1. Determine the reactions at $A$ and $B$ for the steel bar and loading shown in Fig. 1, assuming a close fit at both supports before the loads are applied. (16%)

2. A solid circular shaft, 1.2 m long and 50 mm in diameter, is subjected to a 4.6 kN-m torque at each end shown in Fig. 2. Assuming the shaft to be made of an elastoplastic material with a yield strength in shear of 150 MPa and a modulus of rigidity of 77 GPa, determine (a) the radius of the elastic core, (b) the angle of twist of the shaft. When the torque is removed, determine (c) the permanent twist, (d) the distribution of residual stresses. (28%)

3. For the state of plane stress shown in Fig. 3, determine (a) the principal planes and the principal stresses, (b) the stress components exerted on the element obtained by rotating the given element counterclockwise through 30°. (20%)

4. For the uniform beam and loading shown in Fig. 4, determine (a) the reaction at each support, (b) the slope at end $A$. (20%)

5. Knowing that for the cast iron link shown (Fig. 5) and neglecting the effect of fillets, the allowable stresses are 30 MPa in tension and 120 MPa in compression, determine the largest force $P$ which can be applied to the link. (16%)

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**Fig. 1**

**Fig. 2**

**Fig. 3**

**Fig. 4**

**Fig. 5**