

The University of Asia Pacific
Department of Civil Engineering
Final Examination Spring 2013
Program : B.Sc Engineering (Civil)

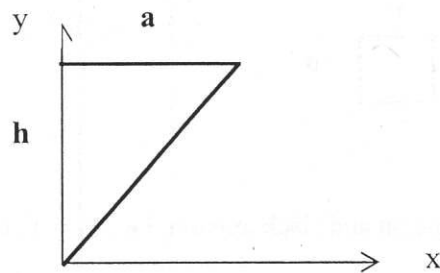
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 A

Course No: CE 103
 Full Marks: 150

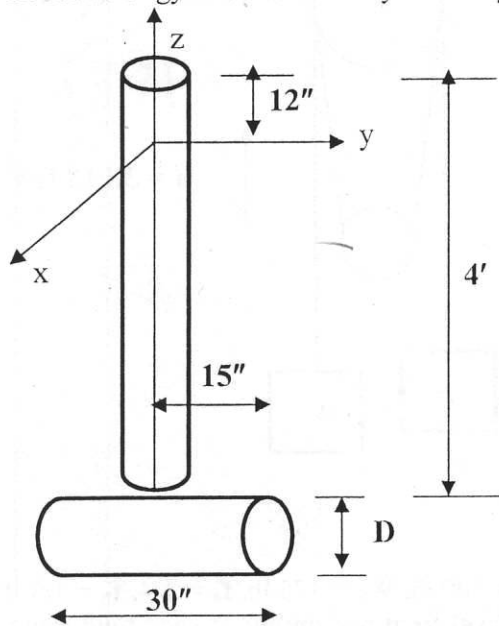
Course Title: Engineering Mechanics II
 Time: 3.0 hours

There are **EIGHT** questions. Answer any **SIX**. The figures in the right margin indicate the marks of the questions.

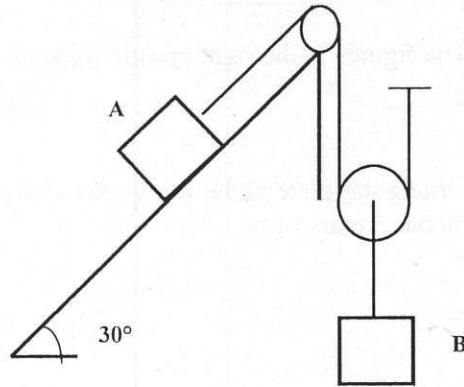
- 1.(a) Calculate mass moment of inertia of the triangular plate about the y-axis. Assume the plate is made of a uniform material and has a mass of m . (12)



- (b) The wood handle of the mallet, shown in the following figure, is $L = 4$ ft long, 3.69 lb in weight and has a uniform cross section. The head, weighing 15.8 lb, is a wood cylinder of diameter $D = 5$ inch. The mallet head with the handle inclusion is homogeneous. Find the radius of gyration of the body with respect to the 'x' axis. (13)

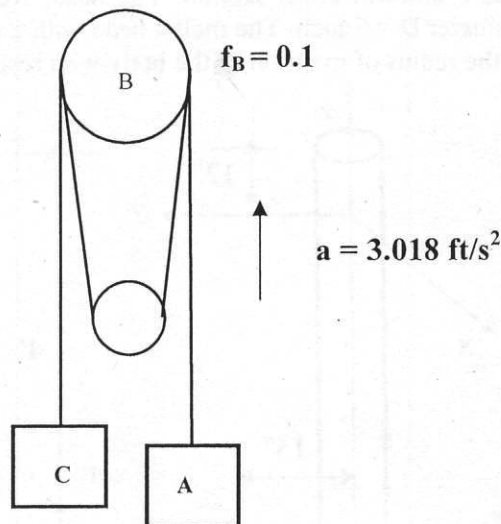


- 2.(a) In the following figure, the pulleys are weightless and frictionless. The coefficient of friction between the block and incline is 0.25. If the system starts from rest, determine the acceleration of each block. Also find out the tension of each cord. (13)

