Registration No. : | | | | | | | | | | |

Total number of printed pages – 7

B. Tech
BE 2104

Second Semester Regular Examination – 2015

MECHANICS

BRANCH (S) : AEIE, AERO, AUTO, BIOTECH, CHEM, CIVIL, CSE, EC, EEE, EIE, ELECTRICAL, ETC, FASHION, IT, MANUTECH, MECH, MINING, MM, MME, PLASTIC, TEXTILE

QUESTION CODE : J 406

Full Marks – 70

Time : 3 Hours

*Answer Question No. **1** which is compulsory and any **five** from the rest.*
The figures in the right-hand margin indicate marks.

1. Answer the following questions : 2×10

(a) A simple supported beam AB of span 6m carries two point loads 12kN and 10kN at 2m and 4m from the end A. Determine the reactions at A and B by the principle of virtual work.

(b) Show that the trajectory path of a projectile is parabolic.

(c) How can you find the line of action of the resultant of a system of parallel forces ?

(d) What is the first moment of area of a semicircular section about its diameter ?

(e) From what height must a heavy elastic ball be dropped on a floor so that after rebounding thrice, it will reach a height of 10 m ?

P.T.O.

(f) A force of 10kN acting downward is to be resolved into a force of same magnitude and a couple at a point 100 m away from the force towards right. Determine the force and the couple at the mentioned point.

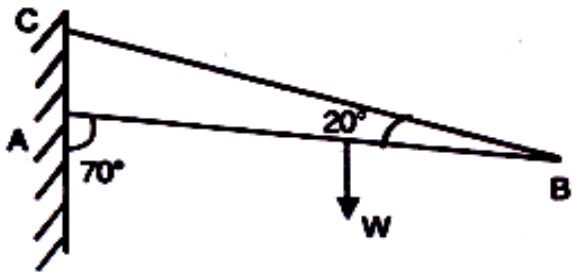
(g) A heavy drum of mass **m** rests on a horizontal rough floor in contact with a rough wall. Find couple to start the drum.

(h) For a given velocity and horizontal range, how many angles of projections are possible, Determine.

(i) Find the moment of inertia of a square about an axis passing through its diagonal.

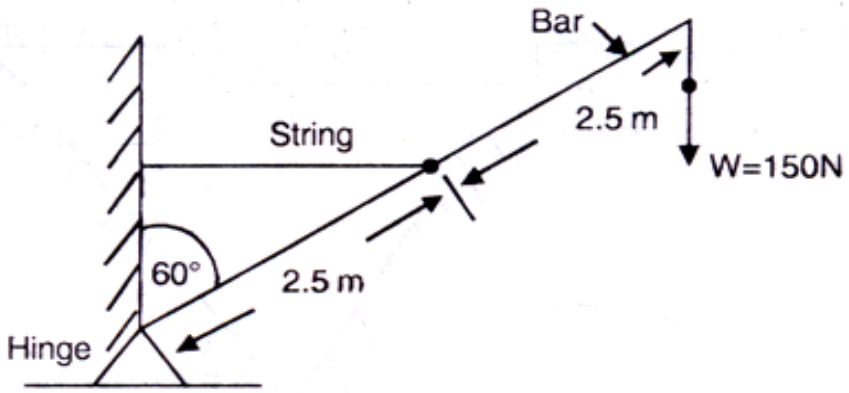
(j) Prove that two perfect elastic bodies of equal masses exchange velocities in the case of direct impact.

2. (a) **A prismatic bar AB of weight W=650N is hinged to a vertical wall at A and supported at B by a cable BC. Determine the magnitude and direction of the reaction at the hinge A and tension in the cable BC (see figure bellow)** 5



(b) A rigid prismatic bar 5m long is supported in a vertical plane by hinge at one end and by a horizontal string attached to it at its mid-point. A 150N weight

hangs vertically from the free end of the bar. Neglect the weight of the bar; determine the tension in the string and the direction of reaction at hinge. (see figure bellow) 5

