Group 1

Write a C++ program or each of the following problems:

1. Write a C++ program to enter a distance in meters and print out its value in kilometers, yards, and miles. (Note: 1 m = 0.001 km = 1.094 yd = 0.0006215 mi).

2. Write a C++ program to enter length and width of a rectangle, compute and print the area and perimeter of the rectangle. Print both rounded to the nearest tenth of a foot.

3. Write a program to compute the cost for carpeting a room. Input should consist of the room length (in meters), room width (in meters), and carpet price per square meter.

4. Compute and print the number of minutes in a year.

5. Given a positive number, print its square and square root.

6. The arithmetic mean of two numbers is the result of dividing their sum by 2. The geometric mean of two numbers is the square root of their product. The harmonic mean of two numbers is the arithmetic mean of their reciprocals. Write a program that takes two floating-point numbers as inputs and displays these three means.

7. Write a C++ program to take a depth (in kilometers) inside the earth as input data; compute and display the temperature at that depth in degrees Celsius and Fahrenheit. The relevant formulas are:

   \[ \text{Celsius} = 10 \times \text{depth} + 20 \quad \text{(Celsius temperature at depth in km)} \]
   \[ \text{Farhrenheit} = 1.8 \times \text{Celsius} + 32 \]

8. The Pythagorean Theorem states that the sum of the squares of the sides of a right triangle is equal to the square of the hypotenuse. For example, if two sides of a right triangle have lengths 3 and 4, then the hypotenuse must have a length of 5. The integers 3, 4, and 5 together form a Pythagorean triple. There is an infinite number of such triples. Given two positive integers, m and n, where m > n, a Pythagorean triple can be generated by the following formulas:

   \[ \text{Side1} = m^2 - n^2 \]
   \[ \text{Side2} = 2mn \]
   \[ \text{Hypotenuse} = \sqrt{\text{side1}^2 + \text{side2}^2} \]

Group 2

1. In a laboratory, the time of an experiment is measured in seconds. Write a C++ program to enter the time in seconds, convert and print out it as a number of hours, minutes and seconds. Use appropriate format for the output.

2. Write a C++ program to enter an integer number of 4 digits and print it out in an inverse order. For example if the input is 5723 the output should be 3275.

3. Draw a Flow chart and write a program in C++ that reads three integer numbers and computes their average. The program also determines the smallest number and prints out a message indicating whether that smallest number is even or odd. Print out the input and results with appropriate format.

4. Write a program that gets the coefficients of a quadratic equation \( ax^2 + bx + c = 0 \) and prints out its two real roots (if any).

5. An AUC faculty recently signed a 3-year contract that included a salary increment of 7, 6, and 5%, respectively, for the next 3 years. Write a program that allows a user to enter the current salary and then prints the compounded salary for each of the next 3 years.
What does the following program do? That is, if you were to run the program, exactly what would the output be?

```cpp
// Program jknm
#include <iostream>
using namespace std;

int main () {
    const int c1 = 3;
    const float c2 = 2.75;
    int j, k, n, m;
    float y;
    //
    n = 3.25;     // statement 1
    n = n + 2.5 * c1 + c2;   // statement 2
    m = 3.75 + n/c1;    // statement 3
    j = n % m;    // statement 4
    k = m % n;    // statement 5
    if ( j != k )
        y = j + c2;   // statement 6
    else
        y = k – c2;   // statement 7
    cout << “The value of j = “ << j << endl;  // statement 8
    cout << “The value of k = “ << k << endl; // statement 9
    cout << “The value of m = “ << m << endl; // statement 10
    cout << “The value of n = “ << n << endl; // statement 11
    cout << “The value of y = “ << y << endl; // statement 12
    return 0;
}
```

Use the following table to trace the given program (i.e., to plot the value of different variables as instructions are executed one after the other and finally showing the output).

<table>
<thead>
<tr>
<th>Statement Number</th>
<th>m</th>
<th>j</th>
<th>k</th>
<th>n</th>
<th>y</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
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<td>11</td>
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<td></td>
</tr>
<tr>
<td>12</td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
</tbody>
</table>
1. The island nation of Babbage charges its citizens an income tax each year. The tax rate is based on the following table. Write a program that, when given a person’s income, prints the tax owed rounded to the nearest dollar.

