

Indian Institute of Engineering Science and Technology, Shibpur

B.Tech.- M. Tech. Dual Degree 1st Semester Examination 2018

(CS, EE, ET IT) Mechanics AM - 1201

Full marks: 70

Time: 3 Hrs.

One mark is kept for neatness

Answer both Part A and Part B in ONE ANSWER-SCRIPT

Part A

(Answer any three Questions)

1. A uniform ring of mass m and radius r carries an eccentric mass m_0 at a radius b and is in an equilibrium position on the incline, which makes an angle α with the horizontal as shown in Fig. Q.1. If the contacting surfaces are rough enough to prevent slipping, write the expression for the angle θ which defines the equilibrium position. 12
2. The light bar is used to support the 50-kg block in its vertical guides as shown in Fig Q.2. If the coefficient of static friction is 0.3 at the upper end of the bar and 0.40 at the lower end of the bar, find the friction force acting at each end for $x = 75$ mm. Also find the maximum value of x for which the bar will not slip. 12
3. Determine the magnitude and nature of force in the member BF of the loaded truss shown in Fig. Q.3. 12
4. Compute the volume V of the solid generated by revolving the right triangle as shown in Fig. Q.4. about z-axis through 180° . 12
5. Determine the moments of inertia of the Z-section as shown in Fig. Q.5 about its centroidal x_0 - and y_0 - axes. 12

Part B

(Answer any three Questions)

6. The preliminary design for a rapid transit system calls for the train velocity to vary with time as shown in the plot as the train runs the 3.2 km between stations A and B as shown in Fig. Q.6. The slopes of the cubic transition curves (which are form a $+bt+ct^2+dt^3$) are zero at the end points. Determine the total run time t between the stations and the maximum acceleration. 11
7. A roofer tosses a small tool to the ground. What minimum magnitude of horizontal velocity v_o is required so that the tool has to just miss the roof corner B? Also determine the horizontal distance d from B to C where the tool will hit the ground as shown in Fig. Q.7. 10+1
8. Determine the relationship that governs the velocities of four cylinders shown in Fig. Q.8. Assume all velocities as positive downwards. How many degrees of freedom are there? 10+1
9. The 8 kg cylindrical collar A is released from rest in the position as shown in Fig Q.9 and drops onto the spring attached on guide B. Calculate the velocity of the v of the cylinder when the spring has been compressed by 50 mm. 11
10. A steel ball of mass m strikes a spring supported steel plate of mass m with a velocity $v_o = 22$ m/sec at an angle of 60° with the horizontal as shown in Fig Q.10. The coefficient of restitution between the ball and the plate is 0.7. Compute the final velocities of both the masses immediately after the impact. 11

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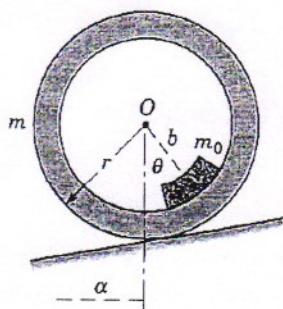


Fig. Q.1

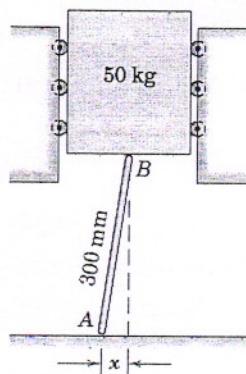


Fig. Q.2

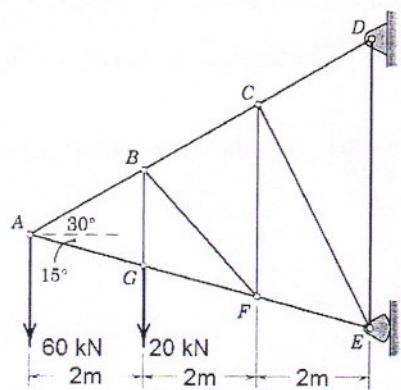


Fig. Q.3.

