

Fill in the circle of the best (closest) answer. If you are confident none of the choices are correct, leave all of the circles blank and "box in" your answer below the question itself.

01 a b c d e f g
 ○ ○ ○ ○ ○ ○ ○ ○

02 ○ ○ ○ ○ ○ ○ ○ ○

03 ○ ○ ○ ○ ○ ○ ○ ○

04 ○ ○ ○ ○ ○ ○ ○ ○

05 ○ ○ ○ ○ ○ ○ ○ ○

06 a b c d e f g
 ○ ○ ○ ○ ○ ○ ○ ○

07 ○ ○ ○ ○ ○ ○ ○ ○

08 ○ ○ ○ ○ ○ ○ ○ ○

09 ○ ○ ○ ○ ○ ○ ○ ○

10 ○ ○ ○ ○ ○ ○ ○ ○

11 a b c d e f g
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12 ○ ○ ○ ○ ○ ○ ○ ○

13 ○ ○ ○ ○ ○ ○ ○ ○

14 ○ ○ ○ ○ ○ ○ ○ ○

15 ○ ○ ○ ○ ○ ○ ○ ○

16 a b c d e f g
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17 ○ ○ ○ ○ ○ ○ ○ ○

18 ○ ○ ○ ○ ○ ○ ○ ○

19 ○ ○ ○ ○ ○ ○ ○ ○

20 ○ ○ ○ ○ ○ ○ ○ ○

21 a b c d e f g
 ○ ○ ○ ○ ○ ○ ○ ○

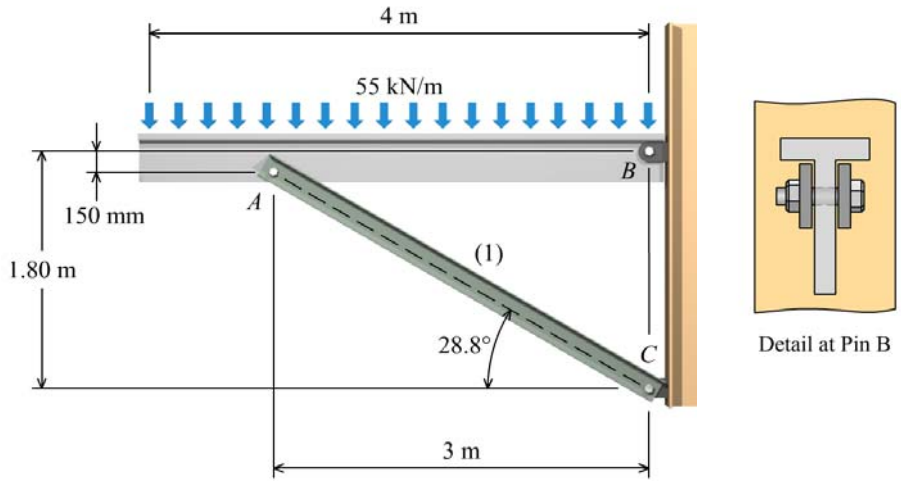
22 ○ ○ ○ ○ ○ ○ ○ ○

23 ○ ○ ○ ○ ○ ○ ○ ○

A rigid tee beam is supported by pin-connected steel strut (1) and by a pin connection at B . The beam is subjected to a uniformly distributed load of $w = 55 \text{ kN/m}$.

1. Determine the axial force in member (1). (4 points)

- a. 163 kN
- b. 167 kN
- c. 279 kN
- d. 304 kN

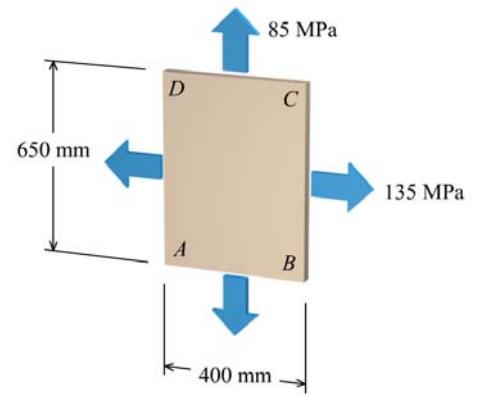


2. The resultant force acting in pin B is 260 kN. If the shear stress in pin B must be limited to 90 MPa, determine the minimum diameter that may be used for the pin. (3 points)

