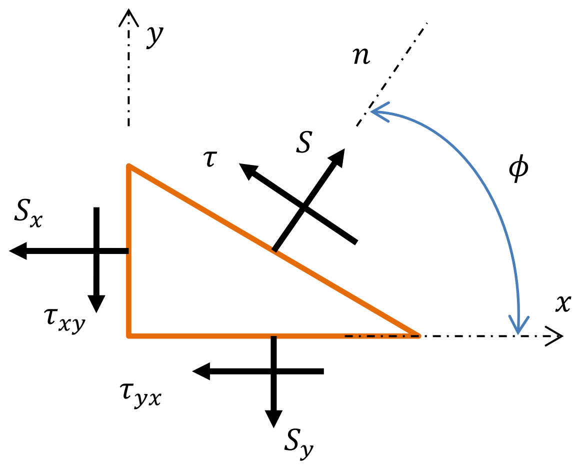
Exam 3

Please put your answers in the following table.

1	2	3	4	5	6	7	8	9	10

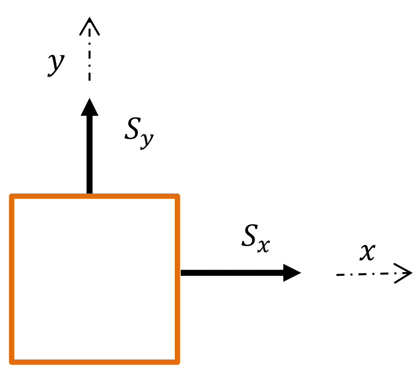
1. An element is cut by an oblique plane with a normal n at an angle $\phi = 60^0$ counterclockwise from the x axis. If $S_x \sim N(60, 6^2)$ MPa, $S_y \sim N(50, 5^2)$ MPa, $\tau_{xy} \sim N(30, 3^2)$ MPa, what is the distribution of shear stress?



A. $S \sim N(78.5, 7.8^2)$ MPa B. $S \sim N(78.5, 4.8^2)$ MPa
C. $S \sim N(78.5, 5.6^2)$ MPa D. $S \sim N(78.5, 6.8^2)$ MPa

2. For the above problem, which of the following statements is not true about the first principle shear stress τ_1?
   A. The smaller is the mean of τ_{xy}, the smaller is the mean of τ_1
   C. The larger is the standard deviation of τ_{xy}, the larger is the standard deviation of τ_1
   D. The larger is the standard deviation of σ_y, the smaller is the standard deviation of τ_1
   D. τ_1 is not normally distributed

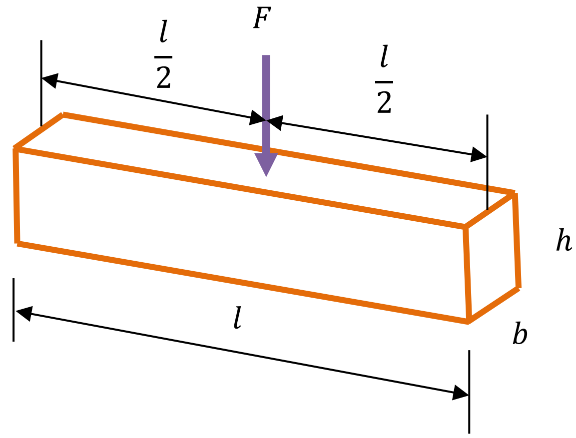
3. A stress element is subjected to two-dimensional stress as shown in the figure. The Poisson's ratio is $\nu = 0.3$ and the modulus of elasticity is $E = 60$ MPa. If $S_x \sim N(80, 8^2)$ MPa and $S_y \sim N(60, 6^2)$ MPa, determine the mean and standard deviation of the axial strain ϵ_x.



A. $\mu = 0.51, \sigma = 0.064$
B. $\mu = 0.51, \sigma = 0.051$
C. $\mu = 0.64, \sigma = 0.064$
D. $\mu = 0.64, \sigma = 0.051$

4. For problem 3, if the length of the element is $l = 1$ mm and the maximum allowable axial elongation is $\delta_a = 0.7$ mm, determine the probability of failure.
   A. $\Phi(-2.95)$ B. $\Phi(-1.65)$ C. $\Phi(2.95)$ D. $\Phi(-2.68)$

