

N.B. (1) Question No. 1 is compulsory.

(2) Attempt any four questions from the remaining six questions.

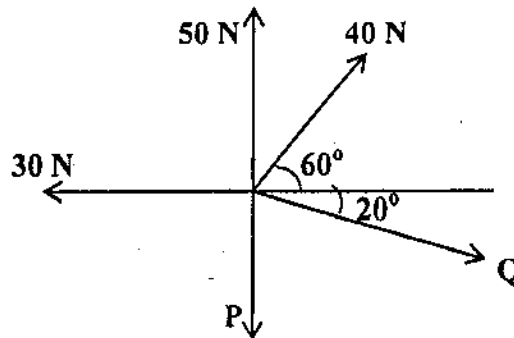
(3) **Figures** to the right indicate full marks.

(4) Assume **suitable** additional data if necessary and state the same clearly in your answer.

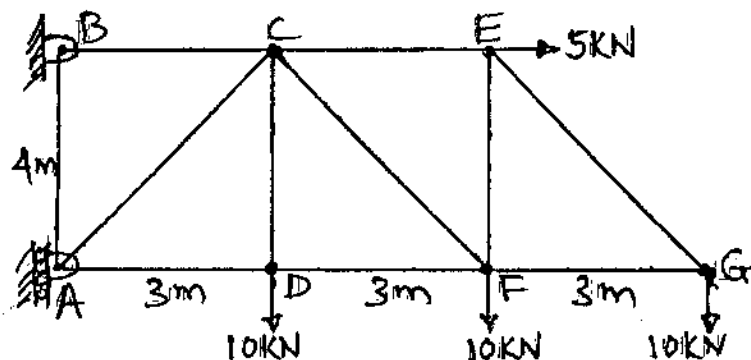
(5) Take $g = 9.81 \text{ m/s}^2$.

1. Solve any four of the following :—

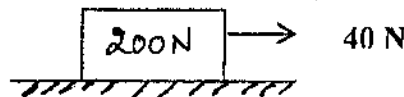
- (a) Five concurrent coplanar forces act on a body as shown in figure. Find the forces P and Q such that the resultant of the five forces is zero. 5



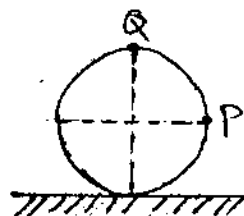
- (b) For the truss loaded as shown in figure find the force in members CE and CF by method of sections only. 5



- (c) A block of weight 200 N rests on a horizontal surface. The co-efficient of friction between the block and the horizontal surface is 0.4. Find the frictional force acting on the block if a horizontal force of 40 N is applied to the block. 5

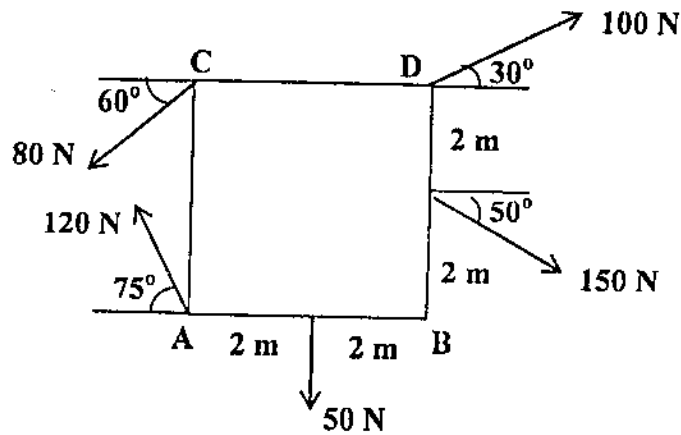


- (d) Prove that the path travelled by a projectile is a parabola. 5
- (e) A wheel of radius 0.75 m rolls without slipping on a horizontal surface to the right. Determine the velocities of the points P and Q shown in figure when the velocity of centre of the wheel is 10 m/s towards right. 5