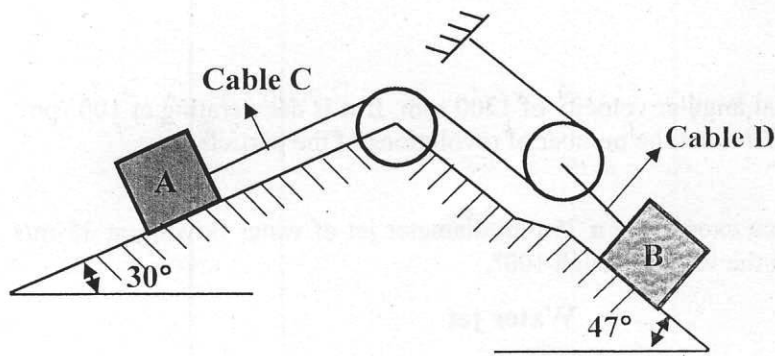


- (b) Derive the relation between the tight tension and slack tension, i.e., $T_1 = T_2 e^{f\theta}$. (12)

- 3.(a) Refer to the following figure, weight of block A is 5000 lb. What is the value of weight C? (10)

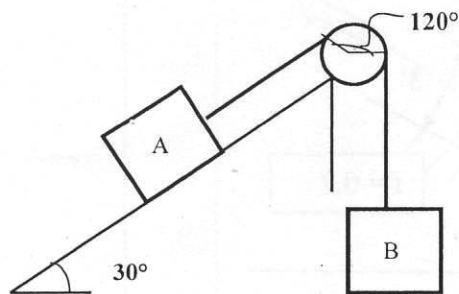


- (b) In the following figure, $W_A = 300$ lb, $W_B = 175$ lb, $f_A = 1/4$, $f_B = 1/3$. How far and in what direction does 'A' travel from rest during 25 sec? Find also the forces in the cable C and in the cable D. The cables are weightless and the pulleys are weightless and frictionless. (15)

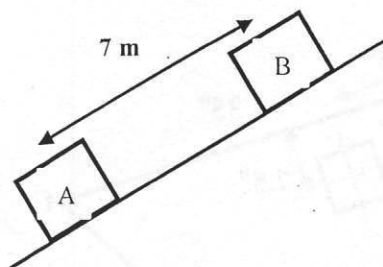


- 4.(a) The position of a particle which moves along straight line is defined by the relation, $s = t^3 - 6t^2 - 15t + 40$, where s is in ft and t is in second. Determine (12)
- The time at which the velocity will be zero
 - The position and distance traveled by the particle at that time
 - The acceleration of the particle at that time
 - The distance traveled by the particle from 4 sec. to 6 sec.

- (b) A 50 lb block is in a plane inclined at an angle of 30° . The coefficient of friction is 0.2 for both plane and cable. As shown in the figure, another block B weighing 100 lb is suspended from the other end of the cable. What are the tension forces in the cable? What is the speed of block A after moving 20 ft from rest? Assume that weight of the cable is negligible. (13)

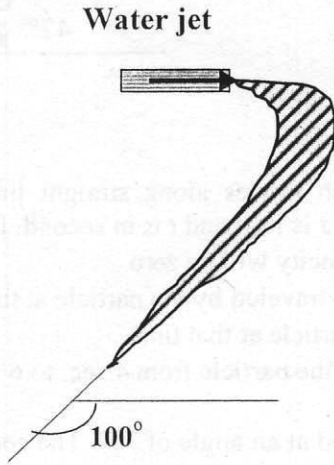


- 5.(a) Boxes are placed on an incline at uniform intervals of time t and slide down with uniform acceleration. As any box B is released with preceding box A already had moved 7 m and 1 second. Later A and B are 12 m apart. Determine the value of t . (13)

