



Introduction to C++ Programming: Solutions

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*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

```

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```
16     cout << "The product is " << result << endl; // print result; end line
17 } // 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).

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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 Evaluation*) 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