LAB ASSIGNMENTS

Problem Solving and Program Design Using C

(CSE 3942)

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Lab Assignment-1

1. Programming Projects on Overview of C and Top-Down Design With Functions

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1.1 Write a program to assist in the design of a hydroelectric dam. Prompt the user for the height of the dam and for the number of cubic meters of water that are projected to flow from the top to the bottom of the dam each second. Predict how many megawatts (1MW = 10^6W) of power will be produced if 90% of the work done on the water by gravity is converted to electrical energy. Note that the mass of one cubic meter of water is 1000 kg. Use 9.80 $meters/second^2$ as the gravitational constant g . Be sure to use meaningful names for both the gravitational constant and the 90% efficiency constant. For one run, use a height of 170 m and flow of 1.30×10^3 m^3/s. The relevant formula (w = work, m = mass, g = gravity, h = height) is: w = mgh.

1.2 Metro City Planners proposes that a community conserve its water supply by replacing all the community's toilets with low-flush models that use only 2 liters per flush. Assume that there is about 1 toilet for every 3 persons, that existing toilets use an average of 15 liters per flush, that a toilet is flushed on average 14 times per day, and that the cost to install each new toilet is $150. Write a program that would estimate the magnitude (liters/day) of the water saved and the total cost to install new toilets based on the community's population.

1.3 Write a program that calculates the acceleration (m/s^2) of a jet fighter launched from an aircraft-carrier catapult, given the jet's takeoff speed in km/hr and the distance (meters) over which the catapult accelerates the jet from rest to takeoff. Assume constant acceleration. Also calculate the time (seconds) for the fighter to be accelerated to takeoff speed. When you prompt the user, be sure to indicate the units for each input. For one run, use a takeoff speed of 278 km/hr and a distance of 94 meters. Relevant formulas (v = velocity, a = acceleration, t = time, s = distance)

$$v = at$$
$$s = \frac{1}{2}at^2$$

1.4 You have saved $500 to use as a down payment on a car. Before beginning your car shopping, you decide to write a program to help you figure out what your monthly payment will be, given the car's purchase price, the monthly interest rate, and the time period over which you will pay back the loan. The formula for calculating your payment is

$$\text{payment } = \frac{iP}{1-(1+i)^{-n}}$$

where P = principal (the amount you borrow)
i = monthly interest rate ($\frac{1}{12}$ of the annual rate)
n = total number of payments

Your program should prompt the user for the purchase price, the down payment, the annual interest rate and the total number of payments (usually 36, 48, or 60). It should then display the amount borrowed and the monthly payment including a dollar sign and two decimal places.

1.5 A cyclist coasting on a level road slows from a speed of 10 mi/hr to 2.5 mi/hr in one minute. Write a computer program that calculates the cyclist's constant rate of acceleration and determines how long the cyclist will take to come to rest, given an initial speed of 10 mi/hr. (Hint:

Use the equation

$$a = \frac{v_f - v_t}{t}$$

where a is acceleration, t is time interval, v_1 is initial velocity, and v_f is final velocity.) Write and call a function that displays instructions to the program user and a function that computes a, given t, v_f, and v_r.

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

Celsius = 10 (depth) + 20 (Celsius temperature at depth in km)
Fahrenheit = 1.8 (Celsius) + 32

Include two functions in your program. Function *celsius_at_depth* should compute and return the Celsius temperature at a depth measured in kilometers. Function *fahrenheit* should convert a Celsius temperature to Fahrenheit.