Programming Exercises

Chapter 1: Introduction to Computers, Programming, and Java

1.1 (*Display three messages*) Write a program that displays `Welcome to Java`, `Welcome to Computer Science`, and `Programming is fun`.

***1.3** (*Display a pattern*) Write a program that displays the following pattern:

```
    J       A       V       V      A
    J      A A       V     V      A A
J   J     AAAAA       V V       AAAAA
 J J     A     A       V      A      A
```

1.5 (*Compute expressions*) Write a program that displays the result of

$$\frac{9.5 \times 4.5 - 2.5 \times 3}{45.5 - 3.5}.$$

1.7 (*Approximate π*) π can be computed using the following formula:

$$\pi = 4 \times \left(1 - \frac{1}{3} + \frac{1}{5} - \frac{1}{7} + \frac{1}{9} - \frac{1}{11} + \ \ldots\ \right)$$

Write a program that displays the result of $4 \times \left(1 - \frac{1}{3} + \frac{1}{5} - \frac{1}{7} + \frac{1}{9} - \frac{1}{11}\right)$ and $4 \times \left(1 - \frac{1}{3} + \frac{1}{5} - \frac{1}{7} + \frac{1}{9} - \frac{1}{11} + \frac{1}{13}\right)$. Use `1.0` instead of `1` in your program.

1.9 (*Area and perimeter of a rectangle*) Write a program that displays the area and perimeter of a rectangle with the width of `4.5` and height of `7.9` using the following formula:

$$area = width \times height$$

*1.11 (*Population projection*) The U.S. Census Bureau projects population based on the following assumptions:

- One birth every 7 seconds
- One death every 13 seconds
- One new immigrant every 45 seconds

Write a program to display the population for each of the next five years. Assume the current population is 312,032,486 and one year has 365 days. *Hint*: In Java, if two integers perform division, the result is an integer. The fractional part is truncated. For example, `5 / 4` is `1` (not `1.25`) and `10 / 4` is `2` (not `2.5`). To get an accurate result with the fractional part, one of the values involved in the division must be a number with a decimal point. For example, `5.0 / 4` is `1.25` and `10 / 4.0` is `2.5`.

Chapter 2: Elementary Programming

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
```

2.3 (*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
```

***2.5** (*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
```

***2.7** (*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
```

2.9 (*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
```

**2.13 (*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
```

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
```

***2.17** (*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
```

***2.19** (*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
```

***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
```

***2.23** (*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
```

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no star = easy
* = moderate
** = hard
*** = challenging
