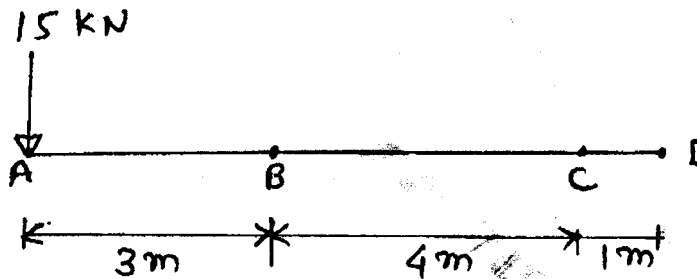(3 Hours)   [Total Marks : 100

N.B. (1) Question No. **1** is **compulsory**.
  (2) Attempt any **four** questions from remaining **six** questions.
  (3) Assume **suitable** data if **necessary** and mention the same **clearly**.
  (4) Take $g = 9.81$ m/sec^2.

1. Solve any **four** of the following :—
  (a) Resolve 15 kN force acting at 'A' into two parallel components at B and C.   **5**


  (b) Derive an expression for centrifugal tension in flat belt drive.   **5**
  (c) Find 'P' required to accelerate the block shown in figure below at 2·5 m/sec^2.   **5**
   Take $\mu = 0.3$.

  (d) A particle moves in X – Y plane and its position is given by $\bar{r} = (3t)i + (4t - 3t^2)j$.   **5**
      Where $\bar{r}$ is the position vector of the particle measured in meters at time 't'
      seconds. Find the radius of curvature of its path and normal and tangent
      components of acceleration when if crosses X-axis again.
  (e) Write short notes on following :—   **5**
      (i) Classification of truss
      (ii) Assumptions made in the analysis of perfect truss.

