Code No. 007

FACULTY OF ENGINEERING

B.E. I year (Regular–Main) Examination, May/June 2009

ENGINEERING MECHANICS

(Common to all branches)

Time : 3 Hours] [Max. Marks : 75

Answer **all** *questions of Part A.*
Answer **five** *questions from Part B.*
Assume missing data, if any suitably.

Part A – (Marks : 25)

1. The resultant of the two forces is 14 KN when they act at 60°. The same forces when they act at 90° produce a resultant of 12 KN. Determine the magnitude of the two forces. 2

2. Explain degrees of freedom for a coplanar parallel force system. 2

3. A force $F = 4i + 3j + 2k$ is applied at a point whose position vector from '*O*' is given by $r = i + 2j + 3k$. What is the resulting moment about '*O*'. 2

4. A body of weight '*w*' is kept on an inclined plane of angle 'θ' with the horizontal. The angle of friction is 'ϕ'. The minimum force required to be applied parallel to the plane to slide the body up the plane is

   (a) $\frac{w\sin(\theta - \phi)}{\cos\phi}$ (b) $\frac{w\sin(\theta + \phi)}{\cos\phi}$

   (c) $\frac{w\cos\theta + \phi}{\cos\phi}$ (d) $\frac{w\cos(\theta - \phi)}{\sin\theta}$ 2

5. A semicircular area has a horizontal diameter. The height of its centroid above this diameter is 2

   (a) $\frac{r}{3}$ (b) $\frac{r}{\pi}$

   (c) $\frac{2r}{\pi}$ (d) $\frac{\pi r}{4}$

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6. An isosceles triangle has a horizontal base of width 3m and height of 4m. What is its area M.I about a horizontal axis passing through its vertex. 3

7. A beam supporting the loads is Diagram as shown in Fig 1. Draw the free body diagram. 3

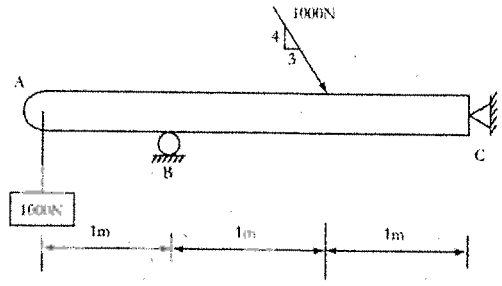

Fig. 1

8. A projectile is required to reach a point whose coordinates are $x = 50$m and $y = 20$m. If $\alpha = 45°$, what should be the velocity of projection. 3

9. A car moves from rest on a curved road of 300m radius and is given a uniform tangential acceleration of 0.75m/sec^2. Determine the time and distance of total to the point where the total acceleration is 0.9m/sec^2. 3

10. What is a compound pendulum. Derive the equation for the time period of a compound pendulum. 3

Part B – (Marks : 5 × 10 = 50)

11. A boom AC is supported by a ball and socket Joint at 'c' and by the cables BE and AD as shown in Fig 2. Forces 'F' and 'P' act respectively from B to E and A to D. Taking F_m=10 N/m and P_m=20 N/m determine

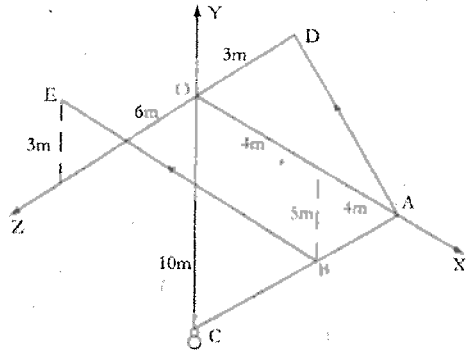

Fig. 2

(a) Component of F perpendicular to plane DAC 4

(b) Component of P perpendicular to plane EAC 3

(c) Length of common perpendicular between BE and AD. 3

12. Two cylinders A and B weighing 200N and 100N are connected by a bar of negligible weight and are resting on smooth planes as shown in Fig 3. Find the force 'P' that will hold the system in equilibrium.

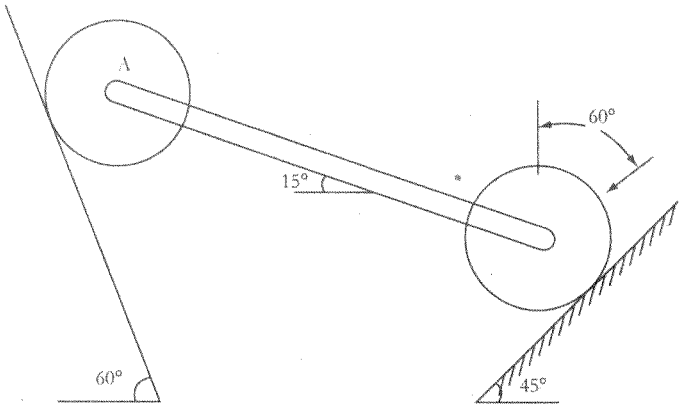

Fig. 3

13. Two blocks A and B of weights 600N and 1200N respectively rest against a wall and a floor as shown in Fig 4. Determine the minimum horizontal force 'P' necessary to hold the blocks in equilibrium. Coefficients of friction are 0.2 for the floor 0.3 for the blocks, and 0.4 for the wall.

