CSC 126 Introduction to Computer Science
Midterm Exam

Name: _____________________________

1. (5 points) What is the output of this program?

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

int main()
{
    // (next 6 questions, 0.5 points each)
    int a = 1, b = 2, c = 3, d = 4;
    cout << (d / c) << endl; // (1) ________
    cout << (d + 2.4 / c) << endl; // (2) ________
    cout << (d % c) << endl; // (3) ________
    cout << (--a) << endl; // (4) ________
    cout << (!(c > d) || a > b) << endl; // (5) ________
    cout << (c == 4 ? b : c) << endl; // (6) _______

    // (next 2 questions, 1 points each)
    char letter = 'Z';
    do {
        cout << letter << " ";
        letter -= 3;
    } while (letter > 'K');
    cout << endl; // (7) ________

    int k = 2;
    for (int i = 1; i < 6; i++)
    {
        cout << k << " ";
        k /= -0.5;
    }
    cout << endl; // (8) ________

    return 0;
}
```

Page 1 of 6
2. (3 points) **Leap Year**

In the Gregorian calendar, each **leap year** has 366 days instead of 365, by extending February to 29 days rather than the common 28.

All years which are perfectly divisible by 4 are leap years except for century years (years ending with 00) which is leap year only if it is perfectly divisible by 400. For example: 2012, 2004, 1968 are leap years, but 1971, 2006 are not leap years. Similarly, 1200, 1600, 2000, 2400 are leap years but, 1700, 1800, 1900 are not.

In this program, user is asked to enter a year and this program checks whether the year entered by user is leap year or not.

**Solution:**

```cpp
int main() {
    int year;
    cout << "Enter a year: ";
    cin >> year;

    // leap year if perfectly divisible by 400
    if (year % 400 == 0) {
        cout << year << " is a leap year.";
    }
    // not a leap year if divisible by 100
    // but not divisible by 400
    else if (year % 100 == 0) {
        cout << year << " is not a leap year.";
    }
    // leap year if not divisible by 100
    // but divisible by 4
    else if (year % 4 == 0) {
        cout << year << " is a leap year.";
    }
    // all other years are not leap years
    else {
        cout << year << " is not a leap year.";
    }

    return 0;
}
```
3. (3 points) **Print a Box**

The following program asks the user to enter a number \( n \). It then prints a box that has \( n \) rows and columns. For example, if \( n = 7 \) the program would print:

```
******
* * *
* * *
* * *
* * *
* * *
******
```

**Solution:**

```c++
int main()
{
    int n = 10;

    for ( int j = 0; j < n; j++ ) cout << "*";
    cout << endl;

    for ( int i = 0; i < n-2; i++ )
    {
        cout << "*";
        for ( int j = 0; j < n-2; j++ ) cout << " ";
        cout << "*" << endl;
    }

    for ( int j = 0; j < n; j++ ) cout << "*";
    cout << endl;
}
```
4. (3 points) **Silly Table**

This program takes a positive integer from a user and displays a silly table. For example, if the input number is 5, the program would print:

\[
\begin{align*}
1 &= 1 \\
1 + 1 &= 2 \\
1 + 1 + 1 &= 3 \\
1 + 1 + 1 + 1 &= 4 \\
1 + 1 + 1 + 1 + 1 &= 5 \\
\end{align*}
\]

**Solution:**

```cpp
int main()
{
    int n = 5;

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

    return 0;
}
```
5. (3 points) **Absolute Difference**

Write a complete program that does the following:

1. It asks the user to enter a positive integer with 2 digits.
2. If the entered number is out of range, the message *Too difficult!* is printed and the program terminates.
3. Otherwise the program prints the absolute value of the difference of the two digits in the number that was entered. Here is an example of how the program should work:

   Enter a 2-digit integer: 79
   Absolute difference: 2

**Solution:**

```cpp
int main()
{
    cout << "Enter a 2-digit integer: ";
    int n;
    cin >> n;

    if ( n < 10 || n > 99 )
    {
        cout << "Too difficult!" << endl;
    }
    else
    {
        int a = n / 10, b = n % 10;
        int d = a > b ? a - b : b - a;
        cout << "Absolute difference: " << d << endl;
    }

    return 0;
}
```
6. (3 points) **Guess the Number**

Write a program that lets the user guess the number from the computer. The program should work as follows:

1. When the program begins, the computer determines a random number between 1 to 100. (Don’t display it yet.)
2. The user enters his or her guessing at the keyboard.
3. The computer tells his or her guessing is higher or lower.
4. The computer displays the total number of guessing (how many tries) until the user finds this number at last.

**Solution:**

```cpp
int main()
{
    srand(time(0));

    int computer = rand() % 100 + 1;

    cout << "Guess my number between 1 -- 100: ";
    int user;
    int tries = 0;

    while ( 1 )
    {
        cin >> user;
        tries++;
        if ( user < computer ) cout << "Tow low" << endl;
        else if ( user > computer ) cout << "Tow high" << endl;
        else
        {
            cout << "You got it!" << endl;
            cout << "You tried " << tries << " time(s)!" << endl;
            break;
        }
    }

    return 0;
}
```