2. (a) Find the resultant of coplaner force system given below and locate the same on **10** AB with consideration of applied moment of 4800 N-mm.
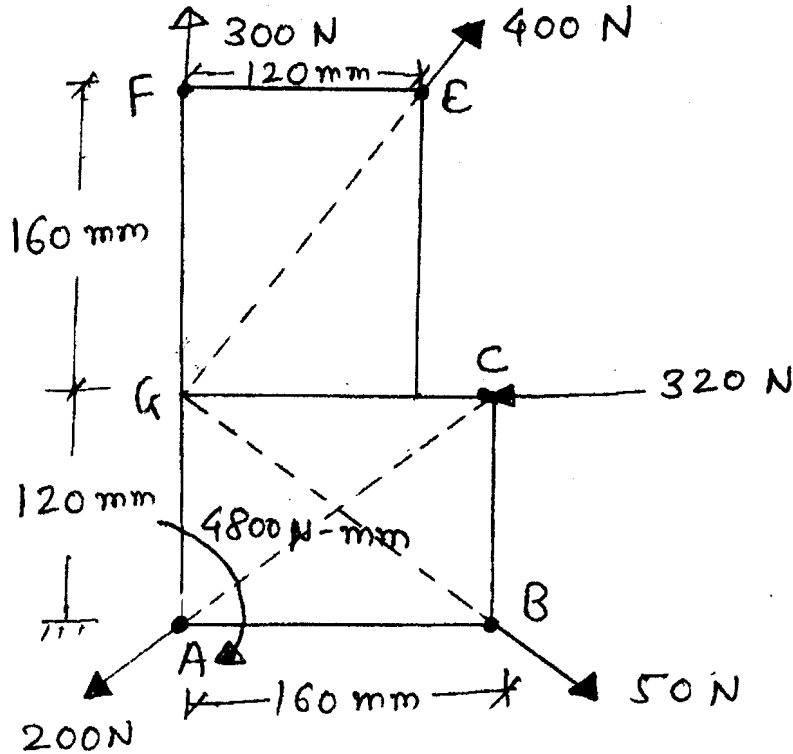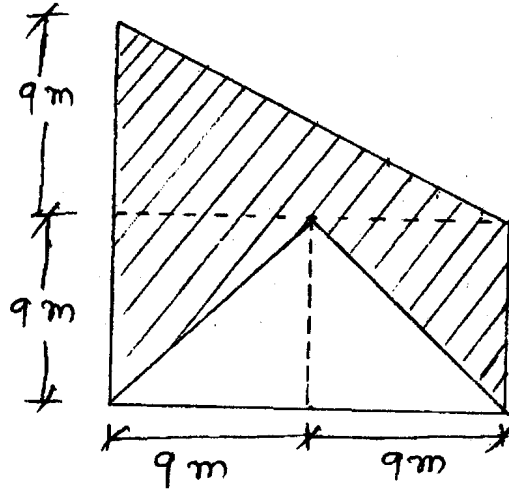
(b) If the link CD is rotating at 5 rad/sec. anticlockwise, determine the angular velocity   **10**
of link AB at the instant shown.
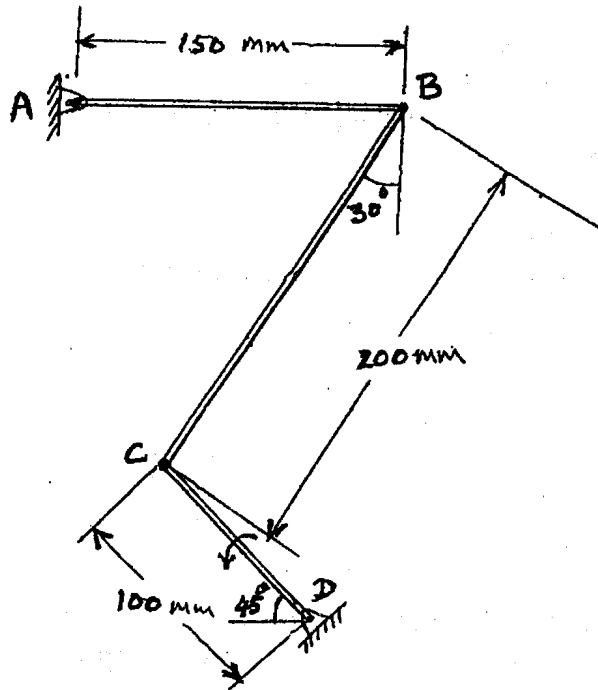
3. (a) Locate the centroid of the shaded area as shown in **figure**. Also determine area   **10**
moment of inertia of shaded area about its centroidal X-axis.

