2 Introduction to C++ Programming: Solutions

What's in a name? that which we call a rose
By any other name would smell as sweet.
—William Shakespeare

When faced with a decision, I always ask, "What would be the most fun?"
—Peggy Walker

"Take some more tea," the March Hare said to Alice, very earnestly. "I've had nothing yet," Alice replied in an offended tone: "so I can't take more." "You mean you can't take less," said the Hatter: "it's very easy to take more than nothing."
—Lewis Carroll

High thoughts must have high language.
—Aristophane

Objectives

In this chapter you'll learn:

- To write simple computer programs in C++.
- To write simple input and output statements.
- To use fundamental types.
- Basic computer memory concepts.
- To use arithmetic operators.
- The precedence of arithmetic operators.
- To write simple decision-making statements.

Self-Review Exercises

2.1 Fill in the blanks in each of the following.

a) Every C++ program begins execution at the function _____.

ANS: `main`.

b) A _____ begins the body of every function and a _____ ends the body.

ANS: left brace ({), right brace (}).

c) Every C++ statement ends with a(n) _____.

ANS: semicolon.

d) The escape sequence `\n` represents the _____ character, which causes the cursor to position to the beginning of the next line on the screen.

ANS: newline.

e) The _____ statement is used to make decisions.

ANS: `if`.

2.2 State whether each of the following is *true* or *false*. If *false*, explain why. Assume the statement `using std::cout;` is used.

a) Comments cause the computer to print the text after the `//` on the screen when the program is executed.

ANS: False. Comments do not cause any action to be performed when the program is executed. They are used to document programs and improve their readability.

b) The escape sequence `\n`, when output with `cout` and the stream insertion operator, causes the cursor to position to the beginning of the next line on the screen.

ANS: True.

c) All variables must be declared before they are used.

ANS: True.

d) All variables must be given a type when they are declared.

ANS: True.

e) C++ considers the variables `number` and `NuMbEr` to be identical.

ANS: False. C++ is case sensitive, so these variables are unique.

f) Declarations can appear almost anywhere in the body of a C++ function.

ANS: True.

g) The modulus operator (`%`) can be used only with integer operands.

ANS: True.

h) The arithmetic operators `*`, `/`, `%`, `+` and – all have the same level of precedence.

ANS: False. The operators `*`, `/` and `%` have the same precedence, and the operators `+` and `-` have a lower precedence.

i) A C++ program that prints three lines of output must contain three statements using `cout` and the stream insertion operator.

ANS: False. A single statement using `cout` containing multiple `\n` escape sequences also can print several lines.

2.3 Write a *single* C++ statement to accomplish each of the following (assume that `using` declarations have *not* been used):

a) Declare the variables `c`, `thisIsAVariable`, `q76354` and `number` to be of type `int`.

ANS:
```
int c, thisIsAVariable, q76354, number;
```

b) Prompt the user to enter an integer. End your prompting message with a colon (:) followed by a space and leave the cursor positioned after the space.

ANS:
```
std::cout << "Enter an integer: ";
```

c) Read an integer from the user at the keyboard and store it in integer variable `age`.

ANS:
```
std::cin >> age;
```

d) If the variable number is not equal to 7, print "The variable number is not equal to 7".

ANS:
```
if ( number != 7 )
   std::cout << "The variable number is not equal to 7\n";
```

e) Print the message "This is a C++ program" on one line.

ANS:
```
std::cout << "This is a C++ program\n";
```

f) Print the message "This is a C++ program" on two lines. End the first line with C++.

ANS:
```
std::cout << "This is a C++\nprogram\n";
```

g) Print the message "This is a C++ program" with each word on a separate line.

ANS:
```
std::cout << "This\nis\na\nC++\nprogram\n";
```

h) Print the message "This is a C++ program". Separate each word from the next by a tab.

ANS:
```
std::cout << "This\tis\ta\tC++\tprogram\n";
```

2.4 Write a statement (or comment) to accomplish each of the following (assume that using declarations have been used):

a) State that a program calculates the product of three integers.

ANS:
```
// Calculate the product of three integers
```

b) Declare the variables x, y, z and result to be of type int (in separate statements).

ANS:
```
int x;
int y;
int z;
int result;
```

c) Prompt the user to enter three integers.

ANS:
```
cout << "Enter three integers: ";
```

d) Read three integers from the keyboard and store them in the variables x, y and z.

ANS:
```
cin >> x >> y >> z;
```

e) Compute the product of the three integers contained in variables x, y and z, and assign the result to the variable result.

ANS:
```
result = x * y * z;
```

f) Print "The product is " followed by the value of the variable result.

ANS:
```
cout << "The product is " << result << endl;
```

g) Return a value from main indicating that the program terminated successfully.

ANS:
```
return 0;
```

2.5 Using the statements you wrote in Exercise 2.4, write a complete program that calculates and displays the product of three integers. Add comments to the code where appropriate. [*Note:* You'll need to write the necessary using declarations.]

