

20/12/2023

Duration: 3 hours

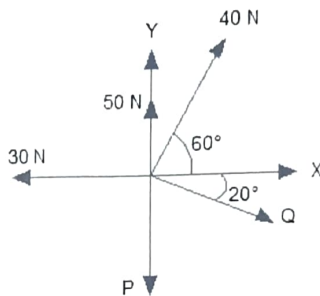
Total: 80 Marks

Note :

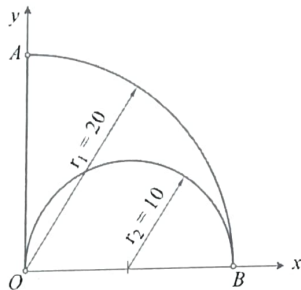
- Question No.1 is compulsory.
- Solve ANY THREE questions from the remaining five questions.
- Figure to the right indicates full marks.
- Assume suitable data wherever required, but justify the same.
- Take $g = 9.81 \text{ m/s}^2$.

Q. 1 Solve ANY FOUR questions from following. (Each question carries 5 marks). 20

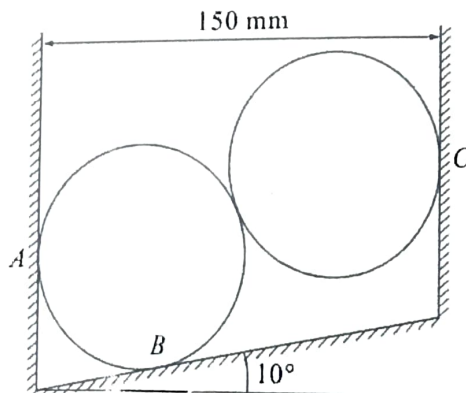
- a) Determine forces P & Q such that resultant of given system in figure is zero.



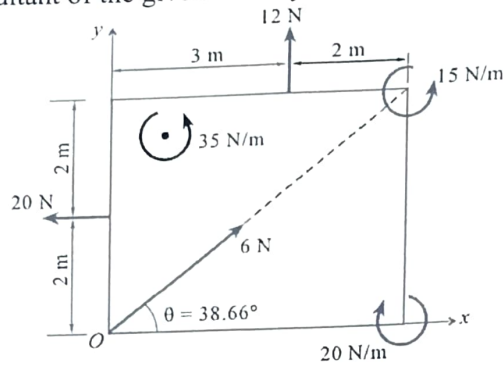
- b) Define the Instantaneous Centre of Rotation and write the properties of Instantaneous Centre of Rotation.
- c) Acceleration of a particle moving along a straight line is represented by the relation $a = 50 - 36t^2$. Determine the velocity of the particle when it has travelled 52 m and the time taken by it before it comes to rest again.
- d) Define angle of repose and prove that angle of friction = angle of repose
- e) Determine the centroid of the shaded area



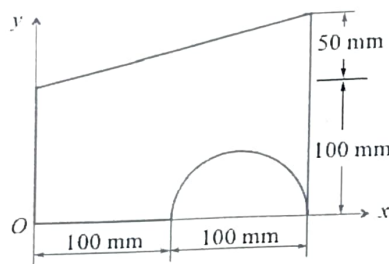
Q. 2 a) Two identical cylinders of weight 200 N and diameter 100 mm are placed as shown in figure. Determine the support reactions at A, B and C. 8



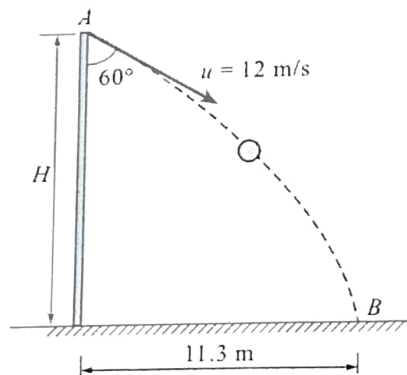
- b) Calculate the resultant of the given force system and locate it with respect O. 6



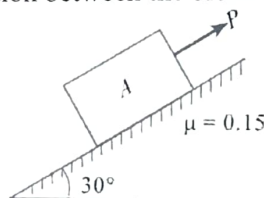
- c) Determine the "x" and "y" coordinates of the Centroid for the shaded area shown. 6



- Q.3 a) A ball is thrown with a 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. Determine the height of the building. 8

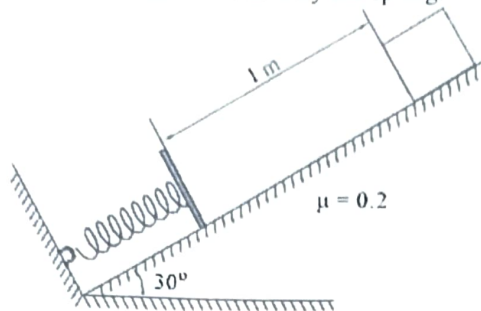


- b) A block of 1000 N is placed on an inclined surface (30° to horizontal). Determine the force required to prevent the sliding of the block down the plane if the coefficient of friction between the block and surface is 0.18. 6