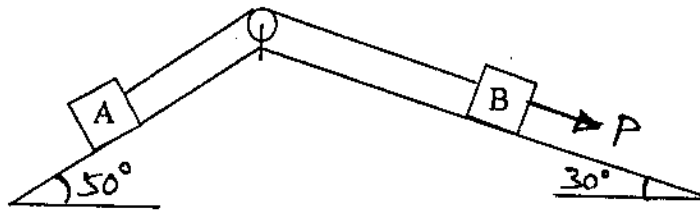


- (f) A vertical lift of weight 10 kN moving from rest with constant acceleration acquires an upward velocity of 4 m/s over a distance of 5 m. Determine the tension in the cable supporting the lift. 5

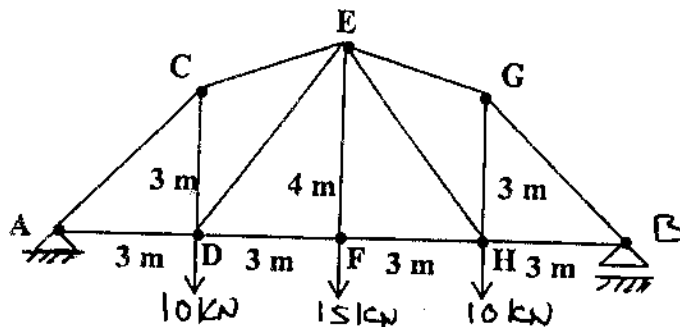
2. (a) Determine the resultant of the system of forces shown in figure. Locate the point where the resultant cuts the base AB. 10



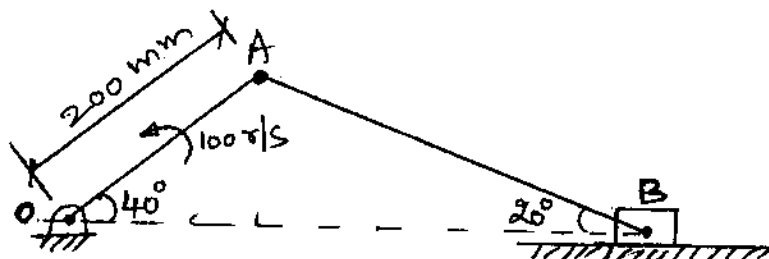
- (b) Two blocks A and B of weight 500 N and 750 N respectively are connected by a cord that passes over a frictionless pulley as shown in figure. The coefficient of friction between the block A and the inclined plane is 0.4 and that between the block B and the inclined plane is 0.3. Determine the force P to be applied to block B to produce the impending motion of block B down the plane. 10



3. (a) Find the forces in the members of the pin jointed truss loaded as shown in figure. Tabulate the forces. 8

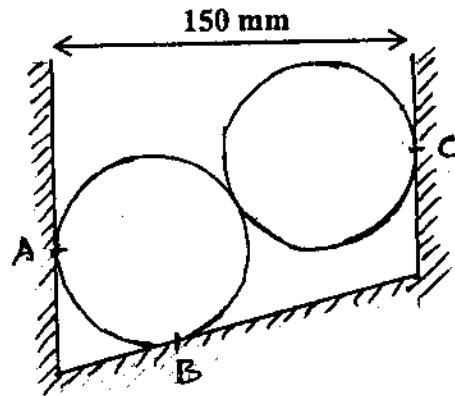


- (b) A slider crank mechanism is shown in figure. The crank OA rotates anticlockwise at 100 rad/s. Find the angular velocity of rod AB and the velocity of the slider at B. 12

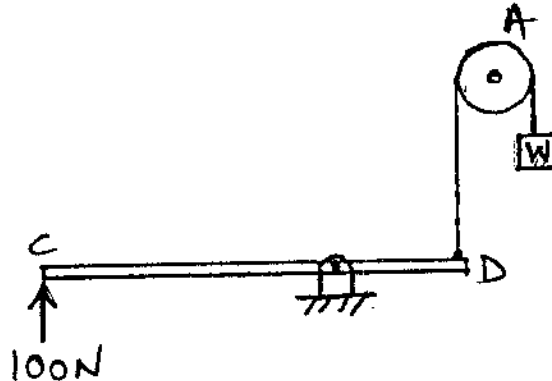


4. (a) A smooth spherical ball A of mass 5 Kg is moving in a horizontal plane from left to right with a velocity of 10 m/s. Another ball B of mass 6 Kg traveling in a perpendicular direction with a velocity of 20 m/s collides with A in such a way that the line of impact is in the direction of motion of ball B. Assuming $e = 0.7$, determine the velocities of balls A and B after impact. 8

