NOTE: There are 9 Questions in all.
- **Question 1 is compulsory and carries 20 marks. Answer to Q. 1 must be written in the space provided for it in the answer book supplied and nowhere else.**
- **Out of the remaining EIGHT Questions answer any FIVE Questions. Each question carries 16 marks.**
- **Any required data not explicitly given, may be suitably assumed and stated.**

Q.1   **Choose the correct or best alternative in the following:**   **(2x10)**

a.   Two forces of equal magnitude P acts at an angle θ to each other. Their resultant is equal to

   (A) $2P \sin\theta/2$ **(B)** $2P \cos\theta/2$
   (C) $2P \cos\theta$ **(D)** $2P \cos2\theta$

b.   Bulk modulus is measured in terms of
   (A) N/m   **(B)** N/m^2
   (C) Nm/s   **(D)** Ns/m^2

c.   Which of the following is not a projectile

   (A) A ball thrown upwards.
   (B) A stone thrown horizontally from the top of a tower.
   (C) A rocket forced into space.
   (D) A bullet fired from the gun.

d.   A system of three forces acts on a body and keeps it in equilibrium. The forces need to be

   (A) Coplanar only.
   (B) Concurrent only
   (C) Coplanar as well as Concurrent.
   (D) Coplanar but may or may not be Concurrent.

e.   A stationary object of 10 kg mass is acted upon by 20N force for 5 seconds. The object will attain a final velocity of

   (A) 10m/s   **(B)** 20m/s
   (C) 30m/s   **(D)** 35m/s

f.   Young's modulus for a perfectly rigid body is

(A) zero   (B) 0.5
(C) unity   (D) infinity

g. A projectile will cover the maximum vertical distance in a maximum time when the angle of projection is

(A) 30°   (B) 45°
(C) 60°   (D) 90°

h. The moment of inertia of a triangle of base width 'b' and height 'h' with respect to its base would be

(A) $bh^3/8$ (B) $bh^3/12$
(C) $bh^3/24$ (D) $bh^3/36$

i. The Elastic constants E, G and K are related by the expression

(A) E=9GK/(3K+G)   (B) E= 3GK/(K+2G)
(C) E=GK/(2K+G)   (D) E=3GK/(2K+G)

j. In a perfect machine the Mechanical Advantage (MA) is

(A) Equal to V.R.   (B) Less than V.R.
(C) More than V.R.   (D) None of them.

Answer any FIVE Questions out of EIGHT Questions.
Each question carries 16 marks.

Q.2 a. State and Explain Polygon law of forces. **(6)**

b. The magnitude of two forces is such that, if they act at right angle, their resultant is 100N and when they act at an angle of 60°, their resultant is $\sqrt{14800}$N. Determine the magnitude of two forces. **(10)**

Q.3 a. State conditions of equilibrium for bodies subjected to coplanar forces. **(6)**

b. The resultant of forces P Newton and 30 Newton is 40N. The resultant force is inclined at 60° to the 30N force. Find the magnitude & direction of P. **(10)**

Q.4 a. Define centroid of a plane surface **(3)**

b. Calculate the MOI for the plane shown in Fig.1, about horizontal and vertical axes (I_{xx} and I_{yy}) of the section. **(13)**

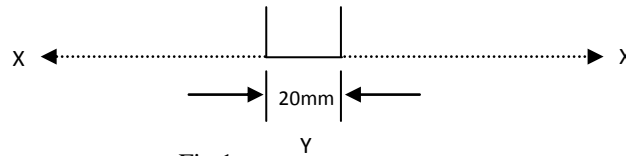X ←···→ X

20mm

Y
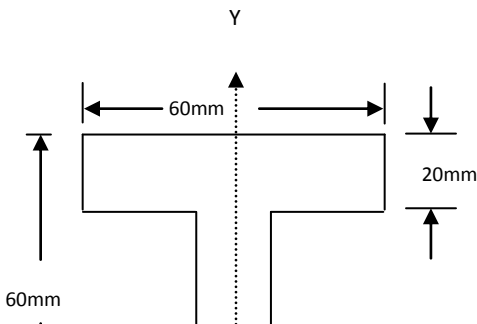
Fig.1

Q.5 a. Define friction, Coefficient of friction and Limiting friction. **(6)**

b. A body weighing 120 N is lying on a horizontal plane for which $\mu = 0.8$
   Determine :-
   (i) Normal friction
   (ii) Limiting force of friction.
   (iii) Horizontal force required to move it.
   (iv) Angle of friction. **(10)**

Q.6 a. Define angular velocity and angular acceleration for circular motion. **(4)**

b. A ball of mass 2Kg is whirled around a circular path of radius 2m. The ball makes
   five revolutions per second. Calculate centripetal force acting on the ball.
   (12)

Q.7 a. State D'Alembert's principle. **(4)**

b. Two railway wagons 150kN and 120kN are moving on the same railway line and
   in the same direction at speeds of 4m/s and 6m/s respectively. They collide &
   subsequently move together. Calculate common speed & loss of K.E. due to
   impact. **(12)**

Q.8 a. Define the terms
   (i)Young's Modulus (ii) Modulus of Rigidity (iii) Factor of safety. **(6)**

b. The following data was obtained during tensile test conducted on mild steel bar
   (i) Diameter of bar = 4cm (ii) Length of bar =30cm, (iii) Load at Elastic limit =
   300 kN (iv) Extension at a load at 200 kN = 0.45mm (v) maximum load = 420kN
   (vi) Total extension = 75mm (vii) Diameter of the rod at the failure = 3.40cm.

   Calculate :-
   (a) Young's Modulus   (b) Stress at elastic limit
   (c) Percentage elongation   (d) Percentage decrease in area. **(10)**

Q.9 a. Define Shear force and Bending moment. **(4)**

b. A cantilever beam of length 3m carries a uniformly distributed load of 4 kN/m run over a length of 2m from the free end. Determine the shear force and bending moments at end of load and fixed end. Draw the shear force and bending moment diagrams for the cantilever beam. **(12)**