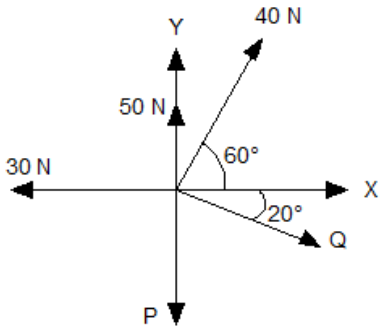
Duration: 3 hours **Total: 80 Marks**

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 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.

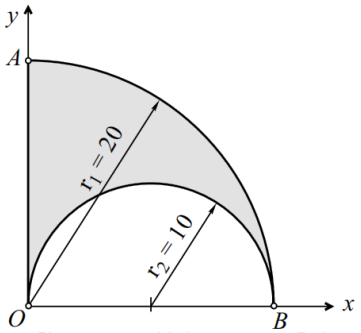


b) Define the Instantaneous Centre of Rotation and write the properties of Instantaneous Centre of Rotation.

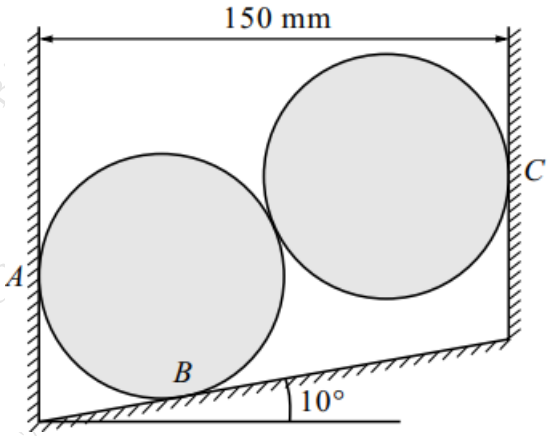
c) Acceleration of a particle moving along a straight line is represented by the relation $a = 50 - 36t^2$. Determine the velocity of the particle when it has travelled 52 m and the time taken by it before it comes to rest again.

d) Define angle of repose and prove that angle of friction = angle of repose

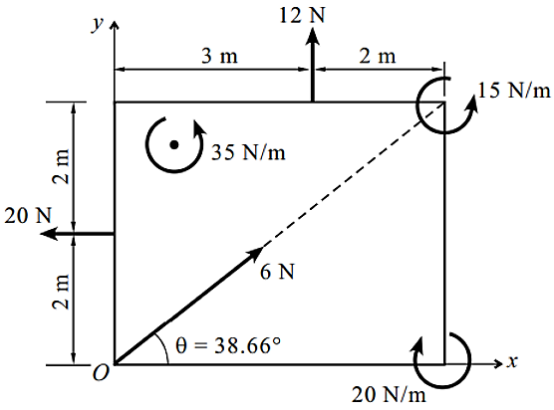
e) Determine the centroid of the shaded area



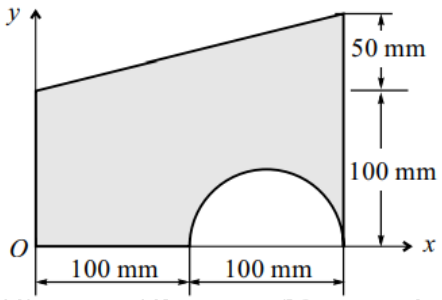
Q. 2 **a)** Two identical cylinders of weight 200 N and diameter 100 mm are placed as shown in figure. Determine the support reactions at A, B and C. **8**



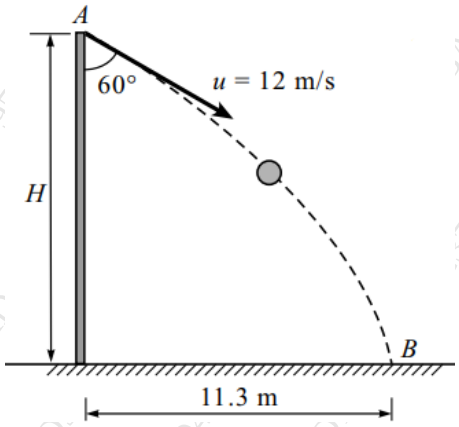
b) Calculate the resultant of the given force system and locate it with respect O. **6**



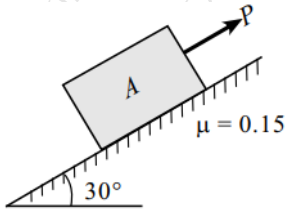
c) Determine the "x" and "y" coordinates of the Centroid for the shaded area shown. **6**



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**

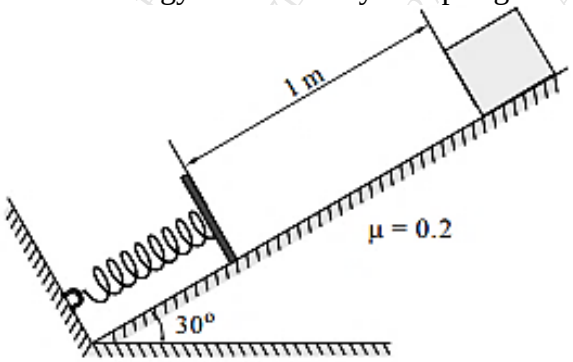


b) A block of 1000 N is placed on an inclined surface (30 degrees to horizontal). Determine the force required to prevent the sliding of the block down the plane if the coefficient of friction between the block and surface is 0.18. **6**