- a. 0.68 mm
- b. 21.4 mm
- c. 42.9 mm
- d. 60.7 mm
- e. 678 mm

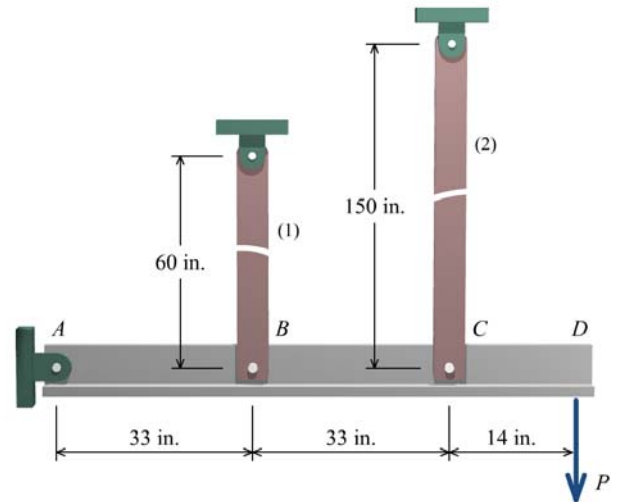
3. A 10-mm-thick aluminum [$E = 70 \text{ GPa}$; $\nu = 0.33$] plate is subjected to the stresses shown. Determine the change in length of vertical side AD . (5 points)

- a. 0.231 mm
- b. 0.376 mm
- c. 0.789 mm
- d. 0.993 mm
- e. 1.254 mm



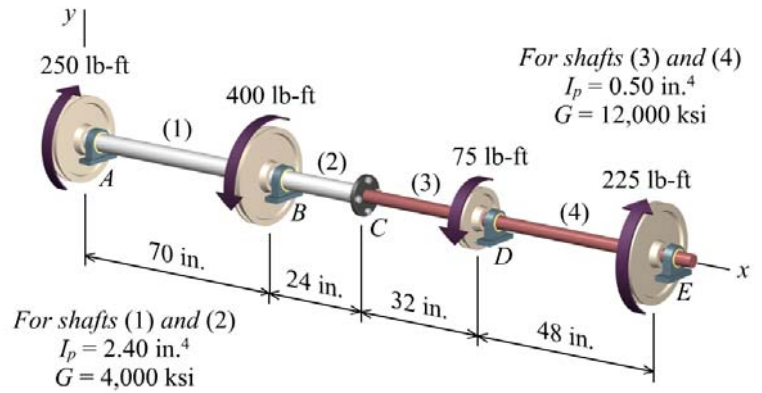
4. Rigid beam $ABCD$ is supported by bars (1) and (2) and by a pin at A . If the normal strain in each bar must not exceed $1,100 \mu\epsilon$, determine the magnitude of the maximum allowable vertical deflection of the rigid beam at D . (9 points)

- a. 0.066 in.
- b. 0.160 in.
- c. 0.200 in.
- d. 1.333 in.
- e. 2.667 in.



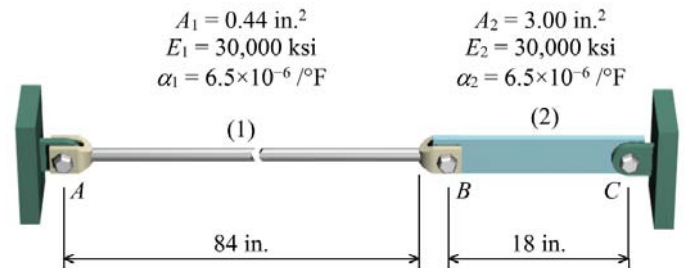
5. For the compound shaft shown, determine the magnitude of the rotation angle of pulley D with respect to pulley B . (5 points)

- a. 0.0012 rad
 b. 0.0051 rad
 c. 0.0138 rad
 d. 0.0141 rad
 e. 0.0168 rad

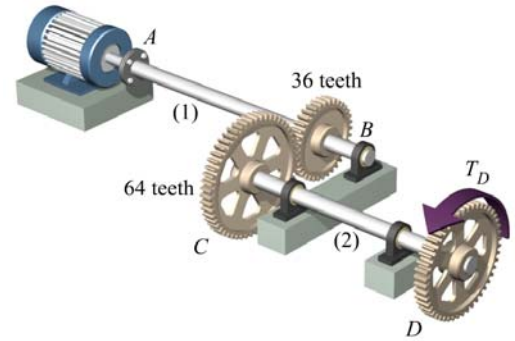


6. Steel rod (1) and steel bar (2) are connected at B with a bolt in a double shear connection. The supports at A and C are rigid, and the assembly is stress free at a temperature of 90°F . Determine the magnitude of the axial force in rod (1) when the temperature is -30°F . (10 points)

