Total No. of Questions : 6] [Total No. of Pages : 11

P 1121 **[2667]-108**

F.E.

26 NOV 2004

ENGINEERING MECHANICS

(Revised Course-2003)

Time : 3 Hours] *[Max. Marks : 100*

Instructions:

1) *Answer 3 questions from section I and 3 questions from section II.*
2) *Answers to the two sections should be written in separate books.*
3) *Neat diagrams must be drawn wherever necessary.*
4) *Figures to the right indicate full marks.*
5) *All questions carry equal marks.*
6) *Your answers will be valued as a whole.*
7) *Assume suitable data, if necessary.*
8) *All questions are compulsory.*

SECTION - I

Q1) a) A weight W rest on the bar AB as shown in Fig.1. The cable connecting W and B passes over frictionless pulley. If bar AB has negligible weight, show that the reaction at A is $W\frac{(L-a)}{(L+a)}$ **[8]**

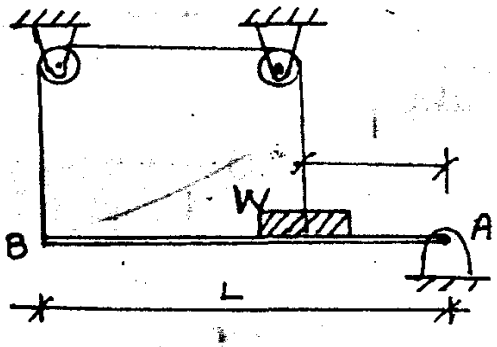


Fig - 1

b) To adjust the vertical position of column supporting a weight of 2000 kN, two 5° wedges are used as shown in Fig.2. Determine the force 'P' necessary to start the wedges if the angle of friction at all the surface is 25°. **[9]**

(Neglect friction at rollers)

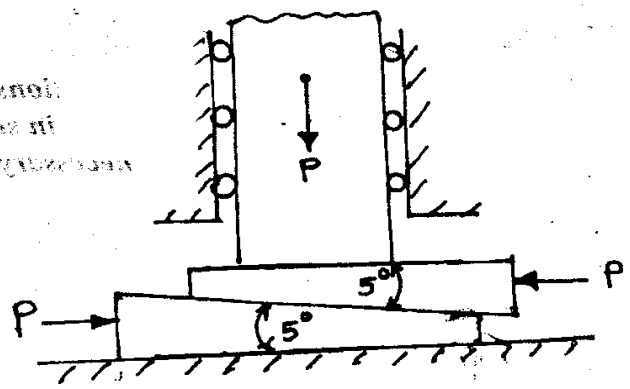


Fig-2

OR

Q1) a) A beam supports a load distributed parabolically over its length. Determine the resultant of this distributed load and line of action. And hence find reaction at any one support. (Refer Fig.3) **[9]**

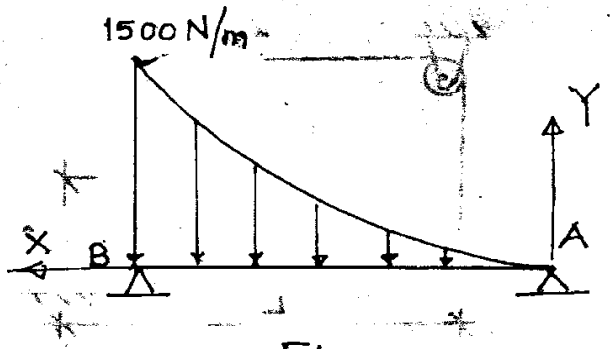


Fig-3

b) Cable AC holding a beam AB, exerts a force 'P' along AC. Knowing that P must have a vertical component of 1750 N, determine the magnitude of force P and its horizontal component. (Refer Fig.4).

Hence find weight 'W' at centre of beam AB. **[8]**

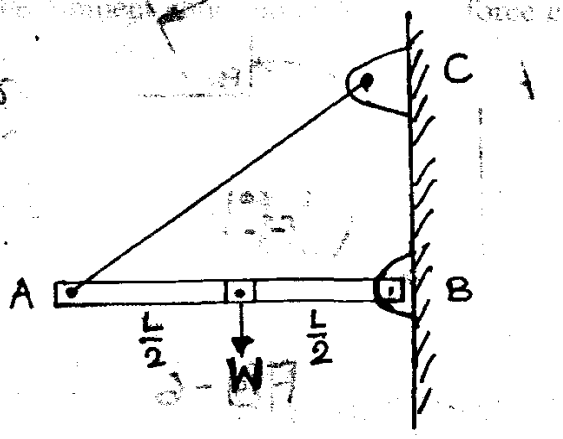


Fig-4

Q2) a) Find analytically or graphically the support reactions and member forces for pin jointed plane truss shown in Fig.5.

