Concept Questions

Please put your answers in the following table.

1	2	3	4	5	6	7	8	9	10

1. Which statement is not true about the mean of a random variable?
   A) The mean is the average of all possible values of the random variable.
   B) The mean could be estimated by adding up samples of the random variable and then dividing by the number of samples.
   C) The mean can be estimated as the middle sample of a sorted set of samples if the number of samples is odd.
   D) The mean has the same unit as that of the random variable.

2. Two independent random variables X_1 and X_2 follow normal distribution with $X_1 \sim N(30, 3^2)$ and $X_2 \sim N(40, 4^2)$, respectively. Which statement is true about $X_1 + X_2$?
   A) The mean of $X_1 + X_2$ is 50.
   B) The mean of $X_1 + X_2$ is 40.
   C) The standard deviation of $X_1 + X_2$ is 3.
   D) The standard deviation of $X_1 + X_2$ is 5.

3. The diameter of a rod is measured 10 times and the results are given below.

   10.10
   10.36
   9.54
   10.17
   10.06
   9.73
   9.91
   10.06
   10.71
   10.55

   The average of the diameter is

   A) 17.2 mm
   B) 20.5 mm
   C) 10.1 mm
   D) 20.4 mm

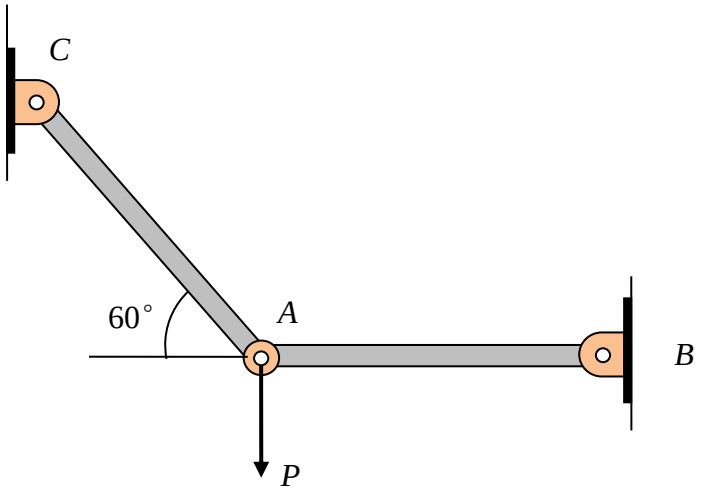
4. For problem 3, the standard deviation of the diameter is
   A) 10.2 mm
   B) 0.01 mm

C) 0.35 mm
D) 105 mm

5. A bar has a diameter of 10 mm and is subject to a random axial force $F \sim N(20, 2^2)$ kN. If the force is normally distributed, determine the mean and standard deviation of the normal stress developed in the bar.
   A) $\mu_S = 256.65$ MPa, $\sigma_S = 25.66$ MPa
   B) $\mu_S = 25.65$ MPa, $\sigma_S = 25.66$ MPa
   C) $\mu_S = 256.65$ MPa, $\sigma_S = 256.65$ MPa
   D) $\mu_S = 156.55$ MPa, $\sigma_S = 15.65$ MPa

6. For problem 5, what is the probability that the force is less than 18 kN or $\Pr\{F < 18 \text{ kN}\}$?
   A) 0
   B) 15.87%
   C) 84.13%
   D) 50%

7. Two aluminum rods with the same diameter of 8.33 mm support the vertical force $P \sim N(30, 4^2)$ kN. Which of the following statements is not true?



   A) The average force developed in rod *AC* is 34.65 kN.
   B) The forces developed in *AC* and *AB* are dependent.
   C) The average force developed in rod *AB* is 17.31 kN.
   D) The standard deviation of the force developed in rod *AC* is the same as that in rod *AB*.

8. For the above problem, if the allowable tensile stress for the aluminum is $S_a \sim N(150, 20^2)$ MPa, what is the probability of failure of rod *AB*? Assume that *P* and S_a Sa are independent.
   A) 0
   B) 50%

C) 10^{-4}
D) 0.02

9. A rod has a diameter of $d = 10\,\text{mm}$. An axial load $P \sim N(30, 1^2)\,\text{k N}$ is applied to the rod. What is not true about the mean of the normal stress?

A) It is a linear function of that of P.
B) It has a value of 382 MPa.
C) It has a value of 156 MPa.
D) It depends on P and d.

10. For the problem 9, what is true about the standard deviation of the normal stress?

A) It has a value of 12.7 MPa.
B) It has a different unit from the mean.
C) It is a linear function of that of d.
D) It depends on the length of the rod.