National University of Computer and Emerging Sciences, Lahore Campus

Course:	Programming Fundamentals	Course Code:	CS-1002
Program:	BS (Computer Science)	Semester:	Fall 2024
Deadline:	10 Sept 24 (11:59 PM)	Total Marks:	10*10 = 100
Sections:	BCS-1B, 1E, 1F Assignment-1		

Instruction/Notes:

Submission Instructions (Read before attempting the Assignment)

1. **Write your roll number and name at the start of each file in comments.**
2. **Indent your code properly and prompt proper message for input and output.**
3. **Submit only one C++ (.cpp) file per question. Do not submit the entire project nor submit any empty files.**
4. **The name of each file must be prefixed with your roll no. and suffixed with the question/part number, i.e. in the following format:** xxL-xxxx_A1_Qx.cpp e.g., (24L-1982_A1_Q1.cpp)
5. **Your program should be generic with regards to the input required in each question (i.e. taking input is mandatory unless specified and hardcoding outputs is strictly prohibited).**
6. **For questions involving rounding numbers and decimals, refer to the reference table at the end of the document.**
7. **Main objective of this assignment is to learn and familiarize yourself with the concepts included. Hence, plagiarism of any capacity will not be tolerated.**

Question 1:

Aslam goes to a 5-star Chinese fine-dining restaurant with 3 of his friends: Meera, Ihtesam and Eesha.

Enjoying a sumptuous meal, they have fully satisfied their appetites but now face the challenge of splitting the bill. Unfortunately, none of them are particularly good at math, and they're struggling to figure out how to divide the bill fairly. Observing their predicament from a distance, you as a programmer, decide to lend a hand by quickly developing a program to help them.

Your task is to create a bill-splitting calculator that accepts seven inputs: the sub total amount (in Rs.), tax percentage, service charges percentage, and the respective split percentages for each of the four individuals. The program should first calculate the grand total after including the tax amount and service charges, and then determine the split amount each person owes based on the percentages provided. Finally, display all of these calculated amounts i.e., (grand total, tax amount, service charges, and the share of each individual like share of Eesha: 2765.5), ensuring that Aslam and his friends can settle the bill with ease and avoid similar situations in the future, thanks to your program.

Question 2

You're an astrophysics graduate student working as a research assistant to Dr. Tyson at the Mauna Kea Observatory in Hawaii. Dr. Tyson is a celebrated astrophysicist working actively in the domain of studying exoplanets.

He has received enormous amounts of data regarding the Kepler-90 multiplanetary system and he plans to determine the gravitational field strength of the system's exoplanets relative to the Earth. He tasks you, his research assistant, to create a program that would take a planet's mass (in Earth masses) and radius (in Earth radii) as input. Using the formula: Gravitational Field Strength (g) = G * M / R^2 (where G is the universal gravitational constant, take G = 6.67, M is the planet's mass and R its radius), calculate and display the planet's gravitational field strength relative to Earth, rounding your answer off to two decimal places.

Question 3

Your friend, Dr. Amelia, is a dedicated oncologist who oversees dozens of cancer patients every week for creating customized chemotherapy regimens to help in their respective treatments.

It gets very hectic for her to calculate a dosage prescription for each of her patients in conjunction with recording and transcribing the measurements and findings. You, as a friend, offer to lessen her worries by automating dosage calculation for her as a programmer.

You are to design a program that calculates a patient's Body Surface Area (BSA) using the Mostellar formula: BSA = $\sqrt{(h * w) \div 3600}$, where ***h*** is the patient height in cm and ***w*** is the patient weight in kgs, and then uses the BSA to determine the adequate dosage. Assume the prescribed drug dosage is 50mg per square meter of BSA. Display both the calculated BSA rounded off to two decimal places and the drug dosage rounded to nearest mg.

Question 4

As a computer science graduate student, you've based your master's research thesis on file compression techniques and their effectiveness in optimizing memory management and resource allocation.

There are several compression algorithms such as Discrete Cosine Transform (DCT), Run-Length Encoding (RLE), Huffman Encoding etc and you have decided to create a program that would aid in calculating the compression ratios for these compression techniques as an assessment factor.

