30/11/17

Indian Institute of Engineering Science and Technology, Shibpur

B.Tech 1st Semester Examination 2017

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. The uniform 40-kg bar with end rollers is supported by the horizontal and vertical surfaces and by the wire AC as shown in Fig. Q.1. Calculate the tension T in the wire and the reactions against the rollers at A and at B. *12*
2. The tongs are used to handle hot steel tubes that are being heat-treated in an oil bath. For a 20° jaw opening, as shown in Fig. Q.2., what is the minimum coefficient of static friction between the jaws and the tube that will enable the tongs to grip the tube without slipping. *12*
3. Determine the magnitude and nature of force in the member BF of the loaded truss shown in Fig. Q.3. *12*
4. The water storage tank as shown in Fig. Q.4. is a shell of revolution and is to be sprayed with two coats of paint which has coverage of 12 m^2 per litre. The engineer (who remembers mechanics) consults a scale drawing of the tank and determines that the curved line ABC has a length of 10 m and that its centroid is 2.0 m from the centreline of the tank. How many litres of paint will be used for the tank including the vertical cylindrical column? *12*
5. Determine I_x, I_y and I_{xy} for the rectangular plate with three equal circular holes as shown in Fig. Q.5. *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.
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 15 lb cylindrical collar is released from rest in the position as shown in Fig Q.9 and drops onto the spring. Calculate the velocity of the v of the cylinder when the spring has been compressed by 2 inch. *11*
10. Determine the coefficient of restitution e that will allow the ball to bounce down the steps as shown in Fig. Q.10. The tread and riser dimensions are d and h, respectively, are the same for every step, and the ball bounces the same distance h′ above each steps. What horizontal velocity v_x is required so that the ball lands in the centre of each tread. *11*

.....*Continued on page 2*

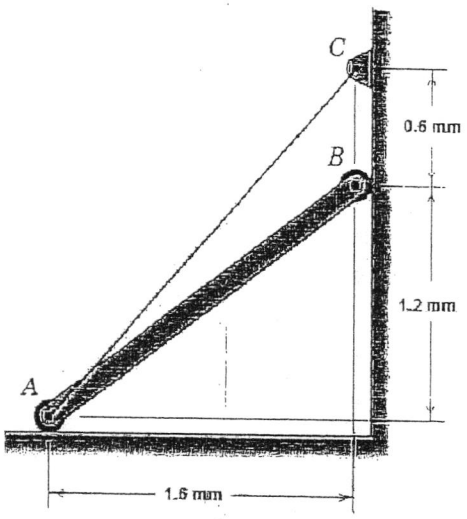


Fig. Q.1

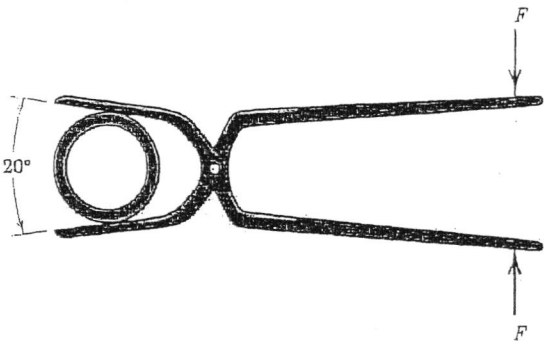


Fig. Q.2

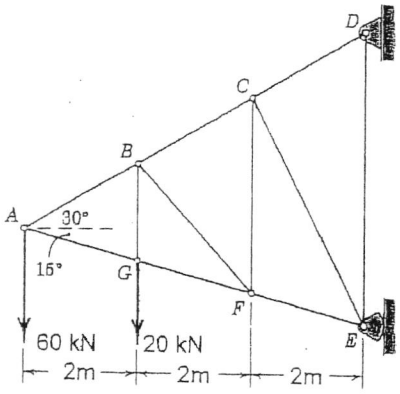


Fig. Q.3.