<table>
<thead>
<tr>
<th>Income</th>
<th>Tax Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>$ 0-5,000</td>
<td>0</td>
</tr>
<tr>
<td>5,001-10,000</td>
<td>3%</td>
</tr>
<tr>
<td>10,001-20,000</td>
<td>5.5%</td>
</tr>
<tr>
<td>20,001-40,000</td>
<td>10.8%</td>
</tr>
<tr>
<td>Over $ 40,000</td>
<td>23.7%</td>
</tr>
</tbody>
</table>

2. Community Hospital needs a program to compute and print a statement for each patient. Charges for each day are as follows:
   a) Room charges: private room, $125.00; semiprivate room, $95.00; or ward, $75.00
   b) Telephone charge: $1.75
   c) Television charge: $3.50

   Write a program to get two values from the keyboard, the first value is an integer value indicating the number of days spent in the hospital, and the second value is a string of three characters. Typical input is: **5 PNY**
   
   where 5 indicates the number of days spent in the hospital, P represents the room type (P, S, or W), N represents the telephone option (Y or N), and Y represents the television option (Y or N).

3. Dr. Khalil, a Professor of CSCI 106, wants you to write a program to compute and print the grade for a student in his class. The grade is based on three mid-term examinations (worth a possible 100 points each) of which the best two are only considered in the computation, five quizzes (10 points each), and a 200-point final examination. Your output should include all scores, the percentage grade, and the letter grade. The grading scale is:

<table>
<thead>
<tr>
<th>Percentage Grade (PG)</th>
<th>Letter Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>90 &lt;= PG &lt;= 100</td>
<td>A</td>
</tr>
<tr>
<td>80 &lt;= PG &lt; 90</td>
<td>B</td>
</tr>
<tr>
<td>70 &lt;= PG &lt; 80</td>
<td>C</td>
</tr>
<tr>
<td>60 &lt;= PG &lt; 70</td>
<td>D</td>
</tr>
<tr>
<td>0 &lt;= PG &lt; 60</td>
<td>F</td>
</tr>
</tbody>
</table>

4. At AUC, the academic standing of a student is determined based on the number of the credit hours that the student has achieved. The rules are as follows:

<table>
<thead>
<tr>
<th>Number of Credit Hours (CrH)</th>
<th>Academic Standing</th>
</tr>
</thead>
<tbody>
<tr>
<td>CrH &lt;  30</td>
<td>Freshman</td>
</tr>
<tr>
<td>30 &lt;= CrH &lt;  60</td>
<td>Sophomore</td>
</tr>
<tr>
<td>60 &lt;= CrH &lt;  90</td>
<td>Junior</td>
</tr>
<tr>
<td>90 &lt;= CrH &lt; 120</td>
<td>Senior</td>
</tr>
<tr>
<td>120 &lt;= CrH</td>
<td>Graduating Senior</td>
</tr>
</tbody>
</table>

   Draw a flow chart and write a program in C++ to input the number of credit hours achieved by the student and print out his/her academic standing. **Show the three phases of software development: the analysis, design, and implementation. Implement your solution in C++ once using nested-if structure and second using switch structure. Assume that the input number of credit hours is always between 0 and 142.**
**Group 5**

1. Write a C++ program to print all the integer numbers that are divisible by 7 in the range 1 to 100.
2. Write a C++ program to print all the integer numbers that are divisible by 5 and 9 in the range 1 to 100.
3. Write a C++ program to print all the integer numbers that are either divisible by 7 or by 9 in the range 1 to 100.
4. Write a C++ program to print all the integer numbers that are divisible by 5 and not divisible by 9 in the range 1 to 100.
5. Write a C++ program to print the count and sum of all the integer numbers that are divisible by 7 in the range 1 to 200.
6. Write a C++ program to generate and print out the following series:
   
   1 2 4 8 16 32 64 128 256
   
7. Write a C++ program to generate and print out the following series:
   
   6 8 11 15 16 21 22 26 29 31
   
8. Write a C++ program to enter 24 readings of temperature (each reading is between -5 and 45), compute and print out the average temperature, maximum temperature and minimum temperature of the day. Enforce the necessary validation on the user input. Use proper format for the output.
9. Write a complete C++ program that produces a table showing the temperature equivalents in degrees Fahrenheit and degrees in Celsius. Let the user enter the starting, ending, and step values. Use the formula:
   
   \[
   \text{celsTemp} = \frac{5.0}{9.0} (\text{farenTemp} - 32.00)
   \]

