Total number of printed pages – 8 **B. Tech**

BENG 1101/BE 2104

First Semester Examination – 2008

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) What do you mean by free body diagram ? What is its importance ?

   (b) How do you specify force ?

   (c) State the laws of friction.

P.T.O.

(d) Differentiate between active forces and reactive forces.

(e) Explain the term 'virtual' in virtual work.

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

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

(h) What is the relation between impulse and momentum ?

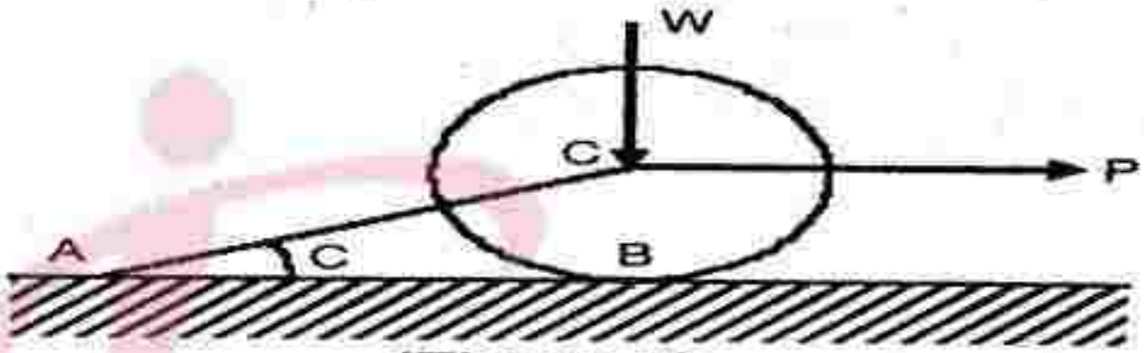
(i) State and explain law of conservation of energy.

(j) What do you mean by degrees of freedom ?

2. (a) Explain what do you mean by concurrent forces in a plane ? What is the condition for equilibrium of concurrent forces in a plane ? 4

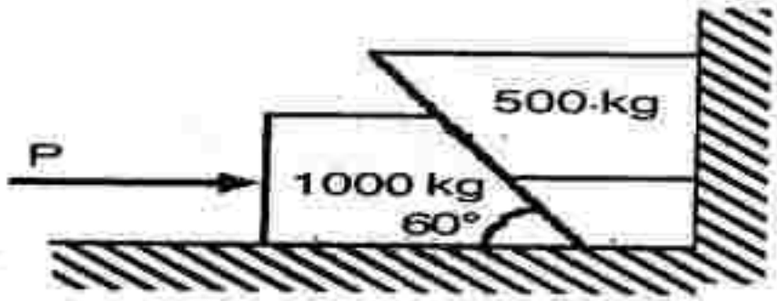
(b) A right circular roller of weight 'W' rests on a smooth horizontal plane and is held in

the figure 1. Find the tension 'S' in the bar AC and the vertical reaction at B if there is also a horizontal force 'P' acting at C. 6



(Figure 1)

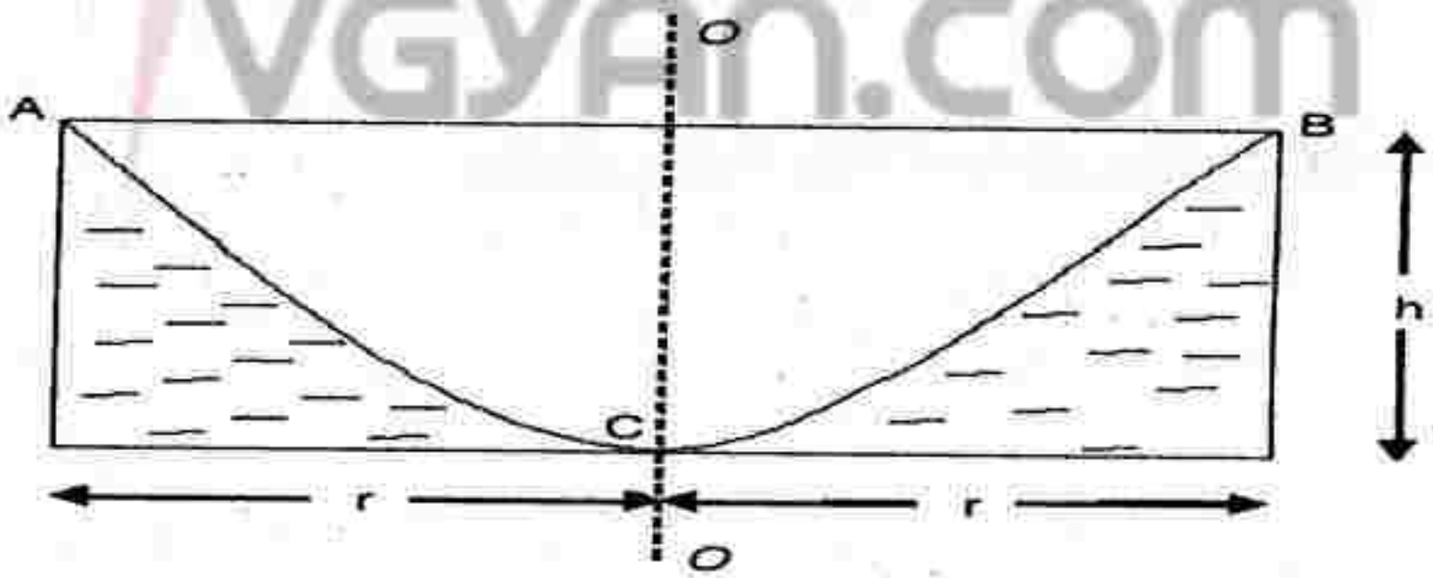
3. Referring to the figure-2, the coefficients of friction are as follows : 0.25 at the floor, 0.30 at the wall and 0.20 between the blocks. Find the minimum value of horizontal force 'P' applied to the lower block that will hold the system in equilibrium. 10