ANS:

```
1  // Calculate the product of three integers
2  #include <iostream> // allows program to perform input and output
3  using namespace std;
4
5  // function main begins program execution
6  int main()
7  {
8     int x; // first integer to multiply
9     int y; // second integer to multiply
10    int z; // third integer to multiply
11    int result; // the product of the three integers
12
13    cout << "Enter three integers: "; // prompt user for data
14    cin >> x >> y >> z; // read three integers from user
15    result = x * y * z; // multiply the three integers; store result
```

```
   cout << "The product is " << result << endl; // print result; end line
} // end function main
```

```
Enter three integers: 2 4 6
The product is 48
```

2.6 Identify and correct the errors in each of the following statements (assume that the statement `using std::cout;` is used):

a)
```
if ( c < 7 );
   cout << "c is less than 7\n";
```
ANS: Error: Semicolon after the right parenthesis of the condition in the `if` statement. Correction: Remove the semicolon after the right parenthesis. [*Note:* The result of this error is that the output statement will be executed whether or not the condition in the `if` statement is true.] The semicolon after the right parenthesis is a null (or empty) statement—a statement that does nothing. We'll learn more about the null statement in the next chapter.

b)
```
if ( c => 7 )
   cout << "c is equal to or greater than 7\n";
```
ANS: Error: The relational operator =>. Correction: Change => to >=, and you may want to change "equal to or greater than" to "greater than or equal to" as well.

Exercises

NOTE: Solutions to the programming exercises are located in the `ch02solutions` folder.

2.7 Discuss the meaning of each of the following objects:

a) `std::cin`

ANS: This object refers to the standard input device that is normally connected to the keyboard.

b) `std::cout`

ANS: This object refers to the standard output device that is normally connected to the screen.

2.8 Fill in the blanks in each of the following:

a) _____ are used to document a program and improve its readability.

ANS: Comments

b) The object used to print information on the screen is _____.

ANS: `std::cout`

c) A C++ statement that makes a decision is _____.

ANS: `if`

d) Most calculations are normally performed by _____ statements.

ANS: assignment

e) The _____ object inputs values from the keyboard.

ANS: `std::cin`

2.9 Write a single C++ statement or line that accomplishes each of the following:

a) Print the message `"Enter two numbers"`.

ANS:
```
cout << "Enter two numbers";
```

b) Assign the product of variables `b` and `c` to variable `a`.

ANS:
```
a = b * c;
```

c) State that a program performs a payroll calculation (i.e., use text that helps to document a program).

ANS: `// Payroll calculation program`

d) Input three integer values from the keyboard into integer variables `a`, `b` and `c`.

ANS: `cin >> a >> b >> c;`

2.10 State which of the following are *true* and which are *false*. If *false*, explain your answers.

a) C++ operators are evaluated from left to right.

ANS: False. Some operators are evaluated from left to right, while other operators are evaluated right to left.

b) The following are all valid variable names: `_under_bar_`, `m928134`, `t5`, `j7`, `her_sales`, `his_account_total`, `a`, `b`, `c`, `z`, `z2`.

ANS: True.

c) The statement `cout << "a = 5;";` is a typical example of an assignment statement.

ANS: False. The statement is an output statement. The text `a = 5;` is output to the screen.

d) A valid C++ arithmetic expression with no parentheses is evaluated from left to right.

ANS: False. Arithmetic operators can appear in any order in an expression, so the expression is `a = b + c * d;` actually evaluates from right to left because of the rules of operator precedence.

e) The following are all invalid variable names: `3g`, `87`, `67h2`, `h22`, `2h`.

ANS: False. `h22` is a valid variable name. The others are invalid because they each begin with a digit.

2.11 Fill in the blanks in each of the following:

a) What arithmetic operations are on the same level of precedence as multiplication? _____.

ANS: division and modulus.

b) When parentheses are nested, which set of parentheses is evaluated first in an arithmetic expression? _____.

ANS: innermost.

c) A location in the computer's memory that may contain different values at various times throughout the execution of a program is called a _____.

ANS: variable.

2.12 What, if anything, prints when each of the following C++ statements is performed? If nothing prints, then answer "nothing." Assume `x = 2` and `y = 3`.

a) `cout << x;`

ANS: `2`

b) `cout << x + x;`

ANS: `4`

c) `cout << "x=";`

ANS: `x=`

d) `cout << "x = " << x;`

ANS: `x = 2`

e) `cout << x + y << " = " << y + x;`

ANS: `5 = 5`

f) `z = x + y;`

ANS: nothing.

g) `cin >> x >> y;`

ANS: nothing.

h) `// cout << "x + y = " << x + y;`

ANS: nothing (because it is a comment).

i) `cout << "\n";`

ANS: A newline is output which positions the cursor at the beginning of the next line on the screen.

2.13 Which of the following C++ statements contain variables whose values are replaced?

a) `cin >> b >> c >> d >> e >> f;`
b) `p = i + j + k + 7;`
c) `cout << "variables whose values are replaced";`
d) `cout << "a = 5";`

ANS: Parts (a) and (b).

2.14 Given the algebraic equation $y = ax^3 + 7$, which of the following, if any, are correct C++ statements for this equation?

a) `y = a * x * x * x + 7;`
b) `y = a * x * x * ( x + 7 );`
c) `y = ( a * x ) * x * ( x + 7 );`
d) `y = (a * x) * x * x + 7;`
e) `y = a * ( x * x * x ) + 7;`
f) `y = a * x * ( x * x + 7 );`

ANS: Parts (a), (d) and (e).

2.15 *(Order of Evalution)* State the order of evaluation of the operators in each of the following C++ statements and show the value of x after each statement is performed.

a) `x = 7 + 3 * 6 / 2 - 1;`
ANS: `*, /, +, -, =, 15`
b) `x = 2 % 2 + 2 * 2 - 2 / 2;`
ANS: `%, *, /, +, -, =, 3`
c) `x = ( 3 * 9 * ( 3 + ( 9 * 3 / ( 3 ) ) ) );`
ANS: innermost parentheses around `3, *, /, +, *, *, 324`