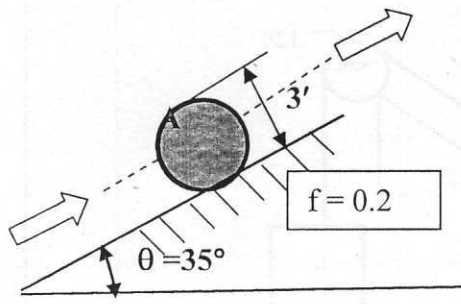


(b) A particle has initial angular velocity of 1200 rpm. If it is decelerating at 100 rpm^2 when it will stop? Find out the number of revolutions of the particle. (12)

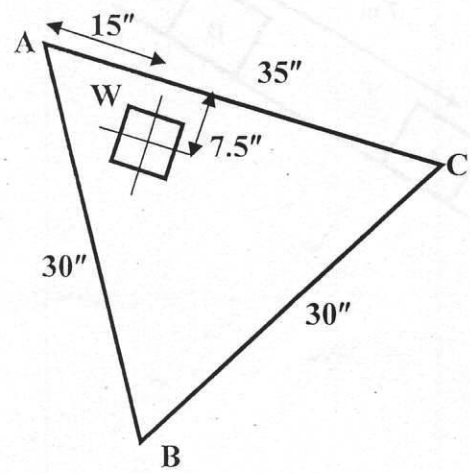
6.(a) Determine the force exerted by a 75 mm diameter jet of water flowing at 35 m/s on a cup that turns the water through 100° . (12)



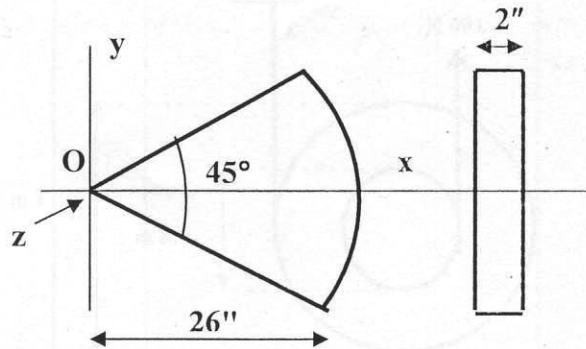
(b) Refer to the following figure, a bullet weighing 0.3 N moving at 600 m/s penetrates 40 N body and emerges with a velocity of 100 m/s. How far and how long will the body move? (13)



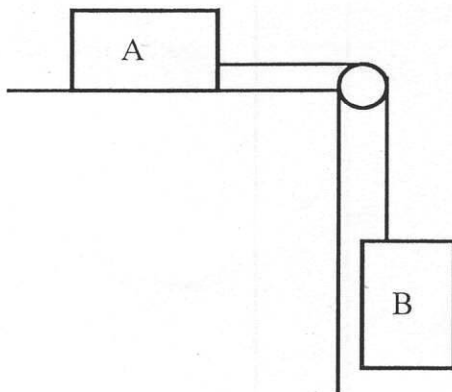
7.(a) As shown in the following figure, the weight $W = 95 \text{ lb}$ is placed on a triangular table. Find the reactions at supports A, B and C. (13)



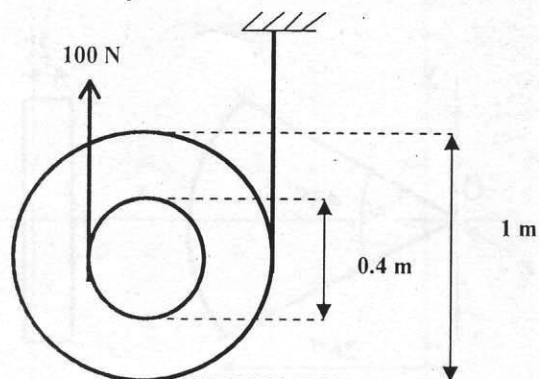
- (b) A 45° sector of a cast iron disk with a radius of 26" is used to balance the reciprocating part of a certain engine as shown in the following figure. Find the mass moment of inertia about the z axis. Unit weight of cast iron is 450 lb/cft. (12)



