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Total number of printed pages - 8

B.TECH
BENG 1101

2ND SEMESTER EXAMINATION, APRIL–2005

MECHANICS

Full Marks – 70

Time – 3 Hours

The figures in the right hand margin indicate full marks for the questions.

Answer Question No. 1 which is compulsory and any five from the remaining questions.

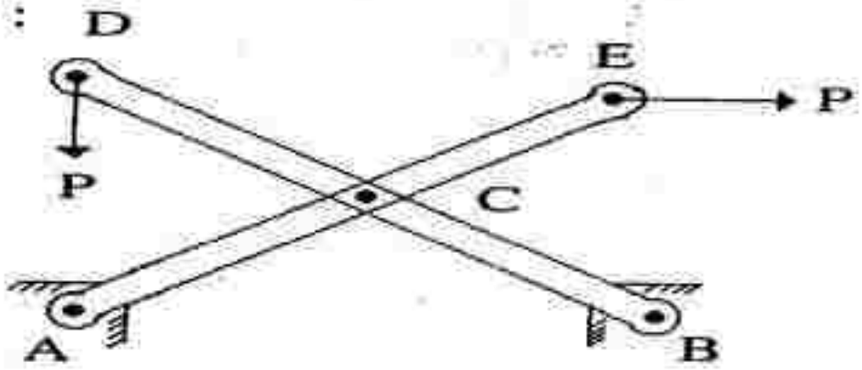
1. Answer **all** question : 2×10

(i) Show that the centroid of a quadrant of a circle of radius R has co-ordinates, $\bar{x}_c = \frac{4R}{3\pi}$ and $\bar{y}_c = \frac{4R}{3\pi}$.

(ii) Draw the Free-Body Diagram of the bar AE

P.T.O.

and the bar DB of the X-frame shown below :



(iii) The motion of a particle is defined by the equations :

$$x = t^2 + 5t - 4$$

$$y = t^3 - 5t^2 + 8t + 4$$

where x & y are in metres. What is its velocity at $t = 2$ sec. ?

(iv) State the equations of Plane Motion of rigid body for :

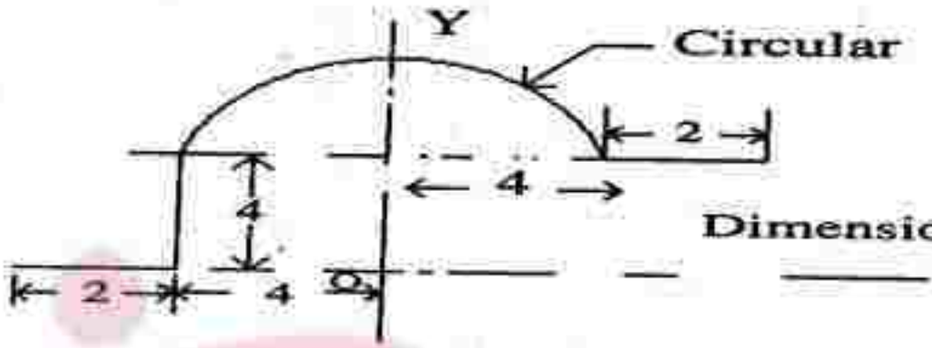
(a) Translation, &

(b) Rotation.

(v) Prove that the linear velocity V of a point P on a rotating rigid body at a distance r from the rotating axis is given by :

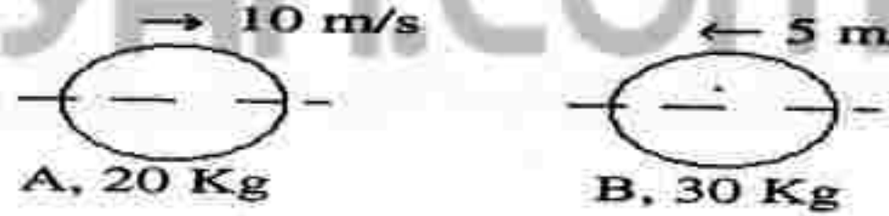
$$V = rw.$$

(vi) What is the x-coordinate of the centroid of the composite curve shown below :



(vii) A particle is projected at such an angle that the horizontal range is four times the maximum height. Find the angle of projection.

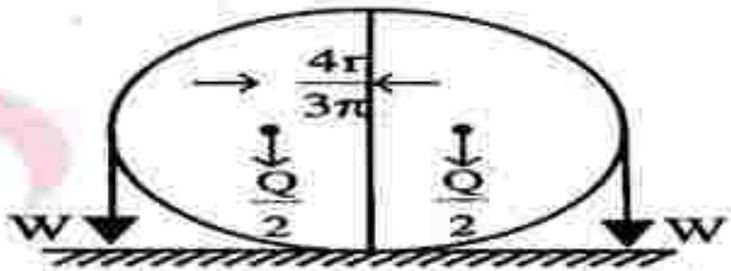
(viii) The velocities of two steel balls before impact are as shown in the figure given below :



If after impact, the ball B moves to the right at 8 m/s, determine the velocity of ball A after impact.

