

ANNA UNIVERSITY COIMBATORE

B.E. / B.TECH. DEGREE EXAMINATIONS : JUNE / JULY 2009

REGULATIONS : 2008

SECOND SEMESTER

080120002 - ENGINEERING MECHANICS

(COMMON TO AERONAUTICAL / AUTOMOBILE / BIOTECH / CHEMICAL / CIVIL / FASHION /
MECHANICAL / MECHATRONICS / METALLURGICAL / TEXTILE CHEMISTRY / TEXTILE TECH.)

TIME : 3 Hours

Max.Marks : 100

PART - A

(20 x 2 = 40 MARKS)

ANSWER ALL QUESTIONS

1. Define Lamé's theorem.
2. If $A=2i-3j-3k$, $B=-4i+3j-5k$, $C=2i+4j-3k$, find the vector $2A-B+2C$ in terms of i, j, k and its magnitude.
3. Differentiate between resolution and composition of forces.
4. The greatest and least resultants of two forces acting on a particle are 35KN and 5KN respectively. If 25KN is the magnitude of the resultant for the given system of forces F_1 and F_2 . Prove that the forces are at right angles.
5. Draw the different types of supports indicating reactions.
6. Enumerate the importance of moment of force in establishing equilibrium of Rigid bodies.
7. State varignon's theorem.
8. When does a rigid body in three dimensions is said to attain in equilibrium?
9. Establish a relationship for identifying the moment of inertia for a circle about its centroidal axis.
10. State parallel axis theorem.
11. Define polar moment of inertia.
12. What is a centroid?

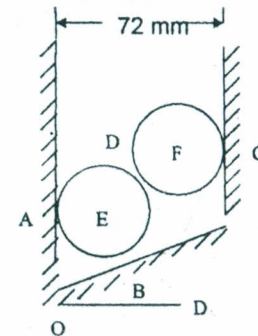
13. A block of mass 'm' moves with an acceleration given by $a(s) = -2s \text{ m/s}^2$ where 's' is in metres. Determine the velocity of the block when $s=10\text{m}$ if the block has a velocity of $v=20\text{m/s}$ when $s=5\text{m}$.
14. A motor bike moves with a speed of 30m/s and a car travels at a speed of 40m/s in the opposite direction. Determine the velocity of motor bike relative to the car.
15. Define coefficient of restitution.
16. A block weighing 100kg starts from rest and moves on a smooth plane. Find the time needed for the block to gain a velocity of 40m/s if a force of 300N is acting parallel to the plane.
17. Enlist the factors that necessitates limiting friction.
18. The diameter of wheel of a vehicle is 600mm . The weight is 1000kN . The coefficient of rolling resistance between the wheel and ground is 0.35mm . Find the force required for constant speed.
19. Find the ratio of tension on tight and slack side of belt for contact angle of 180° with pulley. Assume $\mu=0.18$.
20. State angle of repose.

PART - B

(5 x 12 = 60 MARKS)

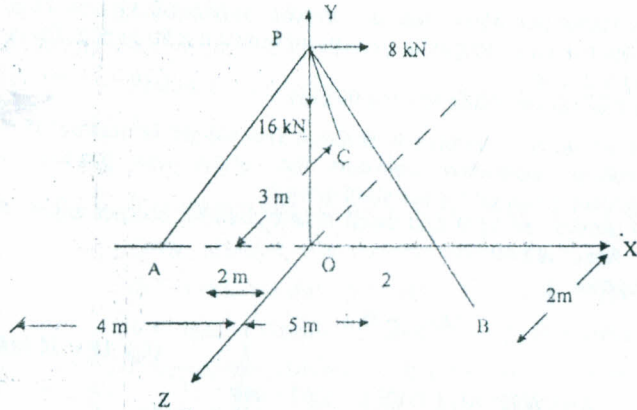
ANSWER ANY FIVE QUESTIONS

21. Two cylinders of diameters 60 mm and 30 mm weighing 160 N and 40 N respectively are placed as shown in figure. Assuming all the contact surfaces to be smooth, find the reactions at A, B and C.