- 8.(a) Two blocks are joined by an inextensible cable as shown. The system is released from rest. What is the velocity of block A after moving 5 ft? Given that frictional coefficient is 0.25 between block A and the plane and the pulley is weightless and frictionless. Use work – energy principle. (12)



- (b) The spool in figure has a mass of 8 kg and a radius of gyration of 0.35 m. If cords of negligible mass are wrapped around its inner hub and outer rim as shown, determine the spool's angular velocity 3 seconds after it is released from rest. (12)



University of Asia Pacific
Department of Civil Engineering
Final Examination Spring 2013 (Section B)
Program: B. Sc. Engineering (Civil)

Course Title: Engineering Mechanics II
 Time: 3 hours

Course Code: CE 103
 Full Marks: 100 (= 10 × 10)

Answer **any 10 (TEN)** of the following **14 (FOURTEEN)** questions. The figures in the right margin indicate the marks of the questions. Assume reasonable values for missing data only, if any.

1. Determine the mass moment of inertia about Y-Y axis of the sphere shown in FIGURE 1. (10)

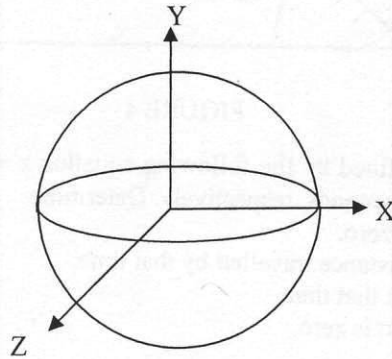


FIGURE 1

2. Determine the mass moment of inertia of the composite body shown in FIGURE 2 about Z-Z axis. It is given that the unit weight of the cone is 490 lb/ft³ and unit weight of the cylinder 530 lb/ft³. (10)

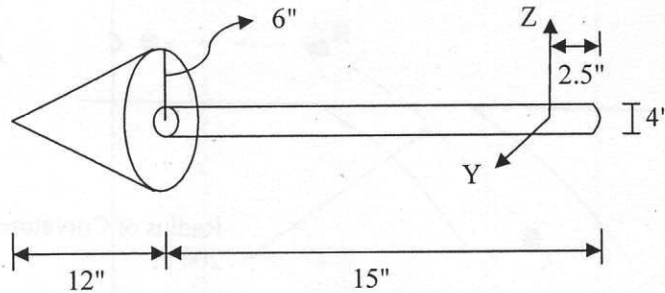


FIGURE 2

3. What is the minimum load W that can be supported by the system shown in FIGURE 3. (10)

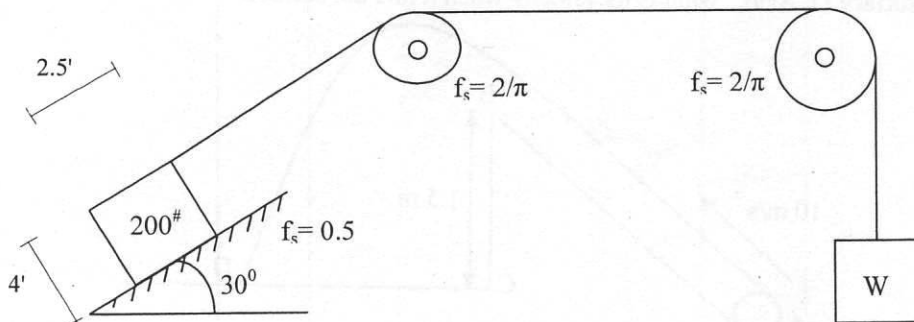


FIGURE 3

4. Referring to FIGURE 4, determine the range of values which the horizontal force P may have without disturbing the equilibrium of the 100-lb block resting on the plane inclined at an angle of 40° with the horizontal. The coefficient of friction between the block and the plane is $f_s = 0.25$ (10)