(Use graph paper for graphical solution) **[7]**

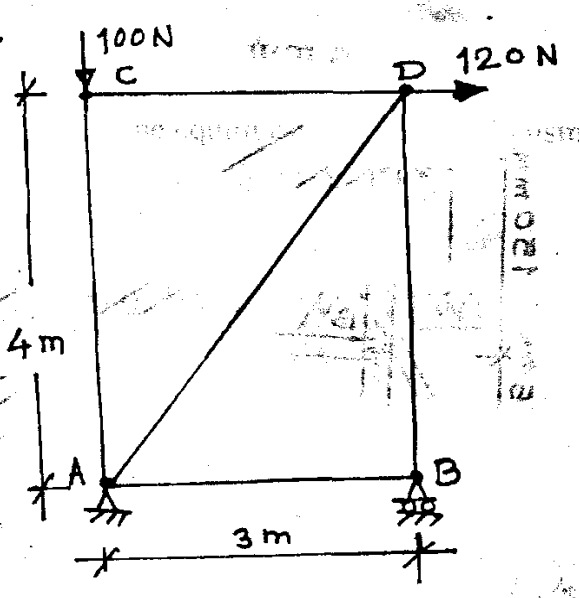


Fig 5

b) A 200 kg block is attached to the lever AO as shown in Fig.6 and spring BC is unstretched when $\theta = 0$. Determine θ for equilibrium position. **[10]**

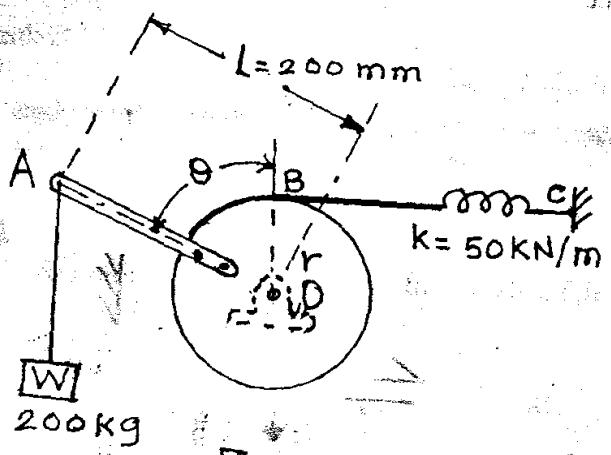


Fig-6

OR

Q2) a) Determine the components of force exerted by the axle of the pulley, as shown in Fig.7, upon the member AC and CF. **[10]**

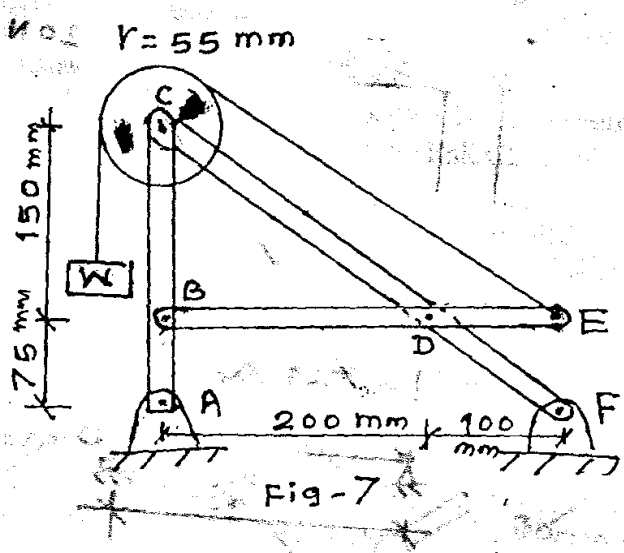


Fig-7

b) Prove that for a body placed on rough inclined plane, the angle of repose is same as the angle of limiting friction. **[7]**

