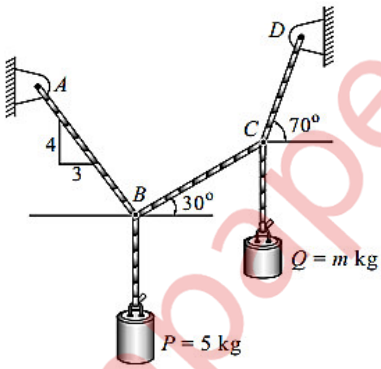
Duration: 3 hours **Total: 80 Marks**

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 the following. (Each question carries 5 marks). **20**

a) Determine the mass m for the equilibrium of the 5 kg block as shown in the figure.

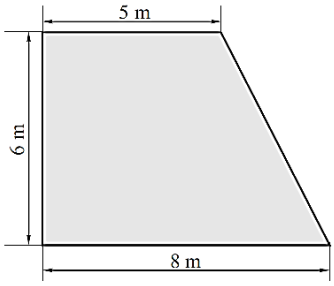


b) Define the Varignon's theorem and write the significance of Varignon's theorem.

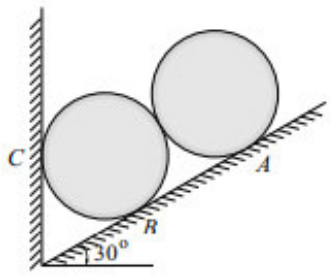
c) Acceleration of a particle moving along a straight line is represented by the relation $a = t^3 - 2t^2 + 7$. At t= 1 second, velocity of the particle is 3.58 m/s and displacement is 9.39 m. Determine the velocity and displacement at t=2 seconds.

d) State the properties of Instantenous Centre of Rotation .

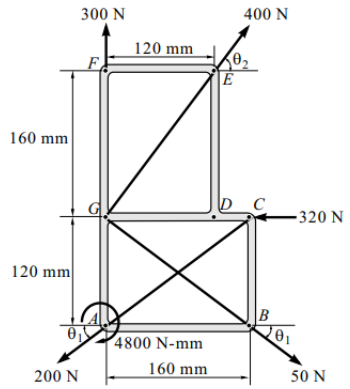
e) Determine the centroid of the given area.



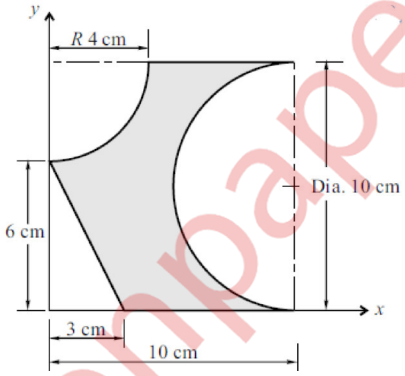
Q. 2 **a)** Two identical rollers of mass 50kg are supported as shown in figure. To maintain the equilibrium, Determine the support reactions assuming all smooth surfaces. **8**



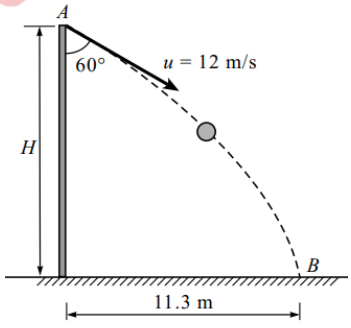
b) Calculate the resultant of the given force system and locate it with respect to the point of action of 200 N force. **6**



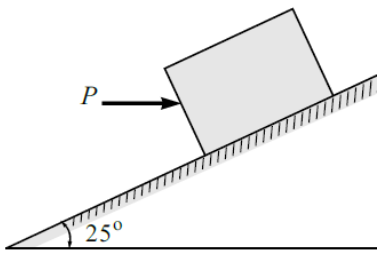
c) Determine the "x" and "y" coordinates of the Centroid for the shaded area shown. **6**



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**

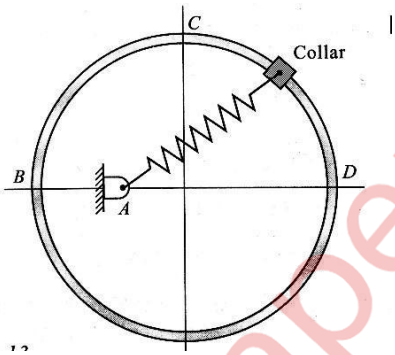


b) A block of 800 N is placed on an inclined surface. Determine the force P required to prevent the sliding of the block down the plane if the coefficient of friction between the block and surface is 0.35. **6**