(b) **Figure** shows acceleration-time diagram for rectilinear motion. Construct velocity-   **10**
time and displacement-time diagrams for the motion assuming that the motion
starts with initial velocity of 5 m/sec from starting point.
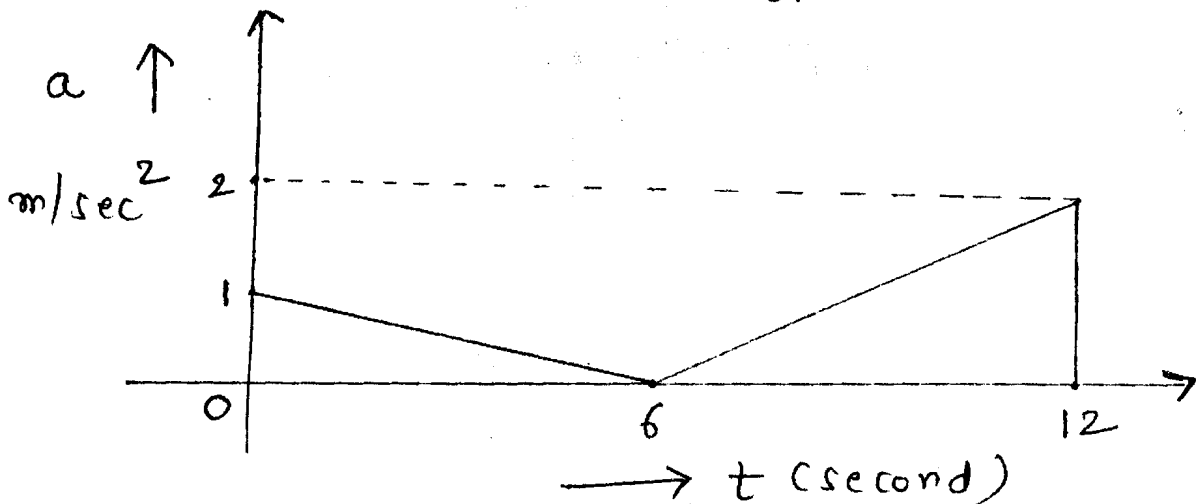
4. (a) What should be the value of 'θ' so that the motion of block 'A' impend down the **10** plane ? The coefficient of friction 'μ' for all the surfaces is 1/3.
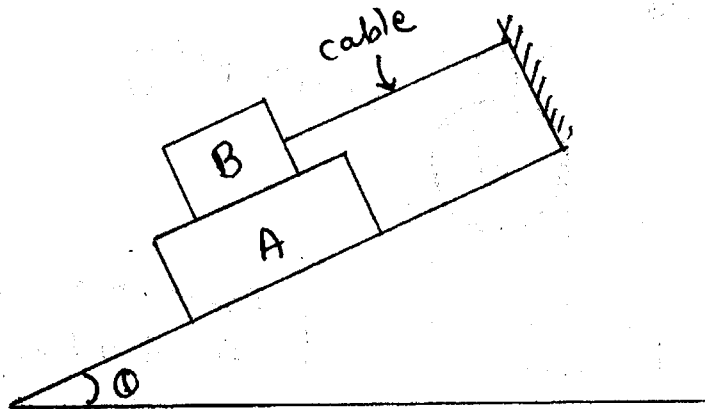

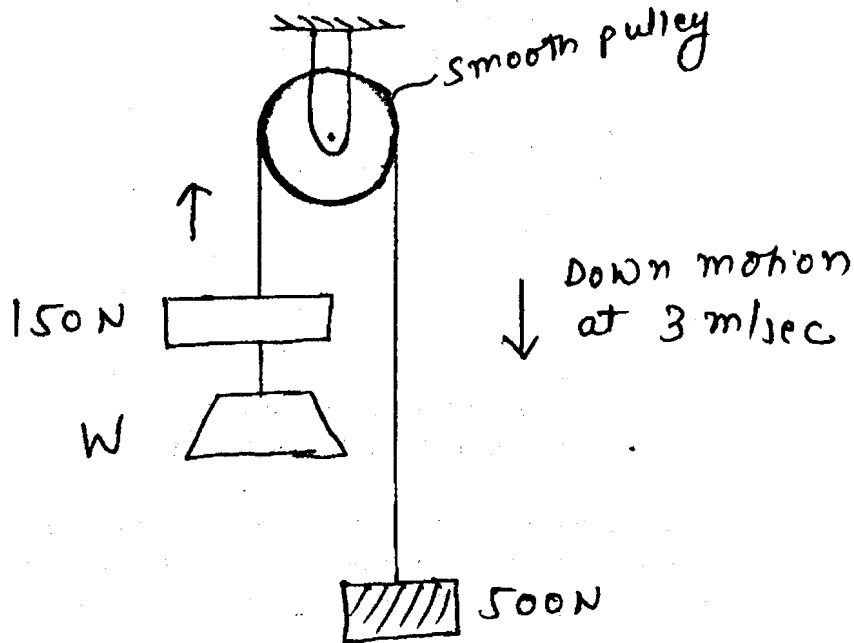mass of block A = 40 kg
mass of block B = 13·5 kg