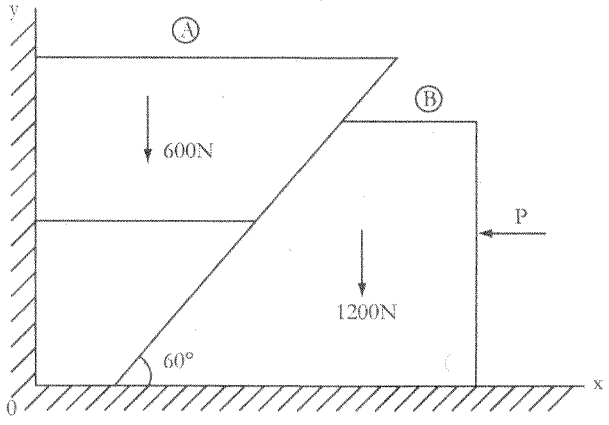

Fig. 4

14. (a) Find the volume generated by revolving a semi circular area about x and y areas as shown in Fig. 5. Use Pappus theorem.

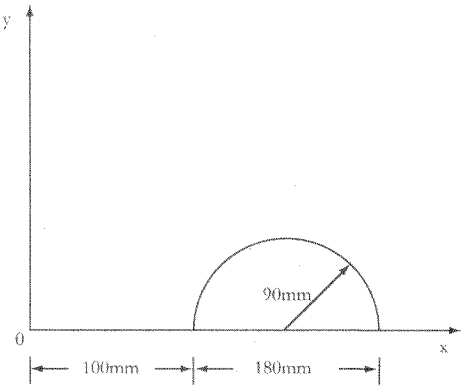

Fig. 5

(b) Find the moment of inertia I_x of the shaded area as shown in Fig 6, obtained by removing the triangular area from the semicircular area.

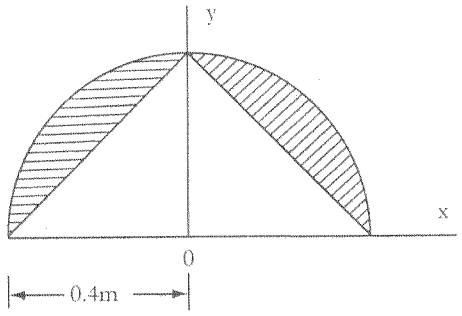

Fig. 6

15. (a) The position vector of a particle is given by $r = 2t^2i + 10tj + \frac{1}{3}t^3K$ where r is in metres and t is in seconds. Determine the normal and tangential components of acceleration and the principal radius of curvature of the path of particle at $t = 3$ seconds. 6

(b) When the angular velocity of a 1.2m dia pulley is 3rad/sec, the total acceleration of a point on its rim is 9 m/sec^2. Determine the angular acceleration of the pulley at this instance. 4

16. Two sliders connected by a rigid link 10 m long, moves in the frictionless guides as shown in Fig 7. If 'B' starts from rest when it is vertically below 'A', determine the velocity of 'B' when $x = 6$ m. Given $W_A = W_B = 200$ N, $W_C = 100$ N. Use work-energy method.

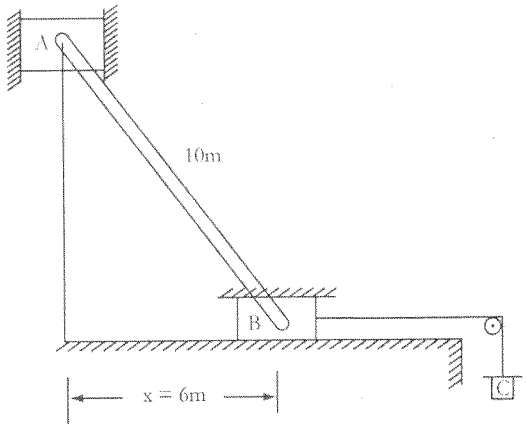

Fig. 7

17. (a) Explain the terms free vibrations, forced vibrations and damped vibrations. 3

(b) A body performing simple harmonic motion has velocities of 15 m/sec when the displacement is 200 mm and 3m/sec when the displacement is 400 mm. The displacements are measured from the mid position. Calculate the frequency and amplitude of motion, what is the acceleration when the displacement is 300 mm. 7