Time: 3 Hours **Total Marks : 80**

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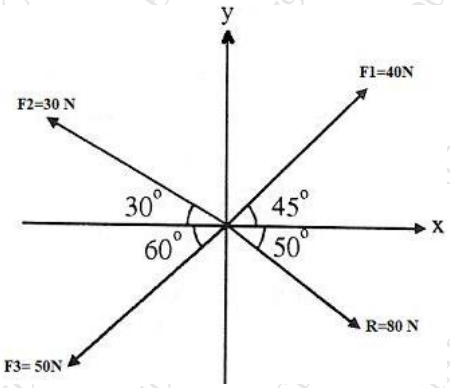
N.B. 1 Question No.1 is Compulsory.
2. Answer any Three more questions out of the remaining Five questions
3 Assume any suitable data wherever required but justify the same.
4 Figures to the right indicate full mark
5 Take g= 9.81 m/s^2

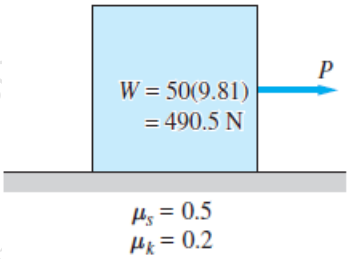
Q.1 Solve Any Four [5x4] **[20]**

a) State and prove Varignon's theorem.

b) Find the fourth force F4 so that the resultant R of the four-force system is as shown in fig.

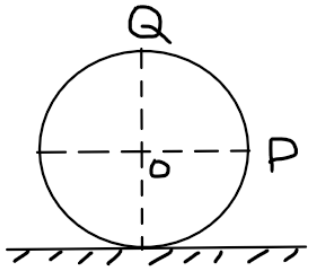


c) The 50-kg block is initially at rest on a horizontal plane. Determine friction force if the magnitude of P is 150 N .

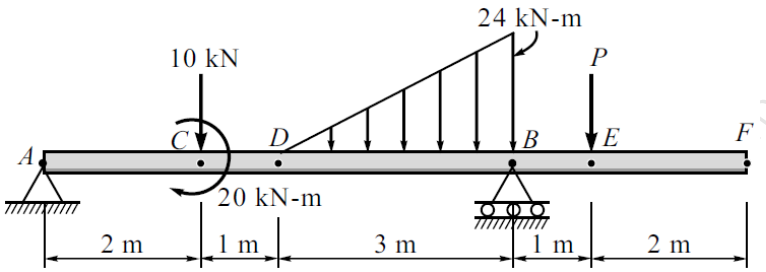


d) For a particle in a rectilinear motion $a = -0.05v^2$ m/s^2. At v =20 m/s, x =0. Find x at v=50 m/s and acceleration at x=50 m.

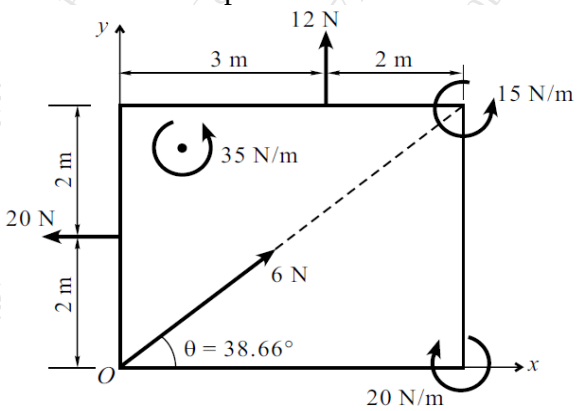
e) A wheel of radius 0.75 m rolls without slipping on a horizontal surface to the right. Determine the velocities of the points P and Q shown in figure 2 when the velocity of centre of the wheel is 10 m/s towards right.