(b) Two smooth spheres A and B having a mass of 2 kg and 4 kg respectively Collide **10** with initial velocities as shown in **figure**. If the coefficient of restitution for the spheres is e = 0·8, determine the velocities of each sphere after collision and their directions.
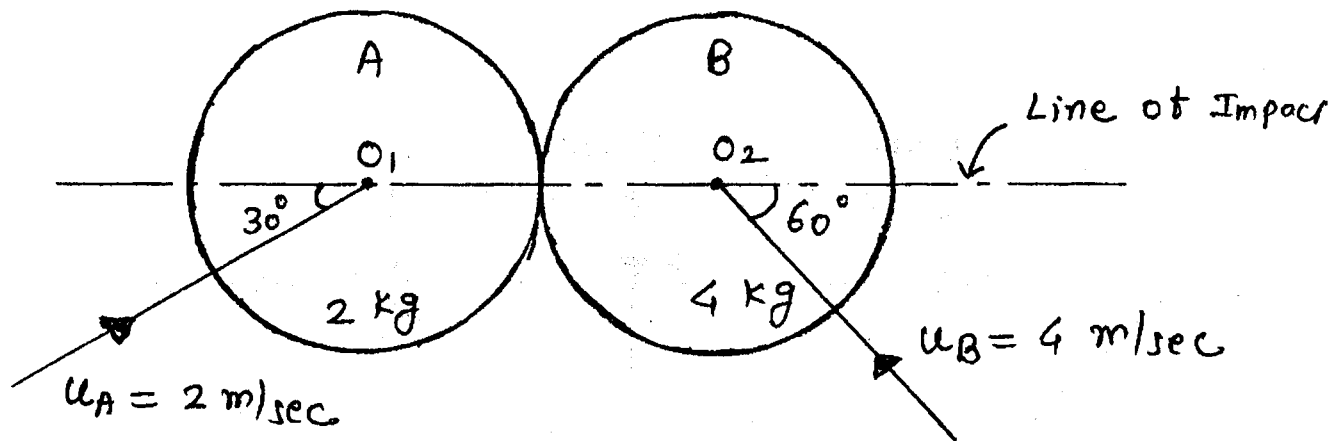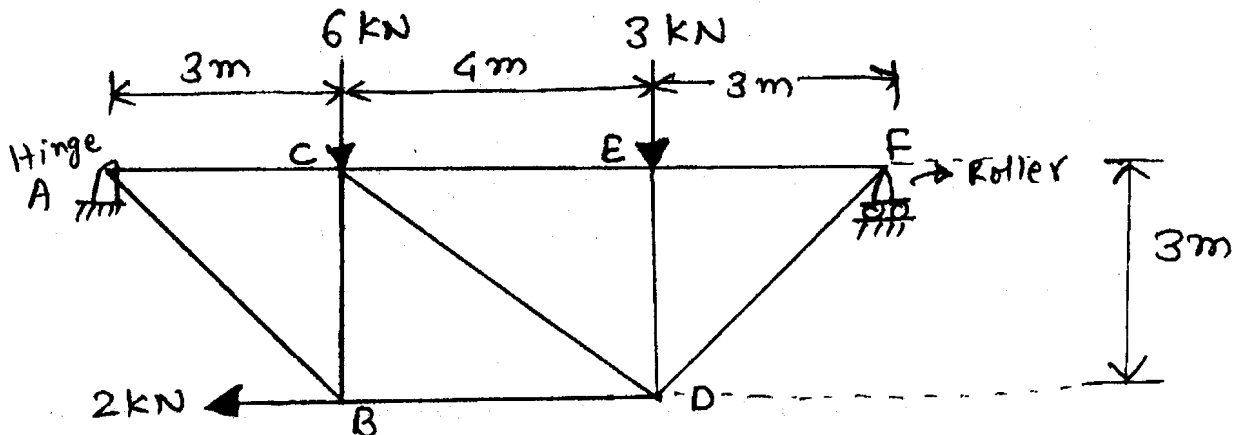

