FE|Sem I| e-Scheme| Nov-25 17/11/25 (1/5)

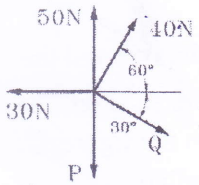
Opcode : 95461

3 Hours **Total Marks: 80**

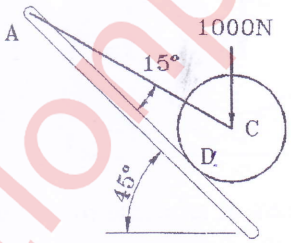
- Question-1 is compulsory.
- Answer any three from remaining five questions.
- Assume any suitable data wherever required, but justify the same. Assumptions made should be clearly stated.
- Illustrate answers with sketches, wherever required.

1. Answer any four

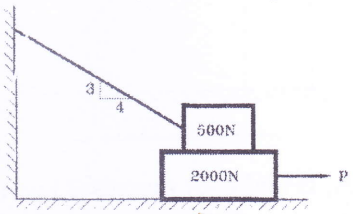
a. Find the forces P & Q, such that the resultant of the given system is zero. **[05]**



b. A roller of weight W= 1000 N rests on a smooth inclined plane. It is kept from rolling down the plane by a string AC. Find the tension in the spring and the reaction at the point of contact D. **[05]**



c. A block weighing 500 N is resting on another block of 2000 N weight. The upper block is tied to a vertical wall by a wire. Determine the horizontal force ***P*** required to pull the lower block. The coefficient of friction between all surfaces of contact is 0.3 **[05]**



d. A sprinter in a 100-m race accelerates uniformly for the first 35 m and then runs with constant velocity. If the sprinter's time for the first 35 m is 5.4 sec, determine his time for the race. **[05]**

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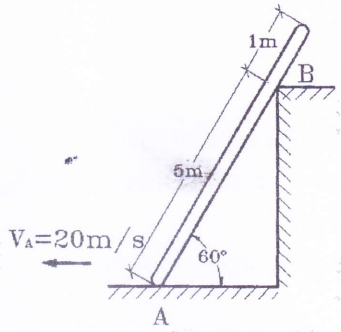
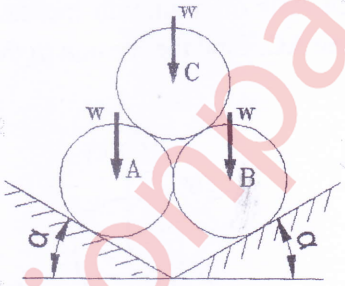
e. The velocity of the point A on the rod is 20 m/s at the instant shown in figure. Locate ICR and determine velocity of the point B on the rod. [05]

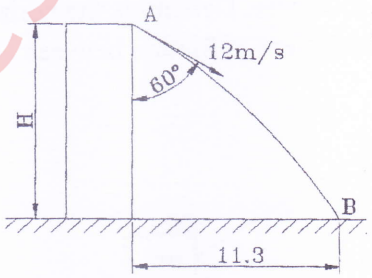


f. A car travelling at a speed of 90 k/hr suddenly applies brakes and comes to stop after skidding 68 m. Determine, [05]
(i) Time needs to stop the car
(ii) Coefficient of friction between the tyre and the road

2a. Three identical right circular cylinders A, B &C, each of weight W, are arranged on smooth inclined surfaces as shown in the figure. Determine the least value of α that will prevent the arrangement from collapsing. [06]



b. A ball thrown with speed of 12 m/s at an angle of 60° with a building strikes the ground 11.3 m horizontally from the foot of the building as shown. Determine the height of the building. [08]



c. Three perfectly elastic balls A, B and C of masses 2 kg, 4 kg and 8 kg move along a line with velocities 4 m/s, 1 m/s and 0.75 m/s, respectively. If the ball-A strikes the ball-B, which in turn strikes the ball-C, determine the velocities of the three balls after the impacts. [06]

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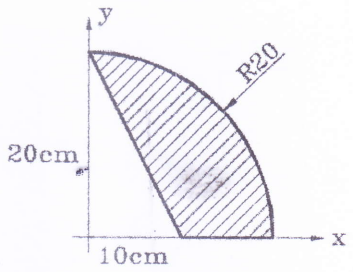
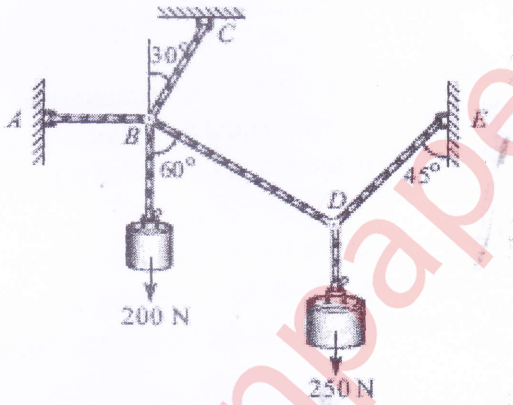
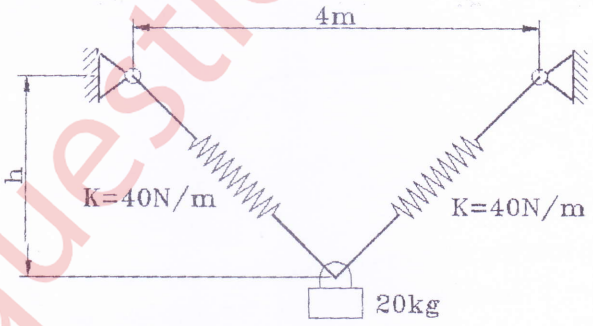
3a. Determine the centroid of the shaded area with respect to the given x and y axes. All dimensions are in cm. **[08]**