10. Write a C++ program that uses *nested loops* to produce the following output:

<table>
<thead>
<tr>
<th>2</th>
<th>4</th>
<th>6</th>
<th>8</th>
<th>10</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>6</td>
<td>9</td>
<td>12</td>
<td>15</td>
</tr>
<tr>
<td>4</td>
<td>8</td>
<td>12</td>
<td>16</td>
<td>20</td>
</tr>
<tr>
<td>5</td>
<td>10</td>
<td>15</td>
<td>20</td>
<td>25</td>
</tr>
</tbody>
</table>

11. Rewrite the following segment of code using a loop that counts down to produce the same result:

   ```
   sum = 0;
   for (k=1; k <= 4; ++k)
   {
       cout << setw (2) << k << endl;
       sum = sum + k;
   }
   ```

12. Rewrite the following segment of code using a loop that counts up to produce the same result:

   ```
   for (j = 10; j >= 4; --j)
   cout << setw (j) << j << endl;
   ```
For each of the following program segments, determine the output of each on your own, then run the program and compare its result with yours.

<table>
<thead>
<tr>
<th>Group 6</th>
</tr>
</thead>
<tbody>
<tr>
<td>For each of the following program segments, determine the output of each on your own, then run the program and compare its result with yours.</td>
</tr>
</tbody>
</table>

| k = 1;  
while (k <= 20)  
{  
if ( k mod 3 == 0)
    cout << k << endl;
    k = k + 2;
} |
| k = 10;  
while (k >= 0)  
{  
cout << k << endl;
    k--;
} |

| count = 0;  
sum = 0;  
while (count < 5)  
{  
count += 1;
    sum += count;
    cout << "The partial sum is" << setw(4) << sum << endl;
}  
cout << "The count is" << setw(4) << count << endl; |
| a = 5;  
b = 2;  
if (a < b)  
for (k = a; k <= b; k = k + 1)
    cout << k << endl;
else  
for (k = a; k >= b; k = k - 1)
    cout << k << endl; |

| x = 5; y = 50;  
do  
x += 10;
while (x < y);  
cout << setw(3) << x << setw(3) << y << endl; |
| x = 5; y = 80;  
do  
x *= 2;
while (x < y);
    cout << setw(3) << x << setw(3) << y << endl; |

| x = 5; y = 30;  
while (x <= y)  
x *= 2;
    cout << setw(3) << x << setw(3) << y << endl; |
| x = 5; y = 30;  
while (x > y)  
x += 2;
    cout << setw(3) << x << setw(3) << y << endl; |

| int x = 2, y = 1;  
while (x < 4)  
y *= x++;
    cout << "x = " << setw(3) << x << "y = " << setw(3) << y << endl; |
| int x, y = 5;  
for (x = 7; x > 10; x *= 2)
    for (y = 3; y <= 5; y++)
        cout << setw(3) << x << setw(3) << y << endl;
    cout << "The Final Value Is: << setw(5) << x / 2 % y; |

| int x = 4, y = 1;  
while (x > 4)  
{  
y *= x++;
    cout << "x = " << setw(3) << x << "y = " << setw(3) << y << endl;
}  
cout << "Final x = " << setw(2) << x << "Final y = " << setw(2) << y << endl; |
| int x = 1, y = 1, z;  
y = y * x++;  
cout << "x = " << setw(2) << x << "y = " << setw(2) << y << endl;
    x = 6;
    y = 2;
    z = --x / y++;
    y = z * + x++;  
cout << "x = " << setw(3) << x << "y = " << setw(3) << y << "z = " << setw(3) << z << endl; |
**Group 7**

Write a program fragment that uses **nested loops** to produce the following graphics. Submit your program together with a print out of the graphics.

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

```
<table>
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<th>3</th>
<th>4</th>
<th>1</th>
<th>2</th>
<th>4</th>
<th>8</th>
</tr>
</thead>
<tbody>
<tr>
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<td>0</td>
<td>0</td>
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<td>4</td>
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<td>6</td>
<td>7</td>
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<td>123</td>
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<td>0</td>
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<td>0</td>
<td>9</td>
<td>10</td>
</tr>
<tr>
<td>$$ $$</td>
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<td>0</td>
<td>0</td>
<td>1</td>
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<td>0</td>
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<td>14</td>
<td>15</td>
<td>16</td>
</tr>
<tr>
<td>$$ $$ $$</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
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<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>
```

**Group 8**

For each of the following program segments, determine the output of each **on your own**, then run the program and compare its result with yours.