Q2 a) Find support reaction at B and load P for the beam shown below. Given that reaction at A is zero **[8]**

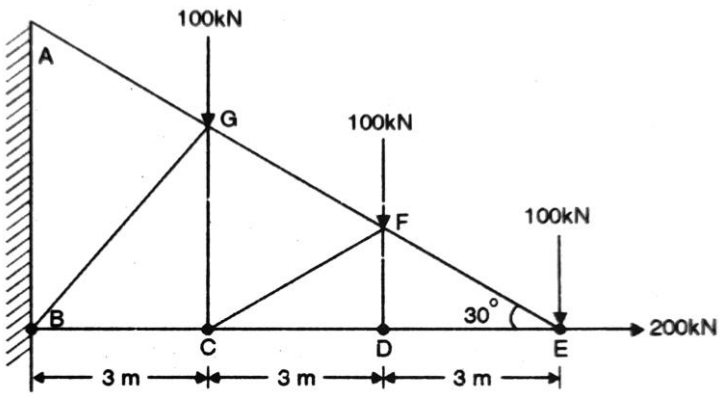


b) Find the resultant and locate it with respect to O. **[6]**

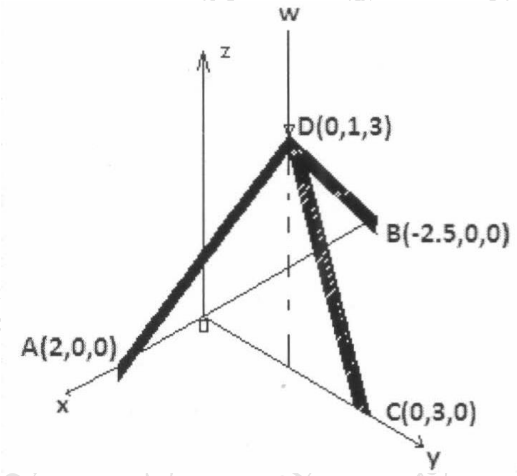


c) A ball is kicked at an angle of 30 degree with horizontal. The point where it strikes the ground has the coordinates (X, Y) =(5,-3).Determine the speed at which it is kicked and the velocity at which it strikes the ground. **[6]**

Q.3 a) A The truss is loaded and supported as shown in figure. Identify zero force members, find forces in members EF,ED and FC by method of joint, find forces in members GF,GC,and BC by method of section **[8]**

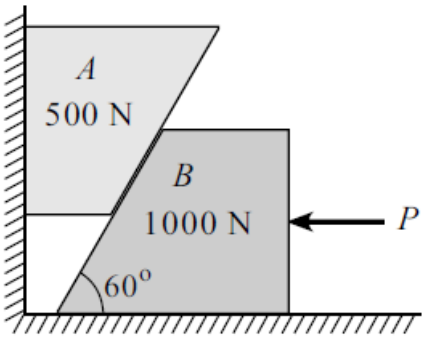


b) The tripod shown in figure supports a vertical load W=100 KN. Find the compressive force acting on each member. All joints are ball and socket type. **[6]**

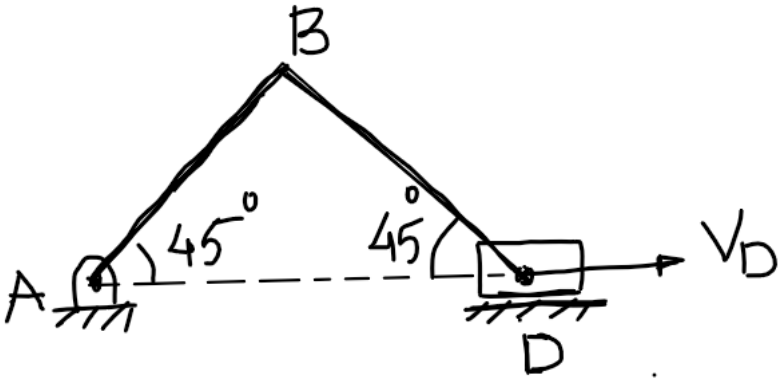


c) A particle moves along a circle of radius 20 cm so that $S = 20\pi t^2$ cm. Find its normal and tangential acceleration after it has completed a revolution. **[6]**

Q.4a) Assuming the values for μ=0.25 at the floor and 0.3 at the wall and 0.2 between the blocks, find the minimum value of a horizontal force P applied to the lower block that will hold the system in equilibrium. **[8]**

