PROGRAMMING EXERCISES

MyProgrammingLab™

Debugging TIP

The compiler usually gives a reason for a syntax error. If you don't know how to correct it, compare your program closely, character by character, with similar examples in the text.

learn from examples

Pedagogical Note

Instructors may ask you to document your analysis and design for selected exercises. Use your own words to analyze the problem, including the input, output, and what needs to be computed, and describe how to solve the problem in pseudocode.

document analysis and design

Sections 2.2–2.12

2.1 (*Convert Celsius to Fahrenheit*) Write a program that reads a Celsius degree in a `double` value from the console, then converts it to Fahrenheit and displays the result. The formula for the conversion is as follows:

```
fahrenheit = (9 / 5) * celsius + 32
```

Hint: In Java, `9 / 5` is `1`, but `9.0 / 5` is `1.8`.

Here is a sample run:

```
Enter a degree in Celsius: 43 Enter
43 Celsius is 109.4 Fahrenheit
```

2.2 (*Compute the volume of a cylinder*) Write a program that reads in the radius and length of a cylinder and computes the area and volume using the following formulas:

```
area = radius * radius * π
volume = area * length
```

Here is a sample run:

```
Enter the radius and length of a cylinder: 5.5 12 Enter
The area is 95.0331
The volume is 1140.4
```

2.3 (*Convert feet into meters*) Write a program that reads a number in feet, converts it to meters, and displays the result. One foot is `0.305` meter. Here is a sample run:

```
Enter a value for feet: 16.5 Enter
16.5 feet is 5.0325 meters
```

2.4 (*Convert pounds into kilograms*) Write a program that converts pounds into kilograms. The program prompts the user to enter a number in pounds, converts it to kilograms, and displays the result. One pound is `0.454` kilograms. Here is a sample run:

```
Enter a number in pounds: 55.5 Enter
55.5 pounds is 25.197 kilograms
```

***2.5** (*Financial application: calculate tips*) Write a program that reads the subtotal and the gratuity rate, then computes the gratuity and total. For example, if the user enters `10` for subtotal and `15%` for gratuity rate, the program displays `$1.5` as gratuity and `$11.5` as total. Here is a sample run:

```
Enter the subtotal and a gratuity rate: 10 15 Enter
The gratuity is $1.5 and total is $11.5
```

****2.6** (*Sum the digits in an integer*) Write a program that reads an integer between `0` and `1000` and adds all the digits in the integer. For example, if an integer is `932`, the sum of all its digits is `14`.

Hint: Use the `%` operator to extract digits, and use the `/` operator to remove the extracted digit. For instance, `932 % 10 = 2` and `932 / 10 = 93`.

Here is a sample run:

```
Enter a number between 0 and 1000: 999 Enter
The sum of the digits is 27
```

***2.7** (*Find the number of years*) Write a program that prompts the user to enter the minutes (e.g., 1 billion), and displays the number of years and days for the minutes. For simplicity, assume a year has `365` days. Here is a sample run:

```
Enter the number of minutes: 1000000000 Enter
1000000000 minutes is approximately 1902 years and 214 days
```

***2.8** (*Current time*) Listing 2.7, ShowCurrentTime.java, gives a program that displays the current time in GMT. Revise the program so that it prompts the user to enter the time zone offset to GMT and displays the time in the specified time zone. Here is a sample run:

```
Enter the time zone offset to GMT: -5 Enter
The current time is 4:50:34
```

2.9 (*Physics: acceleration*) Average acceleration is defined as the change of velocity divided by the time taken to make the change, as shown in the following formula:

$$a = \frac{v_1 - v_0}{t}$$

Write a program that prompts the user to enter the starting velocity v_0 in meters/second, the ending velocity v_1 in meters/second, and the time span t in seconds, and displays the average acceleration. Here is a sample run:

```
Enter v0, v1, and t: 5.5 50.9 4.5 Enter
The average acceleration is 10.0889
```

2.10 (*Science: calculating energy*) Write a program that calculates the energy needed to heat water from an initial temperature to a final temperature. Your program should prompt the user to enter the amount of water in kilograms and the initial and final temperatures of the water. The formula to compute the energy is

```
Q = M * (finalTemperature - initialTemperature) * 4184
```

where `M` is the weight of water in kilograms, temperatures are in degrees Celsius, and energy `Q` is measured in joules. Here is a sample run:

```
Enter the amount of water in kilograms: 55.5 Enter
Enter the initial temperature: 3.5 Enter
Enter the final temperature: 10.5 Enter
The energy needed is 1625484.0
```

2.11 (*Population projection*) Rewrite Programming Exercise 1.11 to prompt the user to enter the number of years and displays the population after the number of years. Use the hint in Programming Exercise 1.11 for this program. The population should be cast into an integer. Here is a sample run of the program:

```
Enter the number of years: 5 Enter
The population in 5 years is 325932970
```

2.12 (*Physics: finding runway length*) Given an airplane's acceleration a and take-off speed v, you can compute the minimum runway length needed for an airplane to take off using the following formula:

$$\text{length} = \frac{v^2}{2a}$$

Write a program that prompts the user to enter v in meters/second (m/s) and the acceleration a in meters/second squared (m/s^2), and displays the minimum runway length. Here is a sample run:

```
Enter speed and acceleration: 60 3.5 Enter
The minimum runway length for this airplane is 514.286
```

**2.13 (*Financial application: compound value*) Suppose you save $100 *each* month into a savings account with the annual interest rate 5%. Thus, the monthly interest rate is 0.05/12 = 0.00417. After the first month, the value in the account becomes

```
100 * (1 + 0.00417) = 100.417
```

After the second month, the value in the account becomes

```
(100 + 100.417) * (1 + 0.00417) = 201.252
```

After the third month, the value in the account becomes

```
(100 + 201.252) * (1 + 0.00417) = 302.507
```

and so on.

