public boolean canBeTriangle() {
    if (this._sideA > 0 && this._sideB > 0 && this._sideC > 0 &&
        this._sideA + this._sideB > this._sideC &&
        this._sideB + this._sideC > this._sideA &&
        this._sideC + this._sideA > this._sideB) {
      return true;
    }
    else {
      return false;
    }
  }

  public void displayLengths() {
    System.out.println("Side A: " + this._sideA);
    System.out.println("Side B: " + this._sideB);
    System.out.println("Side C: " + this._sideC);
    if (this.canBeTriangle()) {
      System.out.println("Can be lengths of the three sides of a triangle!");
    }
    else {
      System.out.println("Cannot be lengths of the three sides of a triangle!");
    }
  }

  public void displayArea() {
    double s, area;

    if (this.canBeTriangle()) {
      s = (this._sideA + this._sideB + this._sideC) / 2;
      area = Math.sqrt(s * (s - this._sideA) * (s - this._sideB) * (s - this._sideC));
      System.out.println("Area: " + area);
    }
  }

  public void displayPerimeter() {
    double perimeter;

    if (this.canBeTriangle()) {
      perimeter = this._sideA + this._sideB + this._sideC;
      System.out.println("Perimeter: " + perimeter);
    }
  }
}

public class App {
  public static void main(String[] args) throws Exception {
    Triangle tr = new Triangle();

