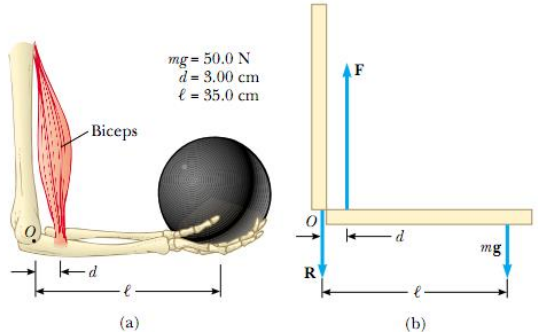
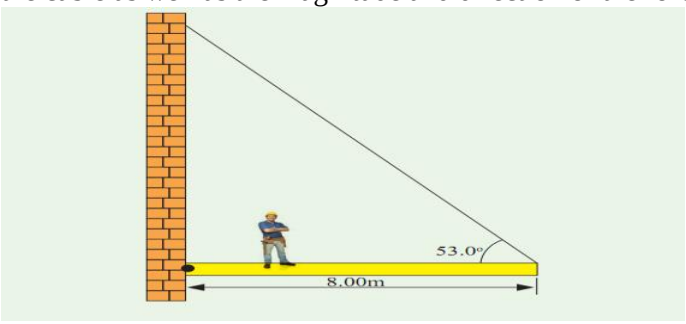
EXERCISE.3.A

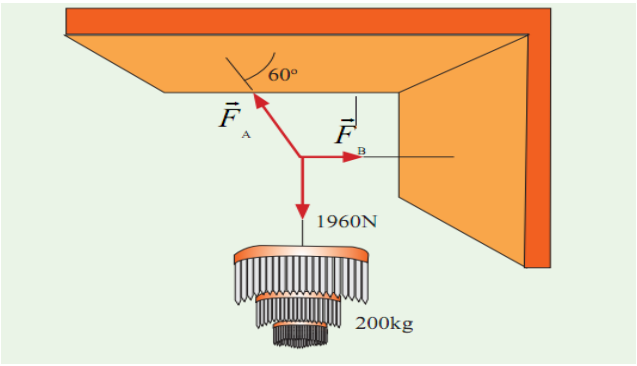
1. A person holds a 50N sphere in his hand. The forearm is horizontal, as shown in Figure. The biceps muscle is attached 3cm from the joint, and the sphere is 35cm from the joint. Find the upward force exerted by the biceps on the forearm and the downward force exerted by the upper arm on the forearm and acting at the joint. Neglect the weight of the forearm.



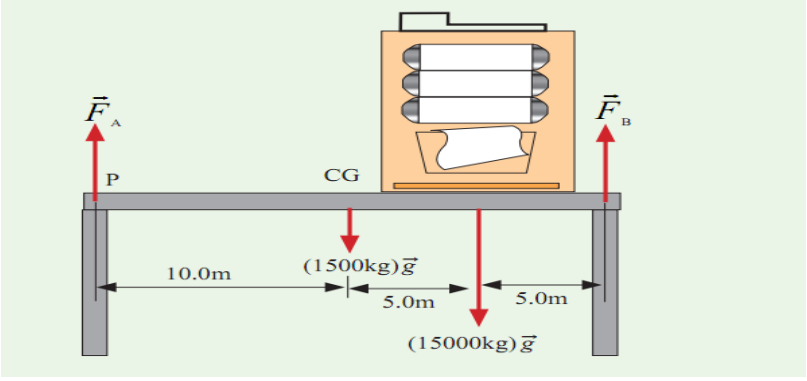
2. A uniform horizontal beam with a length of 8m and a weight of 200N is attached to a wall by a pin connection. Its far end is supported by a cable that makes an angle of 53° with the beam. If a 600N person stands 2m from the wall, find the tension in the cable as well as the magnitude and direction of the force exerted by the wall on the beam.