(ix) State the Triangle Law of Forces and the Lami's theorem.

(x) Two halves of a round homogeneous cylinder are held together by a thread wrapped round the cylinder with two equal weights, W N attached to its ends as shown. Each half weighs Q N (where N stands for Newton). Determine W for which both halves will remain in equilibrium on the horizontal plane.



2. Draw the Free-Body diagram of the bar AB and determine the support reactions at A & C. (Fig. A) 10

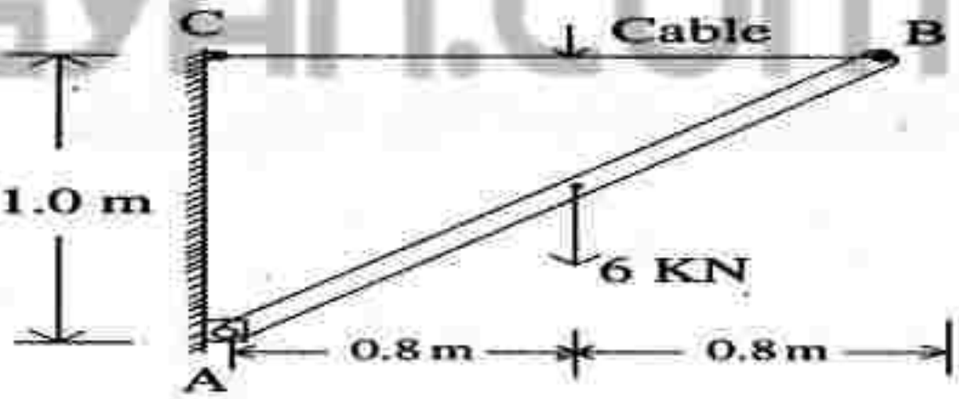


Figure A

3. (a) Indicate briefly the procedure of determining the resultant in magnitude, direction and position of two parallel forces P_1 and P_2 under the cases : 3

(i) P_1 & P_2 acting in the same direction & magnitude of P_1 is not equal to the magnitude of P_2.

(ii) P_1 & P_2 acting in opposite direction and are unequal in magnitude.

(b) Locate the centroid of the area (with a hollow circle) as shown in Figure B. 7

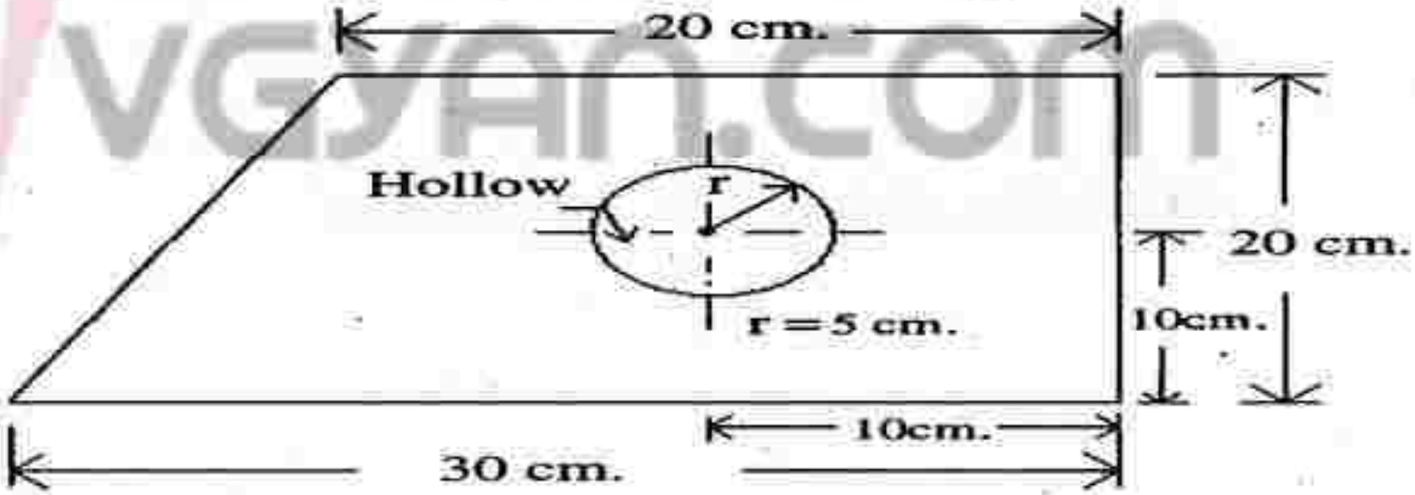


Figure B

4. Find the moment of inertia of the Section shown in Fig. C about the centroidal axis X – X, perpendicular to the web. 10