- (b) Two cylinders each of diameter 100 mm and each weighing 200 N are placed as shown in figure. Assuming that all the contact surfaces are smooth find the reactions at A, B and C. 12

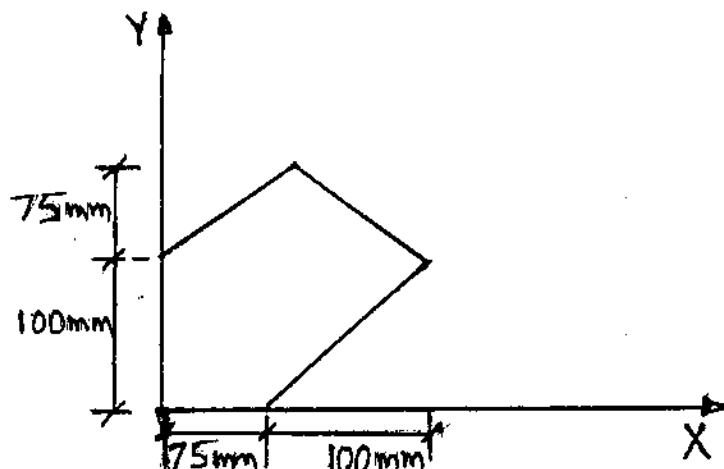


5. (a) A lever CD is connected to cylindrical drum A through a belt as shown in figure such that the drum does not rotate. The coefficient of friction between the belt and the drum is 0.3. A boy exerts a 100 N upward push on the lever at C. Determine — 10
- (i) the maximum weight W that the boy can lift
 - (ii) the maximum weight W that the boy can hold.

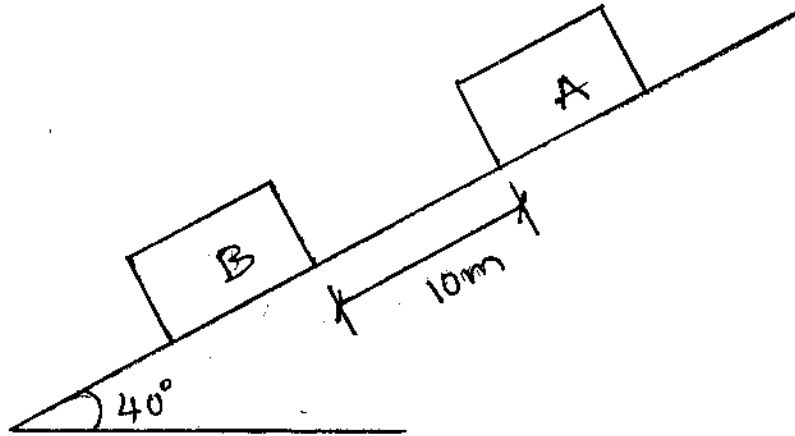


- (b) A stone is dropped from the top of a tower. When it has fallen a distance of 10m, another stone is dropped from a point 38 m below the top of the tower. If both the stones reach the ground at the same time calculate — 10
- (i) the height of the tower
 - (ii) the velocity of the stones when they reach the ground.

6. (a) A particle starting from rest at the position (5, 6, 2) m accelerates at $\vec{a} = 6t\vec{i} - 24t^2\vec{j} + 10\vec{k} \text{ m/s}^2$. Determine the acceleration, velocity and displacement of the particle at the end of 2 seconds. 10
- (b) Find the centroid of the area shown in figure. Also find the moment of inertia of the same area about x axis. 10



7. (a) Two blocks A of weight 500 N and B of weight 300 N are 10 m apart on an inclined plane as shown in figure. The coefficient of friction for blocks A and B with the inclined plane are 0.2 and 0.3 respectively. If the blocks begin to slide down simultaneously calculate the time and distance traveled by each block when block A touches block B. 12



- (b) Find the reactions at the supports of the beam loaded as shown in figure. 8

