

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.


VGYAN.COM
POWER OF KNOWLEDGE

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 ?

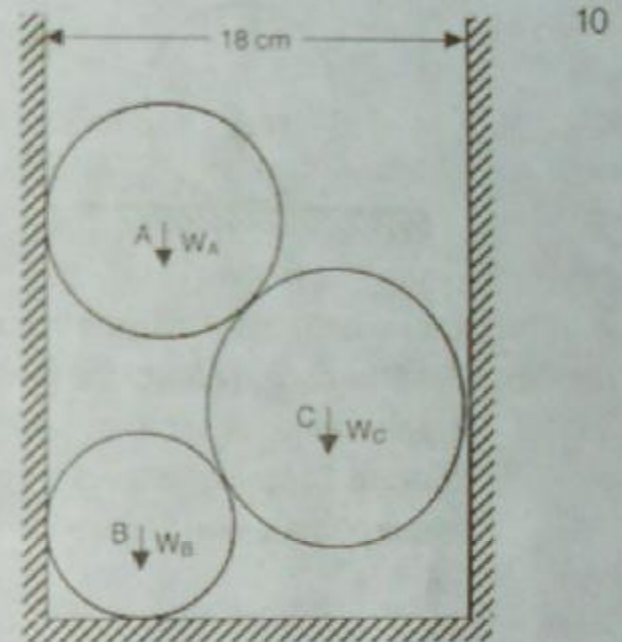
(b) What are the three specifications of the
force ?

P.T.O.

- (c) Explain cone of friction.
- (d) Can the centroid 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'Alembert's 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

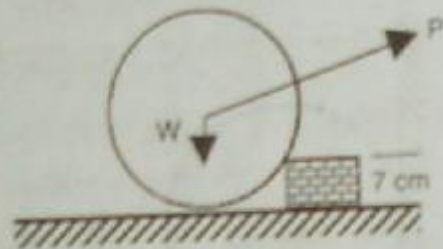
free body diagrams for each cylinder then determine the reaction at the six contact points.



(Figure 1)

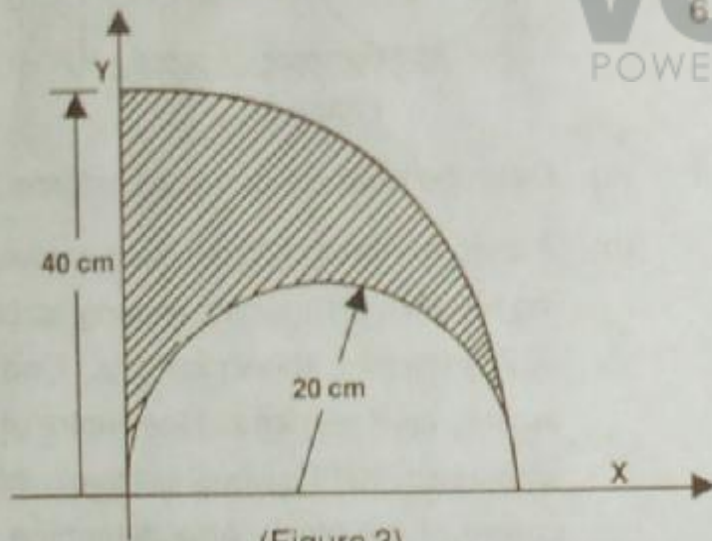
3. (a) Describe what is a con-current force. 2
- (b) A uniform wheel of 30 cm diameter weighing 1000 N rests against a rectangular block of 7 cm height, shown in fig. 2. Find the least force P required at the centre of the wheel such that the wheel just turn over the corner of the block. Also determine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

angle the least force makes with the vertical. 8



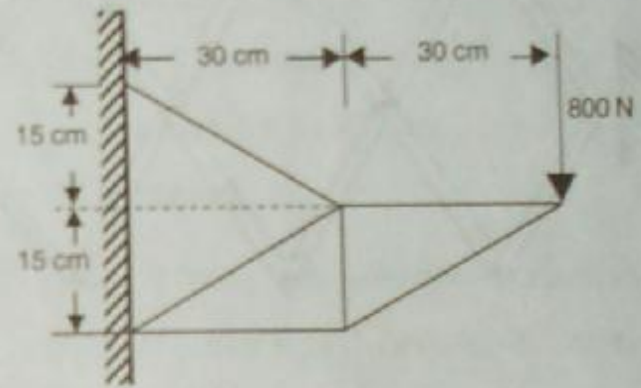
(Figure 2)

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



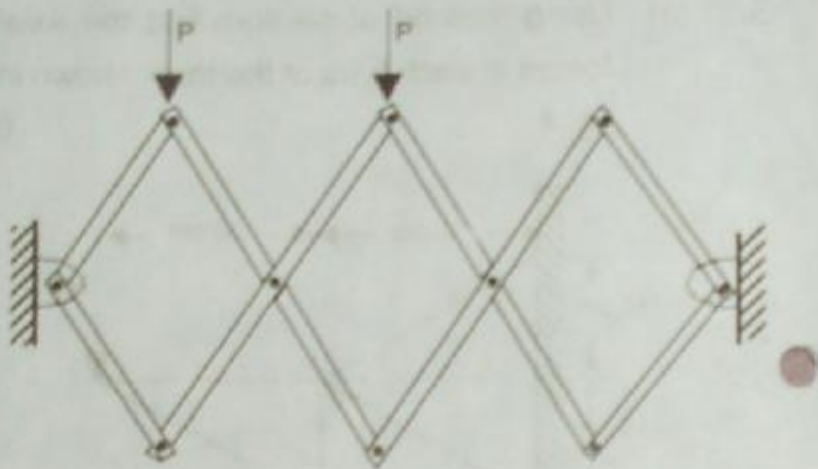
(Figure 3)

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 81 cm 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)

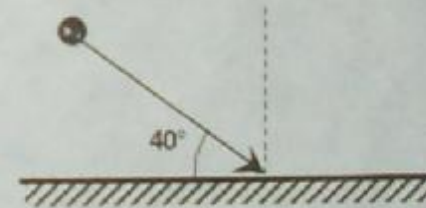
- (b) A wooden block weighing 9.95 kg rest on a rough horizontal plane with coefficient of friction 0.3. If a bullet is fired horizontally into the block with a velocity of 200 m/sec and it remains inside the block after penetration. Determine how far it will be displaced from initial position ? 5
7. (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



K. may
2017/2018