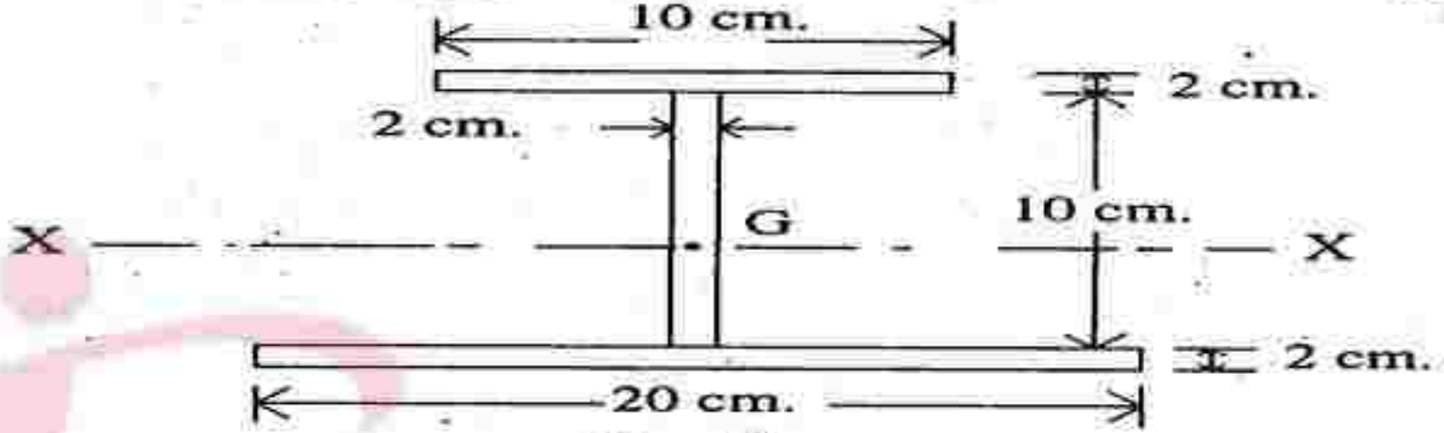


Fig. C

5. (a) Explain D' Alembert's principle and dynamic equilibrium. 4

(b) An elevator of gross weight W = 5000 N. Starts to move upward with constant acceleration and acquires a velocity V = 2 m/s after traveling a distance of 2 m. Find the tensile force S in the cable during the accelerated motion. Neglect friction. 6

6. (a) Two weights are resting on inclined planes as shown in Fig. D. If $W_1 = 100$ N, determine

W_2 by principle of Virtual Work. The planes are smooth. 5

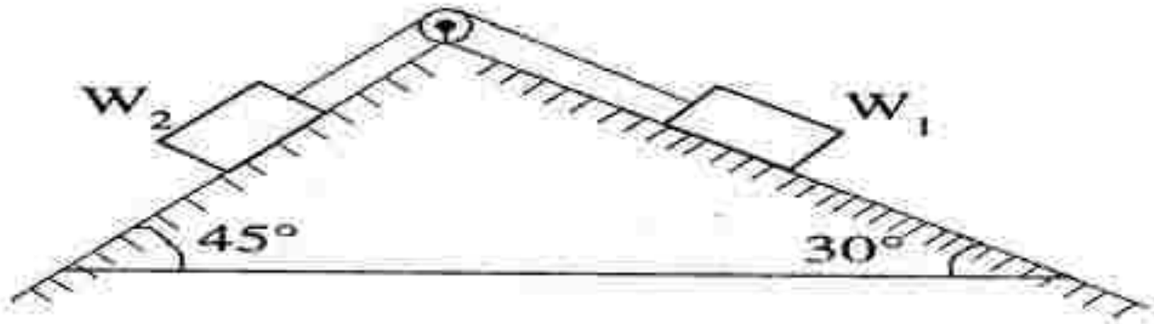


Fig. D

(b) Fig. E shows a block that has a weight of 120 N on a frictionless inclined plane which makes 32° with the horizontal. The force F applied to the block makes an angle of 16° with the horizontal. If the block is in equilibrium find the normal reaction and F. 5

