

[3 Hours]

[Marks 80]

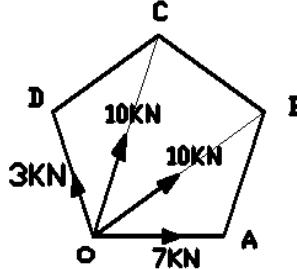
NB:

1. Question No: 1 is compulsory.
2. Attempt any three questions out of remaining five questions.
3. Assume suitable data if necessary and mention the same clearly.
4. Draw suitable sketches whenever necessary.

1. Attempt Any Four :

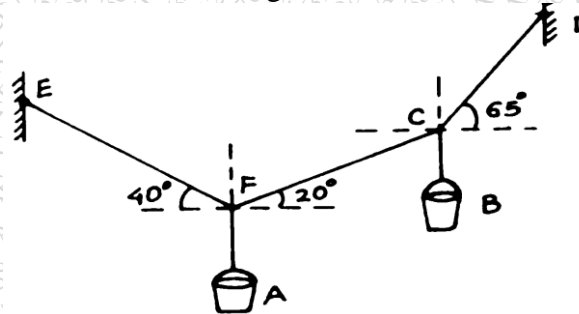
- a) Find the resultant of forces as shown in fig.

(05)



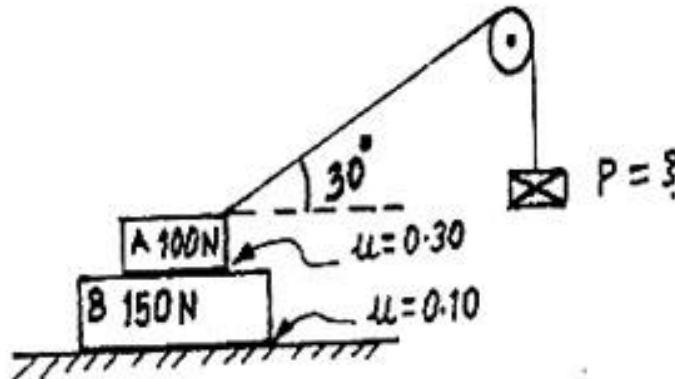
- b) If the cords suspend the two buckets in equilibrium position shown in Fig. Determine weight of bucket B if Bucket A has a weight of 60N.

(05)



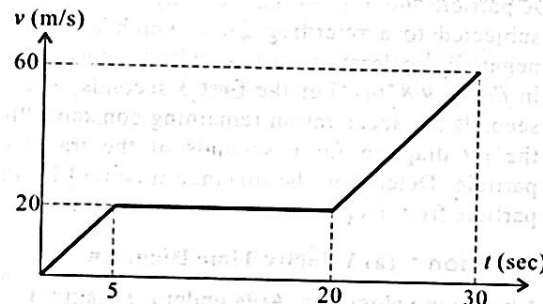
- c) Two blocks A=100N and B=150N are resting on the ground as shown in the fig. Find the minimum weight P in the pan so that body A starts. Assume pulley to be mass less and frictionless.

(05)



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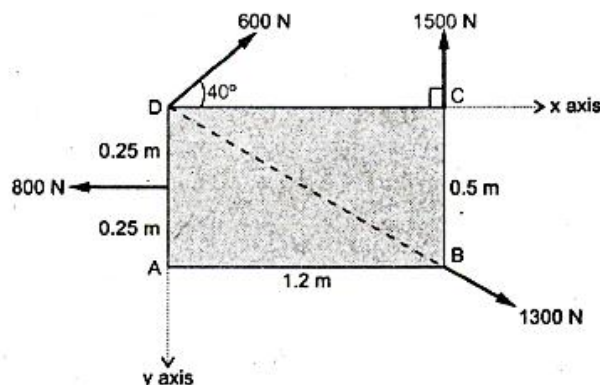
- d) The motion of jet plane while travelling along a runway is defined by the $v-t$ graph as shown in Fig. Construct the $s-t$ graph for the motion. The plane starts from rest. (05)



