(vii) The centre of gravity of solid hemisphere of radius R from its base is
(a) 3R/8 (b) R/2 (c) 3R/4 (d) 2R.

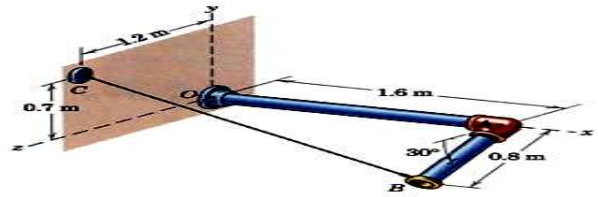
(viii) Moment of inertia of a triangle of base b and height h about the centroidal axis parallel to base is
(a) $\frac{bh^3}{36}$ (b) $\frac{bh^3}{12}$ (c) $\frac{bh^3}{3}$ (d) $\frac{bh^3}{4}$

(ix) The area under the acceleration – displacement (a-s) curve represents the
(a) velocity of a particle
(b) acceleration of the particle
(c) change in kinetic energy of the particle considering unit mass
(d) displacement of the particle.

(x) Equation of motion of a particle is $s = 2t^3 - t^2 - 2$, where s is displacement in meters and t is time in seconds. Acceleration of the particle after 1 second will be
(a) 8 m/s^2 (b) 9m/s^2 (c) 10 m/s^2 (d) 5 m/s^2

Group – B

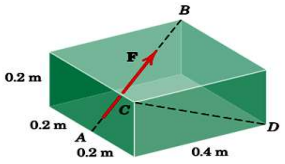
2. (a) The cable *BC* carries a tension of 750N. Write this tension in the cable as a force vector T acting from point *B* to *C* in terms of the unit vectors *i, j* and *k*. The elbow at *A* forms a right angle and makes an angle 30^0 downward with the horizontal *x-z* plane, as shown in the following figure.



(b) A force given by $\vec{F} = 3\vec{i} + 2\vec{j} - 4\vec{k}$ is applied at the point $P\ (1, -1,\ 2)$. Find the magnitude of moment of the force F about the point $\mathrm{A}\ (2, -1,\ 3)$.

6 + 6 = 12

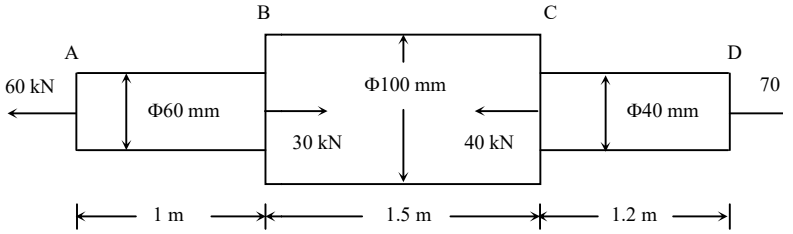
3. (a) If the magnitude of the moment of force F about the line CD (sense from C to D) is 50 N-m. Determine the magnitude of F. Refer to the figure given below.



(b) A force $F_1 = 10i + 6j + 3k$ N acts at a position (3, 0, 2). At point (0, 2, -3) an equal but opposite force $-F_1$ acts. What is the couple moment? What

7. (a) With neat sketch, explain stress-strain diagram for a ductile ma
In the diagram, clearly mark the salient points and identify them.

(b) A bar of variable cross-sectional areas as shown is subject different forces. Find the total elongation of the
Take $E = 2\times10^5\ N/mm^2$.

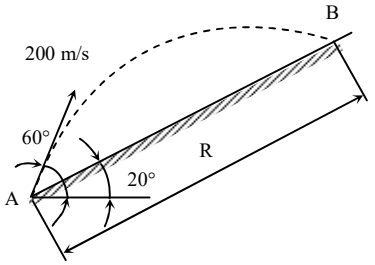


5 + 7

Group – E

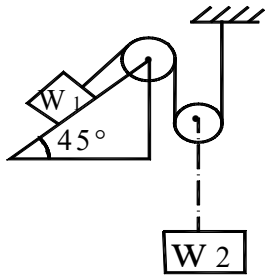
8. (a) The acceleration of a particle which is moving along a straight line is by $a = -0.2\sqrt{v}$, where a is in m/s^2 and v is the velocity in Determine the velocity of the particle (i) at $t = 2$ sec and (ii) at $s =$ Given, the initial conditions at time $t = 0$ sec are $s_0 = 1$ m and $v_0 = 7$

(b) A projectile is launched with an initial speed of 200 m/s at an ar $60°$ with respect to the horizontal. Compute the range R as mea up the incline.

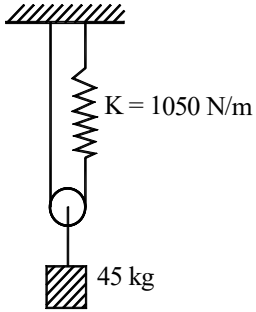


(2 + 2) + 8

9. (a) Find the tension S in the string during motion of the system sho the following figure if $W_1 = 200$ N and $W_2 = 100$ N. The system is vertical plane, and the coefficient of friction between the inclined and the block W_1 is $\mu = 0.2$. Assume the pulleys to be without ma



(b) Please refer to the figure given below. The system is released from rest with the spring initially stretched 75 mm. Calculate the velocity v of the weight after it has further dropped by 12 mm from stretched position. The spring has a stiffness of 1050 N/m. Neglect the mass of the small pulley.



