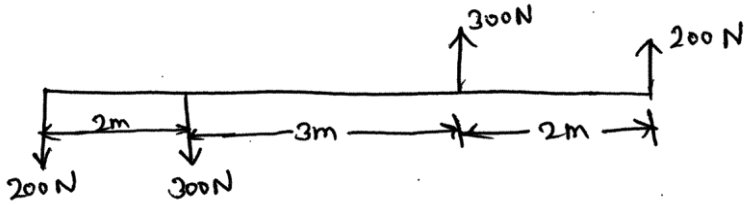
[3 Hours] **[Marks: 80]**

N.B:
1. Question No. **1 is compulsory**.
2. Attempt any **three** questions out of remaining **five** questions.
3. Assume **suitable** data if necessary stating them clearly.
4. Take g = 9·81 m/s^2.
5. Draw suitable sketches wherever necessary.

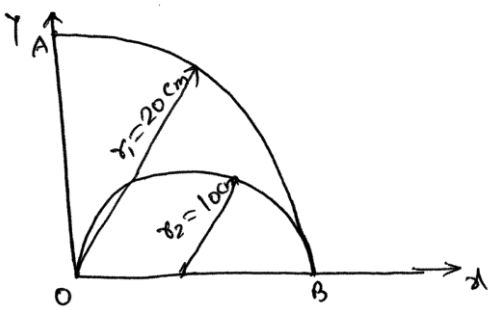
1. Attempt **any four** :

(a) State and prove varignones theorem. **05**

(b) Find the resultant of the force system shown in fig. **05**

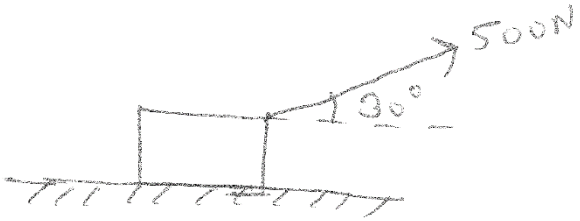


(c) Find the co-ordinate of the centroid of the area shown in fig. **05**



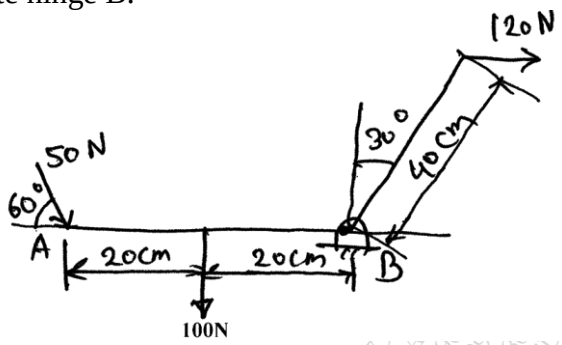
All dimensions are in cm

(d) A force of 500N is acting on a black of 50Kg mass resting on a horizontal surface as shown in fig. Determine the velocity after the block has travelled a distance of 10m. Coeff. of kinetic friction = 0·5 **05**

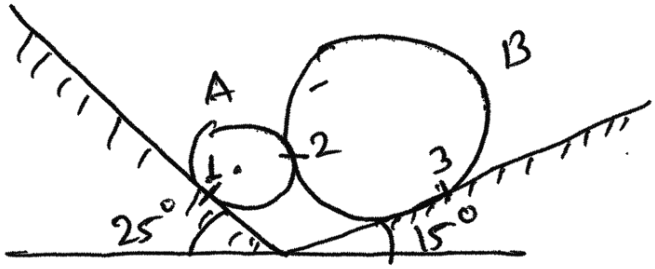


(e) The position vector of a particle which moves in the X-Y plane is given by $\bar{r} = (3t^3 - 4t^2)i + (0{\cdot}5\,t^4)\,J$ m. Calculate velocity and acceleration at t = 1 sec. **05**

2. (a) Find the resultant of the force acting on the bell crank level shown. Also locate its position write hinge B. **08**



(b) Determine the reaction at points of constant 1, 2 and 3. Assume smooth surfaces. **05**