Q3) a) A rectangular plate is supported by brackets to the wall at A and B and by wire CD as shown in Fig.8. Knowing that tension in wire is 200 N, determine the moment about point A, of the force exerted by wire on point 'C'. **[8]**

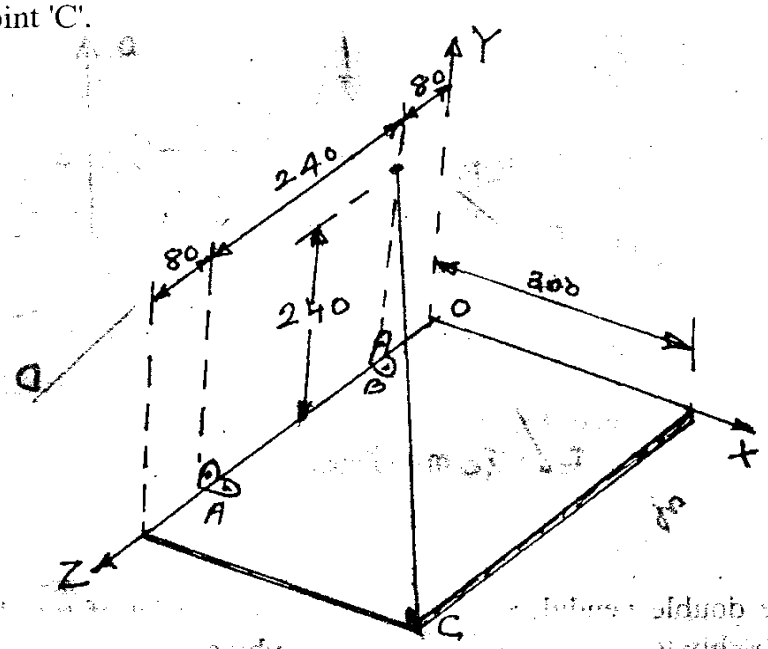


Fig-8

b) Using method of virtual work, determine the magnitude of couple M, required to maintain the equilibrium of the mechanism shown in Fig.9. **[8]**

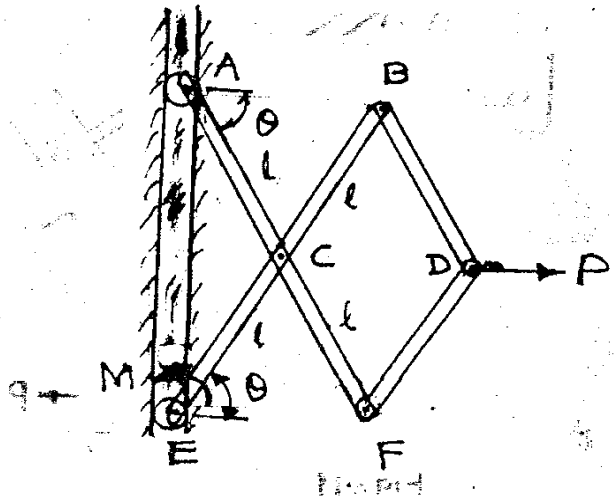


Fig-9

OR

Q3) a) A vertical rod of 1100 kN is supported by the three wire shown in Fig.10. Find the force in each wire. Point C, O and D are in XZ plane while point B 2m above this plane. **[8]**