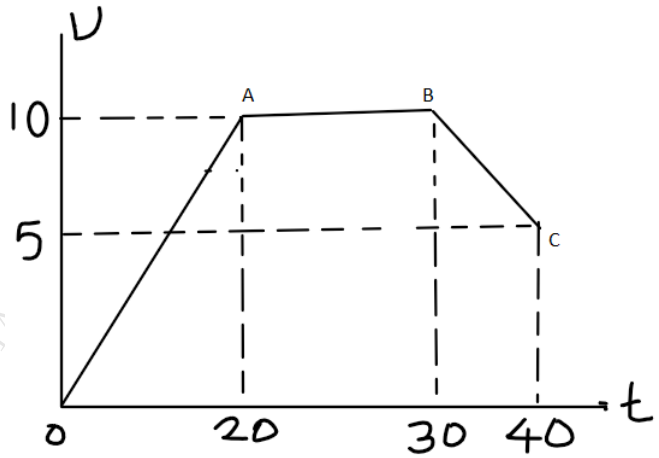


b) Block D shown in figure moves with a speed of 3 m/s. Determine angular velocity of links BD and AB. Take length of link AB = BD = 0.4 m **[6]**

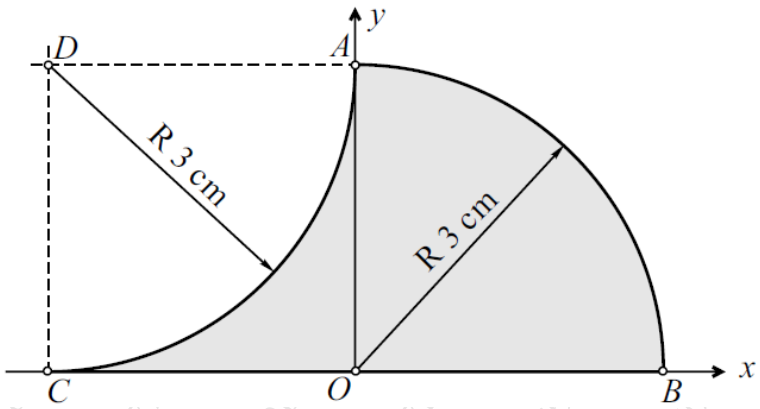


c) Derive equation of trajectory followed by projectile. **[6]**

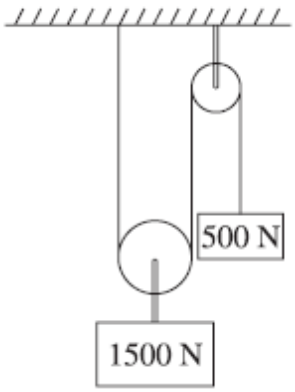
Q.5 a) The velocity time graph for a particle moving along a straight line is shown in figure, Plot x-t and a-t diagram. **[8]**



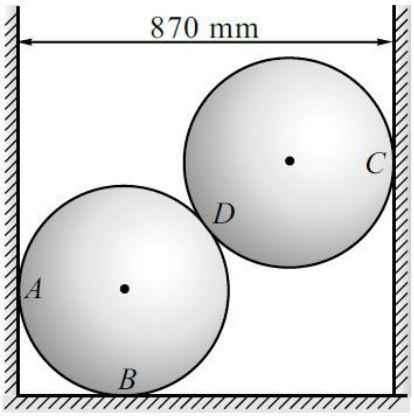
b) Find the centroid of shaded area. All dimensions are in cm. **[6]**



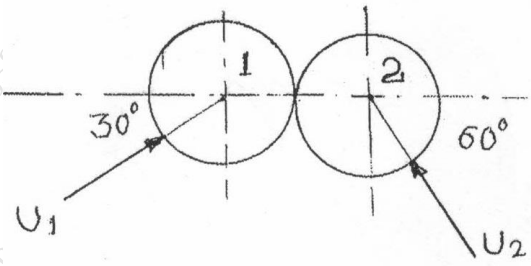
c) Determine the tension in the string and accelerations of blocks *A* and *B* weighing 1500 N and 500 N connected by an inextensible string as shown in Figure. Assume that the pulleys are frictionless and weightless. **[6]**



Q.6 a) Find the reactions at the surfaces of contact A, B, C and D, if weight of each sphere is 100 N and radius is 250 mm. **[8]**



b) Two smooth spheres 1 and 2 having a mass of 2 kg and 4 kg respectively collide with initial velocities 2 m/s and 4 m/s respectively as shown in figure. If the coefficient of restitution for the spheres is 0.8, determine the velocities of each sphere after collision. **[6]**



c) Block A as shown in figure has a mass of 90 Kg and an initial velocity of 10 m/s to the right. The spring constant is 12 KN/m, and the coefficient of kinetic friction is 0.15. How much will the spring deflect in bringing the block to rest ? **[6]**