Total number of printed pages – 8

B. Tech

BENG 1101

First Semester Examination – 2007

MECHANICS

Full Marks – 70

Time – 3 Hours

*Answer Question No. **1** which is compulsory and any **five** from the rest.*

The figures in the right-hand margin indicate marks.

1. Answer the following questions : 2×10

   (a) Why free body diagram is important in mechanics ?

   (b) What are the three specifications of the force ?

(c) Explain cone of friction.

(d) Can the centriod of a lamina lie outside its boundary ? Justify your answer.

(e) Give an example of force proportional to displacement and one force as a function of time.

(f) Why the trajectory of a projectile is a parabola ?

(g) State the importance of D'Alemberts principle.

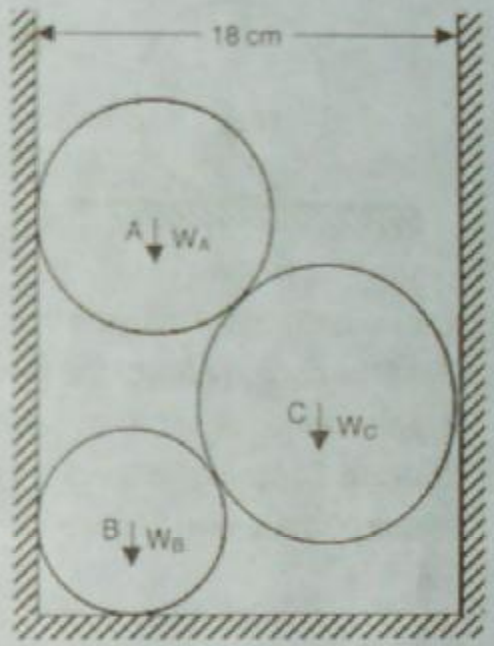
(h) How impulse and momentum is related ?

(i) Explain conservation of energy.

(j) Why the term 'virtual' in virtual work signifies ?

2. Three cylinders A, B and C are piled up in a rectangular channel as shown in figure 1. The weights of the cylinders are W_A = 30 kg, W_B = 60 kg and W_C = 40 kg respectively. The diameter of the cylinders are D_A = 8 cm, D_B = 12 cm and D_C = 10 cm respectively. Draw neat

free body diagrams for each cylinder then determine the reaction at the six contact points. 10

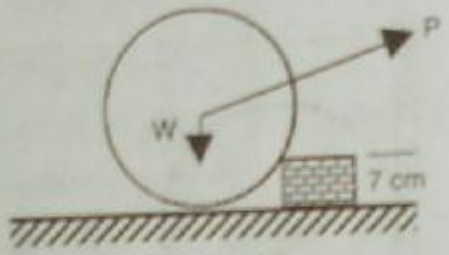


(Figure 1)

3. (a) Describe what is a con-current force . 2

(b) A uniform wheel of 30 cm diameter weighing 1000 N rests against a rectangular block of 7 cm height, shown in fig. 2. Find the least force P required at the centre of the wheel such that the wheel just turn over the corner of the block. Also determine the

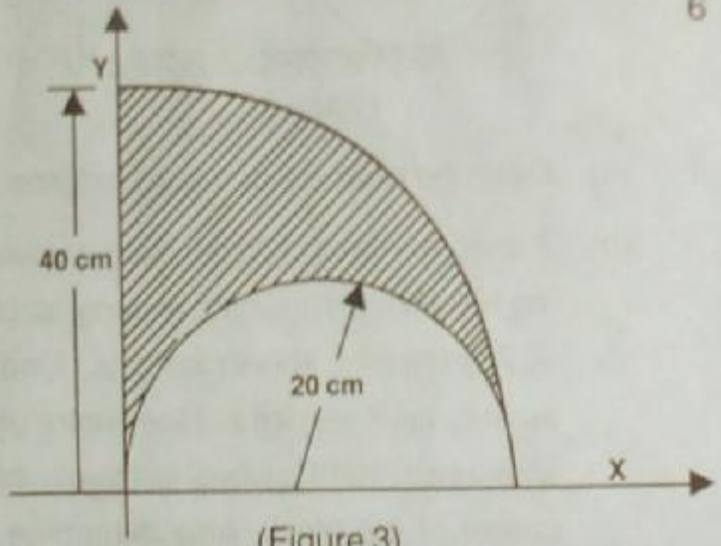
angle the least force makes with the vertical. 8