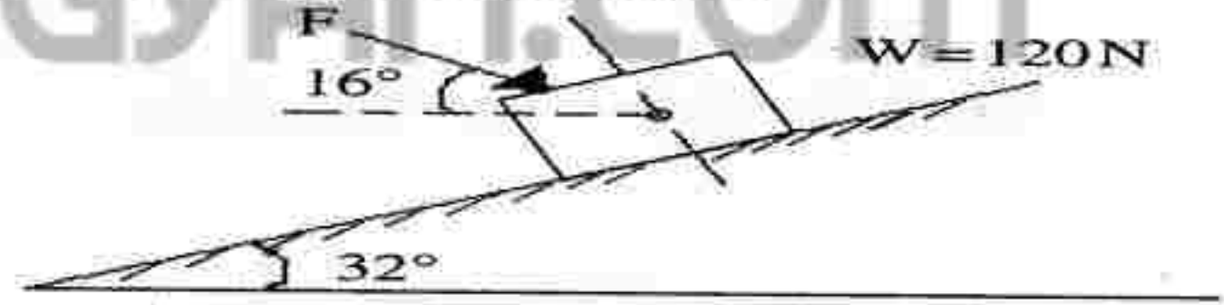


Fig. E

7. A 1 metre diameter cylinder, Fig. F, starts from rest and rolls freely towards right on a smooth plane

under the action of a 500 N weight. Determine the velocity of the cylinder and the velocity of the weight after the weight is released and has descended 5 m. Assume the pulley having no weight. 10

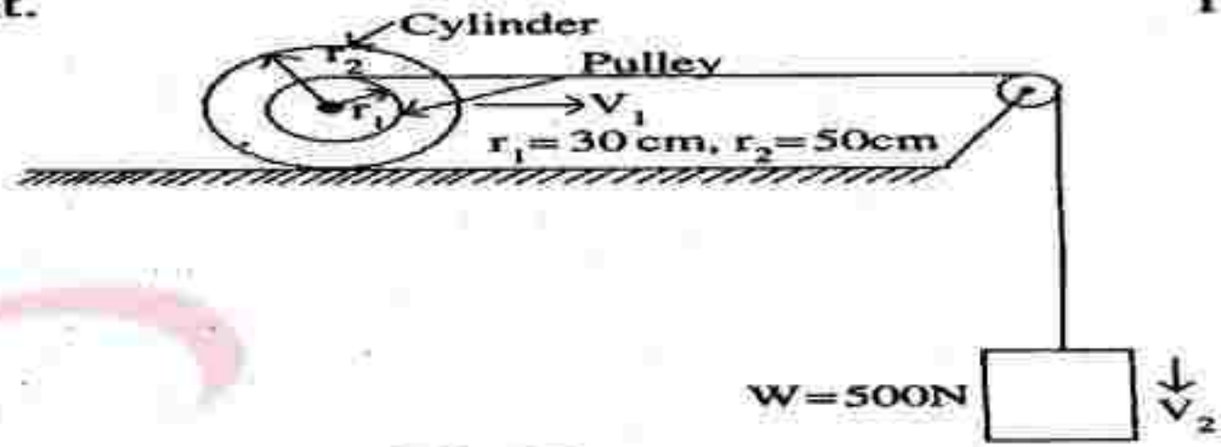


Fig. F

8. Determine the forces in the members AB, AC, BC, DB of the truss, shown in Fig. G, under the given set up of loadings. 10

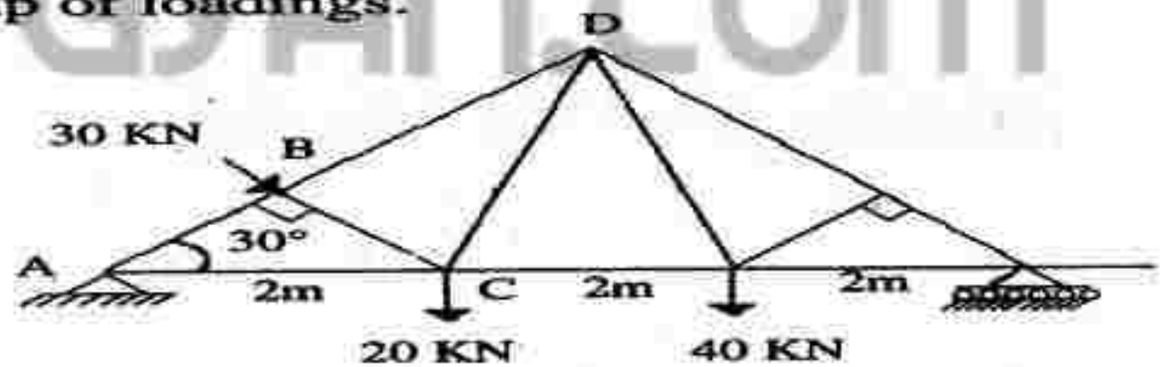


Fig. G