6 + 6 = 12

ENGINEERING MECHANICS
(MECH 1101)

Time Allotted : 3 hrs **Full Marks : 70**

Figures out of the right margin indicate full marks.

Candidates are required to answer Group A and any 5 (five) from Group B to E, taking at least one from each group.

Candidates are required to give answer in their own words as far as practicable.

Group – A
(Multiple Choice Type Questions)

1. Choose the correct alternative for the following: **10 × 1 = 10**

(i) The dot product of two orthogonal vectors is
(a) one (b) zero (c) no definite value (d) 90°.

(ii) A force 2 kN acts along the +ve Y-axis. The vector component of the force (in kN) along the vector $i+j$ is given by
(a) $\frac{i+j}{\sqrt{2}}$ (b) $\sqrt{2}(i+j)$ (c) $i+j$ (d) $i-j$

(iii) For stable equilibrium the potential energy will be
(a) maximum (b) minimum
(c) zero (d) equal to kinetic energy.

(iv) Three forces $\sqrt{3}p, p$ and $2p$ acting on a particle are in equilibrium. If the angle between first and second be 90°, the angle between second and third will be
(a) 30° (b) 60° (c) 120° (d) 150°.

(v) According to the principle of transmissibility of forces, the effect of a force upon a body is
(a) maximum when it acts at the centre of gravity of the body
(b) different at different points in its line of action
(c) the same at every point in its line of action
(d) minimum when it acts at the centre of gravity of the body.

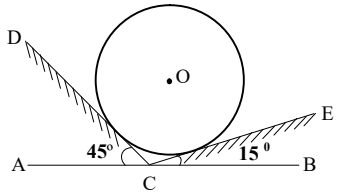
(vi) A body of weight W is placed on an inclined plane. The angle made by the inclined plane with the horizontal, when the body is on the verge of moving down is called
(a) angle of inclination (b) angle of friction
(c) angle of repose (d) angle of limiting friction.

are the direction cosines normal to the plane of the couple? Assume that the co-ordinates are given in metre.

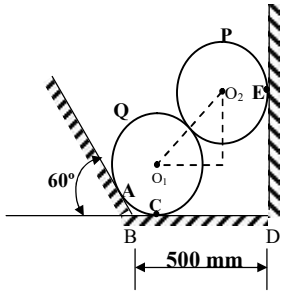
6 + (3 + 3) = 12

Group – C

4. (a) A smooth circular cylinder of radius 1.5 m is lying in two supporting planes as shown in the given figure below. Find the reactions at the surfaces of contact, if there is no friction and the cylinder weighs 1000N.

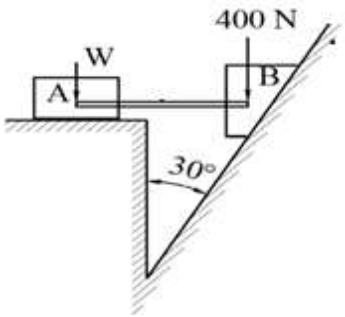


(b) Two spheres P and Q rests in the channel as shown in the following figure. The sphere P has a diameter 400 mm and weight of 200 N, whereas the sphere Q has diameter 500 mm and weight 500 N. If bottom width of the channel is 500 mm and with one side vertical and other side inclined at 60° to horizontal, determine the reaction forces induced in the contact points A, C and E. All contact points are smooth.

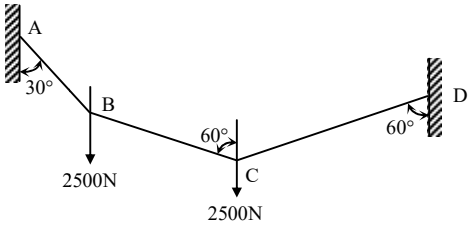


6 + 6 = 12

5. (a) Two blocks connected by a horizontal link AB are supported on two rough planes. The coefficient of friction for block A on the horizontal plane is 0.4 and for block B on the inclined plane is 0.268. What is the smallest weight *W* of block A for which equilibrium of the system can exist? Refer to the following figure please.



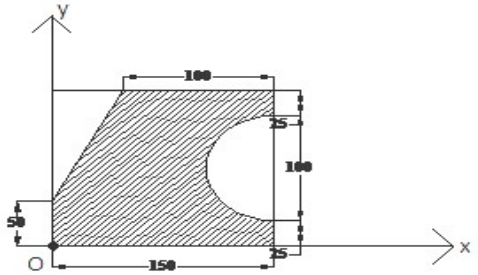
(b) Two equal loads of 2500 N are supported by a flexible string AE points B and C as shown in figure. Find the tensions in the portio BC, CD of the string.



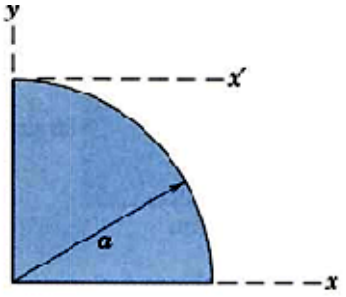
6 + (

Group – D

6. (a) Locate the centroid (x_c , y_c) of the shaded area as shown i following figure. All the dimensions are in mm.



(b) Please refer to the figure given below. Find the area Moment of I of a quarter circle of radius '***a***' about an axis passing along its radius along x-axis.
Hence, using Parallel Axes theorem, find the area Moment of Ine the quarter circle, about the tangential x' axis parallel to the x-a shown in figure.



6 + (