## Concept Questions

Please put your answers in the following table.

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | |

1. Which of the following statements is not true about reliability?
   A) It should not be greater than 1.
   B) It can be negative.
   C) It represents the probability that a mechanical element will not fail in use.
   D) The larger is the reliability, the smaller is the probability of failure.

2. Assume that the failures of components in a parallel system are independent, then the system reliability is more than or equal to the reliability of its components. (true of false)

3. For a series system, the larger is the number of components in the system, the higher is the system reliability. (true of false)

4. A shaft is supported by two bearings with reliabilities of 0.95 and 0.98, what is the overall reliability of the bearing set?
   A) 0.965
   B) 0.95
   C) 0.98
   D) 0.93

5. The actual values of the yield strength (MPa) of a steel shaft are given below.

   70.55, 93.12, 82.16, 85.25, 72.83, 71.03, 89.10, 87.87, 73.67, 93.41

   The mean of the yield strength is
   A) 80.00 MPa
   B) 81.90 MPa
   C) 100 MPa
   D) 60 MPa

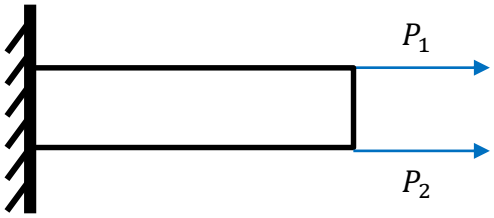
6. For problem 5, what is the standard deviation of the yield strength?
   A) 9.15 MPa
   B) 10.10 MPa
   C) 8.19 MPa
   D) 12.85 MPa

7. A round shaft is subjected to an axial force $F \sim N(50, 5^2)$ kN. The cross-section area of the shaft is $A = 0.001$ m$^2$. What is the mean and standard deviation of stress $S$?

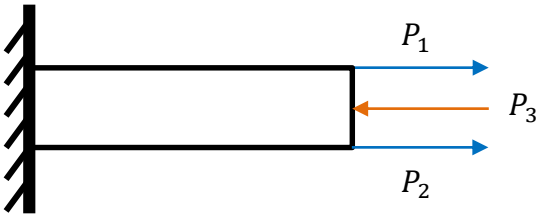
A) $\mu_S = 50$ MPa, $\sigma_S = 5$ MPa
B) $\mu_S = 50$ MPa, $\sigma_S = 25$ MPa
C) $\mu_S = 50$ MPa, $\sigma_S = 2.5$ MPa
D) $\mu_S = 50$ MPa, $\sigma_S = 0.5$ MPa

8. For problem 7, if the yield strength is $S_y = 60$ MPa, determine the reliability of the shaft.
A) 10%
B) 50%
C) 80%
D) 97.72%

9. A cantilever with a section area $A = 0.001$ m$^2$ is subject to two random forces $P_1 \sim N(20, 2^2)$ kN and $P_2 \sim N(20, 2^2)$ kN. If an independent force $P_3 \sim N(20, 4^2)$ kN is also applied to the cantilever, which of the following statements is true after $P_3$ is added?




Case 1




Case 2

A) The mean of the stress increases and the standard deviation increases.
B) The mean of the stress increases and the standard deviation decreases.
C) The mean of the stress decreases and the standard deviation increases.
D) The mean of the stress decreases and the standard deviation decreases.

10. For the above problem, which of the following statements is not true?
A) The mean of the stress in Case 1 is 40 MPa.
B) The mean of the stress in Case 2 is 20 MPa.
C) The standard deviation of the stress in Case 2 is zero.
D) The standard deviation of the stress in Case 2 is greater than $2\sqrt{2}$ kN.