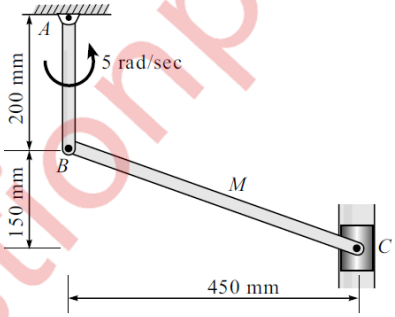


c) A point moving along a path $y=x^2/3$ with a constant speed of 8m/s. What are the x and y components of its velocity when x=3m? Also, find the radius of curvature and acceleration. **6**

Q4 **a)** A collar of mass 1kg is attached to spring and slides without friction along a circular rod which lies in a horizontal plane. The spring is undeformed when the collar is at B knowing that the collar is passing through point D with a speed of 1.8 m/s Determine the speed of collar when it passes through point C and B. Take stiffness of the spring, k=250N/m, Radius of the circular path =300mm and distance OA=125mm. **8**

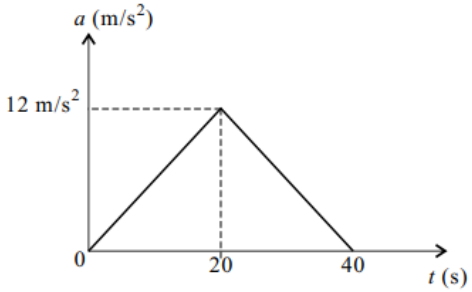


b) At the instant shown, locate the ICR and determine the angular velocity of rod BC and the velocity of the piston C. **6**

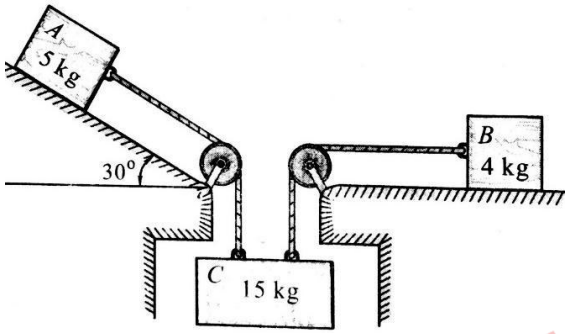


c) A ball is thrown vertically down on a smooth horizontal floor with a velocity of 10 m/s from which it bounces to a height of 3 m. If the coefficient of restitution is 0.7. Find the maximum height it can reach after hitting the ground. **6**

Q5. **a)** A car moves along a straight road such that its acceleration time motion is described by the graph shown in fig. construct v-t and s-t graphs and determine the maximum speed and maximum distance covered. **8**

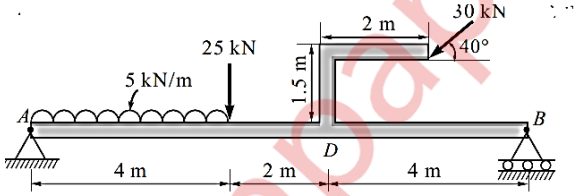


b) The system shown in fig. is released from rest. What is the height lost by bodies A, B and C in 2 sec. Take coefficient of kinetic friction at rubbing surfaces as 0.4. Find tension in each rope. Assume pulleys to be frictionless. **6**

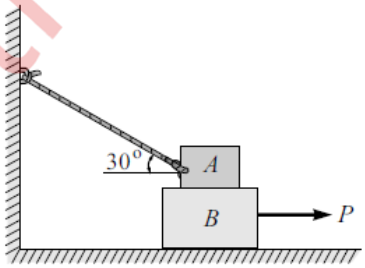


c) A force $F = 100\ N$ N acts at a point A (-2, 3, 5) m has its line of action passing through point B (10, 3, 4) m. Calculate moment of the force about the origin. **6**

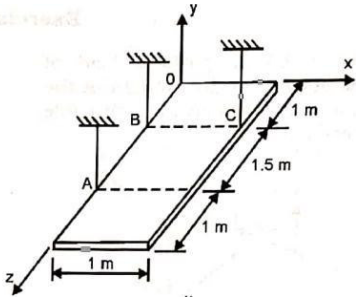
Q6 **a)** A beam is loaded and supported as shown in figure. Find the support reactions at support A and B. **8**



b) Block A weighs 40 kN and the block B weighs 60 kN. The coefficient of friction between A and B is 0.3 and between B and the floor is 0.25. Determine the value of "P" for holding the system in equilibrium. **6**



c) A rectangular plate weighing 500 N is suspended in the horizontal plane using three cables. Find the tension in each cable. **6**



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