7

(a)

Explain what are meant by the *moment of a force* and the *torque of a couple*. Distinguish between the two terms.

……

……

……

……

……

…….. [3]

(b)

One type of weighing machine, known as a steelyard, is illustrated in Fig. 7.1

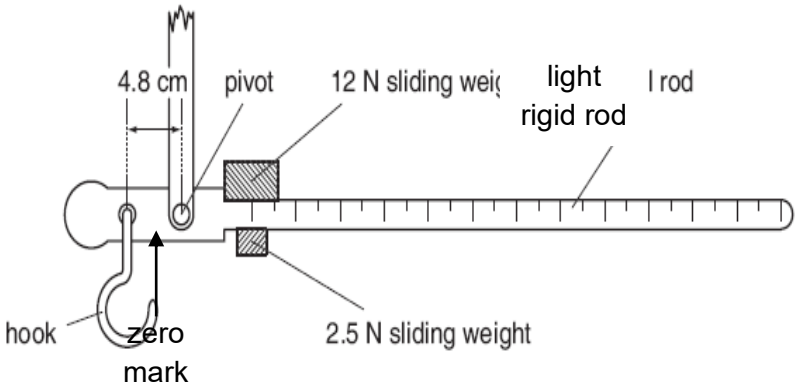


Fig. 7.1

The 12 N and 2.5 N sliding weights can be moved independently along the light rigid rod.

With no load on the hook and the sliding weights at the zero mark on the rigid rod, the rod is horizontal. The hook is 4.8 cm from the pivot.

(i)

Explain why the light rigid rod can remain horizontal with no load on the hook.

……

……

……[1]

(ii)

Explain why the perpendicular distance from the hook to the pivot is deliberately kept shorter compared to the length of the rigid rod.

……

……

……

…… [2]

(iii)

A sack of flour is suspended from the hook. In order to return the light rigid rod to the horizontal position, the 12 N sliding weight is moved 84 cm along the rod and the 2.5 N sliding weight is moved 72 cm.

Calculate the mass of the sack of flour.

mass= ……kg

[2]

(iv)

Explain why this steelyard would be less accurate when weighing objects with a weight of about 25 N.

……

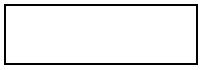
……

……[2]

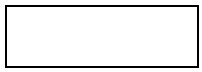
(c)

(i)

By referring to work done being the product of force and the displacement in the direction of the force, derive the formula $E_p = mgh$ for potential energy changes near the Earth's surface.



[3]



(ii)

A typical escalator rises at an angle of 30º to the horizontal. It lifts people through a vertical height of 15 m in 0.50 minute. Assuming all the users stand still while on the escalator, 60 users can get on at the bottom and get off at the top in 0.50 minute. The average mass of a user is 55 kg.

1.

Determine the average power needed to lift the users when the escalator is fully laden.

Assume that any kinetic energy transferred to the users by the escalator is negligible.

average power = ……W

[2]

2.

The frictional force in the escalator system is 1.0×10^4 N when the escalator is fully laden.

Calculate the power to overcome friction.

power = ……W

[3]

3.

When there are 60 users walking up the moving escalator, instead of standing still, at any point in time, explain whether more or less power is required by the motor to maintain the escalator at the same speed.

……

……

……

……[2]

[Total: 20]