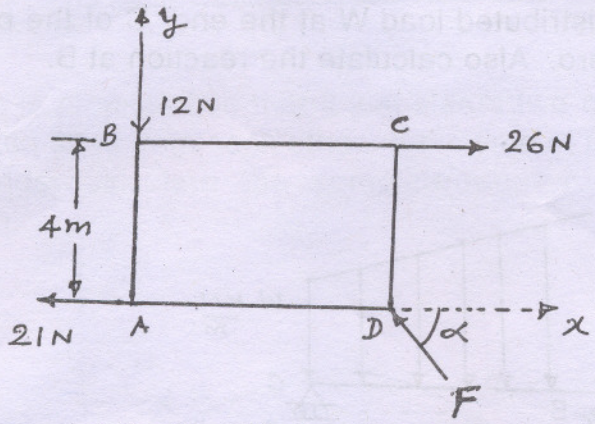
(3 Hours) **[Total Marks : 100**

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 $g = 9{\cdot}81\ m/s^2$.

1. Solve any **four** of the following : **20**

(a) Forces act on the plate ABCD as shown in **Figure**. The distance AB is 4 m. Given that the plate is in equilibrium find.
(i) force F (ii) angle α and (iii) the distance AD



(b) A heavy rod AB of length 3 m lies on horizontal ground. To lift the end B off the ground needs a vertical force of 200 N. To lift A end off the ground needs a force of 160 N. Find the weight of the rod and the position of centre of mass.

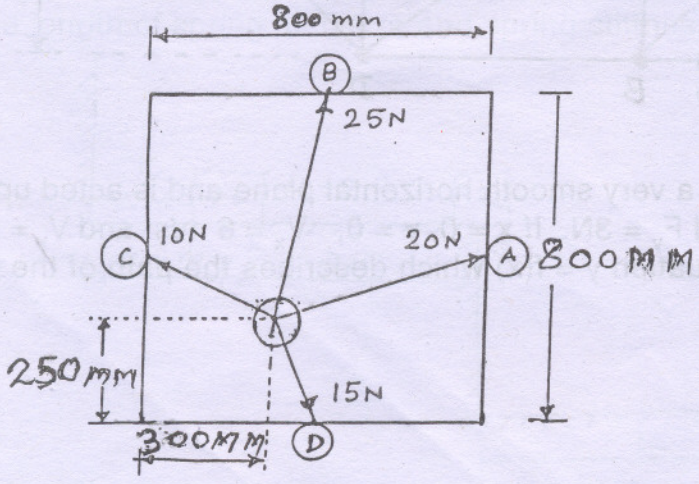
(c) A car of 1000 kg mass is to be parked on the same 10° incline year round. The static coefficient of friction between the tires and the road varies between the extremes of 0·05 and 0·9. Is it always possible to park the car at this place ? Assume that the car can be modeled as a particle.

(d) A point is moving with uniform acceleration. In the 11^{th} and 15^{th} second from the commencement, it moves through 7·2 m and 9·6 m respectively. Find its initial velocity and the acceleration with which it moves.

(e) Find the power transmitted by a belt running over a pulley of 600 mm diameter 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.

(f) At a certain instant a body of mass 15 kg is falling freely under gravity was found to be falling at a speed of 25 m/s. What force will stop the body in 2 seconds ?

2. (a) The striker of caram board laying on the board is being pulled by four players as shown in the **figure.** The players are sitting exactly at the centre of the four sides. Determine the resultant of forces in magnitude and direction. **10**