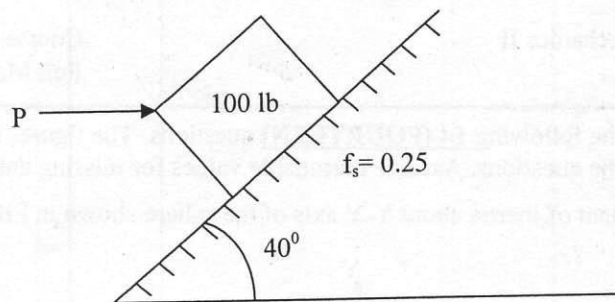


FIGURE 4

5. The motion of a particle is defined by the following equation $x = 6t^4 - 2t^3 - 12t^2 + 3t + 3$, where x and t are expressed in feet and seconds, respectively. Determine (10)
- I. Time when velocity is zero.
 - (a) Position and distance travelled by that time.
 - (b) Acceleration at that time.
 - II. Time when acceleration is zero.
6. A motorist starts from rest at Point A, as shown in FIGURE 5, on a circular entrance ramp when $t = 0$, increases the speed of her automobile at a constant rate and enters the highway at Point B. Knowing that her speed continues to increase at the same rate until it reaches 180 km/h at Point C, determine (a) the speed at Point B, (b) the magnitude of the total acceleration when $t = 14$ s. (10)

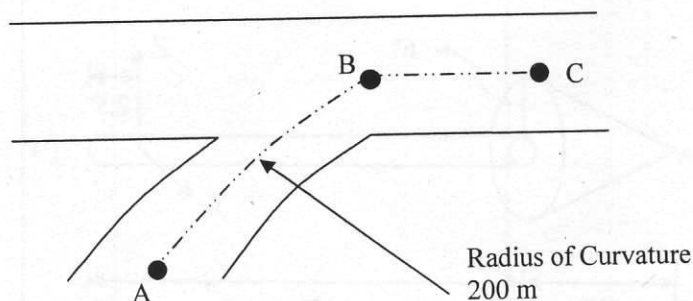


FIGURE 5

7. A 2 kg ball of negligible size is fired from point A with an initial velocity of 10 m/s up the smooth inclined plane, as shown FIGURE 6. Determine the distance from point C to where it hits the horizontal surface D. Also, what is its velocity when it hits the surface. (10)

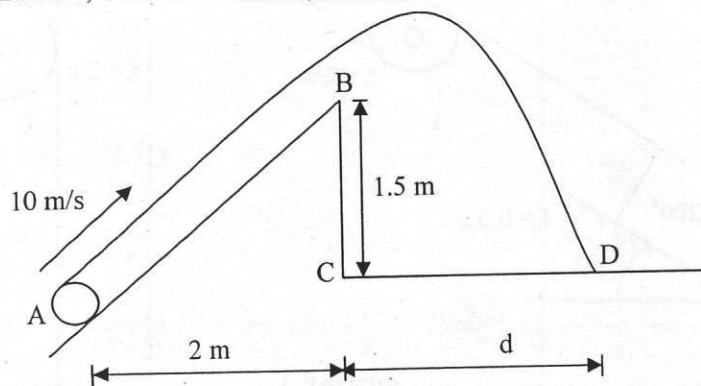


FIGURE 6

8. Referring to FIGURE 7, a 10-lb block passes point A on the smooth track with a speed of $v_a = 5 \text{ ft/s}$. Determine the normal reaction of the block when it reaches point B. (10)