(A)

```
Input data: 5 -5 9 2 6 -4 8 7 -3 0 3 -7
const int n = 6;
int x;
int p = 1;
int i = 1;
bool flag = true;
// while (flag && i <= n)
{  cin >> x;
    if (x > 0)
        {
            p *= x;
            cout << p << endl;
        }
    else
        if (x == 0)
            flag = false;
        i++;
}
```

(B)

```
Input data: 72 75 90 77 70 66 95 88 75 70
int s;
int counterA = 0;
int counterB = 0;
int counterC = 0;
int counterD = 0;
int i = 1;
int n = 10;
while (i <= n)
{  cin >> s;
    if (s >= 90) counterA++;
    else if (s >= 80) counterB++;
    else if (s >= 70) counterC++;
    else counterD++;  

    cout << "counterA = " << counterA << endl;
    cout << "counterB = " << counterB << endl;
    cout << "counterC = " << counterC << endl;
    cout << "counterD = " << counterD << endl;
```

```
Group 9
For each of the following program segments, determine the output of each on your own, then run the program and compare its result with yours.

(A)
```cpp
for (int k = 7; k <= 16; k++)
switch (k % 10)
{
    case 0: cout << "", ";
        break;
    case 1: cout << "OFTEN ";
        break;
    case 2:
    case 8: cout << "IS ";
        break;
    case 3: cout << "NOT ";
        break;
    case 4:
    case 9: cout << "DONE ";
        break;
    case 5: cout << "WELL";
        break;
    case 6: cout << ".";
        break;
    case 7: cout << "WHAT ";
        break;
    default: cout << "Bad number. ";
}
cout << endl;
```

(B)
```cpp
int j; int one[5]; int two[10];
for (j = 0; j < 5; j++)
one[j] = 5*j + 3;
cout << "One contains: ";
for (j = 0; j < 5; j++)
cout << setw(3) << one[j];
cout << endl;
```

(C)
```cpp
const int n = 6;
int L[n] = {3, 5, 5, 4, 9, 9};
bool valu = true;
int k = 0;
while ( (k < n-1) && (valu) )
{
    if (L[k] > L[k+1])
    {
        valu = false;
        cout << setw(2) << k << setw(2) << L[k] << endl;
    }
    else
```
for (j = 0; j < 5; j++)
    {    two[j] = 2*one[j] - 1;
        two[j + 5] = one[4 - j] - 1 + two[j];
    }
cout << “Two contains: “;
for (j = 0; j < 10; j++)
cout << setw(3) << two[j];
cout << endl;
k++;
}
if (valu)
cout << “ The list is OK” << endl;

(D)
int A[8] = {75,70,70,85,55,80,80,65}
int T;
int n = 6;
for (int j = 0; j <= n; j++)
if (A[j] > A[j+1])
    {
        T = A[j];
        A[j] = A[j+1];
        A[j+1] = T;
    }

<table>
<thead>
<tr>
<th></th>
<th>initial</th>
<th>final</th>
</tr>
</thead>
<tbody>
<tr>
<td>A0</td>
<td>75</td>
<td>A0</td>
</tr>
<tr>
<td>A1</td>
<td>70</td>
<td>A1</td>
</tr>
<tr>
<td>A2</td>
<td>70</td>
<td>A3</td>
</tr>
<tr>
<td>A3</td>
<td>85</td>
<td>A4</td>
</tr>
<tr>
<td>A4</td>
<td>55</td>
<td>A5</td>
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<td>A5</td>
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</tr>
<tr>
<td>A6</td>
<td>80</td>
<td>A7</td>
</tr>
<tr>
<td>A7</td>
<td>65</td>
<td></td>
</tr>
</tbody>
</table>
void test (int, int&, int&);
int main()
{
int d = 17; int e = 21; int f = 15; int a = 16; int b = 19;
test(d, e, f);
cout << "In the main program after the first call" << endl;
cout << "the variables are: " << setw(3) << e << setw(3) << d <<
setw(4) << f << endl;
cout << "--------------------------------------------------------------------------";
test(a, b, f);
cout << "In the main program after the second call" << endl;
cout << "the variables are: " << setw(3) << a << setw(3) << d <<
setw(4) << f << endl;
return 0;
}
void test(int t, int& s, int& x)
{
  s = 4;
s = s + 3;
x = x + s + t;
t = 5 * s;
cout << "Function test Output: " << setw(3) << s << setw(3) << t
<<
setw(3) << x << endl;
}
int myfunc(int n)
int main()
{
int s = 0;
for (k = 0; k <= 6; k = k + 2)
s += myfunc(k);
cout << "my result is" << setw(6) << s << endl;
return 0;
}
int myfunc(int n)
{
int f = 1;
for (m = 2; m <= n; m += 1)
f *= m;
return f;
}

Group 11
1. Write a C++ program that declares an array alpha of 50 elements of the type float. Initialize the array so that the first 25 elements are equal to the square of the index variable and the last 25 elements are equal to three times the index variable. Output the array so that 10 elements per line are printed.