(Figure 2)

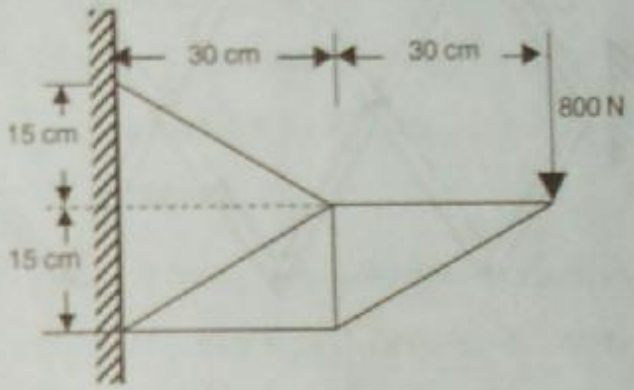
4. (a) Define and explain pappus theorems. 4

(b) Find the coordinates of the centroid of the area obtained after removing a semicircle of radius 20 cm from a quadrant of a circle of radius 40 cm shown as shaded area in fig. 3. 6



(Figure 3)

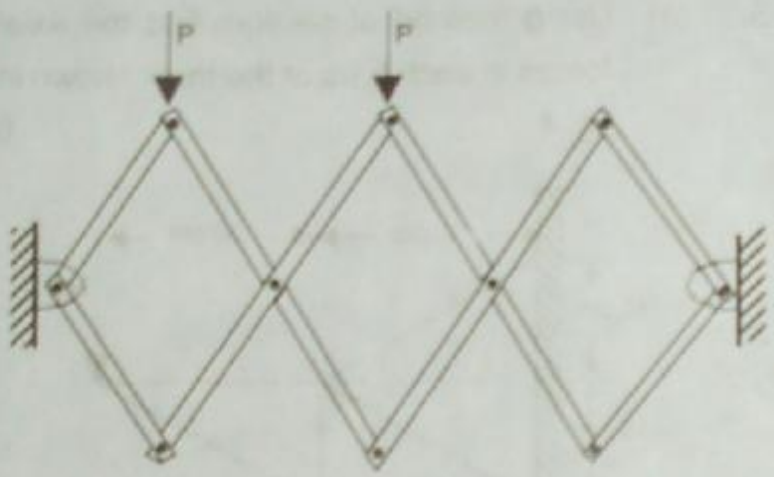
5. (a) Using method of section, find the axial forces in each bars of the truss shown in fig. 4. 6



(Figure 4)

(b) A ball of weight W rests on a spring it produces a static deflection of 2 cm. How much the same will compress the spring if it is dropped from a height of 81cm above the spring ? 4

6. (a) Find the vertical and horizontal components of reaction at support of the plane frame shown in fig. 5. The bars are of equal length of "l" and form three equal squares. Use virtual work principle. 5



(Figure 5)

(b) A wooden block weighing 9.95 kg rest on a rough horizontal plane with coefficient of friction 0.3. If a bullet is fired horizontally into the block with a velocity of 200 m/sec and it remains inside the block after penetration. Determine how far it will be displaced from initial position ? 5

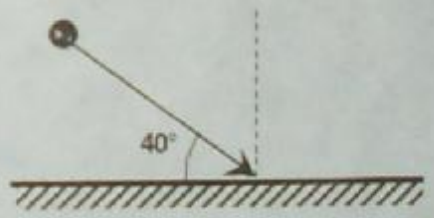
7. (a) The motion of a particle is given by the following equations.

$$x = 3(t + 1)^2 \text{ and } y = 4 / (1 + t)^2$$

Find the velocity and acceleration of the particle at time t = 0. 6

(b) A projectile is fired in such an angle to horizontal such that the range is same as the maximum height. Find the angle at which it is projected. 4

8. (a) A ball moving with velocity 8 m/s hits a smooth surface at an angle 40° to the horizontal plane as shown in fig. 6. Find the velocity and direction of motion after the impact. The coefficient of restitution is 0.4 between the ball and the plane. 5



(Figure 6)

(b) Considering only the rotation of the earth, determine the resultant acceleration of a point in its surface at the latitude 30° N. Assume the radius of the earth R = 6340 km. 5