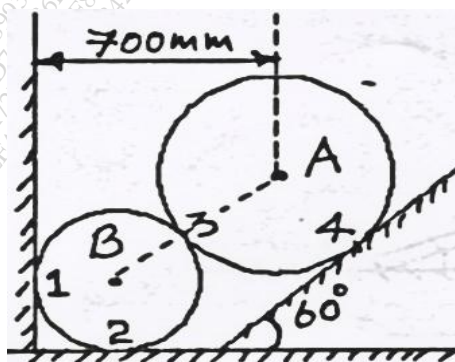
A 50 kg block is kept on the top of a 15° slopping surface is pushed down the plane with an initial velocity of 20m/s. If $\mu_k = 0.4$, determine the acceleration of the block. (05)

2. Attempt:

- a) Four forces acting on a rectangle in the same plane as shown in fig below. Find magnitude and direction of the resultant force. Also find intersection of line of action of resultant with X and Y axes, assuming D as origin. (06)

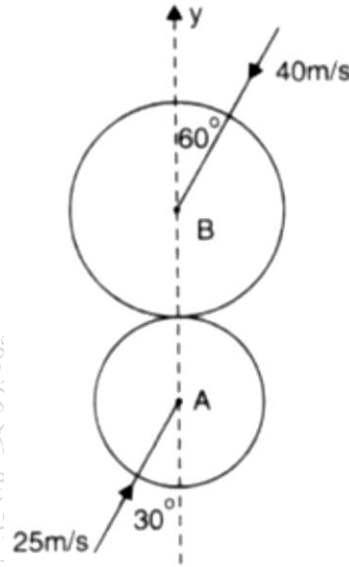


- b) Two spheres A and B of weight 1000N and 750N respectively are kept as shown in fig. Determine the reactions at all contact points 1, 2, 3 and 4. Radius of A = 400 mm and B = 300 mm. (08)



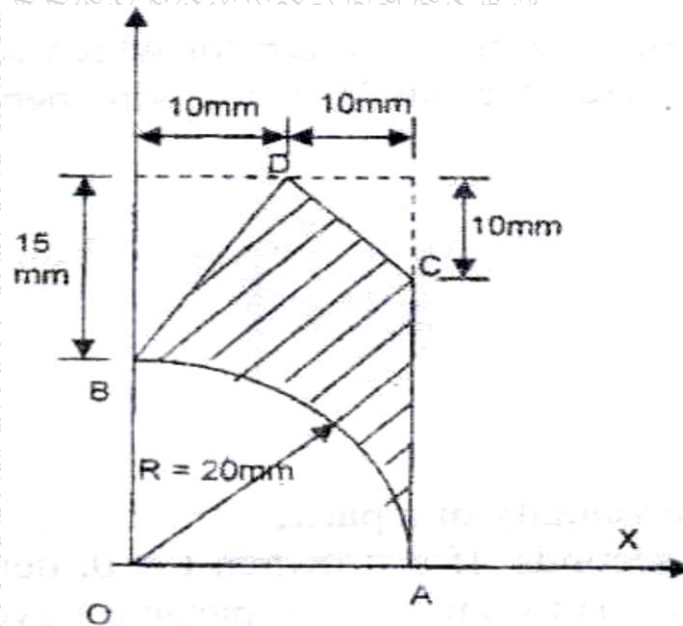
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- c) Two smooth balls A (mass 3 kg) and B (mass 4kg) are moving with velocities 25 m/s and 40 m/s respectively. Before impact, the directions of velocity of two balls are 30° and 60° with the line joining the centers as shown in Fig. If $e = 0.8$, find the magnitude and direction of velocities of the balls after impact. (06)



3. Attempt:

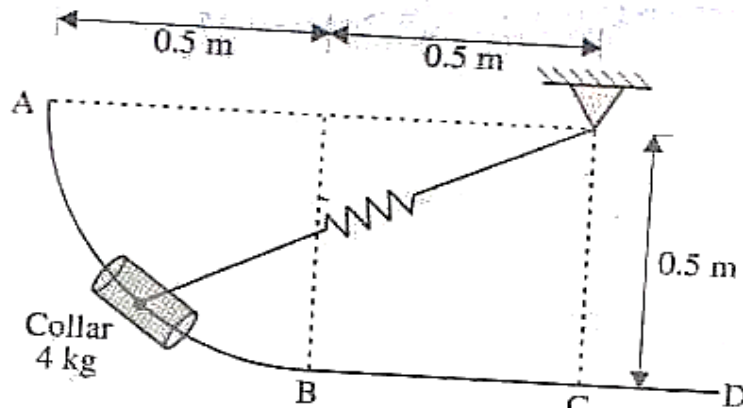
- a) Find the centroid of shaded area as shown in fig. (08)