(Figure 2)

4. (a) State and explain Pappus theorem with neat diagrams. 4

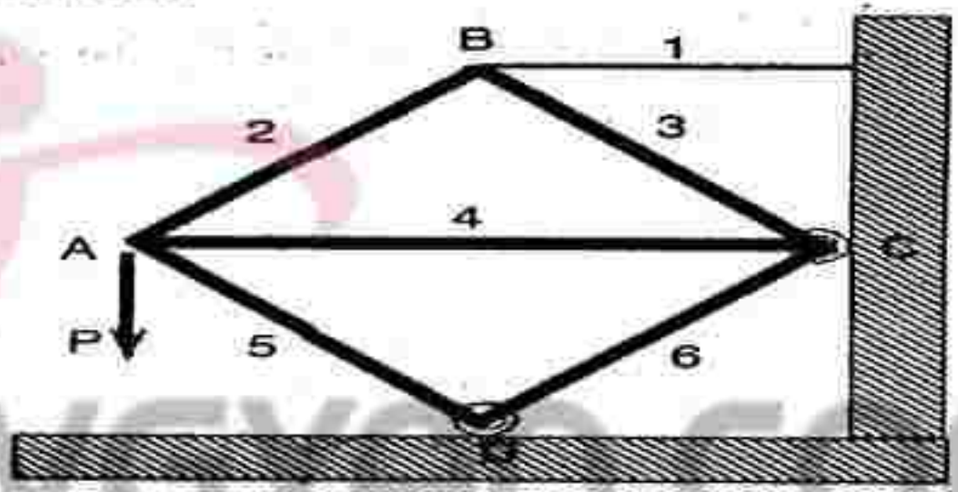
(b) A right circular cylindrical tank containing water spins about is vertical geometric axis *OO* at such speed that the free water surface is a parabaloid *ACB*. Refer figure 3 shown below. What will be the depth of water in the tank when it comes to rest ? 6



(Figure 3)

5. (a) Using method of joints determine the axial

supported and loaded as shown in the figure 4. ABCD is a square; AC is horizontal. 6

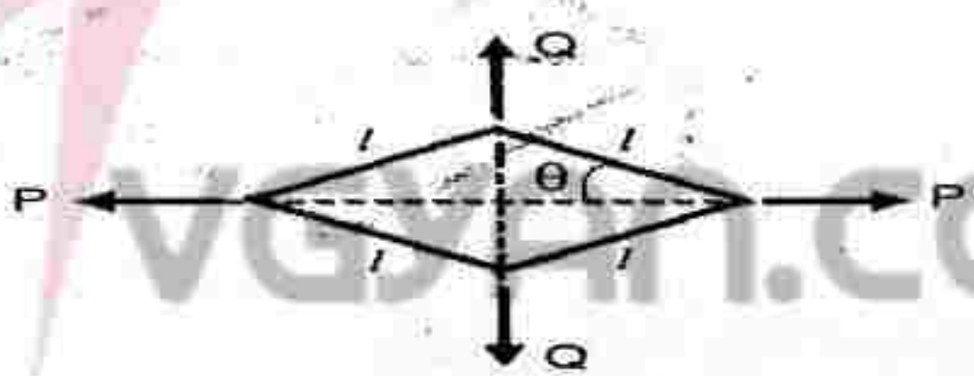


(Figure 4)

