Chapter 5: Control Structures II (Repetition)

Mark the following statements as true or false.

a. In a counter-controlled while loop, it is not necessary to initialize the loop control variable.

b. It is possible that the body of a while loop may not execute at all.

c. In an infinite while loop, the while expression (the decision maker) is initially false, but after the first iteration it is always true.

d. The while loop:  \( j = 0; \ \text{while} \ (j <= 10) \ j++; \) terminates if \( j > 10 \).

e. A sentinel-controlled while loop is an event-controlled while loop whose termination depends on a special value.

f. A loop is a control structure that causes certain statements to execute over and over.

g. To read data from a file of an unspecified length, an EOF-controlled loop is a good choice.

h. When a while loop terminates, the control first goes back to the statement just before the while statement, and then the control goes to the statement immediately following the while loop.

2. What is the output of the following C++ code?

```cpp
int i = 0; int temp = 1;
while (i < 5) {
    i = i + 1;
    temp = temp * i; }
cout << "i = " << i << " and temp = " << temp << endl;
```

3. What is the output of the following C++ code?
int count = 10;  double sum = 0;

while (count > 8) {
    sum = sum + pow(count, 2.0);
    count--; }
    cout << sum << endl;

4. What is the output of the following C++ code?

    int num = 1;
    while (num * num < 30) {
        cout << num << " ";
        num = num + 1; }
    cout << endl;

5. When does the following while loop terminate?

    ch = 'D';
    while ('A' <= ch && ch <= 'Z')
        ch = static_cast<char>(static_cast<int>(ch) + 1);

6. Suppose that the input is 10 30 16 25 76 -1. What is the output of the following code?

    int num = 0;  int sum;  int count = 0;
    cin >> sum;
    while (count < 3) {
        cin >> num;
        sum = sum + num;
        count++;
    }
    cout << "Sum = " << sum << endl;

7. Suppose that the input is 25 36 18 16 -1. What is the output of the following code?

    int num;  int sum;
```cpp
int num; int sum;

cin >> num;
sum = num;
while (num != -1) {
    cin >> num;
    sum = sum + num;
}
cout << "Sum = " << sum << endl;
```

8. **Suppose that the input is 25 36 18 16 -1. What is the output of the following code?**

```cpp
int num; int sum;

sum = num;
while (num != -1) {
    cin >> num;
    sum = sum + num;
}
cout << "Sum = " << sum << endl;
```

9. **Suppose that the input is 10 -6 12 -5 -4 0. What is the output of the following code?**

```cpp
int num; int sum = 0;

sum = num;
while (num != 0) {
    if (num > 0)
        sum = sum + num;
    else
        sum = sum - num;
    cin >> num;
}
cout << "Sum = " << sum << endl;
```

10. **Correct the following code so that it reads and finds the sum of 20**
numbers:

```cpp
int count = 0;  int sum = 0;

cin >> num;

while (count <= 20);
{
  cin >> num;
  
  count++;
  
  sum = sum + count;
}
```

Consider the following program:

```cpp
#include <iostream>

using namespace std;

int main() {

  int num1, num2; int temp = 0;

  cout << "Enter two integers: ";
  cin >> num1 >> num2 ;
  cout << endl ;

  while (((num1 + num2) % 5) != 0)
{
    
    temp = num1 + num2;
    num1 = num2;
    num2 = temp;
    cout << temp << " ";
  }

  cout << endl;
  return 0; }
```

a. What is the output if the input is 13 16?

b. What is the output if the input is -4 6?

c. What is the output if the input is 3 5?

d. What is the output if the input is 1 3?
Suppose that the input is:

58 23 46 75 98 150 12 176 145-999

What is the output of the following program?

```cpp
#include <iostream> using namespace std;

int main() {
    int num;
    cin >> num;
    while (num != -999) {
        cout << num % 25 << " ";
        cin >> num;
    }
    cout << endl;
    return 0;
}
```

The following program is designed to input two numbers and output their sum. It asks the user if he/she would like to run the program. If the answer is Y or y, it prompts the user to enter two numbers. After adding the numbers and displaying the results, it again asks the user if he/she would like to add more numbers. However, the program fails to do so. Correct the program so that it works properly.

```cpp
#include <iostream>
using namespace std;

int main() {
    char response; double num1; double num2;
    cout << "This program adds two numbers." << endl;
    cout << "Would you like to run the program: (Y/y) ";
    cin >> response;
    cout << endl;
```
while (response == 'Y' && response == 'y') {
    cout << "Enter two numbers: ";
    cin >> num1 >> num2;
    cout << endl;
    cout << num1 << " + " << num2 << " = " << (num1 - num2) << endl;
    cout << "Would you like to add again: (Y/y) ";
    cin >> response;
    cout << endl;
}
return 0; }

14. **What is the output of the following program segment?**
    
    ```cpp
    int count = 0;
    while (count++ < 10)
    cout << "This loop can repeat statements." << endl;
    ```

15. **What is the output of the following program segment?**
    
    ```cpp
    int count = 5;    while (--count > 0)
    cout << count << " ";
    cout << endl;
    ```

