

[03 - 2111]

II/IV B.E. DEGREE EXAMINATION.

First Semester

Mechanical Engineering

ENGINEERING MECHANICS - I

(Common with M.S. Mech. Engg.)

(w.e.f admitted batch of 2006 - 2007)

Time : Three hours

Maximum : 70 marks

First question is compulsory.

Answer any FOUR from the remaining.

All questions carry equal marks.

1. (a) Distinguish between moment and couple.
 (b) State the theorem of Guldinus.
 (c) What are the applications of virtual work?
 (d) Define angle of friction.
 (e) Explain the principle of transmissibility.
 (f) Write the necessary and sufficient conditions for equilibrium for a concurrent force system
 (g) Write the importance of centre of gravity.
2. A man attempts to support a stack of books horizontally by applying a compressive force of $F = 120 \text{ N}$, to the ends of the stack with his hands. If each book has a mass of 0.95 kg , determine the

$$\frac{u^2 - v^2}{2g}$$

$$\frac{(100)^2 - (\cos(60)(\sin 30))}{2(9.81)}$$

$$2(9.81)$$

$$\frac{10000 - 250}{19.62}$$

$$122.42$$

To find velocity

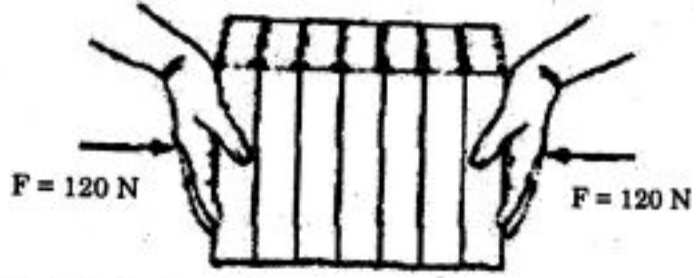
$$v^2 - u^2 = 2gh$$

$$v^2 - 1000 = 19.82 h$$

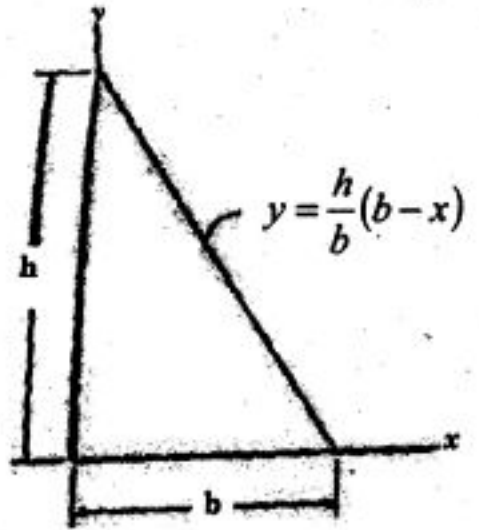
$$v^2 = 19.82(h)$$

$$\frac{10000}{19.82}$$

greatest number of books that can be supported in the stack. The coefficient of static friction between the man's hands and a book is $(\mu_s)_h = 0.6$ and between any two books $(\mu_s)_b = 0.4$.

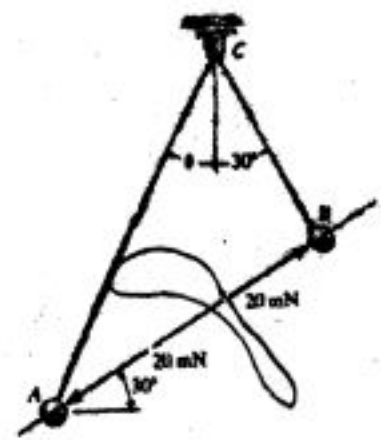


3. (a) State and prove the Pappus theorem with diagram.
 (b) Determine centroid of the given lamina.

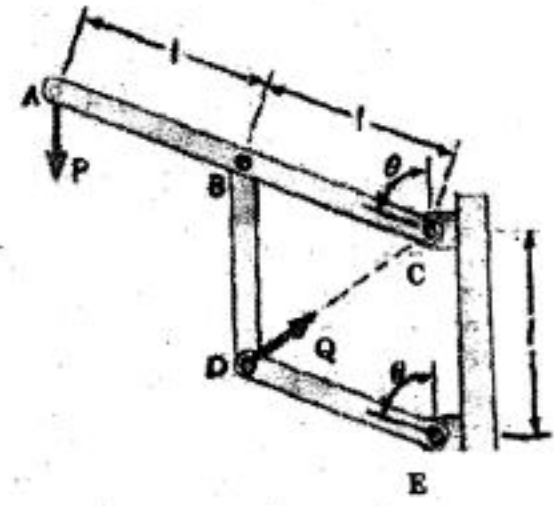


4. (a) Two spheres A and B have an equal mass and are electrostatically charged such that the repulsive force acting between them has a magnitude of 20 mN and is directed along

line AB. Determine the angle θ , the tension in cords AC and BC, and the mass m of each sphere.