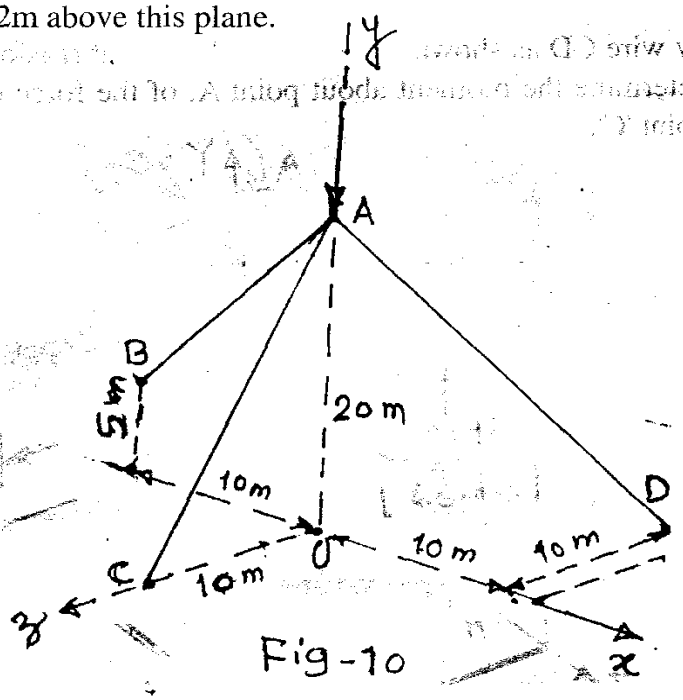


Fig-10

b) The double pendulum shown in Fig.11, consist of two links pinned smoothly together and held in position by a horizontal force P at point C. If the link AB is twice as long and heavy as link BC, find the equilibrium position as defined by angle θ_1 and θ_2. **[8]**

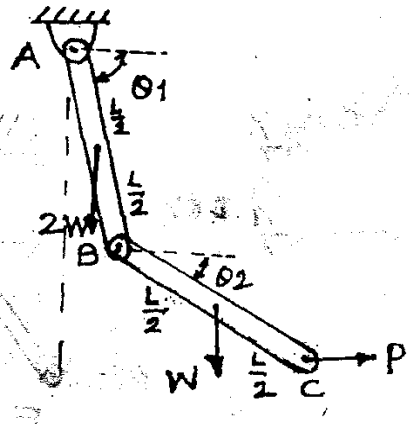


Fig - 11

SECTION - II

Q4) a) A car starting from rest moves along a straight track with an acceleration shown in Fig.12. Determine time 't' for the car to reach a speed of 50 m/s and construct the V-t diagram that describes the motion until the time 't'. **[9]**

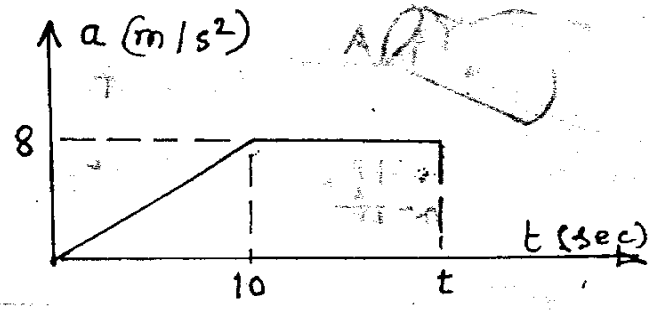
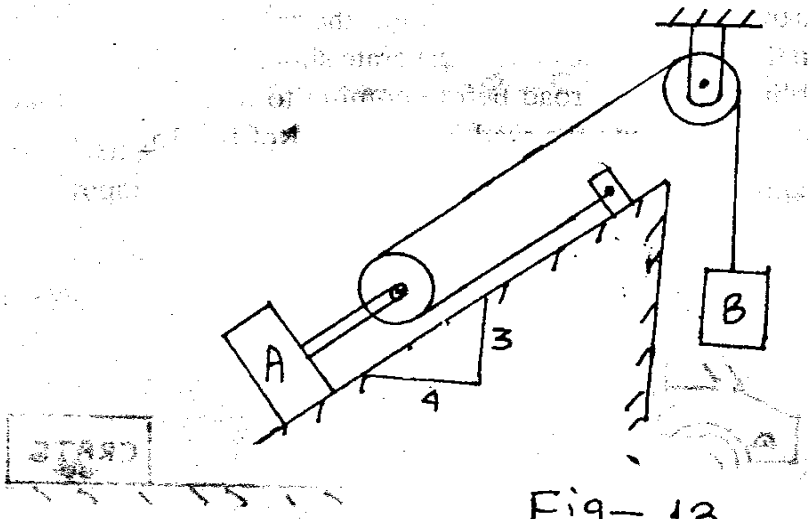


Fig-12

b) The block 'B' has a constant downward acceleration of 0.8 m/s^2. Determine the speed and acceleration of block A, 5 sec after the system starts from rest. Refer Fig.13. **[8]**



Fig– 13

OR

Q4) a) A milk is poured into a glass of height 140 mm and inside diameter 66 mm. If the initial velocity of milk is 1.2 m/s at an angle of 40^{o} with the horizontal, determine the range of values of height 'h' for which the milk will enter the glass. Ref Fig.14. **[9]**