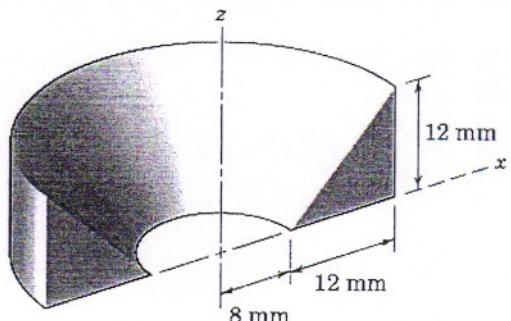


Fig. Q.4

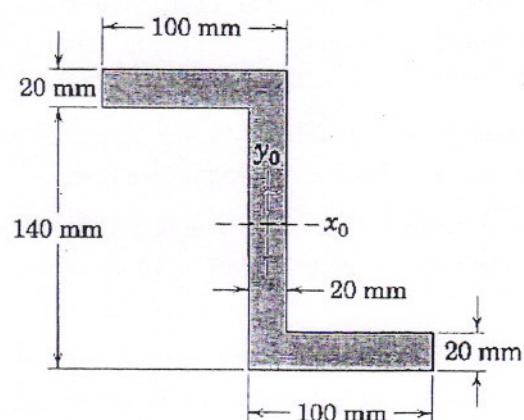


Fig. Q.5

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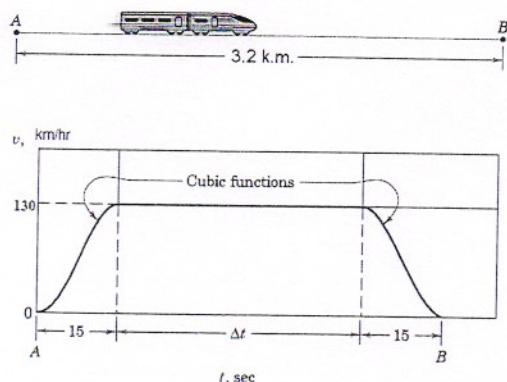


Fig. Q.6

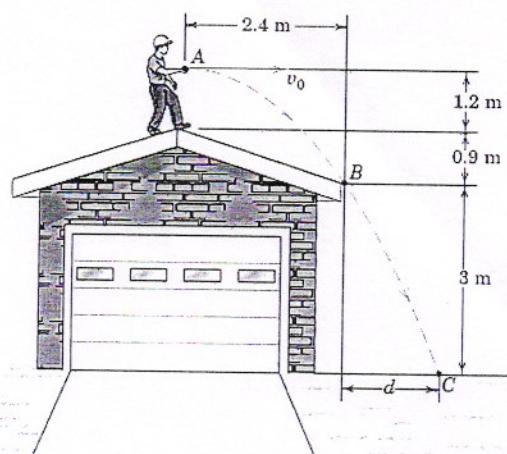


Fig. Q.7

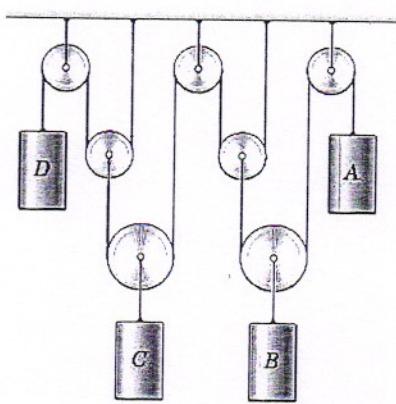


Fig. Q.8

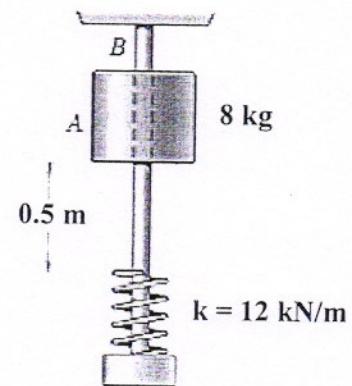


Fig. Q.9

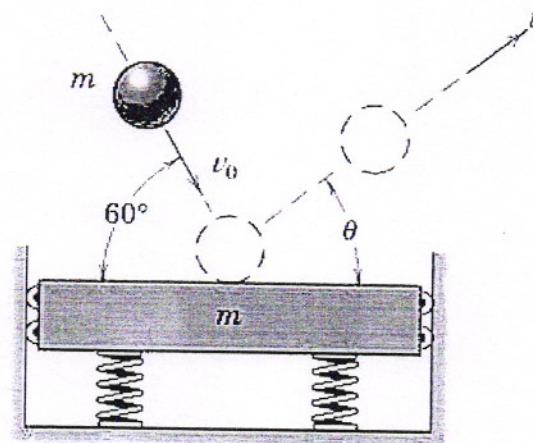


Fig. Q.10