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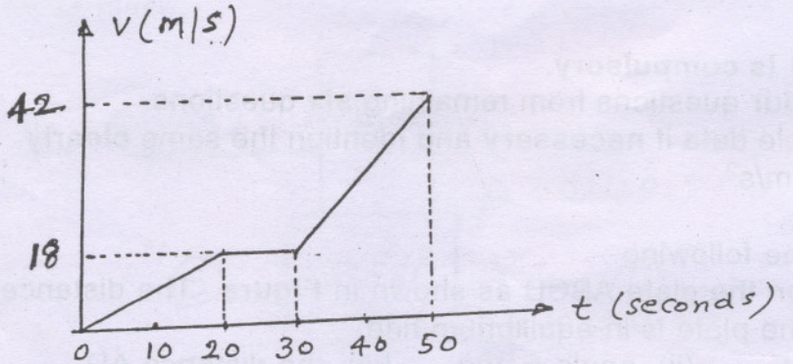
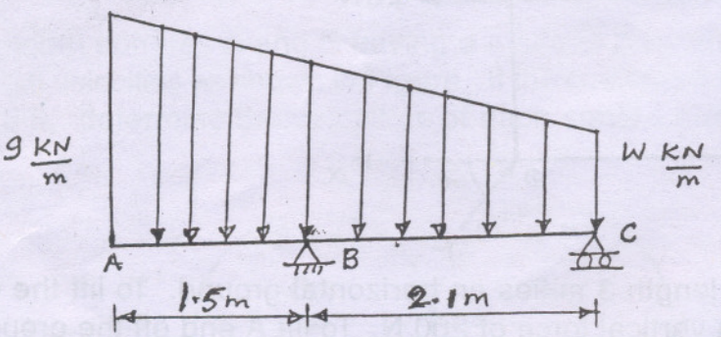
(b) The race car starts from rest and travels along a straight road until it reaches a speed of 42 m/s in 50 seconds as shown by v-t graph. Determine the distance travelled by race car in 50 seconds. Draw x-t and a-t graph. **10**

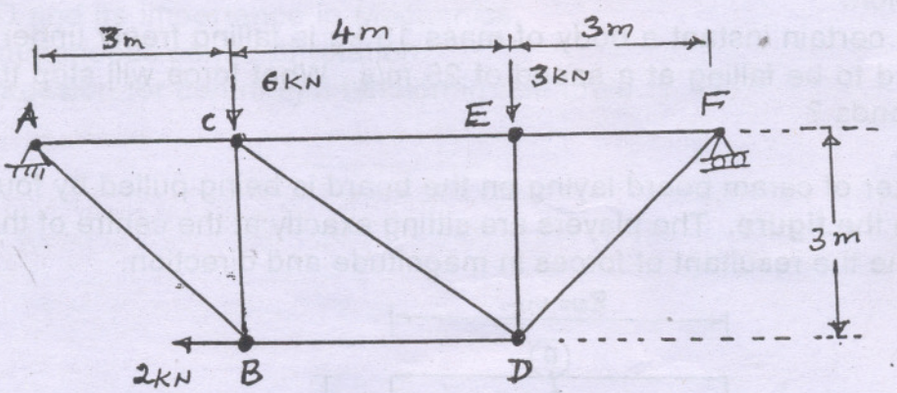


3. (a) Determine the intensity of distributed load W at the end C of the beam ABC for which the reaction at C is zero. Also calculate the reaction at B. **10**



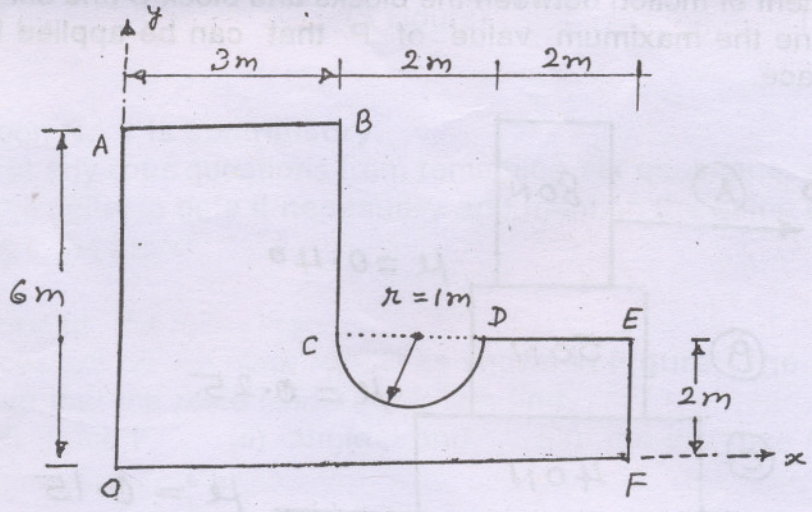
(b) The position of the charged particle moving in a horizontal plane is measured electronically. This information is fed into a computer which employs a curve fitting techniques to generate analytical expression for its position given by $\bar{r} = t^3\,\bar{i} + t^4\,\bar{J}$ where $\bar{r}$ is in meters and t is in seconds. For t = 1 sec, determine (i) the acceleration of the particle in rectangular components (ii) its normal and tangential acceleration and (iii) the radius of curvature of the path. **10**

