TUTORIAL QUESTIONS_FORCES 2

Question 1

An object has a mass of 2.3 kg. When the object falls in air, the air resistance F is given by the equation

$$F = kv^2$$

where v is the velocity of the object and k has the value of 0.042 $Ns^2\ m^{-2}$.

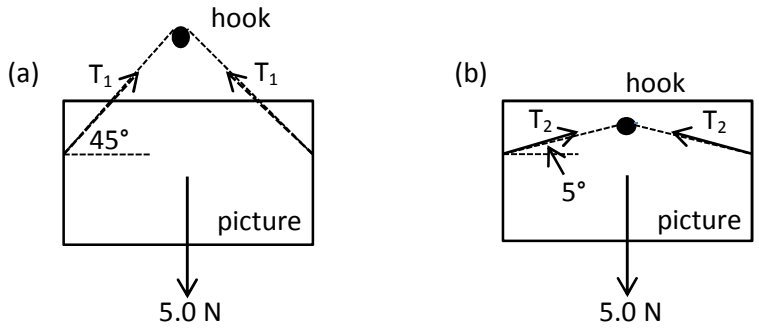
a.) Explain why the object eventually falls with uniform velocity. (the terminal velocity)

b.) Calculate the terminal velocity of the object.

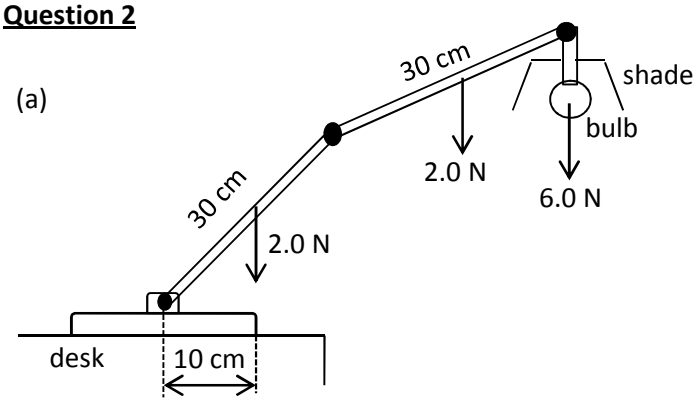
c.) Calculate the acceleration of the object when it is falling with a velocity of 12 ms^{-1}.

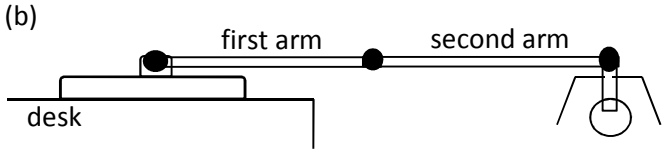
Question 2

A picture of weight 5.0 N is suspended from a hook on a wall by a cord which has a breaking strength of 25.0 N. Initially the picture (a) is found to be too low, the cord is shortened, with the intention of hanging the picture as in (b). However, when the picture is replaced the cord breaks immediately. Explain why the cord broke when supporting a load so much less than its breaking strength.



Question 2





A desk lamp is illustrated as (a). The lamp must be constructed so hat it does not topple over when fully extended as shown in (b). The base of the lamp is circular and has a radius of 10 cm. Other dimensions are as shown. The total weight of the bulb and shade is 6.0 N and each of the two uniform arms has weight of 2.0 N.

a.) On figure (b), draw an arrow to represent the weight of the base.

b.) The lamp will rotate about a point if the base is not strong enough. On figure (b) as well, mark this point and label it P.

c.) Calculate the moments about P for

i.) first arm

ii.) second arm

iii.) light bulb and shade

Question 4

A lift has a mass of 1800 kg and the rope supporting it exerts an upward force on it of 15 000 N.

a.) What is the acceleration of the lift?

b.) If this lift is travelling upwards at a velocity of 3.8 ms^{-1}, how long will it take to stop?

If a man of mass 100 kg gets into the lift as above, and the rope now exerts a force upwards on the lift of 20 000 N, find:

c.) the acceleration of the lift and man.

d.) the force the lift exerts on the man.

Question 5

The take-off acceleration of a high jumper is 17.0 ms^{-2} upwards. His mass is 67 kg.

a.) What force is the ground exerting on the man?

b.) What is the ratio of this force to his weight?

c.) Explain how it is possible for this force to be larger than the high-jumper's weight.

Question 6

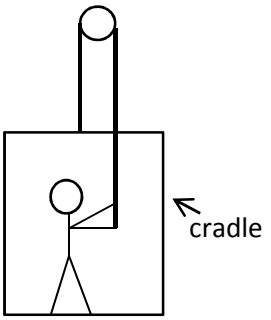
A man in the builder's cradle is lifting himself upwards. (There are safety devices not shown to prevent him falling). He has a mass of 80 kg and the cradle has a mass of 30 kg. He is pulling the rope with a force of 600 N. Draw the free-body diagram of the

a.) man

b.) cradle

c.) Find the acceleration of the man

d.) Find the force that the man exerts on the floor of the cradle.



Question 7

The figure shows a man of weight 800 N pulling a wooden crate of weight 600 N with a frictionless pulley system. The force exerted by the man on the floor is 400 N as the crate moves upwards.

a.) Find the acceleration of the crate and the man.

b.) The tension of the rope.