

BIT Sindri
1st Mid-term examination – 2019
Semester 2 (First year)
Branch – Mech., Civil., Metal., Prod. Min.
Paper – Physics II (Mechanics of Solids)

Time – $1\frac{1}{2}$ hours

Full Marks : 20

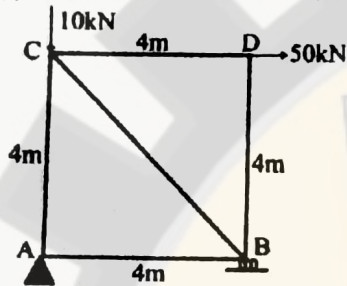
Answer five questions from group A and group B. Group A is compulsory.

Group A (Multiple choice questions)

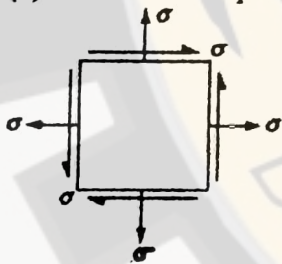
Q.1 Answer any four questions

1X4 = 4

(i) The force in member DB of the truss is



- (a) zero (b) $50\sqrt{2}$ kN C (c) $50\sqrt{2}$ kN T (d) None of these
- (ii) If the arm of a couple is doubled, its moment will
 (a) be halved (b) remain the same (c) be doubled (d) none of the above
- (iii) If the sum of all the forces acting on a body is zero, then the body may be in equilibrium provided the forces are
 (a) Concurrent (b) Parallel (c) Like parallel (d) Unlike parallel
- (iv) A 13m ladder is placed against a smooth vertical wall with its lower end 5m from the wall what should be the coefficient of friction between ladder and the floor so that it remains in equilibrium
 (a) 0.1 (b) 0.15 (c) 0.25 (d) None of these
- (v) The maximum principal stress for the stress shown in the following figure is:



- (a) σ (b) 2σ (c) 3σ (d) 1.5σ
- (vi) A shaft subjected to torsion experiences a pure shear stress on the surface. The maximum principal stress on the surface which is at 45° to the axis will have a value
 (a) $\tau \cos 45^\circ$ (b) $2\tau \cos 45^\circ$ (c) $2\tau \sin 45^\circ$ (d) $2\tau \sin 45^\circ \cos 45^\circ$

Group B (Long answer questions)

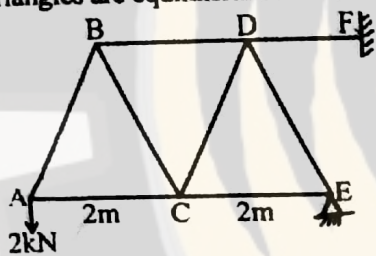
Answer any four questions

4X4 = 16

Q.2. Explain the conditions of equilibrium. Three forces acting on a particle are in equilibrium. The angles between the first and second is 90° and that between the second and third is 120° . Find the ratio of the forces.

Q.3. What do you understand by the term friction? Obtain the relation between angle of repose (γ) and angle of friction (ϕ). A body of weight 50 N is hauled along a rough horizontal plane by a pull of 18 N acting at an angle of 30° with the horizontal. Find the coefficient of friction.

Q.4. A three-panel cantilever-type truss as shown in the following figure is pinned at E and tied to a vertical wall by a member DF. Determine the forces in the bars due to the vertical load 2kN applied at A using method of joints. All the triangles are equilateral of side 2m.



Q.5. What is stress? Show that stress is a tensor quantity.

Q.6. What is the plane stress? Prove that in a body in plane stress the shear stress components on perpendicular faces are equal in magnitude. Derive the following relations

$$(a) \frac{\partial \sigma_x}{\partial x} = -\frac{\partial \tau_{xy}}{\partial y} \quad (b) \frac{\partial \sigma_y}{\partial y} = -\frac{\partial \tau_{xy}}{\partial x}$$

and show that the sum of the normal stresses is independent of the angle of