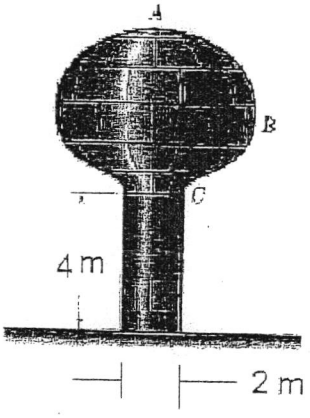
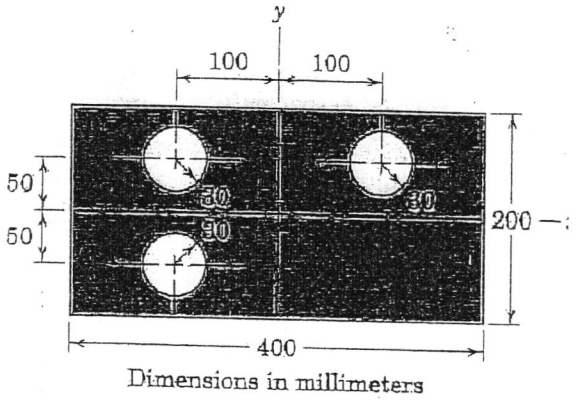


Fig. Q.4



Dimensions in millimeters

Fig. Q.5

.....Continued on page 3

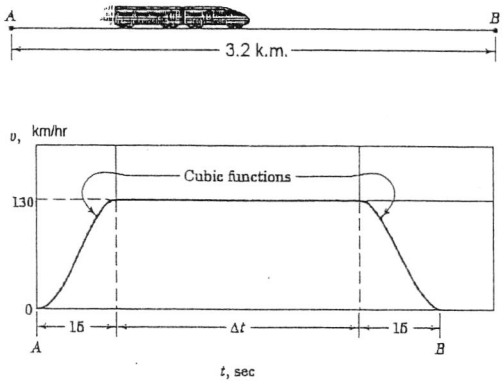


Fig. Q.6

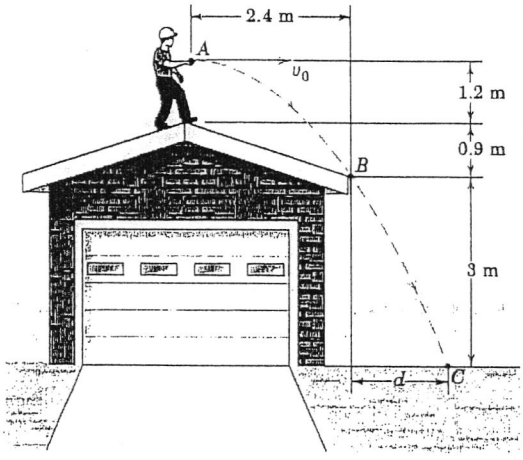


Fig. Q.7

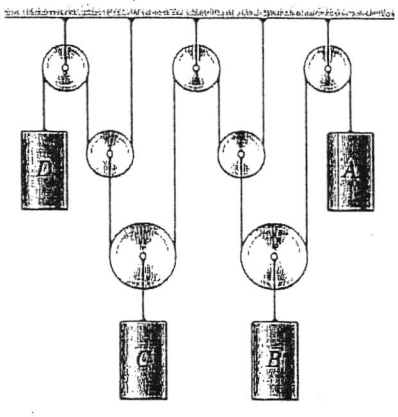


Fig. Q.8

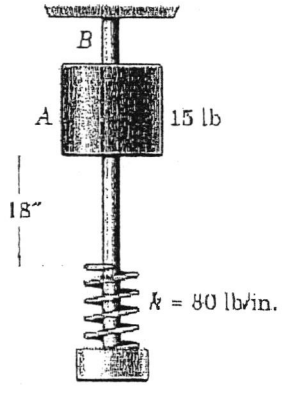


Fig. Q.9

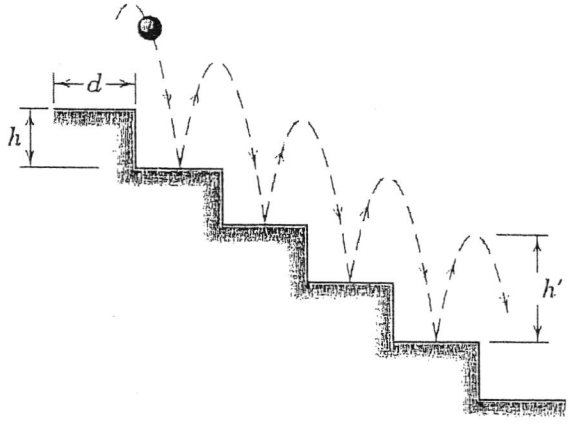


Fig. Q.10