Forces and Motion

1.

A car accelerates at a steady rate of $2.5\,m\,s^{-2}$ along a straight, level road. The mass of the car is 1.3×10^3 kg.

(a) Calculate the magnitude of the resultant force acting on the car.

The total force opposing the motion of the car is 410 N.

(b) Calculate the driving force produced by the wheels.

2.

A rocket of mass 550 kg blasts vertically from the launch pad at an acceleration of $4.2\,m\,s^{-2}$. Calculate:

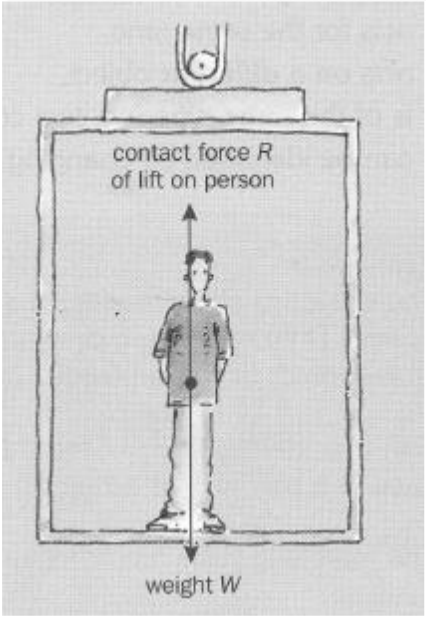
a the weight of the rocket,

b the thrust of the rocket engines.

3.

The diagram shows the forces acting on a person in a lift.
The person has a mass of 70 kg. Taking $g = 10\ \text{N kg}^{-1}$,
calculate the contact force R when:

a) the lift is at rest
b) the lift is accelerating upwards at $1.0\ \text{m s}^{-2}$
c) the lift is accelerating downwards at $2.0\ \text{m s}^{-2}$
d) the lift is ascending at a steady speed.



4.

Fig. 5.1 shows a person standing in a stationary lift.

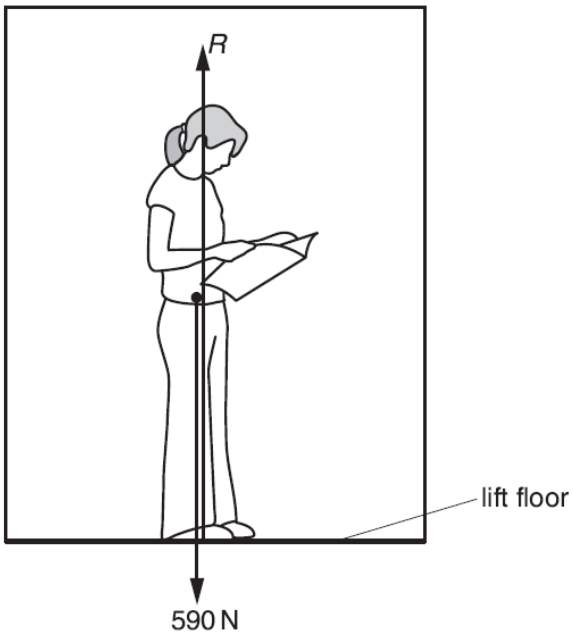


Fig. 5.1

There are only two forces acting on the person. The weight of the person is 590 N. The vertical contact force acting on the person from the floor of the lift is *R*.

(a) Show that the mass of the person is 60 kg.

[1]

(b) The lift starts from rest. It has a constant upward acceleration of 0.50 $m s^{-2}$. Calculate the magnitude of the contact force *R*.

R = ... N **[2]**

(c) After a short period of acceleration, the lift travels upwards at a constant velocity. Explain why the force *R* is equal to the weight of the person when the lift travels at a constant velocity.

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..... **[1]**

(d) State and explain how the force *R* changes at the instant the lift starts to decelerate.

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..... **[2]**

5.

A lift and its occupants have a total mass of 1200 kg. Calculate the tension in the lift cable when the lift is:

a stationary,

b ascending at constant speed,

c ascending at a constant acceleration of $0.4\,m\,s^{-2}$,

d descending at a constant deceleration of $0.4\,m\,s^{-2}$.

6.

A car of mass 1400 kg, pulling a trailer of mass 400 kg, accelerates from rest to a speed of 9.0 m s^{-1} in a time of 60 s on a level road. Assuming air resistance is negligible, calculate:

a the tension in the tow bar,

b the engine force.

7.

A brick of mass 3.2 kg on a sloping flat roof, at 30° to the horizontal, slides at constant acceleration 2.0 m down the roof in 2.0 s from rest. Calculate:

a the acceleration of the brick,

b the frictional force on the brick due to the roof.

8.

(a) Use the relation between force, mass and acceleration to express the newton in terms of the SI units of mass, length and time.

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.....[1]

(b) Fig. 3.1 shows a garden roller, of mass 80 kg, being pulled with a force of 250 N at an angle of 30° to the horizontal. The roller moves at a constant velocity.

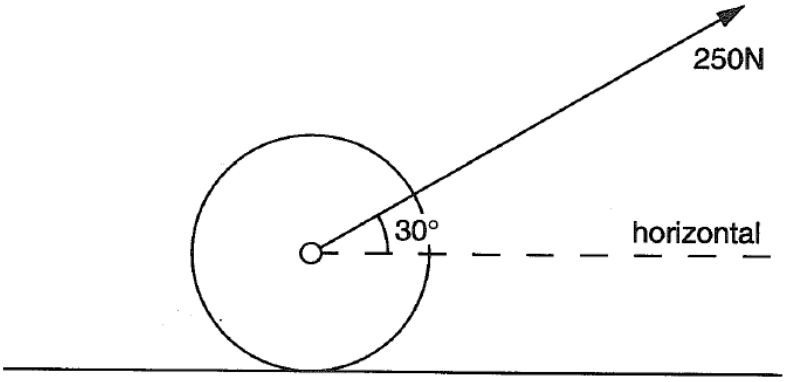

Fig. 3.1

(i) Calculate the weight of the roller.

weight = ... N [1]

(ii) Calculate the magnitude of the horizontal component of the force pulling the roller.

horizontal force = ... N [2]

(iii) Calculate the magnitude of the vertical force exerted by the roller on the ground.

vertical force = ... N [3]