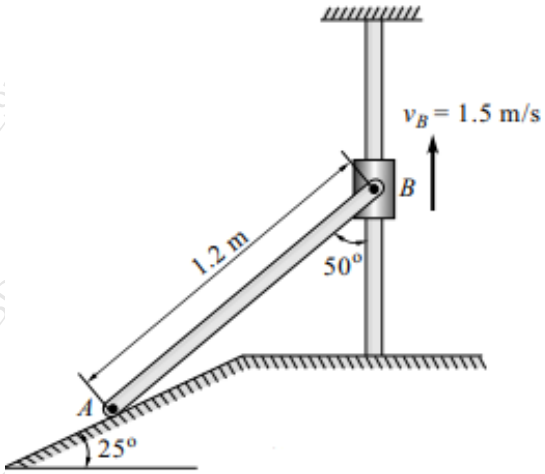


c) A particle follows the path $y = 5 + 0.3x^2$ with a constant speed of 10 m/sec. Determine the components of velocity when x = 2 m and the acceleration of the particle. **6**

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**

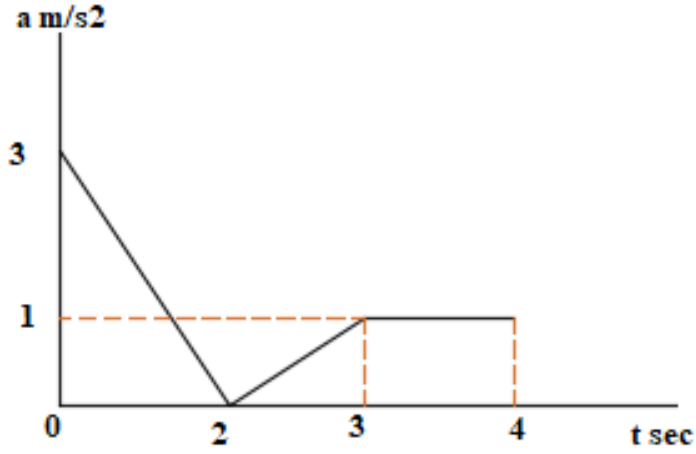


b) The collar "B" moves upwards with a constant velocity of 1.5 m/sec. At the instant shown determine (1) the angular velocity of rod "AB"(2) the velocity of the end "A". AB=1.2 m **6**

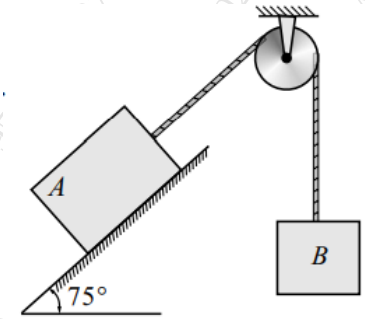


c) A glass ball is dropped on to a smooth horizontal floor from which it bounces to a height of 9m in the first bounce. On the second bounce, it attains a height of 6m. Calculate the coefficient of restitution between the glass and the floor. Also determine the height from where the glass ball was dropped.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

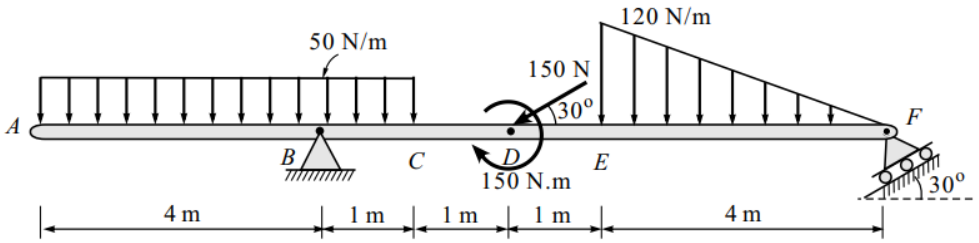


b) A block 'A' of mass 6 Kg resting on inclined plane is connected by string passing over smooth pulleys with another block 'B' of mass 12 Kg as shown in figure. If μ=0.2, Calculate the tension in string and the acceleration of each block. **6**

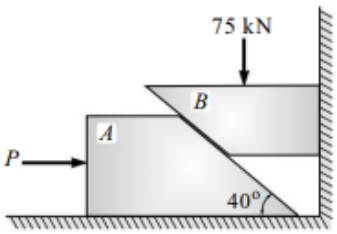


c) A force $F = 3i - 4j + 12k$ N acts at a point "A (1,-2,3) m. Calculate (i) Moment of the force about the origin. (ii) Moment of the force about a point B(2,1,2) **6**

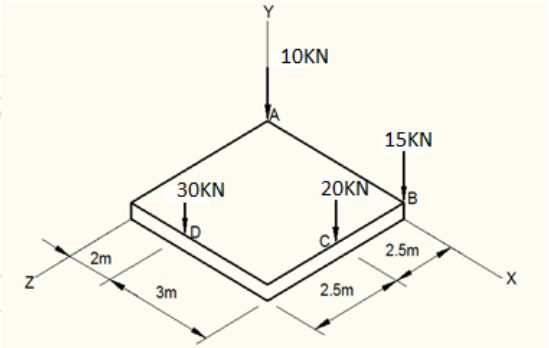
Q6 **a)** A beam is loaded and supported as shown in figure. Find the support reactions at supports B and F. **8**



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 valueof "P" for holding the system in equilibrium. **6**



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



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