Your program takes two inputs: the size of the original data (S_o) and the size of the compressed file (S_c), both in megabytes (MB). Calculate and display the compression ratio (r) as a percentage (%) rounded to one decimal place, using the formula: $r = (1 - (S_c \div S_o)) * 100$. Also, calculate and show the space saved in gigabytes (GB), rounded to three decimal places.

Question 5

You're a freelance business analyst hired by the famous coffee shop chain "Jammin Java" to project their sales for a new location. They want to understand how different factors might affect their daily revenue.

Create a program that takes five inputs: the average price of a coffee drink (in dollars), the expected number of customers per hour during peak times, the number of peak hours per day, the expected

number of customers per hour during non-peak times, and the number of non-peak hours per day. Calculate and display the projected daily revenue, rounded to the nearest dollar. Also, calculate and show the percentage (%) of revenue earned during peak hours versus non-peak hours, rounded to one decimal place.

Question 6

Your friend Ayesha is an aspiring baker who wants to adjust her chocolate chip cookie recipe to produce larger batches for an upcoming bake sale. She needs help scaling the ingredients proportionally.

She has provided you with the base recipe for making 24 of her famously delicious chocolate chip cookies. Your task is to create a program that scales this recipe according to the desired number of cookies. The base recipe for 24 cookies uses 2.25 cups of flour, 0.75 cups of sugar, and 12 ounces of chocolate chips. Scale the ingredients accordingly, rounding up to the nearest quarter unit (0.25) for flour and sugar, and to the nearest ounce for chocolate chips.

Question 7

You are a structural engineer tasked with designing the Mian Muhammad Nawaz Sharif flyover bridge. To ensure the safety and stability of the structure, you need to calculate the maximum bending moment and shear force for one of the main beams of the bridge.

Your job is to create a program that assists in these calculations. The program should accept four inputs: the length of the beam (in meters), the uniform load on the beam (in kN/m), the point load applied at the center of the beam (in kN), and the yield strength of the beam's material (in MPa).

Using the formula $M_{max} = ((w \times L^2) \div 8) + ((P \times L) \div 4)$, where *w* is the uniform load, *L* is the length of the beam, and *P* is the point load, calculate and display the maximum bending moment in kN·m, rounded to two decimal places.

Next, compute the maximum shear force using the formula $V_{max} = ((w \times L) \div 2) + (P \div 2)$, and display this value in kN, also rounded to two decimal places.

This program will help you ensure the bridge design is both safe and efficient.

Question 8

You know that Equation of straight line is $y = mx + c$, where $m = \frac{rise}{run} = \frac{\Delta y}{\Delta x} = \frac{y2-y1}{x2-x1}$. Write a program that asks the user to enter the information of two points of a straight line. Calculate the gradient (m). Substitute the gradient and any of the points of given straight line in the equation to determine the value of "c" i.e., (y-intercept). Now calculate the coordinates of mid-point of the given straight line by using the formula $\frac{x1+x2}{2}, \frac{y1+y2}{2}$. Print the values of gradient, y-intercept and coordinates of mid-point on console.

Question 9

Write a program that asks the user to enter the current sea level, the expected percentage decrease in the sea level each year, and the number of years (number of years must be greater than 10). Your task is to determine the expected sea level and the expected decrease in the sea level after the given

number of years. (Is it possible to calculate the sea level in a single statement? Explore the concept and formula of compound interest for this purpose).

Question 10

Write a program that asks the user to enter the first term, last term and the total number of terms (must be an odd number) of an arithmetic series. (Remember there exists a common difference in arithmetic series like 7, 14, 21, …). Your task is to determine the sum of the given number of terms of an arithmetic series whose first term, last term and total number of terms are already provided by the user e.g., (7+14+21+28+35). Explore the arithmetic series sum formula.

REFERENCE TABLE

Taking Square Root Of An Integer

```
#include <iostream>
#include <cmath>
void main() {
    std::cout << std::sqrt(25) << std::endl; // displays 5
}
```

Rounding-off Decimal Places

```
#include <iostream>
#include <cmath>
void main() {
    std::cout << std::setprecision(3) << 3.142 << std::endl; // displays 3.14
}
```

Rounding-up An Integer

```
#include <iostream>
#include <cmath>
void main() {
    std::cout << std::ceil(3.142) << std::endl; // displays 4
}
```

Rounding-down An Integer

```
#include <iostream>
#include <cmath>
void main() {
    std::cout << std::floor(3.142) << std::endl; // displays 3
}
```