4. (a) Find forces in members CE, CD, and BD by method of sections and remaining forces in members by method of joints. Tabulate the results properly. **10**

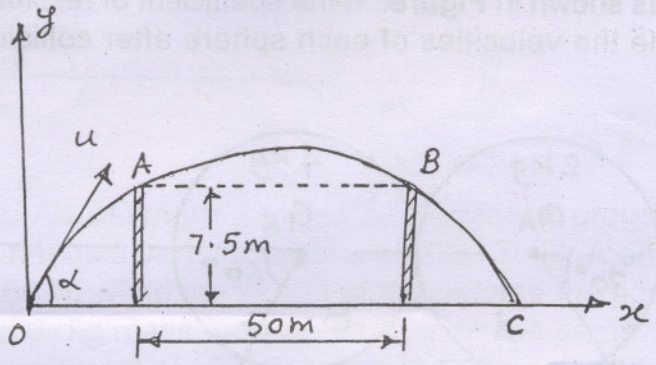


(b) A 2 kg particle rests on a very smooth horizontal plane and is acted upon by force components $F_x = 0$ and $F_y = 3N$. If x = 0, y = 0, $V_x = 6$ m/s and $V_y = 2$ m/s when t = 0, determine the equation y = f(x) which describes the path of the particle. **10**

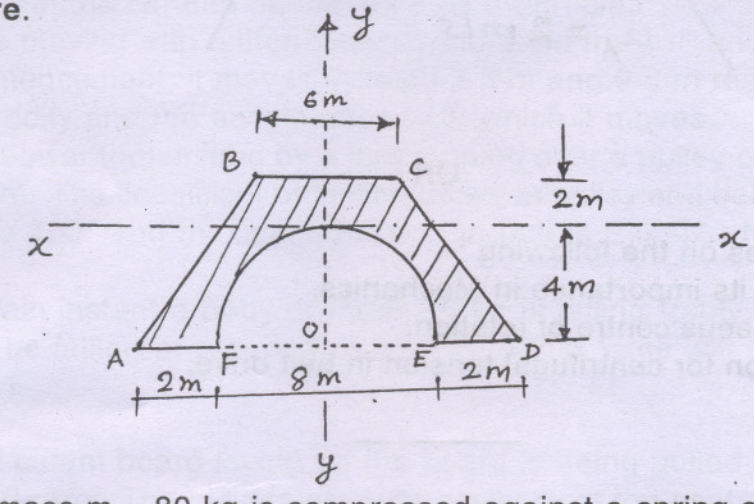
5. (a) Determine the centroid of the bent wire shown in **figure**. **10**



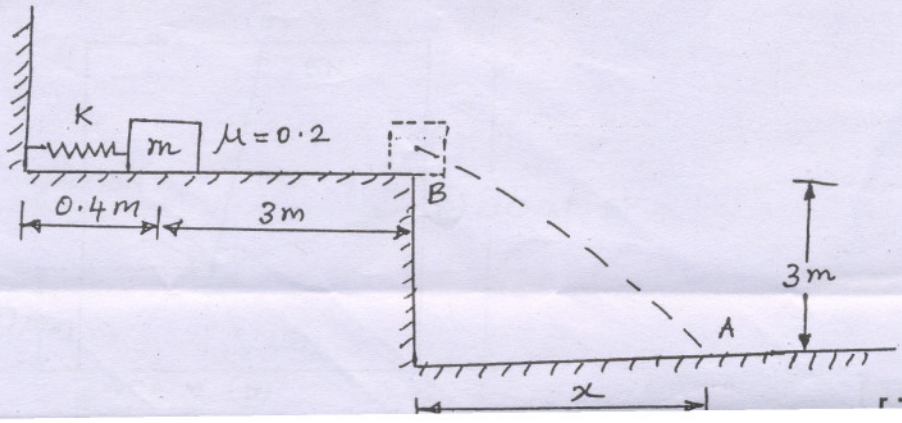
(b) An object is projected so that it just clears two obstacles each 7·5 m high which are situated 50 m from each other. If the time of passing between two obstacles is 2·5 seconds, calculate the complete range of projection and initial velocity of projection. **10**