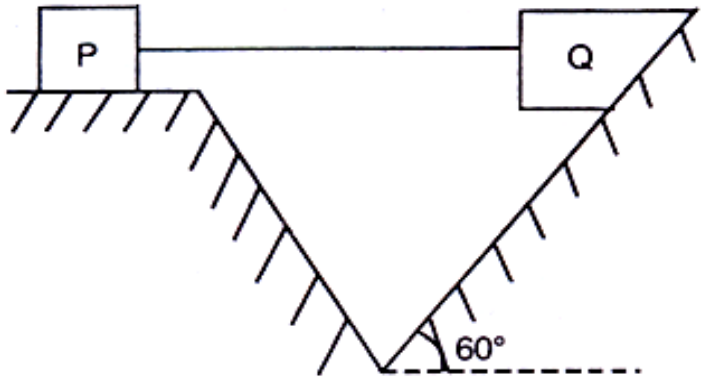


3. (a) A heavy spherical ball of weight W rests in a V-shaped trough whose sides are inclined at angle α and β to the horizontal. Determine the pressure exerted on each side. Neglect friction. Subsequently a similar spherical ball is placed on the side of inclination 'α' and it is made to rest on the first ball. Workout the force exerted by the lower ball on the side inclined at β. (Draw the figures and solve) 6

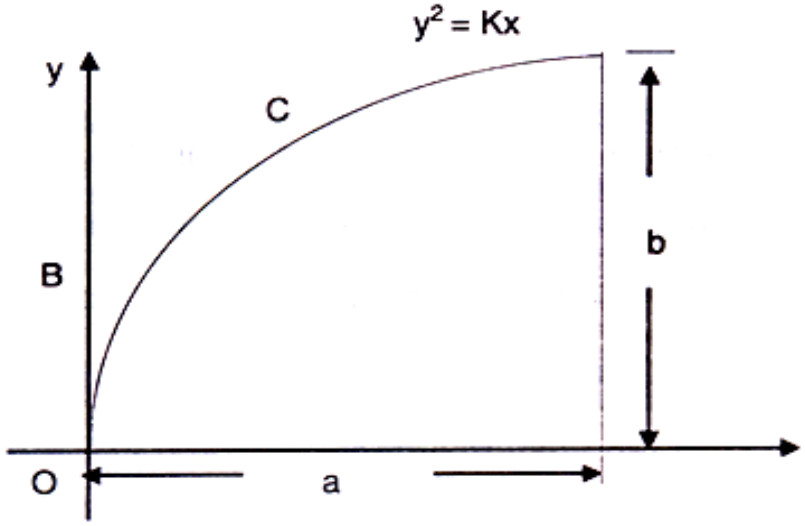
(b) A uniform ladder of weight 25 kN and length 13 m is placed against a smooth vertical wall with its lower end 5m from the wall. The coefficient of friction between the ladder and the floor is 0.3. Show that the ladder will remain in the equilibrium in this position. What is the frictional force acting on the ladder at the point of contact between the ladder and the floor ? (Draw the figure from the question and solve) 4

4. (a) Two blocks P and Q are connected by a horizontal rod by the frictional hinges are supported on two rough planes. The coefficient of friction is 0.3 between the block P and the horizontal surface, and 0.4 between the block

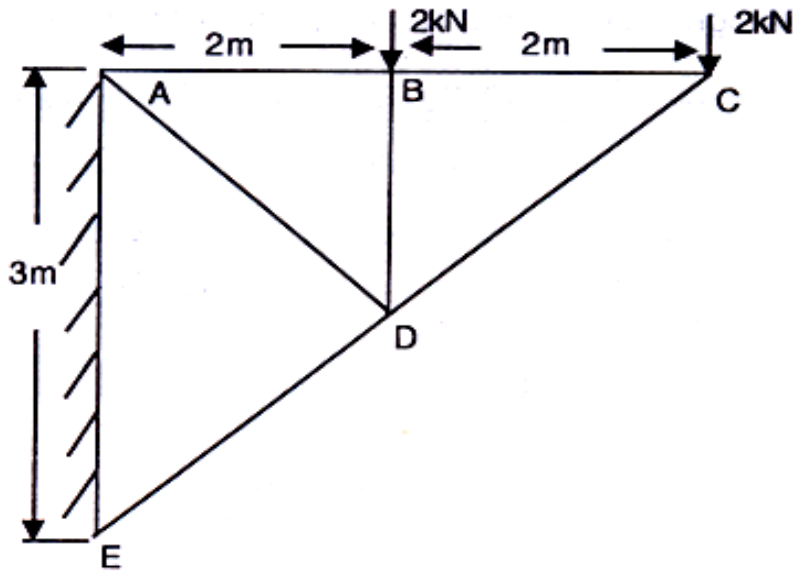
and the inclined surface. Block 'Q' weighs 100 kN. What is the smallest weight of block 'P' to hold the system in equilibrium ? (see figure bellow) 5



