

Total number of printed pages – 8 B.Tech
BE 2104 (New)/BENG 1101 (Old)

Second Semester Examination – 2010

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 are the angles between two forces to make their resultant a minimum and a maximum respectively ?
 - (b) What is an equilibrant ? Discuss with an example.
 - (c) How can you resolve a force into a force and a couple ?

P.T.O.

- (d) Derive an expression for the least force required to drag a body on a rough horizontal plane.
- (e) What is the advantage of 'method of section' over 'method of joints'? Discuss with a very simple example.
- (f) Show the hydrostatic pressure distribution on the vertical face of a dam section. How can this distribution be converted to a single concentrated load?
- (g) What is the first moment of area of a semi-circular area about its diameter d ?
- (h) A particle starting from rest from the origin moves in a straight line whose equation of motion is given by $v = t^3 - 3t^2$. What will be the displacement of the particle after 4 seconds?
- (i) If the speed of a particle along a curved path is constant, what is the value of tangential acceleration?

- (j) What is meant by moment of momentum of a particle?

2. (a) A smooth right circular cylinder of radius 1 meter and weight 10 kN is in equilibrium while resting on smooth inclined planes AB and AC as shown in Figure 1. Find reactions at the surfaces of contact. 5

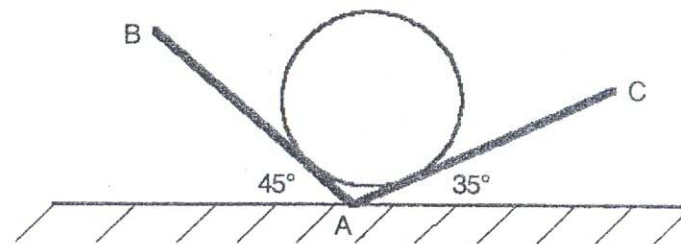


Figure 1

- (b) A force of 40 kN pulls a body of weight 60 kN up an inclined plane, the force being applied parallel to the plane. The inclination of the plane to the horizontal is 30° . Calculate the coefficient of friction. 5
3. A truss of 10 m span is loaded as shown in Fig. 2. Find the forces in the members of the

truss if it is supported on a roller at A and a hinge at B as shown. E and F are mid points of AC and BC while G and H are mid points of AD and BD.

10

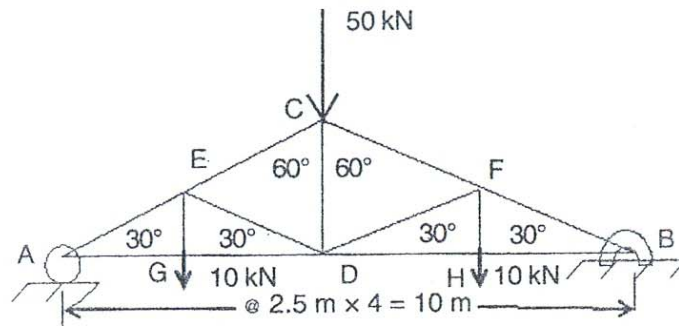


Figure 2

4. (a) A beam ABC is hinged at A and supported on a roller at B. BC being the overhang. It is loaded with distributed loads as shown in Figure 3. Find the reactions at the supports.

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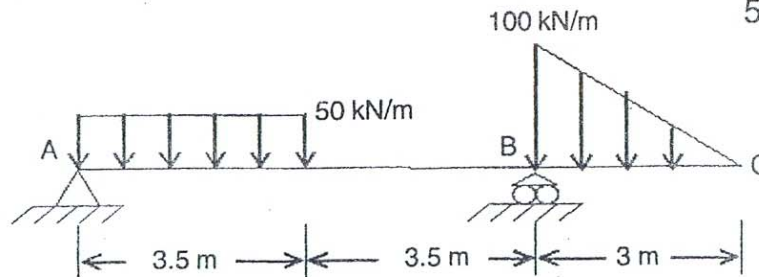


Figure 3

- (b) State and prove the Varignon's theorem.

5

5. (a) Locate the centroid of the area enclosed between a straight line $y = 4x$ and the parabola $y = 2x^2$.

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- (b) Find the moment of inertia about the centroidal X and Y axis of the section shown in Figure 4.

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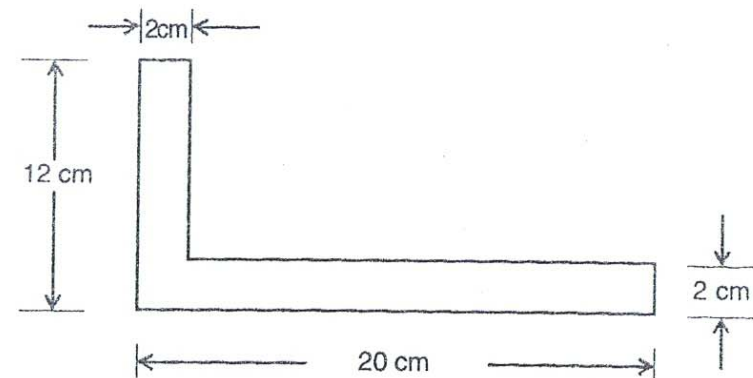


Figure 4

6. (a) A cage descends in a mine shaft with an acceleration of 0.5 m/sec^2 . After the cage has traveled 25 m, a stone is dropped from the top of the shaft. Determine :

6

(i) the time taken by the stone to hit the cage

(ii) the distance traveled by the cage before impact.

- (b) A train starting from rest is uniformly accelerated. The acceleration at any instant is $10/(v-1)$ m/sec² where v is the velocity of the train in m/sec at the instant. Find the distance in which the train will attain a velocity of 60 kmph. 4

7. (a) The maximum range of a projectile is 1600 m. At what angle of elevation θ will the range be 1200 m if the initial velocity remains unchanged? 3

- (b) Considering only rotation of the earth, determine the resultant acceleration of a point on its surface at the latitude 45° N. Assume the radius of the earth $R = 6400$ km. 3

- (c) A ball of weight W is supported in a vertical plane as shown in Fig. 5. Find the compressive force S in the bar BC : (i) just before the string AB is cut and (ii) just after the string AB is cut. Neglect the weight of the bar BC. 4

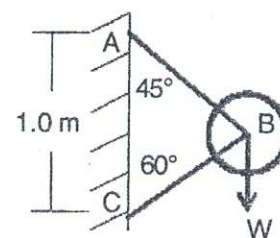


Figure 5

8. A solid right circular roller of radius R and weight W tied to a horizontal plane by a rod AC has initial angular velocity ω_0 as shown in Figure 6. If the rotor is suddenly allowed to rest its full weight on the plane, what time t will elapse before it comes to rest? The coefficient of friction at B is μ . Numerical data are given as follows : $\omega_0 = 20\pi$ rad/sec, $R = 0.3$ m, $\mu = 0.25$, $\alpha = 20^\circ$. 5

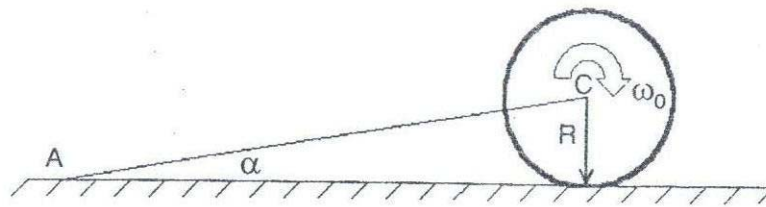


Figure 6

- (b) Find the moment of inertia of a hollow sphere with respect to a diameter if the unit weight of the material is ω and the outer and inner radii are r_o and r_i respectively. 5