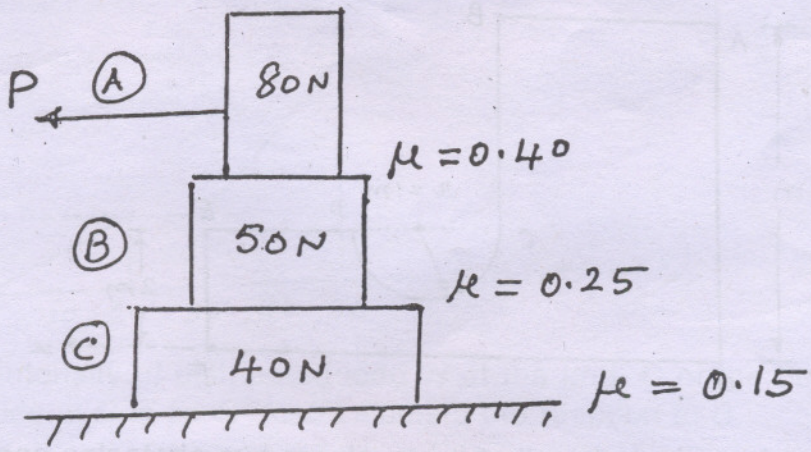
6. (a) Compute the moment of inertia of the shaded area about x-x and y-y axis as shown in the **figure**. **10**



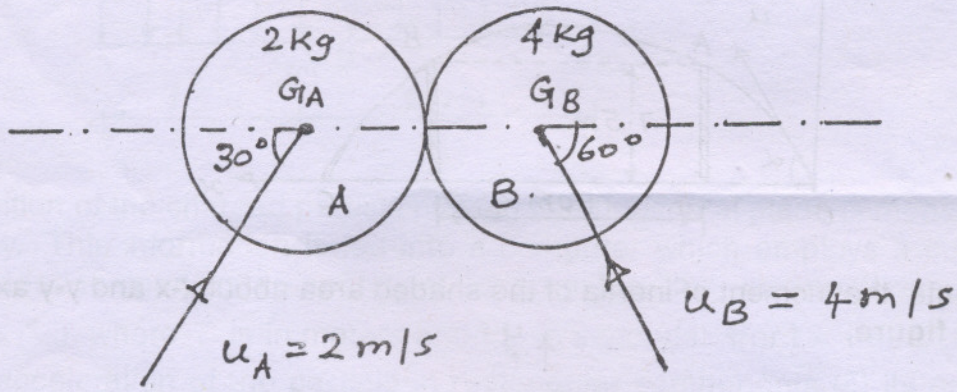
(b) A block of mass m = 80 kg is compressed against a spring as shown in **Figure**. How far from point B [distance x] will the block strike on the plane at point A. Take free length of spring as 0·9 m and spring stiffness as K = 40 × 10^2 N/m. **10**



7. (a) There block are placed on the surface one above the other as shown in **figure.** The static coefficient of friction between the blocks and block C and surface is also shown. Determine the maximum value of P that can be applied before any slipping takes place. **10**



(b) Two smooth spheres A and B having a mass of 2 kg and 4 kg respectively collide 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. **10**



OR

(b) Write short notes on the following :– **10**

(i) FBD and its importance in Mechanics.
(ii) Instantaneous centre of rotation.
(iii) Expression for centrifugal tension in belt drive.

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