

**Instructions: Write hand written answers (Not computer typed). Use a separate page for each question. Write question number, your roll number and name on each page in your own handwriting. Take snapshots of your assignment and pictures of code running, make a pdf with your roll number as file name and submit to GOOGLE classroom by 14<sup>th</sup> July 2023 4pm.**

**Q1:** How C++ program is compiled into an executable? Answer in 4 lines only. Make a flow chart.

**Q2:** Write a program that inputs three integers from the keyboard and prints the sum, average, product, smallest and largest of these numbers. The screen dialog should appear as follows:

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

**Q3:** Write a program that inputs a five digit integer, separates the integer into its digit and prints them separated by three spaces each. For example, if the user types in 42339, the program should print:

```
4      2      3      3      9
```

**Q4:** Develop a C++ program that uses a `while` statement to determine the gross pay for each of several employees. The company pays “straight time” for the first 40 hours worked by each employee and pays “time-and-a-half” for all hours worked in excess of 40 hours. You are given a list of the employees of the company, the number of hours each employee worked last week and the hourly rate of each employee. Your program should input this information for each employee and should determine and display the employee’s gross pay.

**Sample Output:**

```
Enter hours worked (-1 to end): 39
Enter hourly rate of the employee: 10.00
Salary is 390.00 Rs.
```

```
Enter hours worked (-1 to end): 40
Enter hourly rate of the employee: 10.00
Salary is 400.00 Rs.
```

```
Enter hours worked (-1 to end): 41
Enter hourly rate of the employee: 10.00
Salary is 415.00 Rs.
```

```
Enter hours worked (-1 to end): -1
```

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**Q5:** Write a program that ask user to enter an integer number and evaluates its factorial. Your program should print the output as below,

```
Enter an integer : 5
5 x 4 x 3 x 2 x 1 = 120
```

**Q6:** Write a program that ask user to input the number of elements in a Fibonacci sequence and then generates a Fibonacci sequence up-to the given number of elements.

(Hint: In Fibonacci sequence, the next element is the sum of two previous values)

Sample Output:

```
Enter number of elements: 10
0 1 1 2 3 5 8 13 21 34
```

**Q7:** Write a program that reads three non-zero double values and determines and prints whether they could represents sides of triangle.

[Hint:  $a, b$  and  $c$  represents sides of triangle if following criteria is met,

$a + b > c$

$a + c > b$

$b + c > a$ ]

Sample Output:

```
Enter length of three sides: 3 4 5
They are sides of triangle.

Enter length of three sides: 2 2 5
They are not sides of triangle.

Enter length of three sides: 2.4 3.8 5.5
They are sides of triangle.
```

**Q8:** Write a program that reads three non-zero double values and determines and prints whether they are sides of right triangle. The program should verify the results up to 4 decimal places.

[Hint: Use Pythagoras theorem to determine whether the three sides form right triangle.]

Sample Output:

```
Enter length of three sides: 3 4 5
The sides represents right triangle.

Enter length of three sides: 4 5 6.403
The sides don't represents right triangle.

Enter length of three sides: 4 5 6.4031
The sides represents right triangle.
```

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**Q9:** Write a program that ask user to input a floating point number and computes exponential of that number using Taylor series as below,

$$e^x = 1 + \frac{x}{1!} + \frac{x^2}{2!} + \frac{x^3}{3!} + \dots$$

Also, prompt the user for desired accuracy of  $e$  (i.e., the number of terms in summation).

Sample Output:

```
Enter a value whose exponential needs to be evaluated: 1
Enter number of terms for evaluation: 20
Result is: 2.71828
```

**Q10:** Write a program that ask user to input angle in radians and computes its sine using Taylor series as below,

$$\sin(x) = \sum_{n=0}^{\infty} \frac{(-1)^n}{(2n+1)!} x^{2n+1}$$

Also, prompt the user for desired accuracy of  $\sin$ . (i.e., the number of terms in summation).

Sample Output:

```
Enter a value for sin evaluation: 2
Enter number of terms in the summation: 10
Result is: 0.909297
```

**Q11:** Write a program that prints any one of the following pattern as shown below,

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

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**Q12:** A right triangle can have sides that are all integers. A set of three integer values for the sides of a right triangle is called a Pythagorean triple. These three sides must satisfy the relationship that the sum of the squares of two of the sides is equal to the square of the hypotenuse. Find all Pythagorean triples for side1, side2 and hypotenuse all no larger than 500. Use a triple-nested for loop that tries all possibilities.

