Lab 2 Variables, Data Types and Selection Structures

Task 1 Review Questions

1. (Variable Declaration) Are the following integers and floating-point numbers properly declared and/or initialized? If not, correct it.

int 3;	
double;	
int = 19;	
float myten = 10.23;	
double_sum = 2.2;	
int that_value 212;	

2. (Variable Naming) Variable names allow uppercase letters, lowercase letters, digits and underscore ('_'). However, a name cannot start with a digit. Fill in the blanks below:

Invalid variable naming	Valid variable naming	Description
int monthly income	**int monthly_income**	Monthly income of integer type
---		Counter of integer type
double %scale		Scale of double type
---		Sales of bike of double type

3. (Input & Output) C++ defines two standard streams that can be used for text mode input and output, respectively **cin** and **cout**. Operators >> and << are used to direct input and output to and from the stream respectively. Are the following lines written correctly? Why or why not?

Program Segment	User input	Answer
int first, second, third; cin >> first >> second >> third;	24 25 26	
double fourth, fifth, sixth; cin >> fourth >> fifth >> sixth;	24.4 25.5 26	
int seventh, eighth, ninth; cin >> seventh >> eighth >> ninth;	24.4 25.5 26.6	
double tenth, eleventh, twelfth; cin >> tenth >> eleventh >> twelfth;	23.4 24.5	

4. (Value Assignment) Do the following program segments work properly? Why or why not? What is the value of variable *d*?

Program Segment	Answer
int d = 4;	
double a; int d = d * (6 + d);	
double d = "3";	

5. (Variable Initialization and Arithmetic Calculation) What is the value of *z*?

Program Segment	Answer
int z = 9 + 2;	
int z = 9 - 2;	
int z = 5 * 2;	
int z = 8 / 4;	
int z = 9 / 4;	
double z = 9 / 4;	
int z = 222 / 300;	
double z = 222.0 / 300.0;	
int z = 222 / 300.00;	
double z = pow(3, 6);	

6. Translate the following algebraic expressions into C++ expression:

Algebraic expressions	Answer
$y = x + \dfrac{3}{4} - 2$	
$y = x^2 + 6x - 2$	
$y = \dfrac{x}{(1 - x)}$	

7. Run the following program:

```cpp
#include <iostream>

using namespace std;

int main() {

        cout << "Hello there.\n";
        cout << "Here is 5: " << 5 << "\n";
        cout << "endl writes a new line to the screen.";
        cout << endl;
        cout << "Here is a very big number:\t" << 70000 << endl;
        cout << "Here is the sum of 8 and 5:\t" << 8 + 5 << endl;
        cout << "Here's a fraction:\t\t" << 5.0 / 8 << endl;
        cout << "And a very very big number:\t";
        cout << 7000 * 7000 << endl;
        cout << "I am a C++ programmer!\n";

        return 0;
}
```

Add one statement to the program which will display your name and age in a single statement. The name should be shown as a character string. The age should be shown as an integer.

8. (if-else statements) Consider the program below:

```cpp
#include <iostream>

using namespace std;

int main() {

        double slope, xcoord1, ycoord1, xcoord2, ycoord2;

        cout << "Input x coordinate of the first point: ";
        cin >> xcoord1;
        cout << "Input y coordinate of the first point: ";
        cin >> ycoord1;

        cout << "Input x coordinate of the second point: ";
        cin >> xcoord2;
        cout << "Input y coordinate of the second point: ";
        cin >> ycoord2;

        slope = (ycoord2 - ycoord1) / (xcoord2 - xcoord1);

        cout << "The slope of the line between Points 1 and 2 is " << slope << "\n";

        return 0;
}
```

What happen if two points have the same x? Rewrite the program that can validate the input (i.e., display a meaningful error message).

Task 2   Sum, Average, Product, Min and Max

You are required to write a program that receives three integers from the keyboard, and prints the sum, average, product, the smallest and the largest values of these numbers. Sample input and output are shown as follows:

```
Input three different integers: 13 27 14
Sum is 54
Average is 18
Product is 4914
Smallest is 13
Largest is 27
```

Note: The underlined numbers 13, 27 and 14 are to be input by the user.

    (a)   Write down the pseudocode.

    (b)   Write down the C++ code.

Task 3   Salary Calculation

Suppose you are required to develop a program to determine your future salary after 10 years. Your company will offer you a 5% salary increment every year. For example, suppose you earn $18,000 per month. In the next year, you will earn $18,900 [∵ $18,000 + ($18,000 * .05)], $19,845 the year after the next [∵ $18,900 + ($18,900 * .05)], and so on.

In C++, you can calculate exponentiation by using the **pow** function:

$$\textbf{pow(base, exponent)}$$

E.g., to calculate 2^3, use **pow(2, 3)**.

```cpp
#include <iostream>
#include <cmath>

using namespace std;

int main() {

        double x;
        x = pow(2, 3);

        return 0;
}
```

Note: Add **#include <cmath>** at the beginning of your program.

Below are two sample output:

Sample Output 1:

```
What is your salary? 18000
After 10 years, your salary is: 29320.1
```

Sample Output 2:

```
What is your salary? 20000
After 10 years, your salary is: 32577.9
```

Task 4   Roots of the Quadratic Equation

The roots of the quadratic equation $ax^2 + bx + c = 0, a \neq 0$ can be found by the following formula:

$$\frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

➢   If $b^2 - 4ac = 0$, then the equation has repeated root;
➢   If $b^2 - 4ac > 0$, the equation has two distinct real roots;
➢   If $b^2 - 4ac < 0$, the equation does not have any real root.

Complete the followings:

Write a program that prompts the user to input the value of *a*, *b* and *c*. Then, the program should output the roots of the quadratic equation.

Sample input and output:

```
Please enter a: 1
Please enter b: 3
Please enter c: 2

Two real roots: x = -1 or -2
Please enter a: 1
Please enter b: 2
Please enter c: 1

Repeated root: x = -1
Please enter a: 1
Please enter b: 1
Please enter c: 1

No real root
```

State two limitations of your program. Explain briefly. Type your answer in terms of comments at the beginning of your program in a).