    tr.displayLengths();
    tr.displayArea();
    tr.displayPerimeter();
  }
}
```

Review in “Files”

Review Crossword Puzzle

1.



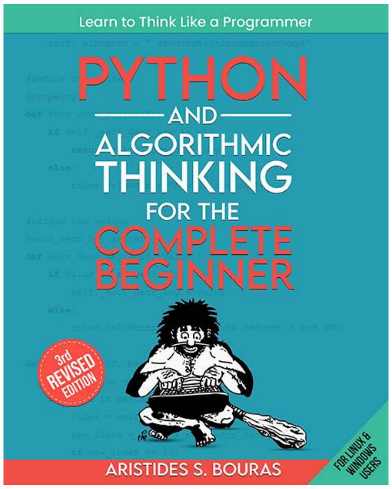
Some Final Words from the Author

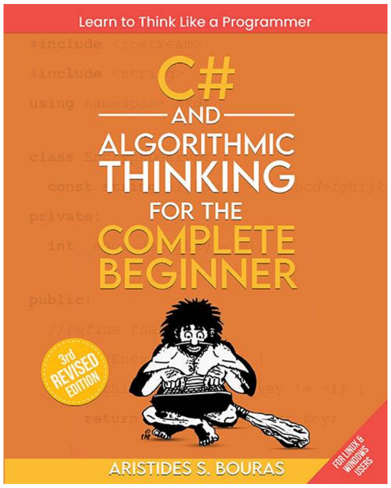
I hope you thoroughly enjoyed reading this book. I made every possible effort to ensure it is beneficial and comprehensible, even for people who may have no prior experience in programming.

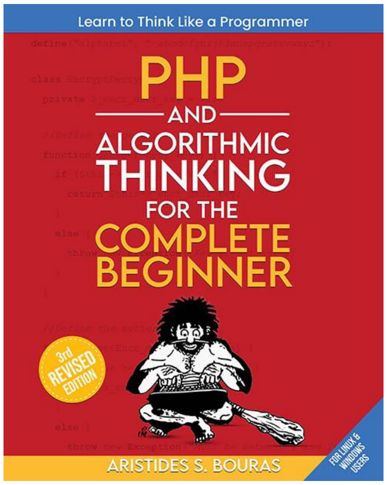
If you found this book valuable, please consider visiting the web store where you purchased it, as well as goodreads.com, to show your appreciation by writing a positive review and awarding as many stars as you think appropriate. By doing so, you will motivate me to keep writing and, of course, you'll be assisting other readers in discovering my work.

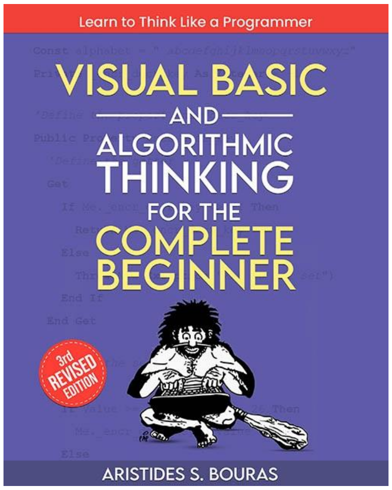
And always remember: Learning is a lifelong, continuous process that begins at birth and extends throughout your lifetime!

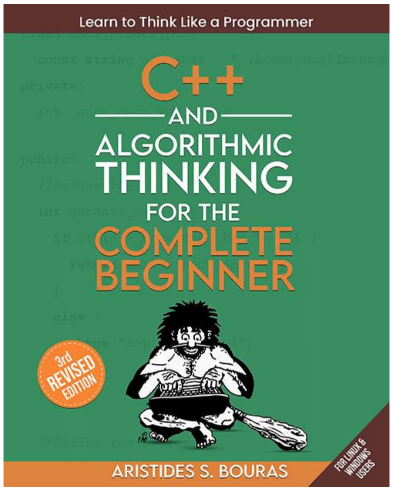
Some of my Books

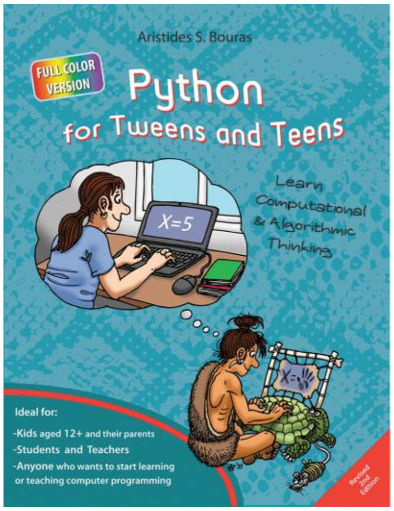


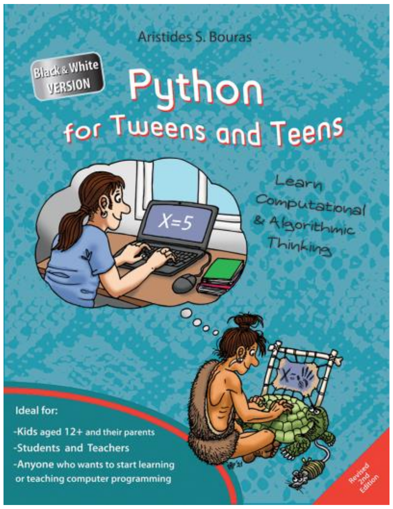


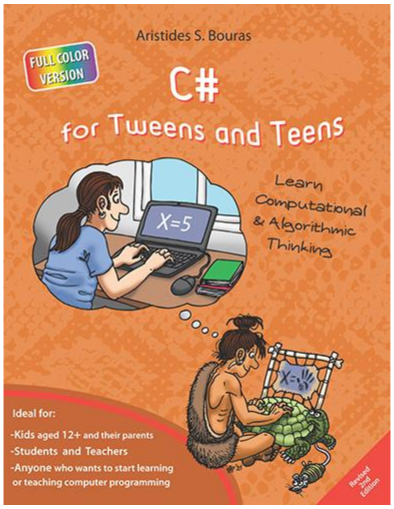


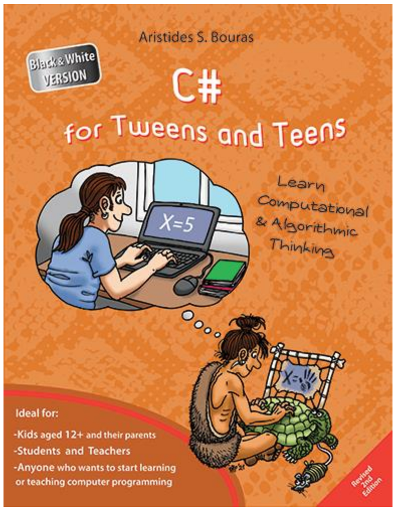


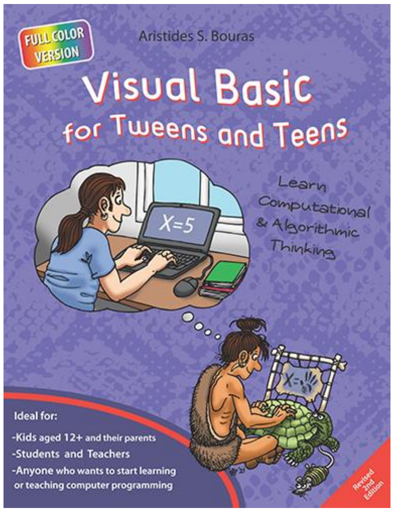


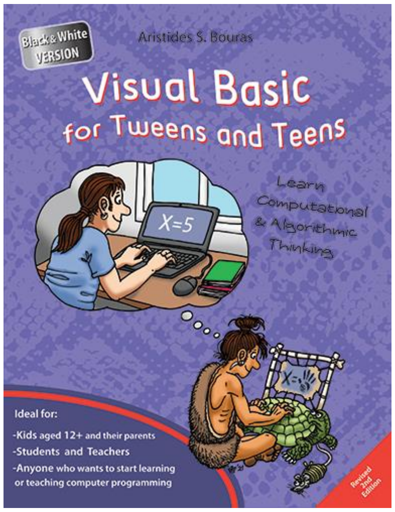

Aristides S. Bouras
FULL COLOR VERSION
Python
for Tweens and Teens
Learn Computational & Algorithmic Thinking
X=5
Ideal for:
-Kids aged 12+ and their parents
-Students and Teachers
-Anyone who wants to start learning or teaching computer programming
Revised 2nd Edition


Aristides S. Bouras
Black & White VERSION
Python
for Tweens and Teens
Learn Computational & Algorithmic Thinking
X=5
Ideal for:
-Kids aged 12+ and their parents
-Students and Teachers
-Anyone who wants to start learning or teaching computer programming
Revised 2nd Edition


Aristides S. Bouras
FULL COLOR VERSION
C#
for Tweens and Teens
Learn Computational & Algorithmic Thinking
X=5
Ideal for:
-Kids aged 12+ and their parents
-Students and Teachers
-Anyone who wants to start learning or teaching computer programming
Revised 2nd Edition


Black & White VERSION
Aristides S. Bouras
C#
for Tweens and Teens
Learn Computational & Algorithmic Thinking
X=5
Ideal for:
-Kids aged 12+ and their parents
-Students and Teachers
-Anyone who wants to start learning or teaching computer programming
Revised 2nd Edition


FULL COLOR VERSION
Aristides S. Bouras
Visual Basic
for Tweens and Teens
Learn Computational & Algorithmic Thinking
X=5
Ideal for:
-Kids aged 12+ and their parents
-Students and Teachers
-Anyone who wants to start learning or teaching computer programming
Revised 2nd Edition


Black & White VERSION
Aristides S. Bouras
Visual Basic
for Tweens and Teens
Learn Computational & Algorithmic Thinking
X=5
Ideal for:
-Kids aged 12+ and their parents
-Students and Teachers
-Anyone who wants to start learning or teaching computer programming
Revised 2nd Edition

For more information about my books visit my website:

https://www.bouraspage.com