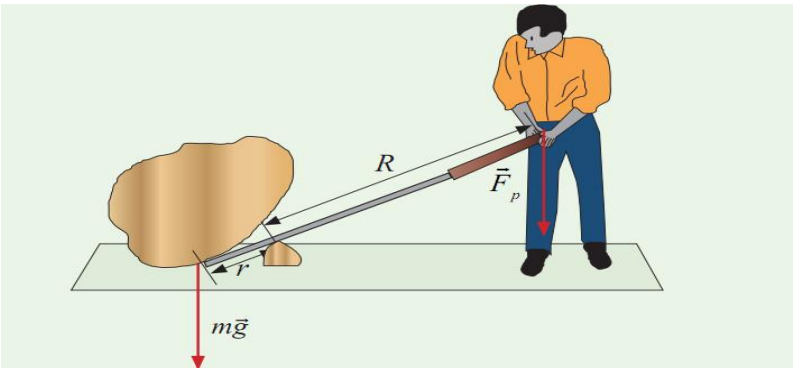
3. Calculate the magnitudes FA and FB of the tensions in the two cords that are connected to the vertical cord supporting the 200kg chandelier in the figure.



4. A uniform 1500kg beam, 20m long, supports a 15,000kg printing press 5 from the right support column, see the figure. Calculate the force on each of the vertical support columns.



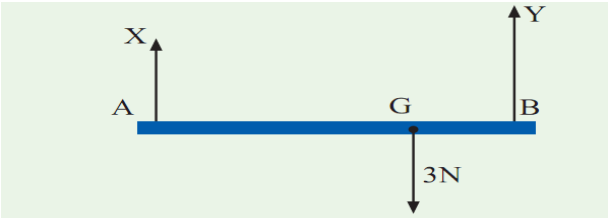
5. The bar in the figure is being used as a lever to pry up a large rock. The small rock acts as a fulcrum (pivot point). The force FP required at the long end of the bar can be quite a bit smaller than the rock's weight mg, since it is torques that balance in the rotation about the fulcrum. If, however, the leverage isn't sufficient, and the large rock isn't budged, what are the two ways to increase the leverage?



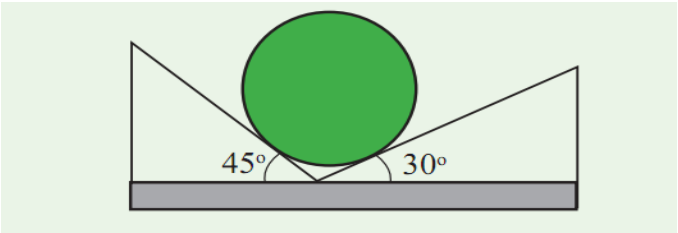
6. The bridge on a river of a country of Central Africa is supposed to have a length of 100m and mass 105kg. It leans on two pillars to its extremities. What are forces exerted on the pillars when three cars (one Mercedes of 1500kg, a Renault of 1200kg and a Fiat 1000kg) are respectively to 30, 80 and 60m from the extremity leaning on the left bank.

7. A horizontal rod AB of negligible weight, 51cm long is submitted in A and in B to two forces F_1 and F_2 of magnitudes respectively 14N and 7N. The force F_1makes an angle of 45° with the vertical and the force F_2 is perpendicular to the rod. Their direction is oriented downward. Determine the characteristics of the force which will make the rod in equilibrium.

8. A horizontal rod AB is suspended at its ends by two strings. (See the figure below). The rod is 0.6m long and its weight of 3N acts at G where AG is 0.4m and BG is 0.2m. Find the tensions X and Y



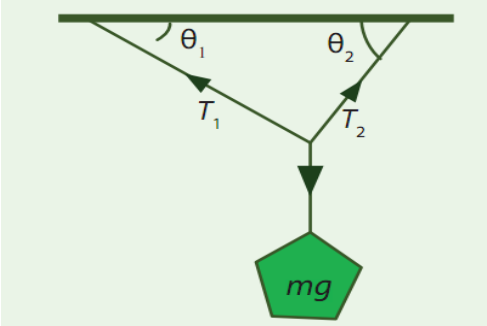
9. A sphere of 50N stands against two inclined planes making respectively angles of 30° and 45°. Calculate the forces of reaction of the two planes on the sphere.