**Q13:** Consider the following code: Explain the output and any errors if any

```
#include <iostream>
using namespace std;
int main()
{
    unsigned short n=1000;
    cout << "n = " << n << endl;
    n *= 10;
    cout << "n = " << n << endl;
    n *= 10;
    cout << "n = " << n << endl;
    n *= 10;
    cout << "n = " << n << endl;
    return 0;
}
```

The output is

```
n = 1000
n = 10000
n = 34464
n = 16960
```

**Q.14** Consider the following code and its output. Explain any errors.

```
#include <iostream>
using namespace std;
int main()
{
    float x=1000.0;
    cout << "x = " << x << endl;
    x *= x; // multiplies n by itself; i.e.,it squares x
    cout << "x = " << x << endl;
    x *= x; // multiplies n by itself; i.e.,it squares x
    cout << "x = " << x << endl;
    x *= x; // multiplies n by itself; i.e.,it squares x
    cout << "x = " << x << endl;
    x *= x; // multiplies n by itself; i.e.,it squares x
    cout << "x = " << x << endl;
```

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```
return 0;
}
```

```
x = 1000
x = 1e+06
x = 1e+12
x = 1e+24
x = inf
```

**Q.15 The following code is for a quadratic equation solver**

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

int main()
{
    float a,b,c;
    cout << "Enter the coefficients of a quadratic equation:" << endl;
    cout << "\ta: ";
    cin >> a;
    cout << "\tb: ";
    cin >> b;
    cout << "\tc: ";
    cin >> c;
    cout << "The equation is: " << a << "*x*x + " << b
    << "*x + " << c << " = 0" << endl;
    float d = b*b - 4*a*c; // discriminant
    float sqrtd = sqrt(d);
    float x1 = (-b + sqrtd)/(2*a);
    float x2 = (-b - sqrtd)/(2*a);
    cout << "The solutions are:" << endl;
    cout << "\tx1 = " << x1 << endl;
    cout << "\tx2 = " << x2 << endl;
    cout << "Check:" << endl;
    cout << "\ta*x1*x1 + b*x1 + c = " << a*x1*x1 + b*x1 + c << endl;
    cout << "\ta*x2*x2 + b*x2 + c = " << a*x2*x2 + b*x2 + c << endl;
    return 0;
}
```

Outputs:

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```
Enter the coefficients of a quadratic equation:
```

```
a: 2
```

```
b: 1
```

```
c: -3
```

```
The equation is: 2*x*x + 1*x + -3 = 0
```

```
The solutions are:
```

```
x1 = 1
```

```
x2 = -1.5
```

```
Check:
```

```
a*x1*x1 + b*x1 + c = 0
```

```
a*x2*x2 + b*x2 + c = 0
```

```
Enter the coefficients of a quadratic equation:
```

```
a: 1
```

```
b: 1e10
```

```
c: 1
```

```
The equation is: 1*x*x + 1e+10*x + 1 = 0
```

```
The solutions are:
```

```
x1 = 0
```

```
x2 = -1e+10
```

```
Check:
```

```
a*x1*x1 + b*x1 + c = 1
```

```
a*x2*x2 + b*x2 + c = 1
```

The first output is correct, but the second output check is not correct. Explain the error and any corrective measure if possible.

#### Q.16 (Body Mass Index Calculator) The formulas for calculating BMI are

Create a BMI calculator application that reads the user's weight in pounds and height in inches (or, if you prefer, the user's weight in kilograms and height in meters), then calculates and displays the user's body mass index. Also, the application should display the following information from the Department of Health and Human Services/National Institutes of Health so the user can evaluate his/her BMI:

$$BMI = \frac{weight\ In\ Pounds \times 703}{height\ In\ Inches \times height\ In\ Inches}$$

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$$BMI = \frac{\text{weight In Kilograms}}{\text{height In Meters} \times \text{height In Meters}}$$

#### BMI VALUES

Underweight: less than 18.5

Normal: between 18.5 and 24.9

Overweight: between 25 and 29.9

Obese: 30 or greater

**Q.17** (Printing the Decimal Equivalent of a Binary Number) Input an integer containing only 0s and 1s (i.e., a “binary” integer) and print its decimal equivalent. Use the remainder and division operators to pick off the “binary” number’s digits one at a time from right to left.

**5.19 (Calculating the Value of  $\pi$ )** Calculate the value of  $\pi$  from the infinite series

$$\pi = 4 - \frac{4}{3} + \frac{4}{5} - \frac{4}{7} + \frac{4}{9} - \frac{4}{11} + \dots$$

Print a table that shows the value of  $\pi$  approximated by computing the first 200,000 terms of this series. How many terms do you have to use before you first get a value that begins with 3.14159?

#### Q.18

**Q.19 and Q.20** Write half page summary of any two of the following case studies from the chapters 6 titled Does Not Compute from the book Humble Pi, A comedy of math erros by Matt Parker. Your summary should include a brief introduction of the problem, what errors it caused and any ways to rectify the problem.

Chapter 6:

Civilizations Game

Switzerland Trains

Deadly code: Therac 25

MS Excel problem

Dangers of Truncation

Divide by Zero