- a. 7.84 kip
 b. 8.35 kip
 c. 12.12 kip
 d. 12.91 kip
 e. 17.96 kip



Consider a typical motor-and-shaft configuration similar to that shown. Assume the system is in equilibrium. (10 points)



7. If the motor shown supplies 45 hp at 320 rpm at A , determine the torque in shaft (1).
 - a. 12.3 lb-ft
 - b. 77.3 lb-ft
 - c. 739 lb-ft
 - d. 4641 lb-ft
 - e. 8863 lb-ft

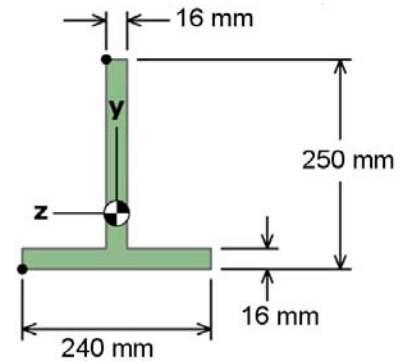
8. If the motor shown supplies 19 kW at 4 Hz, determine the power available at gear D .
 - a. 4.75 kW
 - b. 10.7 kW
 - c. 19.0 kW
 - d. 33.8 kW
 - e. 76.0 kW

9. If the torque supplied by the motor at A is 900 lb-ft, determine the torque in shaft (2).
 - a. 506 lb-ft
 - b. 900 lb-ft
 - c. 1600 lb-ft
 - d. 6075 lb-ft
 - e. 19,200 lb-ft

10. Assume that the torque in shaft (2) is 1,200 N-m. If the allowable shear stress is 45 MPa, determine the minimum diameter that may be used for shaft (2) if the shaft is solid.
 - a. 5.14 mm
 - b. 51.4 mm
 - c. 62.3 mm
 - d. 64.8 mm
 - e. 108 mm

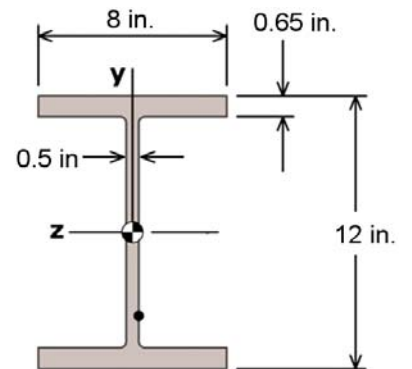
11. Find the distance from the bottom of the beam to the centroid location for the T-beam shown. (5 points)

- a. 61.8 mm
- b. 69.7 mm
- c. 73.7 mm
- d. 180 mm
- e. 188 mm



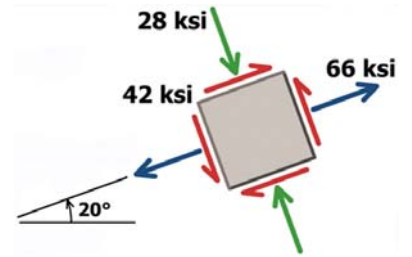
12. Find the moment of inertia of the I-beam shown around the z-axis, which is located at the centroid of the cross-section. (5 points)