Write a program that prompts the user to enter a monthly saving amount and displays the account value after the sixth month. (In Exercise 5.30, you will use a loop to simplify the code and display the account value for any month.)

```
Enter the monthly saving amount: 100 Enter
After the sixth month, the account value is $608.81
```

VideoNote
Compute BMI

*2.14 (*Health application: computing BMI*) Body Mass Index (BMI) is a measure of health on weight. It can be calculated by taking your weight in kilograms and dividing by the square of your height in meters. Write a program that prompts the user to enter a weight in pounds and height in inches and displays the BMI. Note that one pound is `0.45359237` kilograms and one inch is `0.0254` meters. Here is a sample run:

```
Enter weight in pounds: 95.5 Enter
Enter height in inches: 50 Enter
BMI is 26.8573
```

2.15 (*Geometry: distance of two points*) Write a program that prompts the user to enter two points `(x1, y1)` and `(x2, y2)` and displays their distance between them. The formula for computing the distance is $\sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$. Note that you can use `Math.pow(a, 0.5)` to compute $\sqrt{a}$. Here is a sample run:

```
Enter x1 and y1: 1.5 -3.4 Enter
Enter x2 and y2: 4 5 Enter
The distance between the two points is 8.764131445842194
```

2.16 (*Geometry: area of a hexagon*) Write a program that prompts the user to enter the side of a hexagon and displays its area. The formula for computing the area of a hexagon is

$$\text{Area} = \frac{3\sqrt{3}}{2}s^2,$$

where s is the length of a side. Here is a sample run:

```
Enter the side: 5.5 Enter
The area of the hexagon is 78.5895
```

***2.17** (*Science: wind-chill temperature*) How cold is it outside? The temperature alone is not enough to provide the answer. Other factors including wind speed, relative humidity, and sunshine play important roles in determining coldness outside. In 2001, the National Weather Service (NWS) implemented the new wind-chill temperature to measure the coldness using temperature and wind speed. The formula is

$$t_{wc} = 35.74 + 0.6215t_a - 35.75v^{0.16} + 0.4275t_a v^{0.16}$$

where t_a is the outside temperature measured in degrees Fahrenheit and v is the speed measured in miles per hour. t_{wc} is the wind-chill temperature. The formula cannot be used for wind speeds below 2 mph or temperatures below -58°F or above 41°F.

Write a program that prompts the user to enter a temperature between -58°F and 41°F and a wind speed greater than or equal to `2` and displays the wind-chill temperature. Use `Math.pow(a, b)` to compute $v^{0.16}$. Here is a sample run:

```
Enter the temperature in Fahrenheit between -58°F and 41°F:
5.3 Enter
Enter the wind speed (>=2) in miles per hour: 6 Enter
The wind chill index is -5.56707
```

2.18 (*Print a table*) Write a program that displays the following table. Cast floating-point numbers into integers.

```
a      b      pow(a, b)
1      2      1
2      3      8
3      4      81
4      5      1024
5      6      15625
```

***2.19** (*Geometry: area of a triangle*) Write a program that prompts the user to enter three points `(x1, y1)`, `(x2, y2)`, `(x3, y3)` of a triangle and displays its area. The formula for computing the area of a triangle is

$$s = (\text{side1} + \text{side2} + \text{side3})/2;$$

$$\text{area} = \sqrt{s(s - \text{side1})(s - \text{side2})(s - \text{side3})}$$

Here is a sample run:

```
Enter three points for a triangle: 1.5 -3.4 4.6 5 9.5 -3.4 Enter
The area of the triangle is 33.6
```

Sections 2.13–2.17

***2.20** (*Financial application: calculate interest*) If you know the balance and the annual percentage interest rate, you can compute the interest on the next monthly payment using the following formula:

$$\text{interest} = \text{balance} \times (\text{annualInterestRate}/1200)$$

Write a program that reads the balance and the annual percentage interest rate and displays the interest for the next month. Here is a sample run:

```
Enter balance and interest rate (e.g., 3 for 3%): 1000 3.5 Enter
The interest is 2.91667
```

***2.21** (*Financial application: calculate future investment value*) Write a program that reads in investment amount, annual interest rate, and number of years, and displays the future investment value using the following formula:

$$\text{futureInvestmentValue} =$$

$$\text{investmentAmount} \times (1 + \text{monthlyInterestRate})^{\text{numberOfYears}*12}$$

For example, if you enter amount **1000**, annual interest rate **3.25%**, and number of years **1**, the future investment value is **1032.98**.

Here is a sample run:

```
Enter investment amount: 1000.56 Enter
Enter annual interest rate in percentage: 4.25 Enter
Enter number of years: 1 Enter
Accumulated value is $1043.92
```

***2.22** (*Financial application: monetary units*) Rewrite Listing 2.10, ComputeChange.java, to fix the possible loss of accuracy when converting a **double** value to an **int** value. Enter the input as an integer whose last two digits represent the cents. For example, the input **1156** represents **11** dollars and **56** cents.

***2.23** (*Cost of driving*) Write a program that prompts the user to enter the distance to drive, the fuel efficiency of the car in miles per gallon, and the price per gallon, and displays the cost of the trip. Here is a sample run:

```
Enter the driving distance: 900.5 Enter
Enter miles per gallon: 25.5 Enter
Enter price per gallon: 3.55 Enter
The cost of driving is $125.36
```