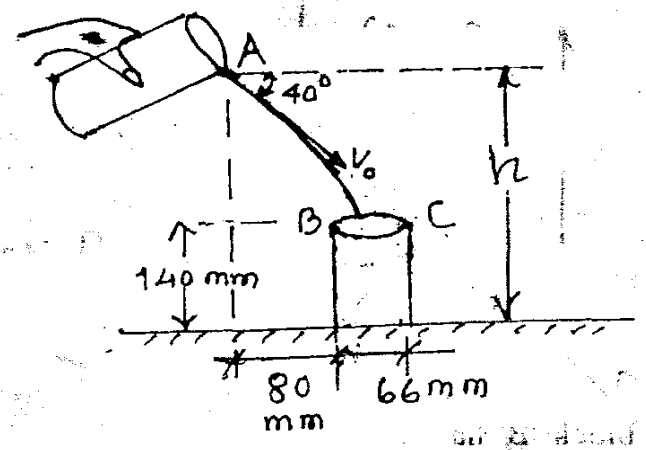


Fig-14

b) A crate having a mass of 60 kg fall horizontally off the back of a truck which is traveling at 80 km/h. Determine the coefficient of kinetic friction between the road and the crate if the crate slides 45m on the ground with no tumbling along the road before coming to rest. Assume that initial velocity of crate along the road is 80 km/h. Ref Fig.15. **[8]**

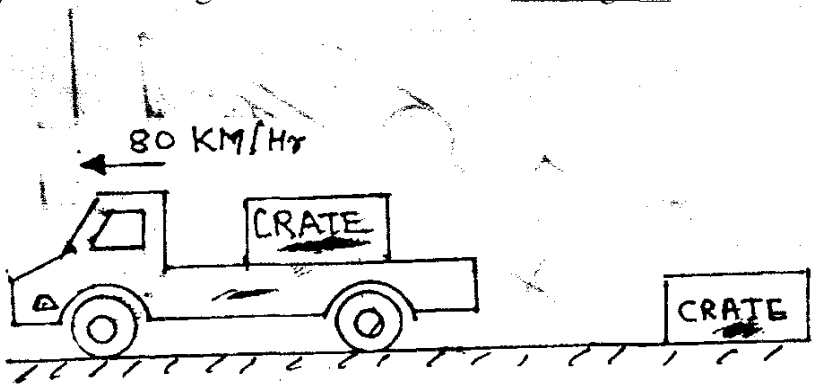


Fig - 15

Q5) a) A partical 'P' moves along the spiral path $r = \left(\frac{10}{\theta}\right)$ m, where θ is in radians. If it maintains a constant speed of V = 6 m/s, determine the magnitude of V_r and V_θ as a function of θ and evaluate each at θ = 1 radian. Ref Fig-16. **[7]**

