2 **(a)** Fig. 2.1 shows a simplified model of a man lifting a suitcase. The spine can be treated as a rigid rod.

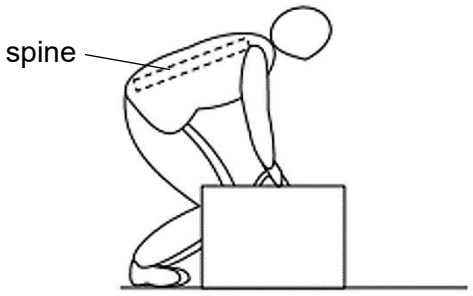


Fig. 2.1

When the suitcase is lifted, three forces P, Q, and R act on the spine which is in equilibrium. P is the force due to lifting the suitcase, Q is the force exerted by the muscles and R is the force acting on the base of the spine.

Fig. 2.2 shows the directions and points of action of only P and Q.

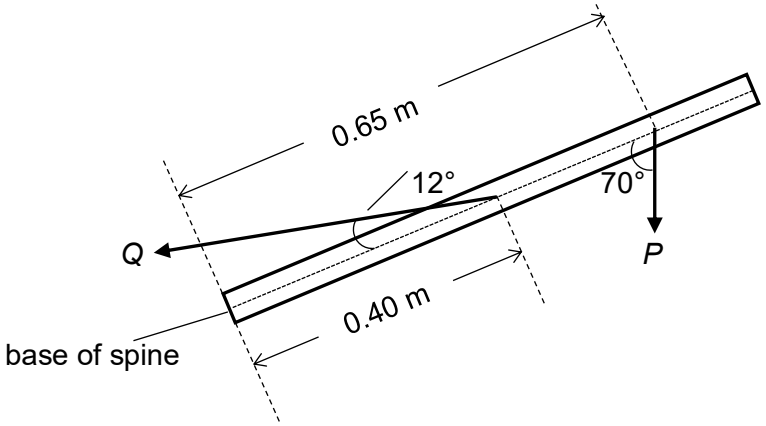


Fig. 2.2

(i) State the conditions required for a body to be in equilibrium.

……..……..

……..……..

……..……..

……..…… [2]

(ii) Force R acts at the base of the spine.

On Fig. 2.3, draw an arrow to represent the direction of force R.

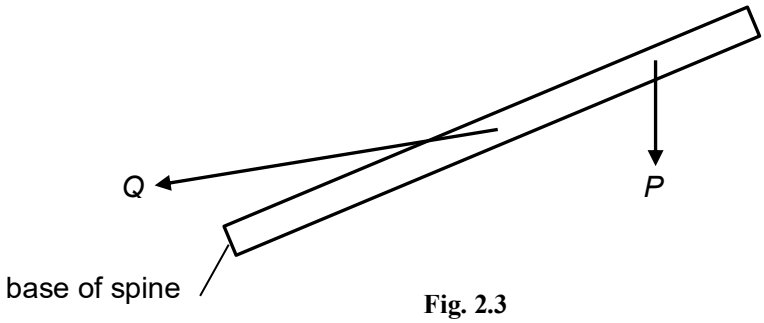


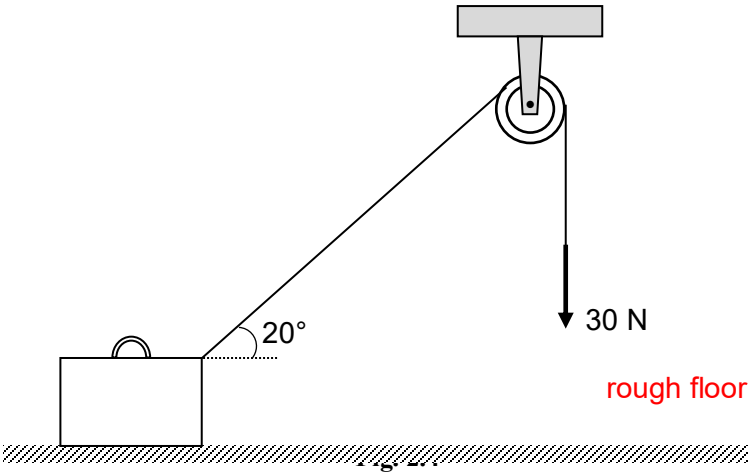
Fig. 2.3

[1]

(iii) Calculate the ratio of $\frac{Q}{P}$.

$\frac{Q}{P}$ = ... [2]

(b) The suitcase of mass 11 kg is tied to a light rope that is passed over a pulley as shown in Fig. 2.4. When the man applies a force of 30 N on the rope, the suitcase accelerates horizontally across a rough floor. The frictional force between the suitcase and the rough floor is 8.5 N.



(i) Determine the normal contact force acting on the suitcase.

normal contact force = …… N [2]

(ii) State Newton's second law of motion.

……..……...……

……..……..…

……..…… [1]

(iii) Determine the horizontal acceleration of the suitcase.

horizontal acceleration = …… m s^{-2} [2]