B.E / B.Tech (Full Time) DEGREE END SEMESTER EXAMINATIONS,

NOV / DEC 2012

COMMON TO ALL BRANCHES)

SECOND SEMESTER

GE 9151 – ENGINEERING MECHANICS

(REGULATIONS 2008)

Time: 3hours Max Marks: 100

Answer ALL questions

PART A (10 x 2 = 20 Marks)

1. A barge (Fig. 1) is pulled by two tugboats. If the resultant of the forces exerted by the tugboats is a 5000N force directed along the axis of the barge, determine the value of α for which tension in rope 2 is minimum.

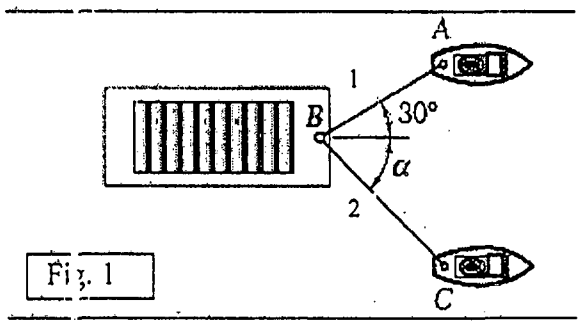


Fig. 1

2. What is the difference between equal and equivalent forces
3. What are the conditions under which a given system of forces acting on a rigid body can be replaced by an equivalent system consisting of a single force?
4. A fixed crane (Fig. 2) has a mass of 1000 kg and is used to lift a 2400 kg crate. It is held in place by a pin at A and a rocker at B. The center of gravity of the crane is located at G. Draw the free body diagram of the crane.

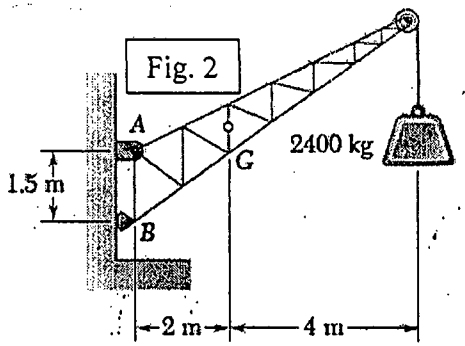


Fig. 2

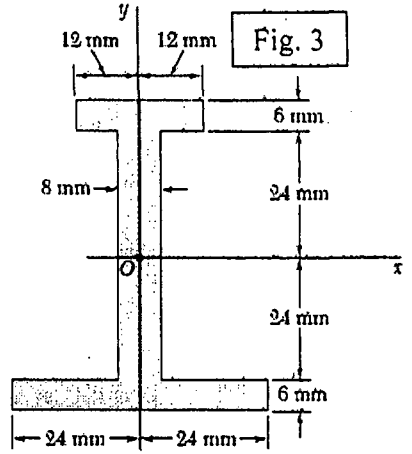


Fig. 3

5. Locate the centroid of the the area shown shaded in fig. 3 along the y axis.
6. The area shown in fig. 4 has principal axes 'a' and 'b' as shown in the figure. What is the product of inertia of this shaded area about the axes a-b?

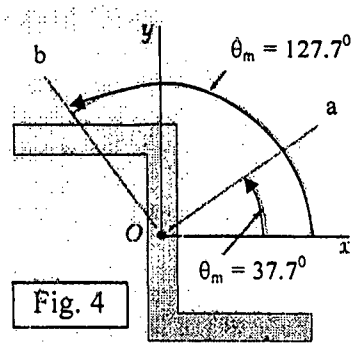


Fig. 4

7. A 20 tonne railroad car moving at a speed of 0.5 m/s to the right collides with a 35 tonne car which is at rest. If after the collision the 35 tonne car is observed to move to the right at a speed of 0.3 m/s, determine the coefficient of restitution between the two cars.
8. A ball is thrown vertically upward with a velocity of 10 m/s. At what time will the ball return to the original position?
9. A 100 N force acts on a 300 N block placed on an inclined plane. The coefficients of friction between the block and the plane are $\mu_s = 0.25$ and $\mu_k = 0.2$. Determine the maximum value of friction force which may develop between the block and the plane (Fig. 5).