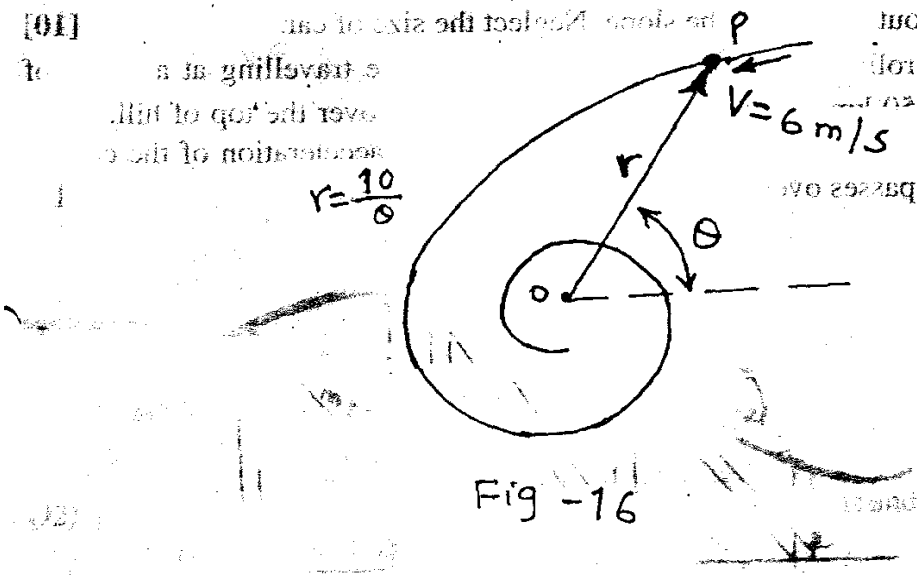


Fig -16

b) The bullet of mass 'm' given a velocity due to gas pressure caused by burning of powder within the chamber of gun. Assuming this pressure creates a force of $F = F_0 \sin\left(\frac{\pi t}{t_0}\right)$ on the bullet, determine the velocity of bullet at any instant in the barrel. What is the bullet's maximum velocity? Also determine the position of the bullet in the barrel as a function of time Ref Fig.17. **[10]**

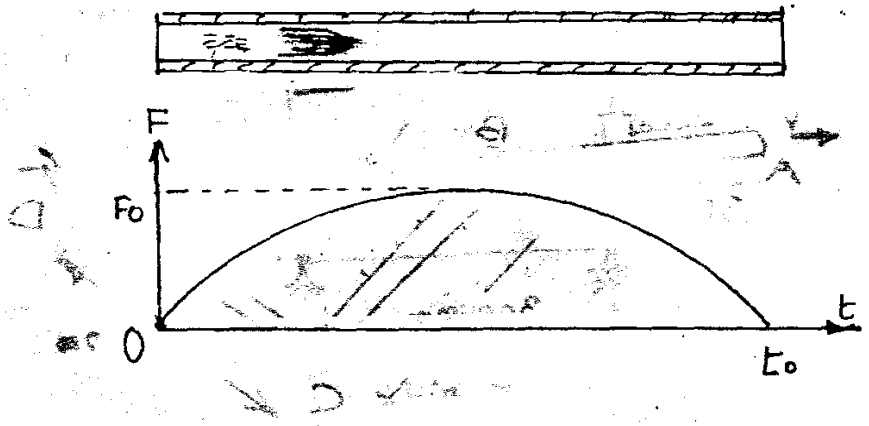


Fig - 17

OR

Q5) a) The sports car having a mass of 1700 kg is travelling horizontally along a 20° banked track which is circular and has a radius of curvature of 100 m. If the coefficient of static friction between the tyres and road is $\mu_s = 0.2$, determine the maximum constant speed at which car can travel without sliding up the slope. Neglect the size of car. **[10]**

b) The roller coaster cars shown in Fig.18 are travelling at a speed of V = 50 km/h (and $\dot{V} = 0$) when they pass over the top of hill. If the radius of curvature is 21 m, determine the acceleration of the cars as they passes over the top of hill. **[7]**

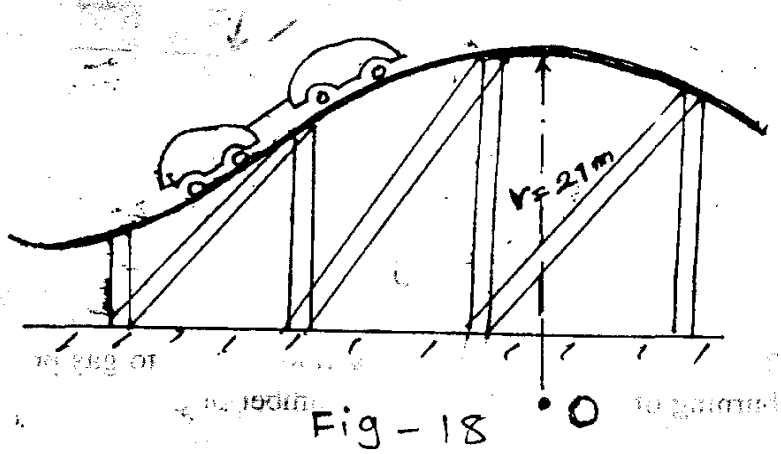


Fig - 18

Q6) a) At the instant shown in Fig-19, $\theta = 60^{\circ}$ and rod AB is subjected to a deceleration of 16 m/s^2 when the velocity is 10 m/s. Determine the angular velocity and angular acceleration of the link CD at this instant. **[8]**

