1. Exactly what would be printed by this program?
    Here's a clue: the first line would be
    a: int 11

```
void output(const string question, const int n)
{ cout << question << ": int " << n << "\n"; }
void output(const string question, const float n)
{ cout << question << ": float " << n << "\n"; }
void output(const string question, const double n)
{ cout << question << ": double " << n << "\n"; }
void output(const string question, const bool n)
{ cout << question << ": bool " << n << "\n"; }

void main()
{
    output("a", 9+2);
    output("r1", 23%5);
    output("r2", 45%5==0);
    output("r3", 240/6-2/6);
    const double e = 82/5+3/5;
    output("r4", e == 16);
    output("r5", 456/100+1/2);
    output("r6", 456.0/100+1/2);
    output("r7", 3126 - 3126 / 100.0 * 100);
    output("r8", 6321 / 100 % 100);
}
```

2. Print the expected output of the programs (a& b) given and explain in plain English as what is the purpose of the function "**c**" in each program. (10 points each)

   a.

```c void c(int r) { if(r > 0) { cout<<r%10; c(r/10); } } void main() { c(3502); } ```	Output:

Purpose of the function c:

   b.

```c int c(int a, int p) { if(p == 0) return 1; return (a * c(a,p-1)); } void main(){ cout<<c(3,4)<<endl; } ```	Output:

Purpose of the function c:

3. Write a C++ function, **using recursion** given the following requirements:
    a. Given a non-negative number the program should return the number of digits
        in the number. (5 points)
        For example,
        first(50230) should return **5** as output
        first(0023) should return **2** as output. (you can ignore preceding zeroes)

    3b. Write a **recursive** C++ function that takes 2 integer parameters and prints the
         number that many number times. (5 points)
         For example:
         second(4,7) should print   **4444444**
         second(25,6) should print **252525252525**

3c. Based on the functions you created for 3.a and 3.b, write a function
format_number to achieve a following output. (10 points)

format_number (int x, int y)
Purpose of this function is to format number x, so that it prints x with y digits.

format_number(23, 5)   should print **00023**
format_number(2,8)   should print **00000002**

5. What is the output of the following programs? (5 points each)

``cpp
void main()
{
   int i,sum = 0;
 	
   for(i=0;i<10;i++)
     sum += (2 * i);
 	
   cout<<sum<<endl;;
}
``	

``cpp
void main()
{
   int i= 0,j=0;
 	
   while(i<100)
     i++;
     j+=2;
 	
   cout<<j<<endl;;
}
``	

``cpp
void main()
{
   int i = 20, j = 15;
 	
   while(i)
   {
     i--;
     j++;
   }
 	
   cout<<j<<endl;
}
``	

``cpp
void main()
{
   int i,j = 0;
   for(i=0;i<10;i++,j--);
   cout<<j<<endl;;
}
``	

6.

a. Understand the following piece of code, and write the same functionality using while loop and for loop. (10 points)

int abc(int a) { ... }	Purpose of the function abc: (2 points)

```
int abc(int a)
{
     if(a <=1)
          return 1;
     else return a * abc(a-1);
}
```

Version of abc using while loop: (4 points)

Version of abc using for loop: (4 points)

6. b Palindrome Checker

A palindrome is a word, phrase, number, or other sequence of characters which reads the same backward as forward, such as **madam** or **racecar.**

You can use the string function length() to get the length of the string.

Example: Input : **madam**   Output: **madam is a palindrome**

Input: **hello** Output: **hello is not a palindrome.**

Write 2 versions of C++ program, to take input from the user and check if the given input is a palindrome or not.

1. **Version using while loop (5 points)**

2. **Version using for loop (5 points)**

7. Files

Write a program to calculate final score and a letter grade.
The input file consists of student's first name, last name and mid-term scores.

The maximum score for each mid-term is 50.

Example input file is as follows (midterms.txt)

Jimmy	Madison	46	34	31	49
Stephanie	Monroe	45	47	42	46
Thomas	Jefferson	39	34	41	46
Ricardo	Clark	40	47	35	35

The logic to calculate the final score is as follows,

The total score is to be converted for 100. Then, the letter grade has to be decided based on the total score %.

Final output expected is as follows (finals.txt)

Jimmy	Madison	80	B
Stephanie	Monroe	90	A
Thomas	Jefferson	80	B
Ricardo	Clark	78.5	C

Final scores 90 and above – Letter Grade A
80 and Above Letter Grade B
70 and above letter grade C
60 and Above letter grade D
And all others F

Write a program to read midterms.txt and produces the file finals.txt.

8. What is the output of the following program? (20 points – 5 points each for 1, 2, 3 & 4)

```
#include <library.h>

const int z = 2;

void main()
{
    int s = 0, x = 1, m;
    int a[z][z][z] = {{        {1, 2},
                               {3, 4}},
                       { {5, 6 },
                         {7, 8}}};

    int b[z][z] = {0};

    cout<<"1a: "<<a[x][s][x+s]<<endl;

    for(int p = 0; p<z; p++)
        for(int q = 0; q<z; q++)
            for(int r = 0;r<z; r++)
            {
                    b[q][r] += a[p][q][r];

                    x += 3;

                    if((p+q+r) % 2 != 0)
                            s += b[q][r];

            }

    cout<<"1b: "<<2*a[z-1][z-2][z-1]<<endl;
    cout<<"2: "<< b[z-2][z-1]<<endl;
    cout<<"3: "<<s<<endl;
    cout<<"4: "<<x<<endl;
}
```

Answer Grid:

1a	
1b	
2	
3	
4	

9. Information Security is very important in this digital age. Write following functions that help secure your messages. (20 points)

a. Create your own hash function, given two strings – your name and your friend's name.

Method signature: **`int get_hash(string x, string y);`**

For example: `get_hash("alex","jen")` the output should be – 8

ie. First sum the indexes of every character and then add up all the individual digits in that sum.

ie. Sum the index of (a + l + e + x + j + e + n)

(1 + 12 + 5 + 24 + 10 + 5 + 14) = 71 , and 7 + 1 = 8.

9 b. Now, create another function – encrypt, which returns an encrypted message for the input message.

```
string encrypt (string message, string sender, string receiver)
```

In this method, first get the hash value of sender and receiver, from the first part. Based on that number, for each character in the message – shift the character to that many positions.

For example : if message = "apple" and your hash function returns 1, you should return string "bqqmf" – i.e a + 1 = b, p + 1 = q, .. and so on.

Another example, `encrypt("netflix","alex","jen")` should return string = "vmbntqf" (ie. n + 8 =v, e + 8 = m, t + 8 = b (note that if it goes beyond z – start with a), … and so on)

10. Structs (20 points)

a. Create a struct course that contains following information, `course code,` `department offering the course, course instructor and number of` `credits (minimum 1 & maximum 3 credits per course)`. Use appropriate datatypes for the definition of struct.
   1. Write a function to initialize a course.
   2. Write a function to print the course information.

10 b. Create a struct – student. A student can enroll in a maximum of 5 courses, per semester. Create a struct student – that contains `student's name, c-number, major, minor, courses enrolled, courses completed`.

      1. Write a function to initialize a student.

      2. Add another field – certified to the struct student, the field certified can hold either true or false. Write a function that sets the value of `certified` field. `certified` is determined based on the number of credits that the student already completed. If the total number of course credits is 12 then `certified` should be set to true.