- a. 51.2 in^4
- b. 51.4 in^4
- c. 219 in^4
- d. 386 in^4
- e. 391 in^4

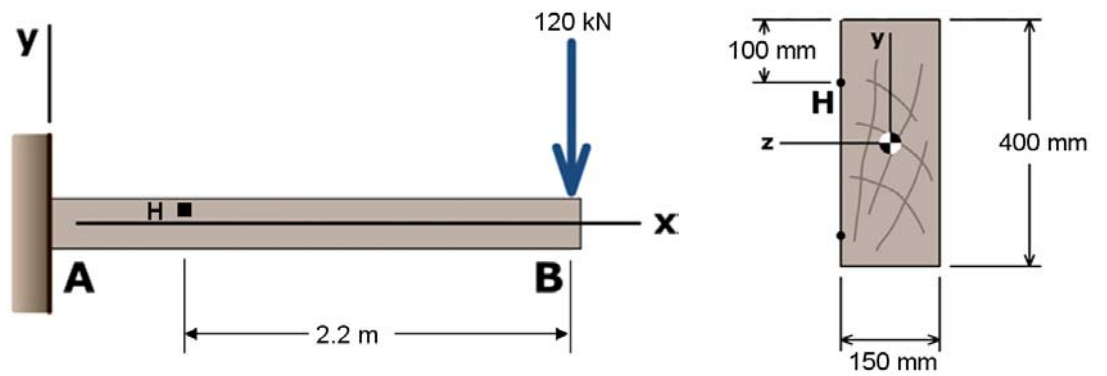


13. Find the principal stresses and the maximum shear stress for the state of stress shown (in ksi). (6 points)

	σ_1	σ_2	τ_{max}
a.	28.0	10.0	62.4
b.	40.6	-2.55	-21.6
d.	82.0	-44.0	1.96
c.	82.0	-44.0	63.0
e.	89.1	4.89	42.1



For the cantilevered beam shown below, find the horizontal shear stress and bending stress (in MPa) at point H on the beam. (10 points)



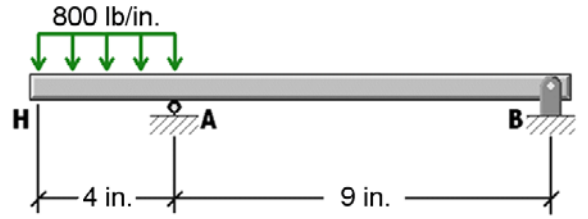
14. σ_x is:
- 66.0
 - 33.0
 - 0.00
 - 33.0
 - 66.0
 - 235

15. σ_y is:
- 66.0
 - 33.0
 - 0.00
 - 33.0
 - 66.0
 - 235

16. τ_{xy} is:
- 2.25
 - 1.50
 - 0.00
 - 1.50
 - 2.25
 - 16.0

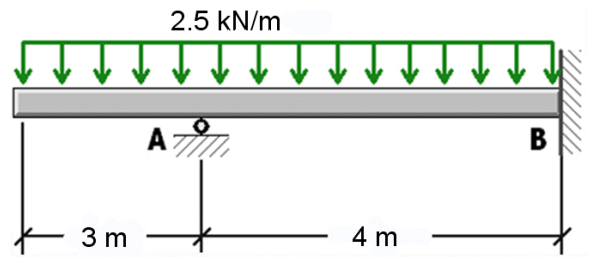
17. Find the magnitude of the deflection of point H for the beam shown. [$E = 29 \times 10^6$ psi, $I = 0.085$ in.⁴] (6 points)

- a. 0.0208 in.
- b. 0.0156 in.
- c. 0.0104 in.
- d. 0.0312 in.
- e. 0.0260 in.
- f. 0.0416 in.



18. For the beam shown below, find the magnitude of the support reaction at point A. [$E = 200 \text{ GPa}$, $I = 350 \times 10^6 \text{ mm}^4$.] (6 points)

- a. 0.38 kN
- b. 0.70 kN
- c. 2.89 kN
- d. 3.52 kN
- e. 6.56 kN
- f. 15.5 kN



A scuba-diving tank has an outside diameter of 200 mm and a wall thickness of 12 mm. The air in the tank is pressurized to 20 MPa.

19. Determine the principal stresses in the plane of the cylinder wall (in MPa). (4 points)

	σ_1	σ_2
a.	36.7	73.3
b.	73.3	36.7
c.	73.3	147
d.	83.3	167
e.	147	73.3
f.	167	83.0



20. Determine the absolute maximum shear stress on the outside surface of the cylinder wall. (2 points)

- a. 36.7 MPa
- b. 41.7 MPa
- c. 46.7 MPa
- d. 73.4 MPa
- e. 83.4 MPa

A 2.5-in.-diameter solid aluminum post is subjected to a horizontal force of $V = 3$ kips, a vertical force of $P = 7$ kips, and a concentrated torque of $T = 11$ kip-in., acting in the directions shown. Determine the normal and shear stresses acting at point H (in ksi). Assume $L = 3.5$ in. (10 points)

21. σ_x is:
- a. -8.27
 - b. -5.42
 - c. -1.43
 - d. 0.00
 - e. 1.43
 - f. 5.42
 - g. 8.27

22. σ_y is:
- a. -8.27
 - b. -5.42
 - c. -1.43
 - d. 0.00
 - e. 1.43
 - f. 5.42
 - g. 8.27

23. τ_{xy} is:
- a. 0.00
 - b. 0.81
 - c. 2.77
 - d. 3.59
 - e. 4.40

