

University Mechanical Engineering

Name: _____ Score: _____

1. Tie rod $d = 12$ mm carrying $P = 25$ kN: normal stress (one decimal, MPa)?
_____ MPa
2. Solid shaft $d = 30$ mm, $T = 300$ N · m: surface shear (one decimal, MPa)?
_____ MPa
3. Simply supported 3 m span, central $P = 6$ kN: maximum moment (one decimal, kN · m)?
_____ kN · m
4. Rectangle 40 x 80 mm, $V = 3$ kN: maximum transverse shear (two decimals, MPa)?
_____ MPa
5. Simply supported 3 m, central $P = 6$ kN, $EI = 341.3$ N · m² x 10⁶: mid-span deflection (two decimals, mm)?
_____ mm
6. Below the transition slenderness, the column stress comes from:
 - ☐ the yield stress directly
 - ☐ the eccentricity formula
 - ☐ the Johnson parabola
 - ☐ Euler with a safety factor
7. An unrestrained steel rod heated by 40 K carries:
 - ☐ strain but no stress
 - ☐ neither
 - ☐ stress but no strain
 - ☐ both stress and strain
8. Shear stress in a solid circular shaft under torsion is:
 - ☐ maximum at the axis
 - ☐ zero at the axis and maximum at the surface
 - ☐ uniform across the section
 - ☐ zero at the surface
9. Under a central point load on a simply supported span, the moment diagram is:

- ☐ parabolic everywhere
- ☐ zero at mid-span
- ☐ a triangle peaking at mid-span
- ☐ a rectangle

10. With both principal stresses positive, the absolute-maximum shear is:

- ☐ the in-plane radius R
- ☐ $\sigma_1 - \sigma_2$
- ☐ zero
- ☐ $\sigma_1 / 2$

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1. **221.0 MPa**

P over πr^2 .

2. **56.6 MPa**

$16T$ over πd^3 .

3. **4.5 kN · m**

$PL/4$.

4. **1.41 MPa**

$1.5 V$ over A .

5. **9.89 mm**

$PL^3/48EI$.

6. **the Johnson parabola**

Euler would exceed yield there; Johnson meets it at $\sigma_y/2$.

7. **strain but no stress**

Free expansion produces deformation only; constraint produces stress.

8. **zero at the axis and maximum at the surface**

$\tau = T \rho / J$ grows linearly with radius.

9. **a triangle peaking at mid-span**

Linear ramps to $PL/4$ at the load point.

10. **$\sigma_1 / 2$**

The out-of-plane plane carries $\sigma_1/2$ when both share a sign.