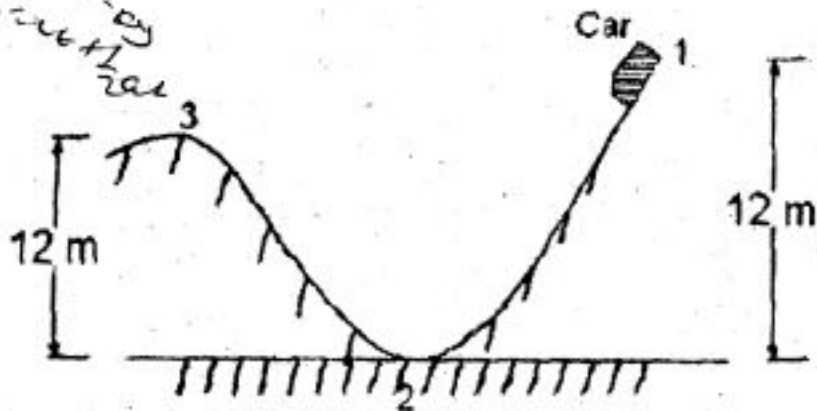


5. Knowing that the line of action of the force Q passes through point C, derive an expression for the magnitude of Q required to maintain equilibrium by using the principle of virtual work.



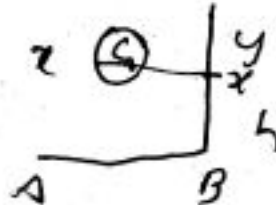
6. A 900 kg car starts from rest at 1 and moves without friction down the track shown in figure.

- (a) Determine the force exerted by the track on the car at point curvature of the track is 5m
- (b) Determine the min, safe value at the radius at curvature at point 3.



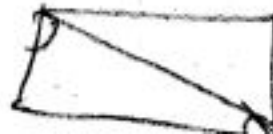
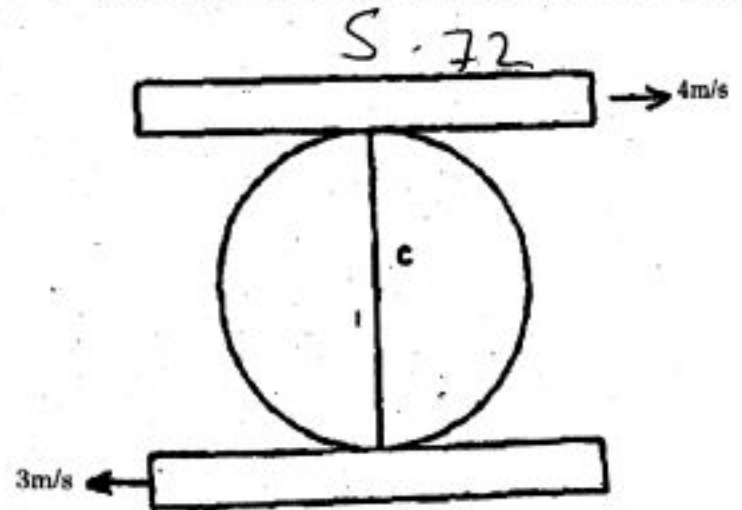
7. (a) Explain the following terms with respect to a projectile.

- (i) horizontal range
- (ii) maximum height
- (iii) time of flight and
- (iv) path.



$v^2 = u^2 - 2gh$ $v = 105.7$
 (b) A Soldier fires a bullet at an angle of 30° upward from the horizontal from his position on a wall to strike a target which is 60 m lower than the position of the soldier. The initial velocity of the bullet is 100 m/s. Calculate, the maximum height to which the bullet will rise, the time required for the flight of the bullet and the actual velocity with which it hit the target.

8. (a) A roller of radius 0.1m rides between two horizontal bars moving in opposite directions as shown in figure6 Assuming no slip at the points of contact A and B, locate the instantaneous center 'I' of the roller. Also locate the instantaneous center when both the bars are moving in the same directions.



- (b) A shaft of 100mm diameter and 1 metre long has one of its end fixed and the other end carries a disc of mass 500 kg at a radius of gyration of 450 mm. The modulus of rigidity for the shaft material is 80 GN/m². Determine the frequency of torsional vibrations.
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$$\omega = 11177.2$$

$$v = 105.75$$

$$v = 4197$$

$$105.75 \cdot 75 = 7009.8$$

$$5.75 = 9.817$$

$$7 = \frac{5.75}{9.81}$$

$$7 = 586.136$$