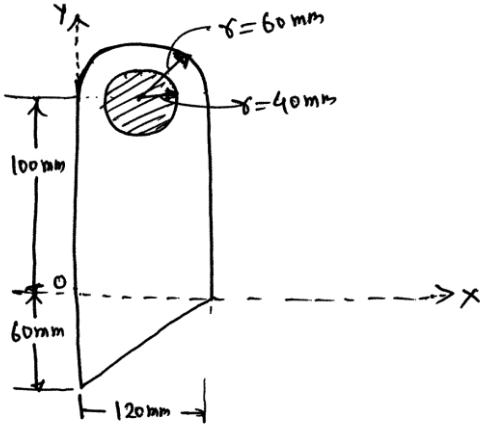


$W_A = 1\ kg, \quad r_A = 1\ cm$

$W_B = 4\ kg, \quad r_B = 4\ cm.$

(c) Two balls having 20Kg and 30Kg masses are moving towards each other with velocities of 10m/s and 5m/s respectively as shown in fig. If other impact the ball having 30Kg mass is moving with 6m/s velocity to the right then determine the coefficient of restitution between the two balls, **06**

3. (a) Determine the centroid of the plant lamina shaded portion is removed. **08**



(b) Explain conditions for equilibrium for forces in spaces. **06**

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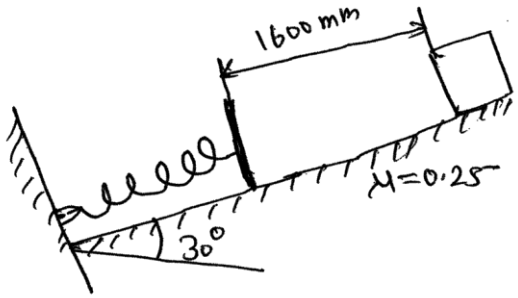
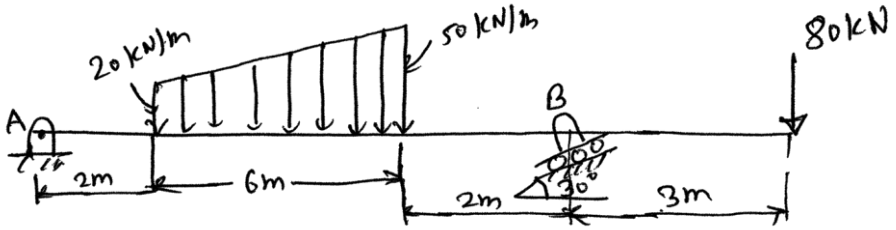
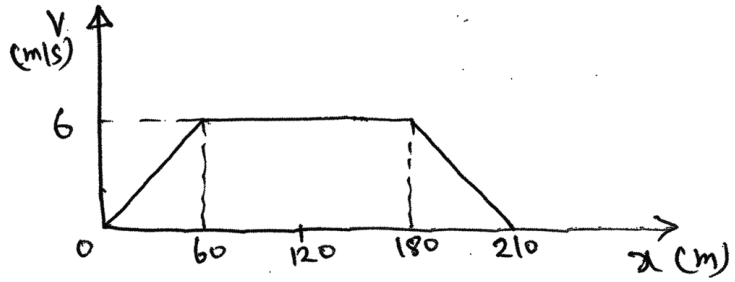
(c) A 30N block is released from rest. If slides down a rough incline having coefficient of friction 0·25. Determine the maximum compression of the spring. **06**



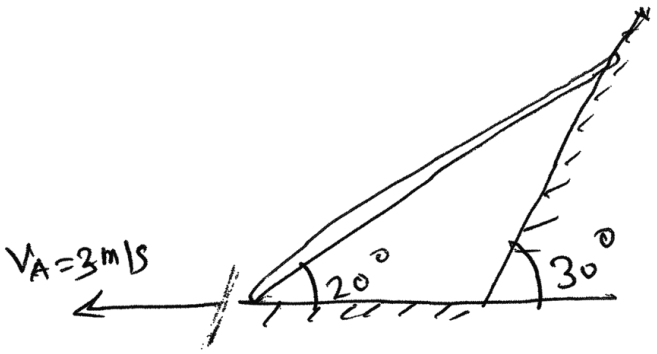
4. (a) Find the support reaction at A and B for the beam loaded as shown in fig. **08**