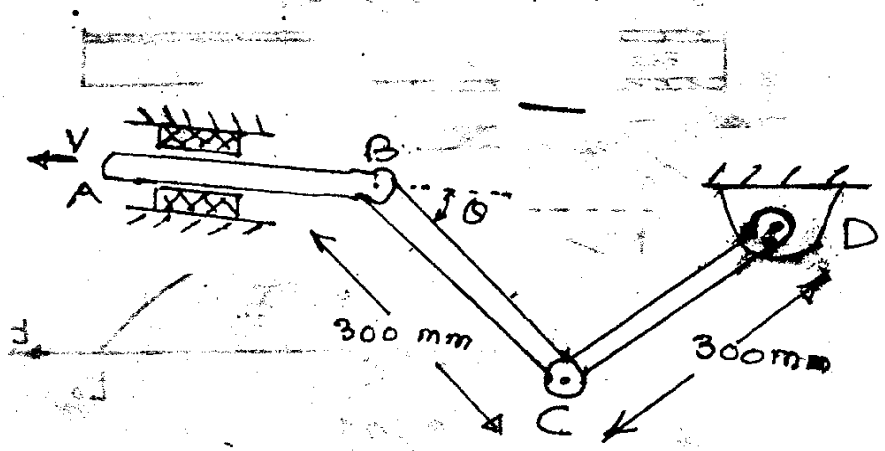


Fig - 19

b) The slider block 'C' moving 1.2 m/s up the incline, as shown in Fig-20. Determine the angular velocity of the links AB and BC and velocity of point 'B' at the instant shown. **[8]**

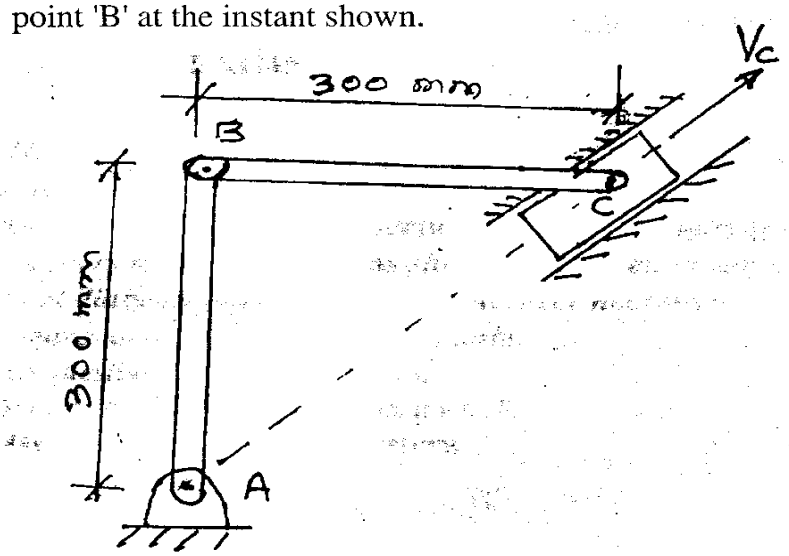


Fig -20

OR

Q6) a) A sphere of mass 'm' and radius 'r' is placed on horizontal surface with no linear velocity but with clockwise angular velocity ω_o. If μ_k is the coefficient of kinetic friction between sphere and the floor, determine

a) time t_1 at which sphere will start rolling without sliding.

b) linear and angular velocity of the sphere at time 't_1' **[8]**

b) The slender rod weighing 400 N is supported by chords AB and BC. If cord AC suddenly breaks, determine the initial angular acceleration of the bar and tension in the cord AB. Ref. Fig-21. **[8]**

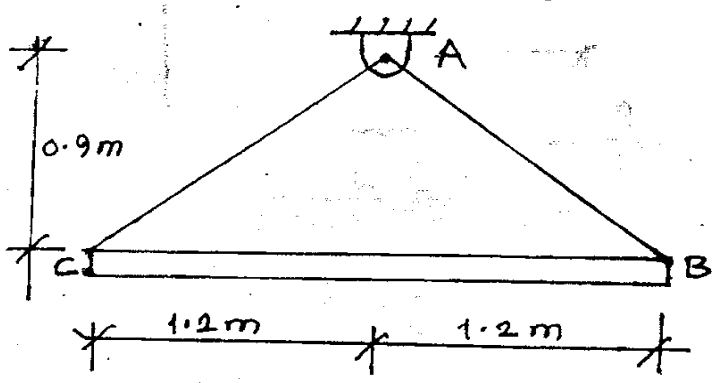


Fig -21

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