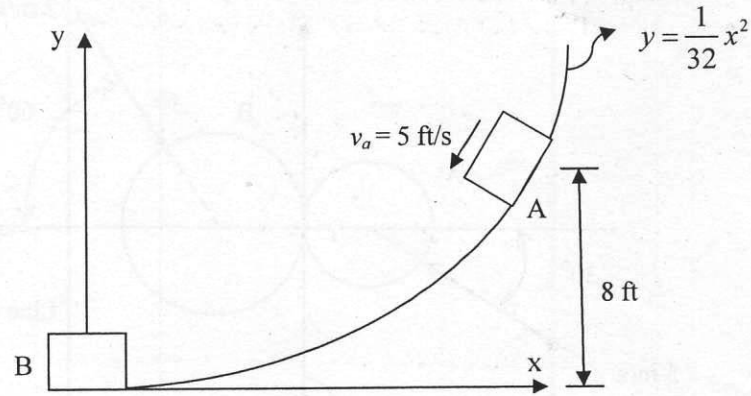


FIGURE 7

9. A 2.5-Mg car increases its speed uniformly from rest to 30 m/s in 30 s up the inclined road, as shown in FIGURE 8. Determine the maximum power that must be provided by the engine, which operates with an efficiency of $\epsilon = 0.8$. Also find the average power supplied by the engine. (10)



FIGURE 8

10. Blocks A and B, as shown in FIGURE 9, have a mass of 4 kg and 6 kg, respectively. If the system is released from the rest, determine the velocity of block B in 7 s. Neglect the mass of pulleys and cord. (10)

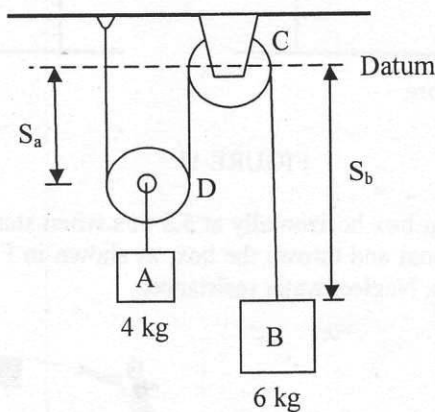


FIGURE 9

11. Two smooth disks A and B, having a mass of 1 kg and 2 kg, respectively, collide with each other with the velocity shown in FIGURE 10. If the coefficient of restitution for the disks is $e = 0.75$ then, determine the x and y components of the final velocities of each disk just after the collision. (10)

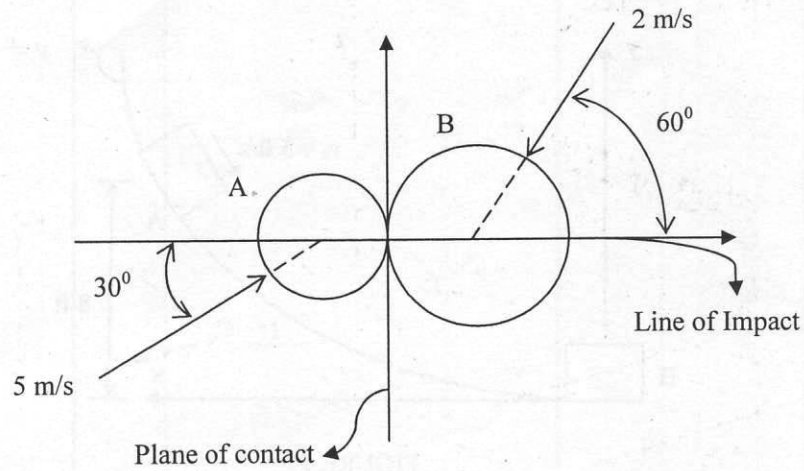


FIGURE 10

12. A 200 g projectile is fired with a velocity of 900 m/s towards the center of 15 kg wooden block, which rests on a rough surface, as shown in FIGURE 11. If the projectile penetrates and emerges from the block with a velocity of 300 m/s, determine the velocity of the block just after the projectile emerges. How long the block will slide on the rough surface, after the projectile emerges from the rough surface, before it comes to rest again? The coefficient of kinetic friction between the block and the surface is 0.2. (10)