- b) Three forces F_1 , F_2 and F_3 act at the origin O. $F_1 = 70$ N acting along OA, where A (2, 1, 3). $F_2 = 80$ N acting along OB, where B (-1, 2, 0). $F_3 = 100$ N acting along OC, where C (4, -1, 5). Find the resultant of these concurrent forces. (06)

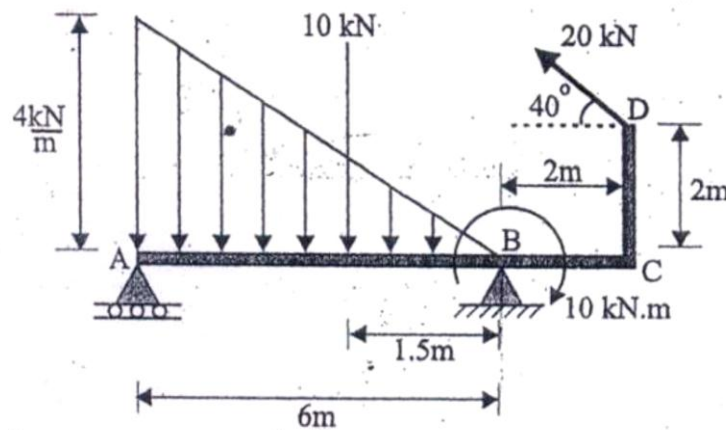
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- c) A 4kg collar is attached to a spring, slides on a smooth bent rod ABCD. The spring has constant $k = 500 \text{ N/m}$ and is undeformed when the collar is at 'C'. If the collar is released from rest at A. Determine the velocity of collar, when it passes through 'B' and 'C'. Also find the distance moved by collar beyond 'C' before it comes to rest again. Refer Fig. (06)

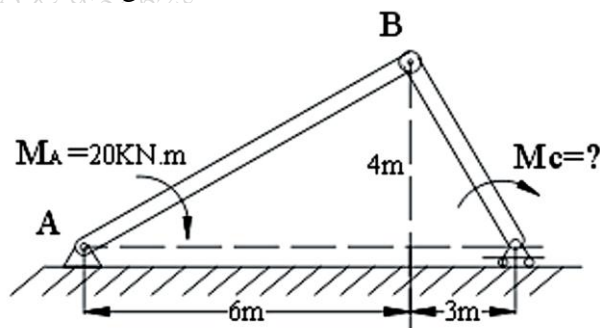


4. Attempt:

- a) Find the support reactions of beam loaded as shown in fig. (08)

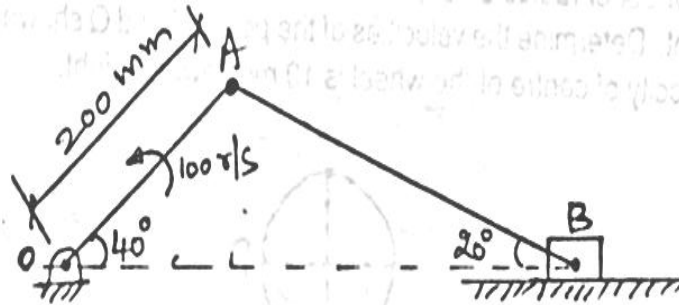


- b) Determine the moment to be applied at C for equilibrium of pin jointed mechanism. Use virtual work method. Refer Fig. (06)



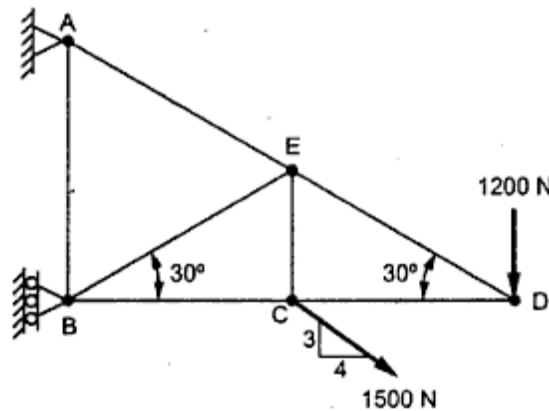
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- c) A slider crank mechanism is shown in Fig. The crank OA rotates anticlockwise at 100 rad/s. Find the angular velocity of rod AB and the velocity of the slider at B. (06)