Fig. 5

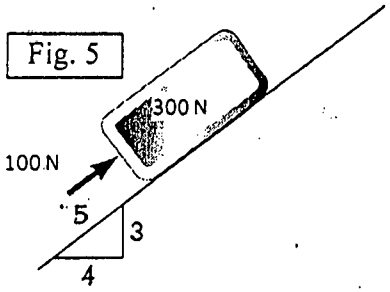
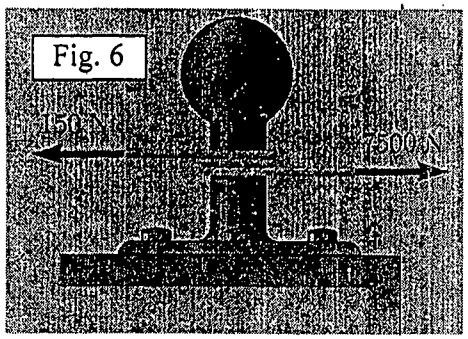


Fig. 6

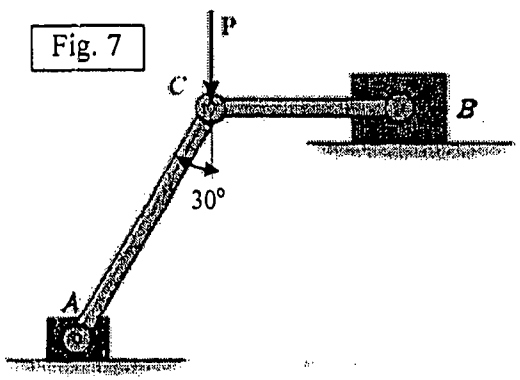


10. A hawser thrown from a ship to a pier is wrapped two full turns around a bollard (Fig. 6). The tension in the hawser is 7500 N; by exerting a force of 150 N on its free end, a dockworker can just keep the hawser from slipping. Determine the tension in the hawser that could be resisted by the 150-N force if the hawser were wrapped three full turns around the bollard.

PART B (5 x 16 = 80 Marks)

11. Blocks A and B in fig. 7 have a mass of 3kg and 9kg respectively, and are connected by weightless links. Determine the largest vertical force P that can be applied at the pin C without causing any movement. The coefficient of static friction between the blocks and contacting surfaces is μ_s=0.3.

Fig. 7



12. (a) (i) The device shown in fig. 8 is used for surgical replacement of the knee joint. If the force acting along the leg is 360N, determine its components along the x' and y axis. (8 marks)

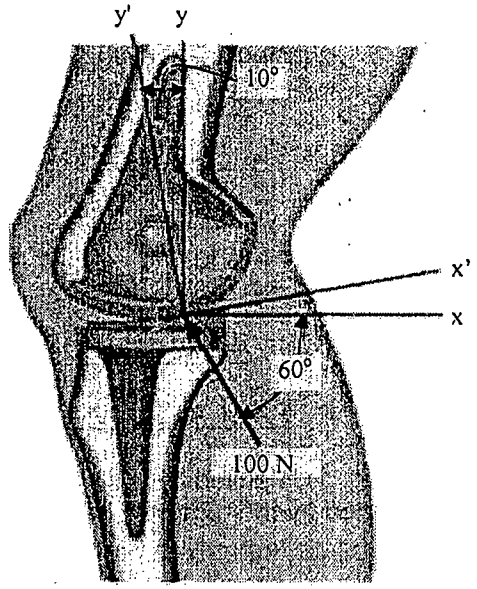


Fig. 8

(a) (ii) A sailor in fig.9 is being rescued using a boatswain's chair that is suspended from a pulley that can roll freely on the support cable *ACB* and is pulled at a constant speed by cable *CD*. Knowing that α = 30° and β = 10° and that the combined weight of the boatswain's chair and the sailor is 900 N, determine the tension (*a*) in the support cable *ACB*, (*b*) in the traction cable *CD*. (8 marks)

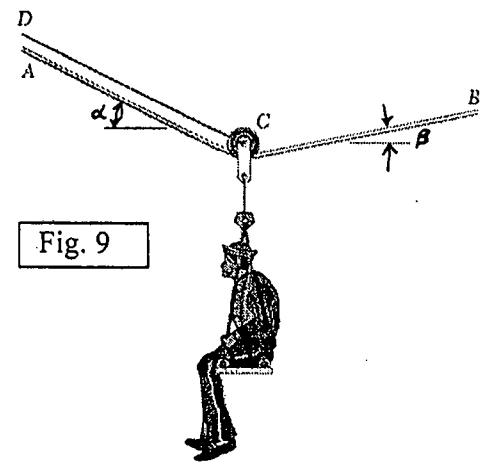


Fig. 9