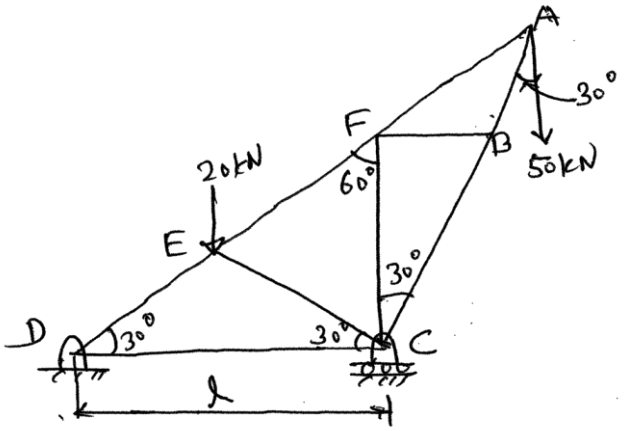
(b) The V-X graph of a rectilinear moving particle is shown. Find acceleration of the particle at 20m, 80m and 200m. **06**



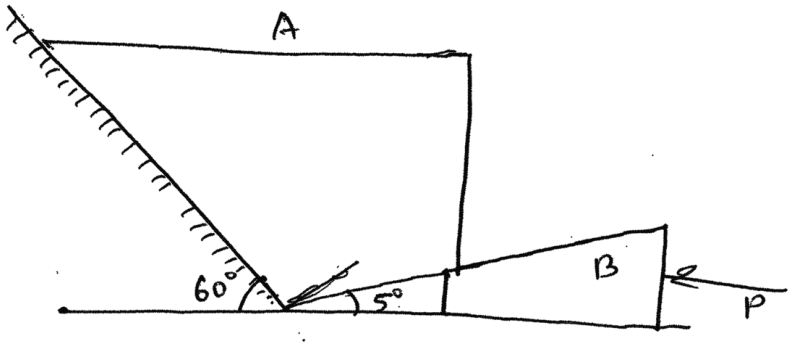
(c) A bar AB 2m long slides down the plane as shown. The end A slides on the horizontal floor with a velocity of 3m/s. Determine the angular velocity of the rod AB and the velocity of end B for the position shown. **06**



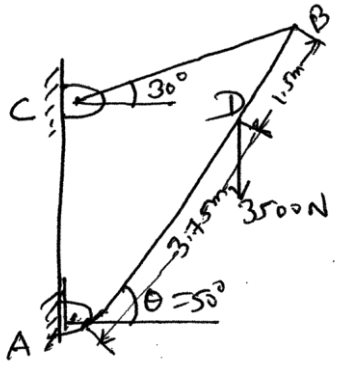
5. (a) Referring to the trus shown in fig. Find **08**
   i. Reaction at D and C
   ii. Zero Force members
   iii. Forces in members FE & DC by method of section.
   iv. Forces in other members by method of joints.



(b) Determine the force 10 required to move the block A of 5000N weight up the inclined plane, coefficient of friction between all contact surfaces is 0·25. Neglect the weight of the wedge and the wedge angle is 15 degrees. **06**



(c) Determine the tension in a cable BC shown in fig by virtual work method. **06**



6. (a) A 500N Crate kept on the top of a 15º sloping surface is pushed down the plane with an intitial velocity of 20 m/s. If $\mu s = 0{\cdot}5$ and $\mu\kappa = 0{\cdot}4$, Determine the distance travelled by the block and the time it will take as it comes to rest. **05**

(b) Derive the equation of the path of a prosotile and hence show that the path traced by a prosectile is a parabolic curve. **05**

(c) A particle is moving in X-Y plane and its position is defined by $\bar{r} = \left(\frac{3}{2}t^2\right)i + \left(\frac{2}{3}t^3\right)J$. **05**

Find ratio of curvature when t = 2 sec.

(d) A force of 100N acts at a point P(−2, 3, 5) m has its line of action passing through Q (10, 3, 4) m. Calculate moment of this force about origin (0,0,0). **05**
