Problem No 1: [Genetic Algorithms]   **[2 + 3 + 2 + 2 + 6 Points]**

Attempt the following questions using the population of solutions/chromosomes given below. The fitness value of each chromosome is also given. If you need a random number in any part then sequentially select one from the following list starting from 0.86 and moving on.

0.86, 0.59, 0.67, 0.14, 0.34, 0.08, 0.11, 0.29, 0.85, 0.76, 0.43, 0.47, 0.89, 0.98, 0.58, 0.03, 0.57

Chromosomes	100000001	010101010	010100110	001100111
Fitness	**8**	**1**	**2**	**9**

Part a) Which chromosome will be selected if fitness proportionate selection is used? Show complete working.

Part b) Assume that single point crossover is to be used to compute two new solutions using the first and third chromosome. Show complete working and the resulting chromosomes obtained after the crossover.

HINT: To determine a crossover point you can map the random number R between 0 and 1 to a random number between 1 and N using simple product of R with N i.e. ceiling(R*N).

Part c) Assume that the chromosome 100101010 has already been selected for mutation using a mutation rate of 0.01. Show the resulting chromosome after mutation.

Part d) What is the concept of elitism in the context of genetic algorithm? How would it help in finding a good solution?

Part e) You are given 10 unique numbers. You have to divide these numbers into 2 sets. Set 1 must have numbers such that their product is as close to 240 as possible. Set 2 must contain numbers such that their sum is as close to 40 as possible. You need to solve this problem using genetic algorithms.

  i. Briefly explain how you would represent the solution as a chromosome.
  ii. Based on your representation, what is the chromosome for the for the solution in which Set 1 contains 2, 3, 4, 10 and Set 2 has 1, 5, 6, 7, 8, 9.
  iii. What should be the fitness function for this problem? Provide mathematical representation only.