5. (a) Find analytically the support reaction at B and load P for the beam as shown in **10** **figure** if reaction at support 'A' is zero.
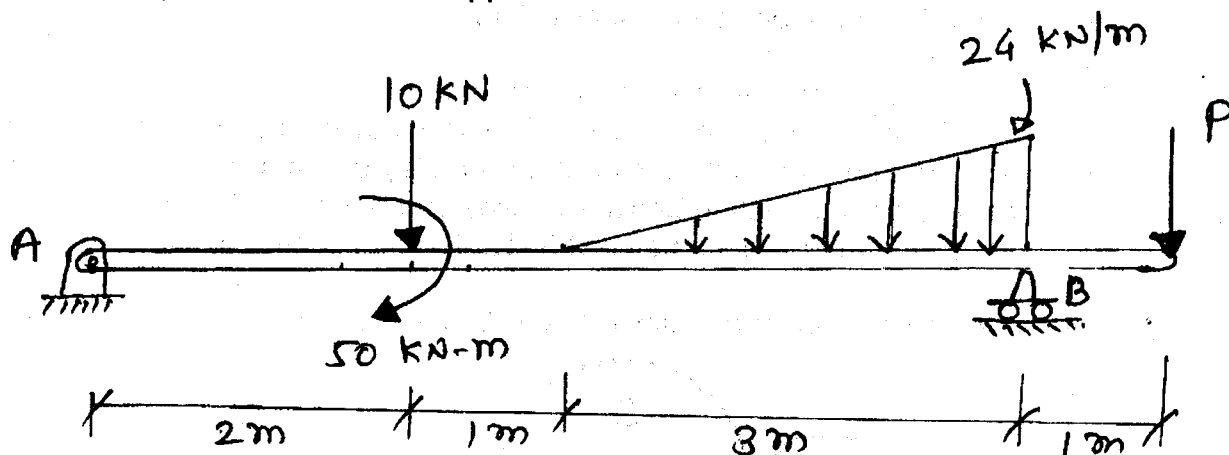
(b) Determine the weight 'W' required to bring the system in the following **figure** to   10
stop in 5 second if at the instant as shown, 500 N block is moving down at 3 m/sec.
The pulley is frictionless.

smooth pulley

150 N

W

Down motion
at 3 m/sec

500 N

6. (a)

6 kN   3 kN

3m   4m   3m

Hinge
A

C   E   F → Roller

3m

2 kN   B   D

A Truss is loaded and supported as shown find —
   (i)   Reactions at A and F   3
   (ii)   Forces in all members by method of joint   9
   (iii) Verify the forces in members CE, CD and BD by method of section.   3
(b) Find the power transmitted by a belt running over a pulley of 600 mm diameter   5
at 200 rpm. The coefficient of friction between pulley and belt is 0·25 and angle
of lap is 160° and maximum tension in belt is 2·5 kN. Neglect centrifugal tension.

7. (a) Determine the reaction at point of contact 1, 2 and 3. Assume smooth surfaces. **10**
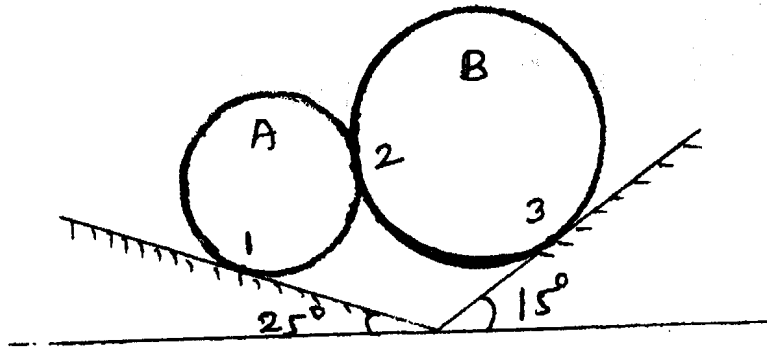
$$m_A = 1 \text{ kg} \qquad m_B = 4 \text{ kg}$$
$$R_A = 1 \text{ cm} \qquad R_B = 4 \text{ cm}$$

(b) Explain the following terms in short :—

    (i) Radius of gyration
    (ii) Work-energy principle
    (iii) Types of Impact

    (iv) Theorm of parallel axis
    (v) Angle of repose.

10