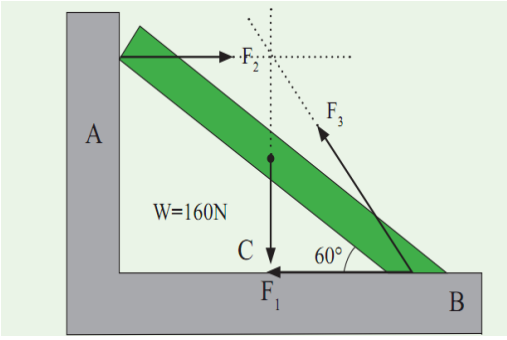
10. A block of mass 330kg is suspended by three unstretchable ropes as shown on the figure below. If the system is in equilibrium,

a) determine T_1

b) If $O_1 = 15°$, $\theta_2 = 30°$, find the tensions in the ropes.

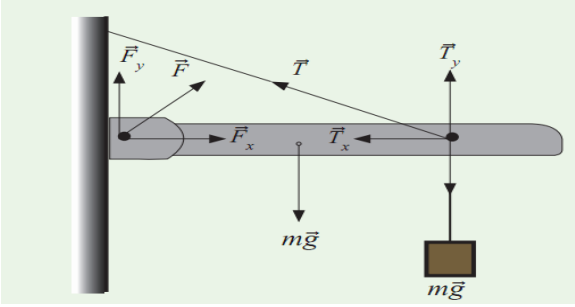


11.A ladder AB weighing 160N rests against a smooth vertical wall and makes an angle of 60° with the ground as shown in the figure below. The ladder has small wheels at the point A such that the friction with the vertical wall is negligible. Find the forces acting on the ladder at point A and point B.



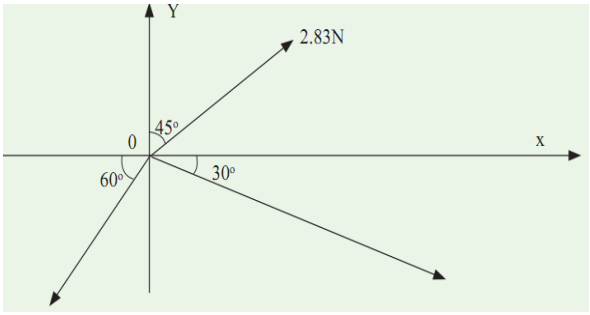
The coefficient of static friction between the ladder and the ground is 0.53. How far up the ladder can the firefighter go before the ladder starts to slip?

12. A homogeneous beam of length 2.2m and of mass m =25kg is fixed on a wall by a hinge and is held in horizontal position by a metallic string making angle of θ = 30° as shown in the figure below. It holds a mass M=280kg suspended at its extremity. Determine the components of the force F exerted by the wall on the beam at the hinge and components of the tension T in the metallic string



13. a) State the conditions under which a rigid body is in equilibrium under the action of coplanar forces.

b) Forces of 2.83N, 4N and 6N act on an object O as shown the figure below.



14. Find the resultant force on the object. When three concurrent forces act on a body which is in equilibrium, the resultant of the two forces should be equal and opposite to the third force. Prove this statement.

15. A uniform ladder of mass m and length L leans against a smooth vertical wall making an angle φ with a horizontal floor. The coefficient of static friction between the ladder and the floor is μ

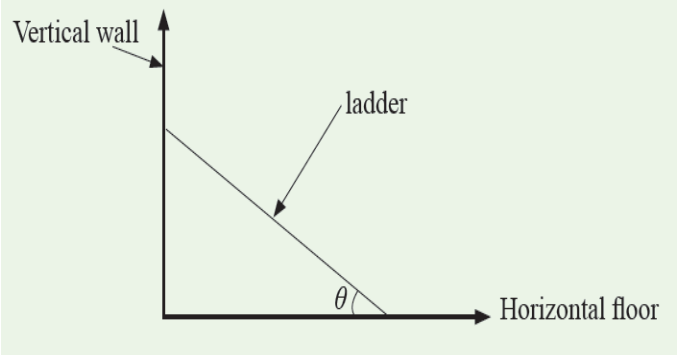


Figure 3.30: Showing a ladder (shape) resting on two surfaces

Find (in terms of μ) the minimum angle θ_m at which the ladder does not slip