16. **What is the output of the following program segment?**
    
    ```cpp
    int count = 5;
    while (count-- > 0)
    cout << count << " ";
    cout << endl;
    ```

17. **What is the output of the following program segment?**
    
    ```cpp
    int count = 1;
    ```
while (count++ <= 5)
    cout << count * (count - 2) << " ";
    cout << endl;

18. **What type of loop, such as counter-control and sentinel-control, will you use in each of the following situations?**

   a. Sum the following series: $1 + (2 / 1) + (3 / 2) + (4 / 3) + (5 / 4) + ... + (10 / 9)$

   b. Sum the following numbers, except the last number: 17, 32, 62, 48, 58, -1

19. **Consider the following for loop:**

```
int j, s;
    s = 0;
    for (j = 1; j <= 10; j++)
        s = s + j * (j - 1);
```

20. **In this for loop, identify the loop control variable, the initialization statement, the loop condition, the update statement, and the statement that updates the value of s. What is the output of the following program segment?**

```
int num = 1;
    int i;
    for (i = 0; i < 5; i++)
        {
            num = num * (5 - i);
            cout << num << " ";
        }
    cout << endl;
```

21. **What is the output of the following program segment?**

```
int num = 0; int count; int y = 0;
    for (count = 1; count <= 5; ++count) {
        num = 3 * (count - 1) + (y - count);
```
21. Assume that the following code is correctly inserted into a program:

```cpp
int s = 0;
int i;
for (i = 0; i < 5; i++) {
    s = 2 * s + i;
    cout << s << " ";
} cout << endl;
```

a. What is the final value of `s`?

   (i) 11     (ii) 4     (iii) 26     (iv) none of these

b. If a semicolon is inserted after the right parenthesis in the `for` loop statement, what is the final value of `s`?

   (i) 0     (ii) 1     (iii) 2     (iv) 5     (v) none of these

c. If the 5 is replaced with a 0 in the `for` loop control expression, what is the final value of `s`?

   (i) 0     (ii) 1     (iii) 2     (iv) none of these

23. State what output, if any, results from each of the following statements:

   a. for(i=1;i<=1; i++)
      
      cout << "*";
      cout << endl;

   b. for(i=2;i>=1; i++)
      
      cout << "*";
      cout << endl;

   c. for(i=1;i<=1; i--)
      
      cout << "*";
      cout << endl;
cout << "*";
cout << endl;

d. for(i=12; i>=9; i--)
    cout << "*";
cout << endl;

e. for (i = 0; i <= 5; i++)
    cout << "*";
    cout << endl;

f. for (i = 1; i <= 5; i++) {
    cout << "*";
    i = i + 1;
}
cout << endl;

24. Write a for statement to add all the multiples of 3 between 1 and 100.

25. What is the output of the following code? Is there a relationship between the variables x and y? If yes, state the relationship? What is the output?

    int x = 19683; int i; int y = 0;
    for (i = x; i >= 1; i = i / 3)
        y++;
    cout << "x = " << x << " y = " << y << endl;

26. Suppose that the input is 5 3 8. What is the output of the following code?

    Assume all variables are properly declared.

    cin >> a >> b >> c;
for (j = 1; j < a; j++) {
    d = b + c;
    b = c;
    c = d;
    cout << c << " ";
} cout << endl;

27. What is the output of the following C++ program segment? Assume all variables are properly declared.

for (j = 0; j < 8; j++) {
    cout << j * 25 << " - ";
    if (j != 7) cout << (j + 1) * 25 - 1 << endl;
    else
        cout << (j + 1) * 25 << endl;  }

28. Suppose that the input is 3 5 7 -6 10. What is the output of the following code?

    int temp = 0; int num;  int count;
    cin >> temp;
    for (count = 0; count <= 3; count++) {
        cout << temp << " ";
        cin >> num;
        temp = temp + num * (count - 1);
    }
    cout << endl;

The following program contains errors that prevent it from compiling and/or running. Correct all such errors.

#include <iostream>
using namespace sdt;

const int SECRET = 111.25;

int main () {

int num1, num2; double x, y;

    cout >> "Enter two integers: ";
cin << num1 << num2;
cout >> endl;
for (count = 1 count > Secret; ++count) {
     
     x = (num1 + num2) / 2.0;
y = (num1 - num2) % 2.0;
num1 := num1 + num2;
num2 := num2 * (count - SECRET - 1)
}

    cout << num1 << " " << num2 << " " << x % 5 << " " << (y % 7) << endl;
}

return; }

How many times will each of the following loops execute? What is the output in each case?

a. x=5; y=50;
    do
     x = x + 10;
    while (x < y);
    cout << x << " " << y << endl;

b. c. x=5; y=80;
    do   x = x * 2;
    while (x < y);
    cout << x << " " << y << endl;

d. x=5; y=20;
    do   x = x + 2;
while (x >= y);
cout << x << " " << y << endl;

e. 
x=5;
y=35; while (x < y)
x = x + 10;
cout << x << " " << y << endl;

f. 
x=5; y=30;
while (x <= y)
x = x * 2;
cout << x << " " << y << endl;

g. 
x=5; y=30;
while (x > y)
x = x + 2;
cout << x << " " << y << endl;