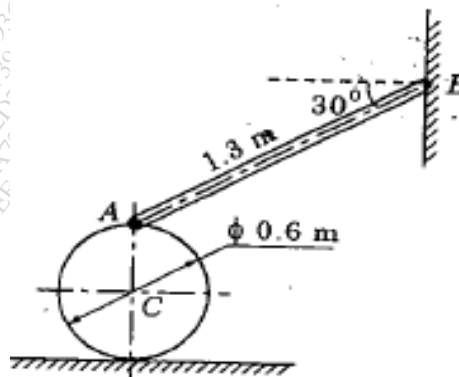


5. Attempt:

- a) Find the forces in the members BC, BE and AE by method of sections and remaining members by method of joints. (08)

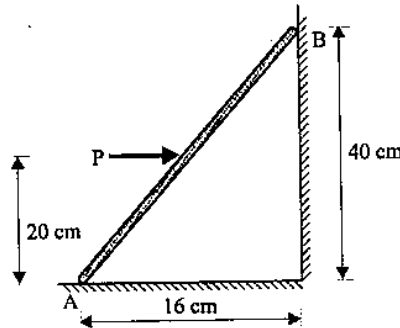


- b) A particle moves in x-y plane and its position is given by $\mathbf{r} = (3t)\mathbf{i} + (4t - 3t^2)\mathbf{j}$, where \mathbf{r} is the position vector of particle in meters at time t sec. Find the radius of curvature of the path and normal and tangential components of acceleration when it crosses X-axis again. (06)
- c) C is a uniform cylinder to which a rod AB is pinned at A and the other end of the rod B is moving along a vertical wall as shown in Fig – 4. If the end B of the rod is moving upwards along the wall with a speed of 3.3 m/s find the angular velocity of wheel and rod assuming that cylinder is rolling without slipping. (06)

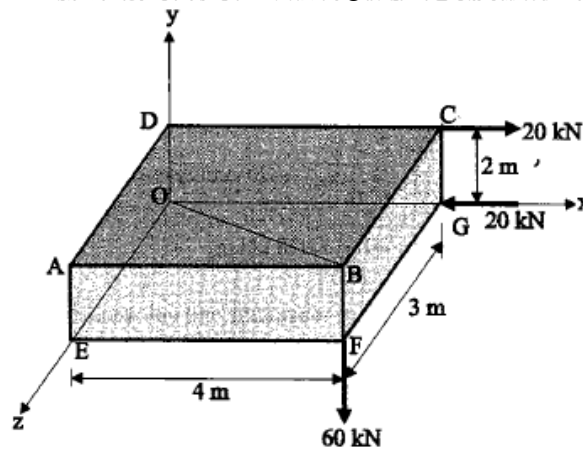


6. Attempt:

- a) A 100N uniform rod AB is held in position as shown. If $\mu=0.15$ at A and B calculate range of value of P for which equilibrium is maintained. (08)



- b) A box of size 3 X 4 X 2m is subjected to three forces as shown in fig. Find in vector form the sum of moments of the three forces about diagonal OB. (06)



- c) Two blocks A and B are separated by 10 m as shown in Figure on a 20° incline plane. If the blocks start moving, find the time t when the blocks collide and distance travelled by each block. Assume $\mu_k = 0.3$ for block A and plane and $\mu_k = 0.10$ for block B and plane. (06)

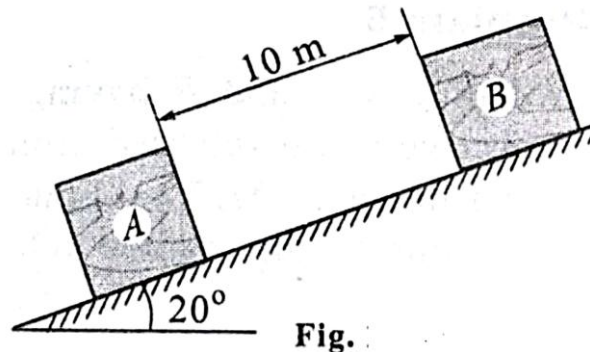


Fig.