

## PROGRAMMING EXERCISES

1. Write a program that takes a decimal value between 1 and 10 and displays its equivalent Roman numeral value. Display an error message if the value entered is outside of the acceptable range. Write a two class solution. The second class should allow the user to input a test value.
2. Ever heard of acid rain? This is rainfall with a very low pH. Write an application that will enable you to display the pH level for a swimming pool and whether an additive is needed or not. The pH is a measure of how acidic or basic the water is and is typically given on a 0–14 scale. Below 7.0 is defined as acidic, with 7 being neutral. Levels much above 7 are said to be basic or alkaline. Everything that enters a pool has a pH value. To have pH in balance the water is adjusted with additions of pH increasers (bases) or pH decreasers (acids) to achieve the range of 7.2–7.8. Allow the user to input the pH level number. Display a message indicating the health (i.e., acidic, neutral, or alkaline) and whether an additive is required. If an additive is required, identify the type. The water should be described as acidic, requiring bases, when the pH is lower than 7. Consider the pH level as neutral for pH levels in the range 7–7.8 and alkaline, requiring acid for pH levels greater than 7.8. Display an appropriate message when invalid values are entered.
3. Write a two-class solution to calculate and display a person's body mass index (BMI). BMI is an internationally used measure of obesity. Depending on where you live, the Imperial BMI formula or the Metric Imperial Formula is used. Once the BMI is calculated, display a message of the person's status. Prompt the user for both their weight and height. The BMI status categories, as recognized by the U.S. Department of Health & Human Services, are given in the following table:

BMI	Weight Status
Below 18.5	Underweight
18.5–24.9	Normal
25–29.9	Overweight
30 & above	Obese

Provide constructors and methods so that both imperial and metric objects can be instantiated. Use the second class to test your design.

4. Write a program that calculates the take-home pay for an employee. The two types of employees are salaried and hourly. Allow the user to

input the employee's first and last name, id, and type. If an employee is salaried, allow the user to input the salary amount. If an employee is hourly, allow the user to input the hourly rate and the number of hours clocked for the week. For hourly employees, overtime is paid for hours over 40 at a rate of 1.5 of the base rate. For all employees' take-home pay, federal tax of 18% is deducted. A retirement contribution of 10% and a Social Security tax rate of 6% should also be deducted. Use appropriate constants. Design an object-oriented solution. Create a second class to test your design.

5. A large Internet merchandise provider determines its shipping charges based on the number of items purchased. As the number increases, the shipping charges proportionally decrease. This is done to encourage more purchases. If a single item is purchased, the shipping charge is \$2.99. When customers purchase between 2 and 5 items, they are charged the initial \$2.99 for the first item and then \$1.99 per item for the remaining items. For customers who purchase more than 5 items but less than 15, they are charged the initial \$2.99 for the first item, \$1.99 per item for items 2 through 5, and \$1.49 per item for the remaining items. If they purchase 15 or more items, they are charged the initial \$2.99 for the first item, \$1.99 per item for items 2 through 5, and \$1.49 per item for items 6 through 14, and then just \$0.99 per item for the remaining items. Allow the user to enter the number of items purchased. Define appropriate constants, use the `decimal` data type, and display the shipping formatted charges.
6. Write an application that computes the area of a circle, rectangle, and cylinder. Display a menu showing the three options. Allow users to input which figure they want to see calculated. Based on the value inputted, prompt for appropriate dimensions and perform the calculations using the following formulas:

Area of a circle =  $\pi * \text{radius}^2$

Area of a rectangle =  $\text{length} * \text{width}$

Surface area of a cylinder =  $2 * \pi * \text{radius} * \text{height} + 2 * \pi * \text{radius}^2$

Write a modularized solution that includes class methods for inputting data and performing calculations.

7. Create a `Month` class that has a single data member of month number. Include a member method that returns the name of the month and another method that returns the number of days in the month. The `ToString()` method should return the name and number of



days. Write a second class to test your `Month` class. The second class should allow the user to input a month number. Display the name of the month associated with the number entered and the number of days in that month. For this exercise, use 28 for February. If the user inputs an invalid entry, display an appropriate message.

8. Create an application with four classes. Three of the classes should contain data and behavior characteristics for circle, rectangle, and cylinder. You could extend your solution to problem number 6 and provide behaviors based on the type of object instantiated. For example, in addition to calculating the area of a circle, also provide methods to calculate circumference or radius. For the rectangle, consider providing behaviors to calculate perimeter and the polygon diagonals. For cylinder, consider providing behaviors to calculate the volume and surface area for a closed cylinder. The fourth class should allow the user to input a figure type from a menu of options. Prompt for appropriate values based on the inputted figure type, instantiate an object of the type entered, and display characteristics about the object.
9. Design a solution that prints the amount of profit an organization receives based on its sales. The more sales documented, the larger the profit ratio. Allow the user to input the total sales figure for the organization. Compute the profit based on the following table. Display the sales and profit formatted with commas, decimals, and a dollar symbol. Display the profit ratio formatted with a percent symbol.

0	–	\$1,000:	3.0%
\$1,000.01	–	\$5,000:	3.5%
\$5,000.01	–	\$10,000:	4.0%
over \$10,000:			4.5%

Be sure to design your solution so that all possible situations are accounted for and tested. Use the decimal data type for your solution. What values did you enter and test to verify your program's correctness?

10. Two fuel stops, Canadian Fuel and American Fuel, are positioned near the U.S. Canadian border. At the Canadian station, gas is sold by the liter. On the American side, it is sold by the gallon. Write an application that allows the user to input information from both stations and make a decision as to which station offers the most economical fuel price. Test your application with 1.259 per liter against 4.50 per gallon. Once the decision is made, display the equivalent prices.