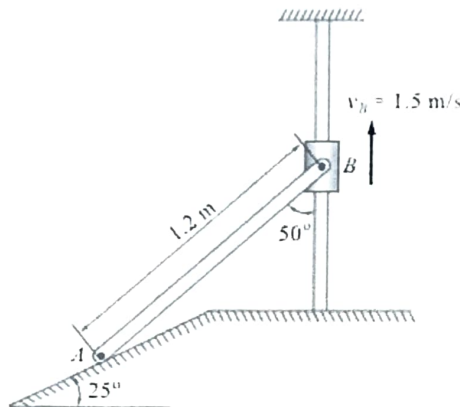


- c) A particle follows the path $y = 5 + 0.3x^2$ with a constant speed of 10 m/sec. Determine the components of velocity when $x = 2$ m and the acceleration of the particle. 6

- Q4 a) A 20 N block is released from rest. It slides down a rough incline having coefficient of friction 0.2 and compresses the spring having modulus 1000 N/m. Determine the maximum compression of the spring and the distance moved by block when the energy is released by the spring. 8

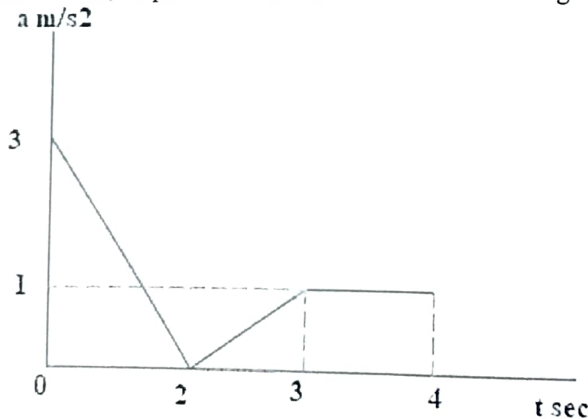


- b) The collar "B" moves upwards with a constant velocity of 1.5 m/sec. At the instant shown determine (1) the angular velocity of rod "AB" (2) the velocity of the end "A". AB=1.2 m 6

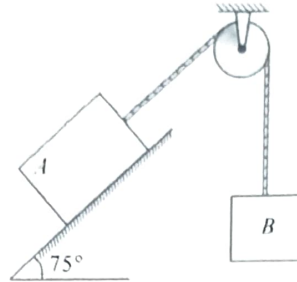


- c) A glass ball is dropped on to a smooth horizontal floor from which it bounces to a height of 9m in the first bounce. On the second bounce, it attains a height of 6m. Calculate the coefficient of restitution between the glass and the floor. Also determine the height from where the glass ball was dropped. 6

- Q5. a) The a-t curve is shown for a particle moving in a straight line. Show the v-t and s-t diagram for 0-4 sec, if particle has started from rest from origin. 8

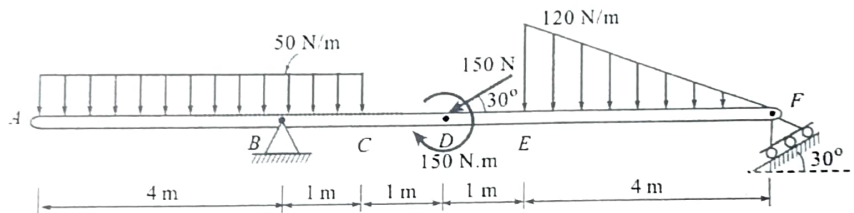


- b) A block 'A' of mass 6 Kg resting on inclined plane is connected by string passing over smooth pulleys with another block 'B' of mass 12 Kg as shown in figure. If $\mu=0.2$, Calculate the tension in string and the acceleration of each block. 6

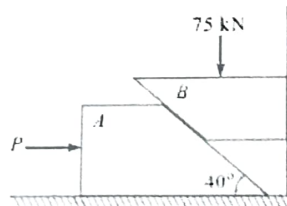


- c) A force $F = 3i - 4j + 12k$ N acts at a point "A (1,-2,3) m. Calculate (i) Moment of the force about the origin. (ii) Moment of the force about a point B(2,1,2) 6

- Q6 a) A beam is loaded and supported as shown in figure. Find the support reactions at supports B and F. 8



- b) Block A weighs 25 kN and the block B weighs 18 kN. Coefficient of friction for all contact surfaces is 0.11. Determine the value of "P" for holding the system in equilibrium. 6



- c) Determine the resultant of the system of parallel forces and determine the position on X-Z plane. 6