2. An integer is said to be prime if it is divisible by only 1 and itself. For example, 2, 3, 5, and 7 are prime, but 4, 6, 8 and 9 are not.
   a. Write a function that determines whether a number is prime.
   b. Use this function in a program that determines and prints all the prime numbers between 2 and 1000.

3. The following formula gives the distance between two points (x₁, y₁) and (x₂, y₂) in the Cartesian plane:

   \[(x₂ - x₁)^2 + (y₂ - y₁)^2\]

Given the center and a point on the circle, you can use this formula to find the radius of the circle. Write a program that prompts the user to enter the center and a point on the circle. The program should then compute and output the circle’s radius, diameter, circumference, and area. Your program must have at least the following functions:
   a. distance: This function takes as its parameters four numbers that represent two points in the plane and returns the distance between them.
   b. radius: This function takes as its parameters four numbers that represent the center and a point on the circle, calls the function distance to find the radius of the circle and returns the circle’s radius.
   c. circumference: This function takes as its parameter a number that represents the radius of the circle and returns the circle’s circumference. (if r is the radius, the circumference is \[2\pi r\]).
   d. area: This function takes as its parameter a number that represents the radius of the circle and returns the circle’s area (if r is the radius, the area is \[\pi r^2\]). Assume \(\pi = 3.1416\).
4. Consider the definition of the function main:
   ```c
   int main ()
   {
      float rate, hours;
      float amount;
      .
      .
      .
   }
   ```

   Write the following definitions:
   a. Write the definition of the function `getHoursRate` that prompts the user to input the hours worked and rate per hour to initialize the variables `hours` and `rate` of the function `main`.
   b. Write the definition of the value-returning function `paycheck` that calculates and returns the amount to be paid to an employee based on the hours worked and rate per hour. The hours worked and rate per hour are stored in the variables `hours` and `rate`, respectively, of the function `main`. The formula for calculating the amount to be paid is as follows: for the first 40 hours, the rate is the given rate; for hours over 40, the rate is 1.5 times the given rate.
   c. Write the definition of the function `printCheck` that prints the hours worked, rate per hour, and the amount due.
   d. Complete the definition of the function `main` that tests each of these functions.

5. Write the following modular program in C++:
   a. Write a function `swap` that takes two integer numbers and swap them (interchange their values).
   b. Write a function `readPair` that reads two integer numbers each of which should be greater than 0 and if the second integer is less than the first, the function `swap` is called to interchange the values of the two integers.
   c. Write a function `multiple` that determines for a pair of integers whether the second integer is a multiple of the first. The function should take two integer arguments and return `true` if the second is a multiple of the first, `false` otherwise.
   d. Write a `main` function that will test \( k \) pairs of integer numbers. For each pair, the function `readPair` is called first to enter values for the two integer numbers, then the function `multiply` is called to test the two numbers. The program should print out the values of the two integers together with a message notifying whether the second integer is multiple of the first, or not.

6. A Class of 40 students has received their grades for 5 exams (each out of 100). Write a structured C++ program (using top-down design) that will do the following:
   a. Read the student data list which consist of the Student ID, and 5 consecutive grades. Do the necessary validation on input.
   b. Print the ID and average score for each student.
   c. Implement a function that calculates the worst average grade.
   d. Print the IDs of all students having the worst average grade.