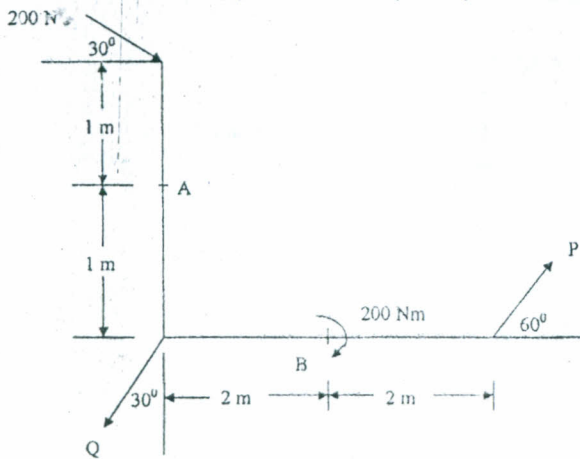


$\angle AOD = 45^\circ$

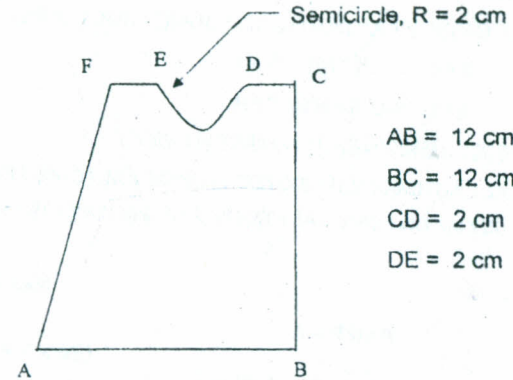
22. A tripod is acted upon by forces at P as shown in the figure. Determine the forces in the legs of tripod if the legs rest on ground at A, B and C whose coordinates with respect to O are as shown in the figure. The height of P above the origin is 10 m



23. For the system of forces shown in figure, determine the magnitudes of P and Q such that the resultant of the system passes through A and B.



24. Find the moment of inertia of plane area as shown in figure about its centroidal X axis.



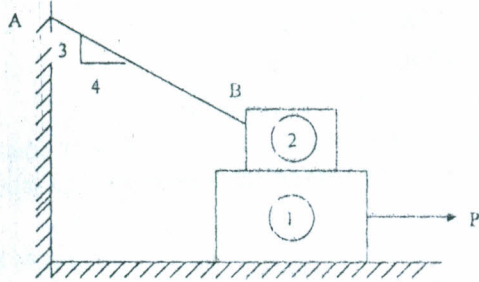
AB = 12 cm
BC = 12 cm
CD = 2 cm
DE = 2 cm

25. (a) A train starts from rest and runs at a velocity of 80 km/h after 3 minutes. Determine the (i) acceleration (ii) distance traveled in 3 minutes and (iii) the time at which it attains a velocity of 60 km/h. (6)

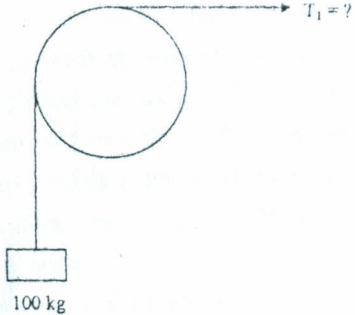
- (b) The motion of a particle along a curve is described by the expressions $x = t^3 + 2t^2 - 5t + 3$ and $y = t^2 - 6t + 5$, where x and y are in meters and t is in seconds. Find the velocity and acceleration of the particle when $t = 3$ s. (6)

26. A block of weight 12 N falls at a distance of 0.75 m on the top of the spring. Determine the spring constant if it is compressed by 150 mm to bring the weight momentarily to rest.

27. A block of weight $W_1 = 1290$ N rests on a horizontal surface and supports another block of weight $W_2 = 570$ N on top of it as shown in figure. Block of weight W_2 is attached to a vertical wall by an inclined string AB. Find the force P applied to the lower block that will be necessary to cause the slipping to impend. The coefficient of friction between 1 and 2 is 0.25 and the coefficient of friction between 1 and the horizontal surface is 0.40.



28. (a) A 100 kg mass is lifted by applying a horizontal force by a belt drive, rolling on a cylinder of 150 mm diameter as shown in figure. Calculate (i) the necessary force (ii) torque at the cylinder surface (iii) power transmitted. The coefficient of friction is 0.20. (8)



- (b) A wheel is attached to the shaft of an electric motor of rated speed of 2000 rpm. When the power is switched on the unit, it attains the rated speed in 10 seconds and when the power is switched off, the unit comes to rest in 100 seconds. Assume uniformly accelerated motion and determine the number of revolutions the unit turns to attain the rated speed. (4)

*****THE END*****