Programming Technique 1 Group Assignment 1

Question 1:

The stress σ on an object is defined by the following formula:

$$\sigma = \frac{F}{A}$$

where F is the force applied to the object and A is the area over which the force is applied. Write a program that will calculate the stress given the force and the area.

Question 2:

Strain is a measure of how much a material deforms. The strain ε that a thin rod undergoes when it is stretched or compressed along its length is computed by:

$$\varepsilon = \frac{\Delta x}{x_0}$$

where Δx is the change in length of the rod (final length – original length) and x_0 is the original length of the rod. Write a program that will calculate the strain of an object, given its initial length and final length.

Question 3:

Quarterbacks in the National Football League (NFL) are rated according to a formula that takes into account passes attempted (Att), passes completed (Cmp), total yards gained passing (Yds), passes caught for touchdown (TD), and passes intercepted by opponents (Int). The formula is:

$$Rating = \frac{100}{6}\left[\frac{Cmp\% - 30}{20} + \frac{AvgYds - 3}{4} + \frac{TD\%}{5} + \frac{9.5 - Int\%}{4}\right]$$

where:
Cmp% = Pass-completion percentage = $(Cmp / Att)x100\%$
AvgYds = Average yards gained per attempt = Yds / Att
TD% = Percentage of passes caught for touchdowns = $(TD / Att)x100\%$
Int% = Percentage of passes intercepted = $(Int / Att)x100\%$

Write a program that takes passing data and computes the passer's efficiency rating. Note that Att, Cmp, Yds, TD and Int are all integer quantities, but that the final rating is a floating-point value.

Question 4:

Newton's law state that the force, F, between two bodies of masses M_1 and M_2 is given by:

$$F = k\left(\frac{M_1 M_2}{d^2}\right)$$

where k is the gravitational constant and d is the distance between the bodies. The value of k is approximately 6.67 x 10^{-8} dyn. cm^2/g^2. Write a program that prompts the user to input the masses of the bodies and the distance between the bodies. The program then outputs the force between the bodies.

Question 5:

If the interest earned on a savings account is compounded annually, it can be compounded by the following formula:

$$A = P(1+i)^t$$

where A is the amount of money in the account at the end of the year, P is the principal (i.e. the original amount invested), i is the annual interest rate, and t is the number of years that the money stays in the account at this interest rate. Write a program that will calculate the amount of money in a savings account at the end of any given year. The program should work for any principal, interest rate and number of years.

Question 6:

Write a program that computes the vapor pressure of water as a function of temperature. The vapor pressure of a liquid or solid is the measure of the volatility of that substance: the higher the vapor pressure, the more likely the substance is to vaporize. The dependence of vapor pressure on temperature is often described by the Antoine Equation:

$$p = A - \left(\frac{B}{T+C}\right)$$

in which p is the vapor pressure, T is absolute temperature, and A, B and C are constants that depends on the substance. For water, A=16.5362, B = 3985.44 and C = -38.9974.

Question 7:

Any given force in the x-y plane can be resolved into two components, one parallel to the x-axis (F_x), the other parallel to the y-axis (F_y):

$$F_x = F\cos\alpha \text{ and } F_y = F\sin\alpha$$

where α is the angle between F and the x-axis. Write a program that prints F_x and F_y for a given force F and angle α.

Question 8:

Write a program to compute the area of a triangle given the lengths of the three sides (a, b and c). The area is given by Heron's formula:

$$A = \sqrt{x(x-a)(x-b)(x-c)} \quad \text{where} \quad x = \frac{1}{2}(a+b+c)$$

Question 9:

Write a program to compute the area of a triangle given two sides a and b and the included angle γ. The program will prompt for the angle in degrees and convert the angle to radians. The area is calculated by the following formula:

$$A = \frac{1}{2}ab\sin\gamma$$

Question 10:

Write a program that prompt the user to input the elapsed time for an event in seconds. The program then outputs the elapsed time in hours, minutes and seconds. For example, if the elapsed time is 9630 seconds, then the output is 2:40:30.

Question 11:

The monthly payment on a loan may be calculated by the foloowing formula:

$$Payment = \frac{Rate * (1+Rate)^N}{((1+Rate)^N - 1)} * L$$

Rate is the monthly interest rate, which is the annual interest rate divided by 12. (12% annual interest would be 1 percent monthly interest). N is the number of payments and L is the amount of the loan. Write a program that asks for these values and displays the loan amount, monthly interest rate, number of payments, monthly payment, amount paid back and interest paid.

Question 12:

Joe's Pizza Palace needs a program to calculate the number of slices a pizza of any size can be divided into. The program will the user to input the diameter of the pizza in inches. The program will then calculate the number of slices that may be taken from a pizza of that size and display a message telling the number of slices. To calculate the number of slices that may be taken from the pizza, you must know the following facts:

a) Each slice should have an area of 14.125 inches.
b) To calculate the number of slices, simply divide the area of the pizza by 14.125.
c) The area of the pizza is calculated by:

$$Area = \pi r^2$$

Question 13:

Interest rates can be compounded on any schedule (eg. monthly, quarterly or annually). The following is a general formula for computing compound interest:

$$A = P\left(1 + \frac{i}{n}\right)^{nt}$$

where A is the amount of money in the account at the end of the year, P is the principal (i.e. the original amount invested), i is the annual interest rate, t is the number of years that the money stays in the account at this interest rate and n is the number of times in a year that interest is compounded. Write a program that will calculate the amount of money in a savings account at the end of any given year. The program should work for any principal, interest rate, number of years, and compounding schedule.

NOTES:

1. Each group must choose two of the assignments (as your first and second choice) listed above. I will assign the assignment using a "first-come-first-serve" policy. For example, the first group that email me with the choice of question 3 and question 9 as its second choice will get to do the question 3. But for the second group emailed me with the same choices will get to do the question 9 .
2. Please confirm with me the chosen projects together with your group members name via email (radziahm@utm.my) by **Wednesday(2nd. November 2011).**

INSTRUCTIONS:

1. This assignment MUST be submitted by **Monday (14/11/11) before 4 p.m**. at my office.
2. Do this assignment in a group of three (You choose your group member).
3. For the solution, you are required to develop pseudo code, flowchart and C++ code.
4. Each group must submit a **hardcopy (pseudo code, flowchart, C++ code and a sample of running** - send to my office), **team evaluation form** (hardopy – enclosed in the report) and **softcopy** (via e-learning) of the C++ program.
5. Failure to submit this assignment on time will cost you **5 marks/day**.
6. **Copying/Plagiarism** in whatever form is strictly prohibited. No marks will be given (zero) to all involved parties if caught copying other's assignment(s).