33. **Rewrite the following as a for loop:**

```cpp
int i = 0, value = 0;

while (i <= 20) {
    if (i % 2 == 0 && i <= 10)
        value = value + i * i;
    else if (i % 2 == 0 && i > 10)
        value = value + i;
    else
        value = value - i;
    i = i + 1;
} 
cout << "value = " << value << endl;
```
The **do. .while** loop in the following program is supposed to read some numbers until it reaches a sentinel (in this case, -1). It is supposed to add all of the numbers except for the sentinel. If the data looks like:

```
12 5 30 48 -1
```

the program does not add the numbers correctly. Correct the program so that it adds the numbers correctly.

```cpp
#include <iostream>

using namespace std;

int main() {
    int total = 0, count = 0, number;
    do {
        cin >> number;
        total = total + number;
        count++; }
    while (number != -1);
    cout << "The number of data read is " << count << endl;
    cout << "The sum of the numbers entered is " << total << endl;
    return 0; }
```

37. **Given the following program segment:**

```
for (number = 1; number <= 10; number++)
    cout << number;
```

write a **while** loop and a **do. .while** loop that have the same output.
Given the following program segment:

```c
int limit = 4;
int first = 5;
int j;
for (j = 1; j <= limit; j++)
{
    cout << first * j << endl;
    first = first + (j - 1);
}
cout << endl;
```

write a `while` loop and a `do . . while` loop that have the same output.

Consider the following program:

```c++
#include <iostream>

using namespace std;

int main() {
    int num1, num2; int temp = 0;
cout << "Enter two integers: ";
    cin >> num1 >> num2;
cout << endl ;
do {
    temp = num1 + num2 ;
    num1 = num2 ;
    num2 = temp  ;
    cout << temp << " ";
} while (((num1 + num2) % 5) != 0);
cout << endl;
return 0; }
a. What is the output if the input is 13 16?
b. What is the output if the input is -4 6?
c. What is the output if the input is 3 5?
d. What is the output if the input is 13 15?

To learn how nested for loops work, do a walk-through of the following program segments and determine, in each case, the exact output.

a. int i, j;
for (i = 1; i <= 5; i++)
{
    for (j = 1; j <= 5; j++)
        cout << “\t” << i;
    cout << endl;
}

b. int i, j;
for (i = 1; i <= 5; i++)
    for (j = (i + 1); j <= 5; j++)
        cout << j;
    cout << endl;

c. int i, j;
for (i = 1; i <= 5; i++)
    for (j = 1; j <= i; j++)
        cout << j;
    cout << endl;

d. const int M = 10;
const int N = 10; int i, j;
for (i = 1; i <= M; i++)
    for (j = 1; j <= N; j++)
        cout << “\t” << M * (i - 1) + j;
    cout << endl;
What is the output of the following program segment?

```cpp
int count = 1;
do {
    cout << count *(count - 2) << " ";
} while (count++ <= 5);
cout << endl;
```

What is the output of the following code?

```cpp
int num = 12;
while (num >= 0) {
    if (num % 5 == 0) {
        num++;
        continue;
    }
    cout << num << " ";
    num = num - 2; }
cout << endl;
```

What is the output of the following code?

```cpp
int num = 12;
while (num >= 0) {
    if (num % 5 == 0) {
        num++;
        continue;
    }
    cout << num << " ";
    num = num - 2; }
cout << endl;
```
cout << num << " ";
num = num - 2; }
cout << endl;

**PROGRAMMING EXERCISES**

1. Write a program that prompts the user to input an integer and then outputs both the individual digits of the number and the sum of the digits. For example, it should output the individual digits of 3456 as 3 4 5 6, output the individual digits of 8030 as 8 0 3 0, output the individual digits of 2345526 as 2 3 4 5 5 2 6, output the individual digits of 4000 as 4 0 0 0, and output the individual digits of -2345 as 2 3 4 5.

Write a program that reads a set of integers and then finds and prints the sum of the even and odd integers.

Write a program that prompts the user to input a positive integer. It should then output a message indicating whether the number is a prime number. (Note: An even number is prime if it is 2. An odd integer is prime if it is not divisible by any odd integer less than or equal to the square root of the number.)

Write a program that uses while loops to perform the following steps:

a. Prompt the user to input two integers: firstNum and secondNum (firstNum must be less than secondNum).

b. Output all odd numbers between firstNum and secondNum.

c. Output the sum of all even numbers between firstNum and secondNum.

d. Output the numbers and their squares between 1 and 10.

e. Output the sum of the square of the odd numbers between firstNum and secondNum. Output all uppercase letters.
The program in Example 5-6 implements the Number Guessing Game. However, in that program, the user is given as many tries as needed to guess the correct number. Rewrite the program so that the user has no more than five tries to guess the correct number. Your program should print an appropriate message, such as “You win!” or “You lose!”.