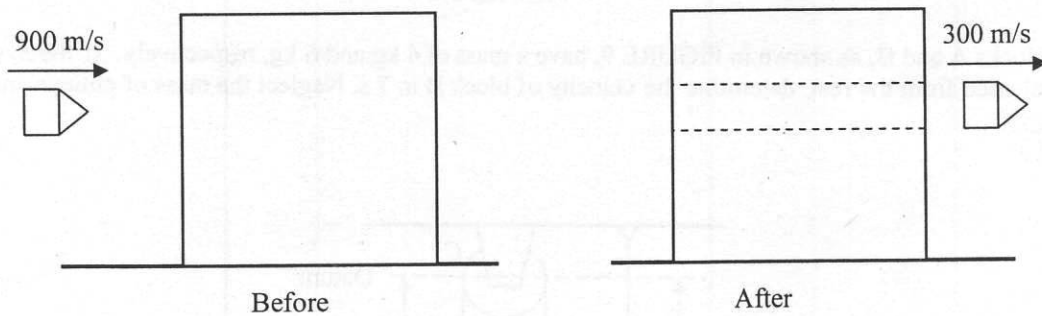


FIGURE 11

13. A 75 kg man can throw a 15 kg box horizontally at 5.2 m/s when standing on the ground. If instead he firmly stands on a 100 kg boat and throws the box, as shown in FIGURE 12, determine how far the boat will move in 3 seconds. Neglect water resistance. (10)



FIGURE 12

14. Referring to FIGURE 13, determine the force acting along the axis of each of the three struts needed to support the 500 kg block. (10)

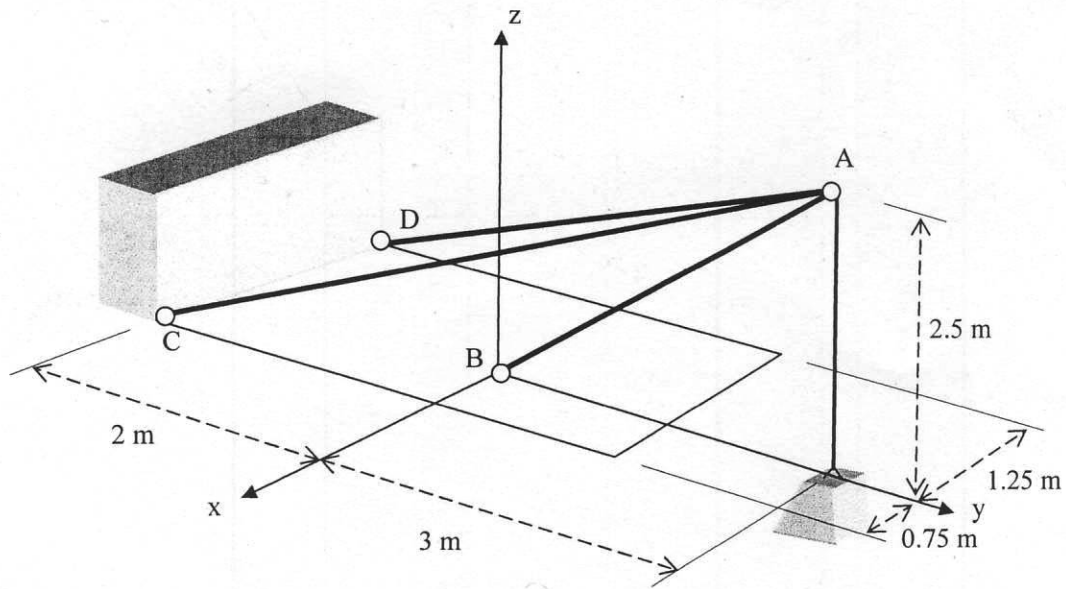


FIGURE 13