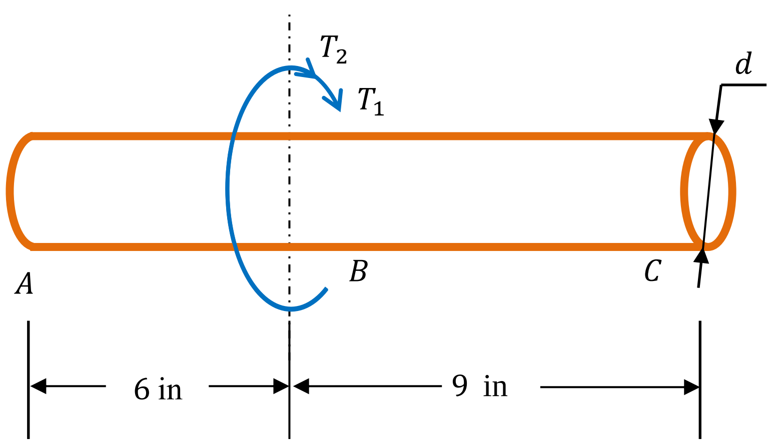
5. A concentrated load $F \sim N(6000,\ 600^2)$ N is applied to a beam with a rectangular cross-section as shown in the figure. The width and height of beam are $b = 60$ mm and $h = 80$ mm, respectively. And the length of the beam is $l = 2$ m. What is the distribution of the maximum bending stress?



A. $\tau_{\max} \sim N(46.9, 22^2)$ MPa B. $\tau_{\max} \sim N(46.9, 4.69^2)$ MPa
C. $\tau_{\max} \sim N(64.9, 6.49^2)$ MPa D. $\tau_{\max} \sim N(64.9, 4.69^2)$ MPa

6. For the above problem, if the allowable bending stress is $S_a \sim N(70,\ 7^2)$ MPa, what is the reliability of the beam?
   A. $\Phi(1.72)$ B. $\Phi(-2.75)$ C. $\Phi(2.75)$ D. $\Phi(-1.72)$

7. Two torques are applied to a round shaft as shown in the figure. The diameter of the shaft is $d = 1$ in. And the modulus of rigidity is $G = 11.5(10^6)$ psi If $T_1 \sim N(160,\ 16^2)$ lbf·in and $T_2 \sim N(120,\ 12^2)$ lbf·in, what is the distribution of the angle of twist at B?

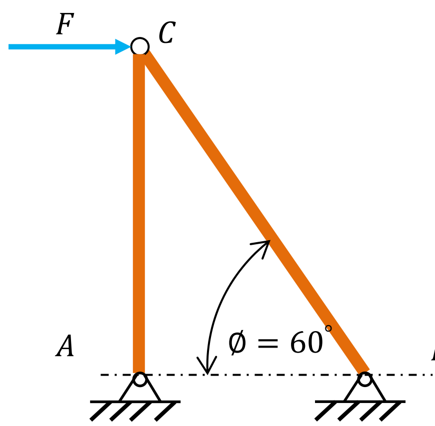


A. $\theta \sim N(8.93(10^{-4}), (8.93(10^{-5}))^2)$ rad B. $\theta \sim N(8.93(10^{-4}), (6.38(10^{-5}))^2)$ rad
C. $\theta \sim N(6.38(10^{-4}), (6.38(10^{-5}))^2)$ rad D. $\theta \sim N(6.38(10^{-4}), (8.93(10^{-5}))^2)$ rad

8. For the above problem, if the allowable angle of twist is $\theta_a = 1(10^{-4})$, determine the probability of failure of the shaft.
A. $\Phi(-2.5)$ B. $\Phi(2.5)$ C. $\Phi(-1.68)$ D. $\Phi(1.68)$

9. A shaft is subjected to a torque $T \sim N(200,\ 20^2)$ N·m. If the shaft speed is 2500 rev/min, what is the distribution of the power that the shaft can transmit?
A. $\mu = 52.4\ \text{kW}, \sigma = 5.24\ \text{kW}$
B. $\mu = 5.24\ \text{kW}, \sigma = 0.524\ \text{kW}$
C. $\mu = 62.8\ \text{kW}, \sigma = 6.28\ \text{kW}$
D. $\mu = 6.28\ \text{kW}, \sigma = 0.628\ \text{kW}$

10. A force $F \sim N(60,\ 6^2)$ kN is applied to a truss as shown in the figure. The rod BC has a round cross-section with a dimeter of $d = 0.1$ m. If the yield stress of rod BC is $S_y = 20$ MPa, determine the reliability of rod BC.



A. $\Phi(-3.10)$ B. $\Phi(2.82)$ C. $\Phi(-2.82)$ D. $\Phi(3.10)$