Model Question

NEPAL COLLEGE OF INFORMATION TECHNOLOGY

Level: Bachelor

Program: BE

Course: Problem Solving Techniques

Candidates are required to give their answers in their own words as far as practicable.

Attempt all the questions.

1. a) There are m numbers of computers and m+1 number of students in a 'Programming in C' lab. Verify that one computer must be shared by at least two students.   7

OR

A watermelon weighs 500 pounds. It turns out that 99% of the weight of the watermelon is due to water in the watermelon. After the watermelon has sat in a drying room for a while, it turns out that it is only 98% water by weight. How much does it weigh now?

b) A martini is made is made by mixing k parts gin with 1 part vermouth. Gin is usually 40% alcohol while vermouth is 20% alcohol. A martini is said to be dry if it contains relatively little vermouth. For instance, if k = 15 then the martini is said to be dry. If instead k = 5, then the martini is said to be sweet. Discuss by calculating the amount of alcohol in a dry martini vs sweet martini, which one is better?   8

OR

A new car is equipped with three fuel saving devices. Device A, by itself, saves 25% on fuel; device B, by itself, saves 45% on fuel and device C, by itself saves 30% on fuel. Now suppose that the three devices are used together and that they act independently. Will the combination save 20+45+30=100% on fuel? What is the correct answer?

2. a) A cube of a side r is inscribed in a sphere. The sphere is inscribed in a cone with side length equal to the diameter of its base. The cone is inscribed in a right circular cylinder. What is the surface area of the cylinder?   8
   b) There are two married couples that need to cross a river. A small boat is available that will hold just two people at a time. The males involved are quite jealous. No woman can be left with a man unless her husband is also present. There are no other constraints. How can these four people cross the river? What is the fewest numbers of trips possible?   7

3. a) A certain number k is a multiple of 9. Add the digits together. If the result has more than one digit, add those together. Continue adding digits together until you have a one digit answer. It will be a 9. Explain why this is so?   8
   b) Suppose that you have a 9 quart container and a 4 quart container. How can you put exactly 6 quart of water into the large container.   7

4. a) A ten foot pole is dropped into a milling saw and randomly cut into three shorter poles. What is the probability that these three pieces will form a triangle?   7
   b) A 10 years old child puts Rs. 100000 in the bank. She intended with withdraw the money on her 21st birthday. Which one scheme is better for her?

i.   An account with 5% interest compounded daily
ii.   An account with 5.1% interest compounded weekly.   8

5. a) A game is played by two players. They begin with a pile of thirty chips, all the same. For his or her move, a player may remove 1 to 6 chips. The player who removes the last chip wins. What strategy can the first player use so that he will always win?   7

   b) Examine the equations
$$1 = 1$$
$$2+3 + 4 = 1+8$$
$$5+6+7+8+9 = 8+27$$
$$10+11+12+…+16 = 27+64$$
   Determine the pattern and prove the identity.   8

6. a) It begins snowing some time before noon. The snowfall steadily, when measured by the rate of change of depth. At exactly noon, a snow plow begins working at a steady rate (in terms of cubic feet of snow removed per hour). The plow clears two blocks during the first hour of work, and one block during the second hour. At what time did it begin snowing?   8

OR

Construct an 8×8 magic square and explain the constructing process.

b) Suppose that you have 9 pearls. They all look the same, but 8 of have equal weight and one is different. The odd pearl is either lighter or heavier, you do not know which. The only equipment that you have at hand is a balance scale. How can you use the scale to find the odd pearl In just three weighing?   7

OR

Solve the following crypto arithmetic problem:

$$\begin{array}{r} CROSS \\ +ROADS \\ \hline DANGER \end{array}$$

7. Answer any two questions: $(2 \times 5 = 10)$

a) Suppose that S is a set with k elements. Show that S has precisely 2^k subsets.

b) How many zeros end the number 890! – 420!

c) Show that if a polyhedron has all square faces, three meeting at each vertex, then the polyhedron must be a cube.

GOOD LUCK!!!