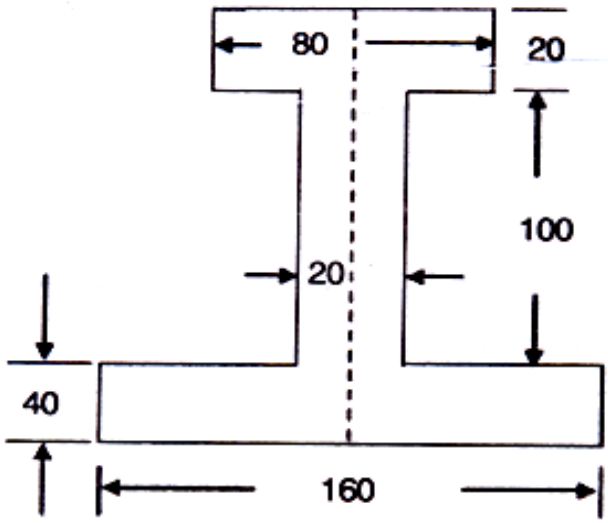
(b) Determine the co-ordinates x_c and y_c of the centroid 'C' of the area bounded by the parabola $y^2 = Kx$ and the straight line $x = a$ and x-axis. (see figure bellow) 5



5. (a) Determine the forces in the various members of the cantilever truss as shown in figure using the method of joints. AB = BC = 2m, Load at B = Load at C = 2 kN, AE = 3 m. 6

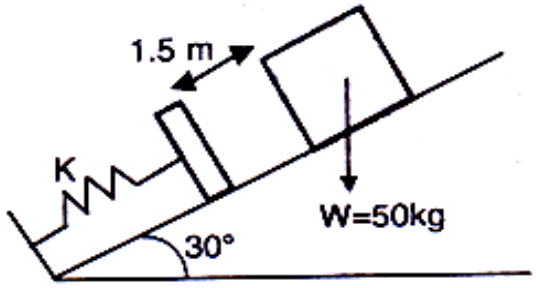


(b) Determine the moment of inertia about the horizontal axis through the centroid of the section (see figure). All dimensions are in mm. 4



6. (a) A stone is dropped from the top of a tower 40m height. At the same instant, another stone is thrown upward from the foot of the tower with an initial velocity of 20m/sec. At what distance from the top and after how much time the two stones cross each other ? Find the relative velocity with which the stone crosses. 4

(b) A body of weight 50kg after sliding 1.5m down the inclined plane, making angle 30°, the block hits a spring of spring constant = 25 N/mm. Co-efficient of friction between the block and the plane = 0.2, calculate maximum deformation of the spring and maximum velocity of the block. 6



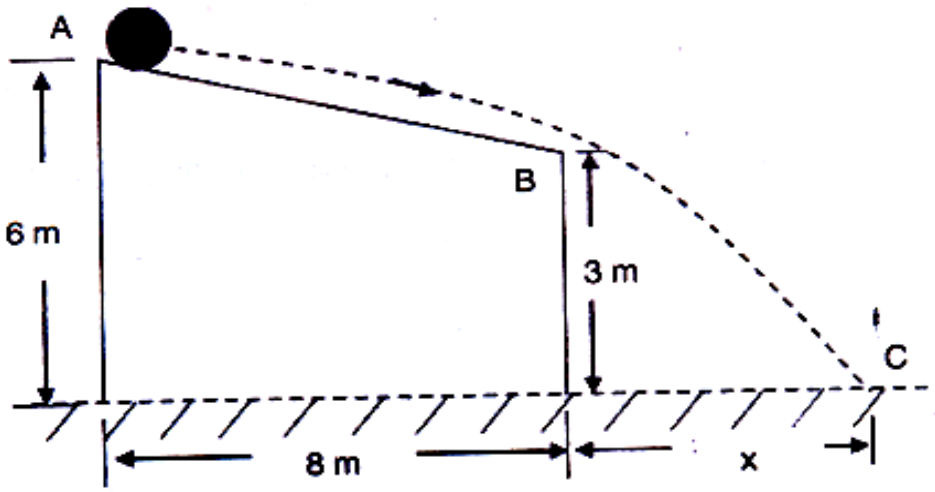
7. Two bodies weighing 300N and 450N are hung to the ends of a rope passing over an ideal pulley. With what acceleration would the heavier body come down ? What is the tension in the rope ? Solve the problem by using 10

(i) The principle of work and energy

(ii) The principle of impulse and momentum

(iii) The D'Alembert's Principle.

8. (a) A ball of weight 1N starts from rest and rolls down the roof and hits the ground as shown in figure. Find at what distance from the building it will hit the ground. Neglecting friction. 6



(b) A uniform flexible chain AB of length 'L' held on a smooth table with a portion 'h' over the hanging (see figure). If released from rest, find the velocity at which the chain will leave the table, 'w' is the weight per unit. Length of the chain = L. 4