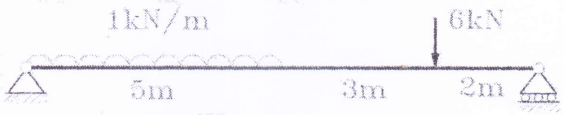
b. A system of connected flexible cables shown in the figure is supporting two vertical forces 200 N and 250 N at points B and D. Determine the forces in various segments of the cable. **[05]**



c. A cylinder has mass 20 kg and is released from rest, when h= 0. Determine the speed when h= 3 m. The springs have unstretched lengths of 2 m. **[07]**



4a. Determine the reactions of all supports of the given beam. **[08]**



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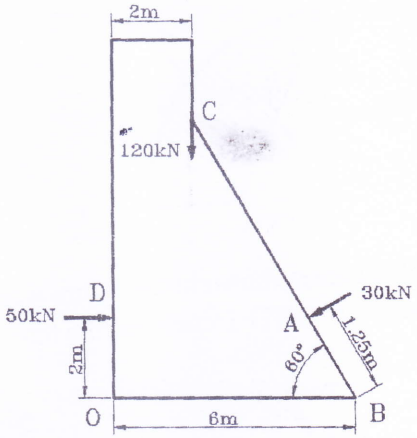
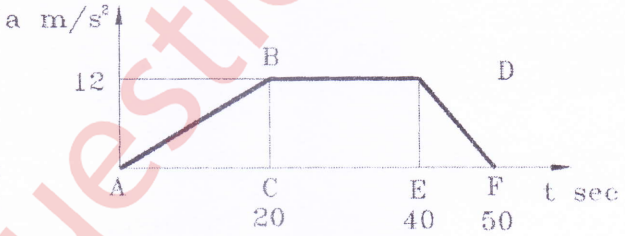
b. The forces acting on 1 *m* length of a dam are shown in figure. Determine the resultant force acting on the dam. Calculate the point of intersection of the resultant with the base. **[07]**



c. A car travels along a depression in a road, the equation of depression being $x^2 = 200y$. The speed of the car is constant equal to 72 km/h. Find the acceleration, when the car is at the deepest point in the depression. What is the radius of curvature at the depression at this point? **[05]**

5a. The lines of actions of three concurrent forces at the origin 'O' passing through points A (1, 2, 4), B (3, 0, -3) and C (2, -2, 4) are having magnitudes $F_A = 40$ N, $F_B = 10$ N and $F_C = 30$ N, respectively. Find the magnitude and direction of their resultant. **[07]**

b. Figure below shows a plot of ***a-t*** curve for a particle moving along a straight line. Draw ***v-t*** and ***s-t*** curves and determine the speed and distance covered by the particle after *50 sec*. Also, find the maximum speed attained by the particle. **[08]**



c. Acceleration of a particle moving along a straight line is represented by the relation $a = t^3 - 2t^2 + 7$. At t= 1 second, velocity of the particle is 3.58 m/s and displacement is 9.39 m. Determine the velocity and displacement at t=2 seconds. **[05]**

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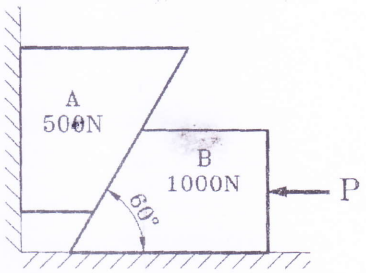
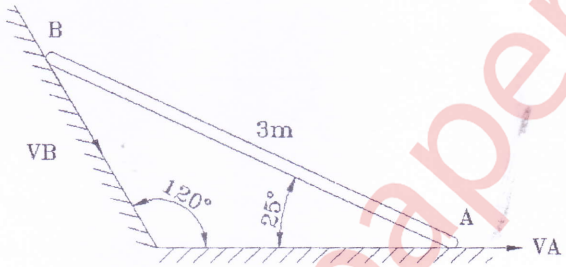
6a. Assuming the values for μ as 0.25 at the floor, 0.3 at the wall and 0.2 between the blocks, find the minimum value of the horizontal force P applied to the lower block that will hold the system in equilibrium. **[08]**



b. A 3 m long bar AB slides down the plane. The velocity of the end A is 3.6 m/s. Using velocity diagram, determine the angular velocity of the rod AB and the velocity of the end B. **[06]**



c. Determine the weight W required to be attached to 150 N block to bring the system to stop in 5 seconds, if at any stage 500 N is moving down at 3 m/s. Assume pulley to be frictionless and massless. **[06]**