

**B.Tech-1st**  
**Engineering Mechanics**

*Full Marks : 50*

*Time :  $2\frac{1}{2}$  hours*

**Answer all questions**

*The figures in the right-hand margin indicate marks*

**Symbols carry usual meaning**

**Any supplementary materials to be provided**

**1. Answer all questions :  $2 \times 5$**

**(a) Explain Pappus theorem.**

**(b) Explain the term 'redundant constraints'.**

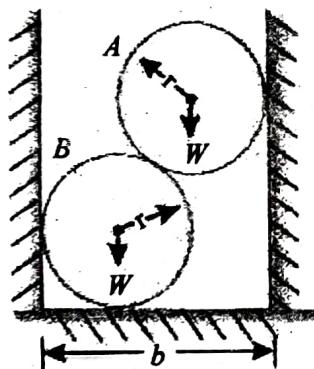
**(c) Describe the stable equilibrium, unstable equilibrium.**

**(d) Explain why a man feels weightless while coming down in a elevator.**

( 2 )

(e) State the principle of conservation of momentum.

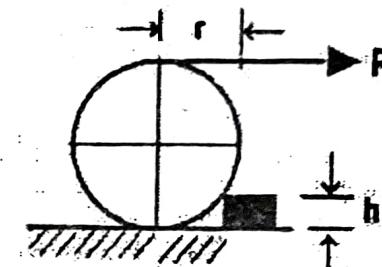
2. Two smooth spheres of weight  $W$  and radius  $r$  each are in equilibrium in a horizontal channel of  $A$  and  $B$  vertical sides as shown in Fig. Find the force exerted by each sphere on the other. Calculate these values, if  $r = 250$  mm,  $b = 900$  mm and  $W = 100$  N. 8



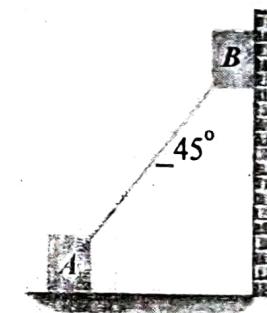
Or

A roller of weight 500 N has a radius of 120 mm and is pulled over a step of height 60 mm by a horizontal force  $P$ . Find magnitudes of  $P$  to just start the roller over the step. 8

( 3 )



3. Two identical blocks of weight  $W$  are supported by a rod inclined at  $45^\circ$  with the horizontal as shown in Figure. If both the blocks are in limiting equilibrium, find the coefficient of friction, assuming it to be the same at floor as well as at wall. 8

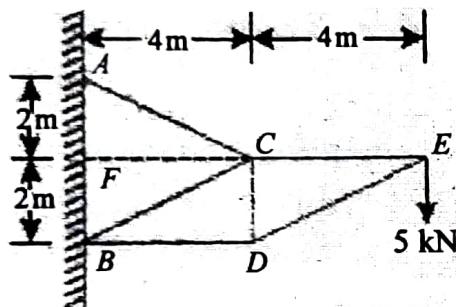


Or

(a) Describe the stable equilibrium, unstable equilibrium and neutral equilibrium. 3

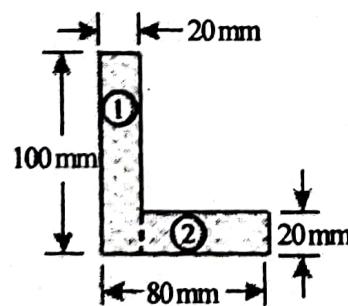
(b) A truss shown in figure is carrying a point load of 5 kN at E. Find the force in the members CE, CD and BD of the truss.

5



4. Find the moment of inertia about the centroidal X-X and Y-Y axes of the angle section shown in figure. 8

8



Or

(a) Using Papus theorem find the volume of the sphere.

4

(b) Find the CG of semicircular arc using integration method.

4

5. A lift goes up to a height of 900 m with a constant acceleration and then the next 300 m with a constant retardation and comes to rest. Find (i) maximum velocity of the lift, if the time taken to travel is 30 seconds; (ii) acceleration of the lift; and (iii) retardation of the lift. Take acceleration of the lift as  $1/3$  of its retardation.

8

Or

(a) A hammer of mass 0.5 kg hits a nail of 25 g with a velocity of 5 m/s and drives it into a fixed wooden block by 25 mm.

Find the resistance offered by the wooden block. 4

(b) A body of mass 200 kg is initially stationary on a  $15^\circ$  inclined plane. What distance along the incline must the body slide before it reaches a speed of 10 m/s ? Take coefficient of friction between the body and the plane as 0.1.

6. A flywheel rotates with a constant retardation due to braking. From  $t = 0$  to  $t = 10$  seconds, it made 300 revolutions. At time  $t = 7.5$  sec, its angular velocity was  $40\pi$  rad/sec. Determine (i) value of constant retardation; (ii) total time taken to come to rest and (iii) total revolutions made till it comes to rest. 8

Or

A projectile fired from the edge of a 150 m high cliff with an initial velocity of

180 m/s at an angle of elevation of  $30^\circ$  with the horizontal. Neglecting air resistance find : (8)

(i) The greatest elevation above the ground reached by the projectile ; and  
 (ii) Horizontal distance from the gun to the point, where the projectile strikes the ground.