(b) A spring gun, having a spring constant of 4 N/mm is held on a vertical position. If the original compression of the spring is 200 mm, how high above its compressed position will it project a ball of weight 20 N ? What will be the velocity of the ball at a height of 2 m ? 4

6. (a) Four bars of equal lengths "*l*" are hinged together at their ends in the form of a rhombus as shown in the figure 5. Using the

principle of virtual work, find the relation between the active forces 'P' and 'Q' for the equilibrium of the system in any configuration as defined by the angle 'θ'. Neglect the weight of the bars. 5

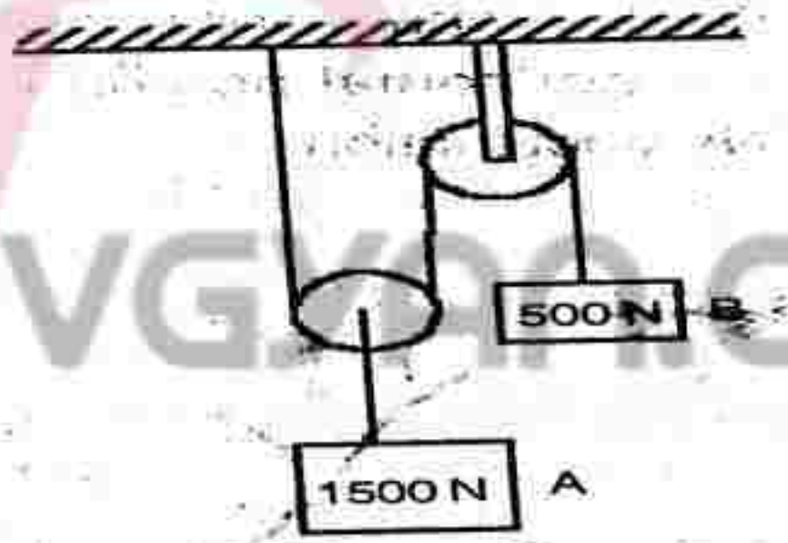


(Figure 5)

(b) An 80 kg man sits in a 50 kg canoe and fires a 100 gm bullet horizontally directly over the bow of the canoe. Neglecting friction of water, find the velocity 'v' with which the canoe will move after the shot if the rifle has a muzzle velocity of 500 m/s.

5

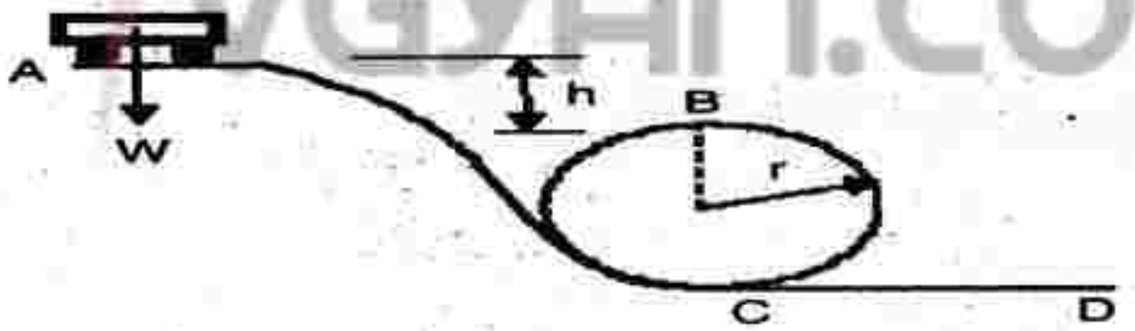
7. Determine the tension in the string and acceleration of blocks A and B weighing 1500 N and 500 N connected by a string and a friction-less and weightless pulley as shown in the figure 6. 10



(Figure 6)

8. (a) Two adjacent guns having the muzzle velocity of 400 m/s fire simultaneously at an angle α and β for the same target at a range 5000 m. Calculate the time difference between the hits. 4

(b) A small car of weight 'W' starts from rest at A and rolls without friction along the loop ACBD as shown in the figure 7. What is the least height 'h' above the top of the loop at which the car can start without falling off the track at point B and for such a starting position what velocity will the car have along the horizontal portion CD of the track ? Neglect friction. 6



(Figure 7)