

# Forces ( $F = ma$ / Resultant forces)

## Question Paper 1

Level	IGCSE
Subject	Physics
ExamBoard	CIE
Topic	General Physics
Sub-Topic	Forces $F = m/a$ / Resultant forces
Paper Type	(Extended) Theory Paper
Booklet	Question Paper 1

**Time Allowed:** 42 minutes

**Score:** /35

**Percentage:** /100

1 The rocket shown in Fig. 2.1 is about to be launched.

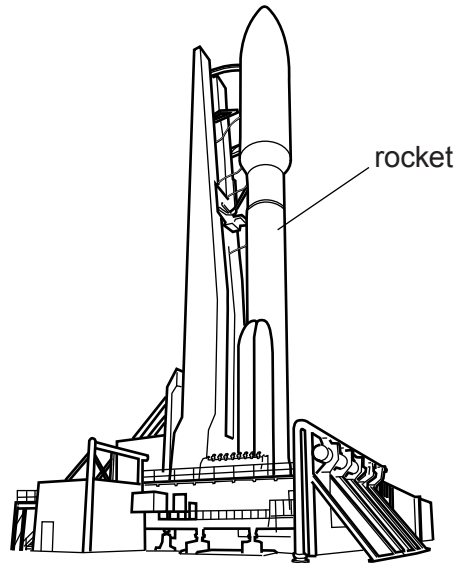


Fig. 2.1

The total mass of the rocket and its full load of fuel is  $2.8 \times 10^6$  kg. The constant force provided by the rocket's motors is  $3.2 \times 10^7$  N.

(a) Calculate

(i) the total weight of the rocket and the fuel,

weight = ..... [1]

(ii) the resultant force acting on the rocket,

resultant force = ..... [2]

(iii) the vertical acceleration of the rocket immediately after lift-off.

acceleration = ..... [2]

**(b)** Suggest why the acceleration of the rocket increases as it rises above the Earth's surface.

.....

..... [1]

[Total: 6]

- 2 Fig. 4.1 shows a heavy ball B of weight  $W$  suspended from a fixed beam by two ropes P and Q.

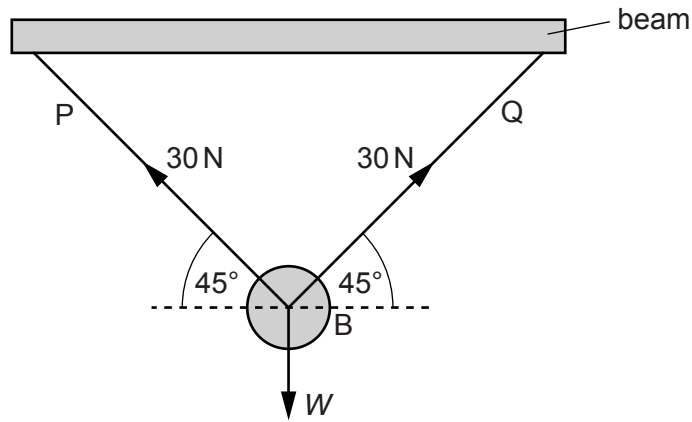


Fig. 4.1

P and Q are both at an angle of  $45^\circ$  to the horizontal. The tensions in P and Q are each 30 N.

- (a) In the space below, draw a scale diagram to find the resultant of the tensions in P and Q. Use a scale of 1.0 cm to represent 5.0 N. Label the forces and show their directions with arrows.

resultant = ..... [4]

- (b) State the direction of the resultant. .... [1]

- (c) State the magnitude of  $W$ . magnitude of  $W$  = ..... [1]

[Total: 6]

3 (a) State the two conditions necessary for a system of forces acting on a body to be in equilibrium.

- 1. ....
- .....
- 2. ....
- .....

[2]

(b) Fig. 1.1 shows a loaded wheelbarrow held in equilibrium by a gardener. The wheel of the wheelbarrow is in contact with the ground at point C.

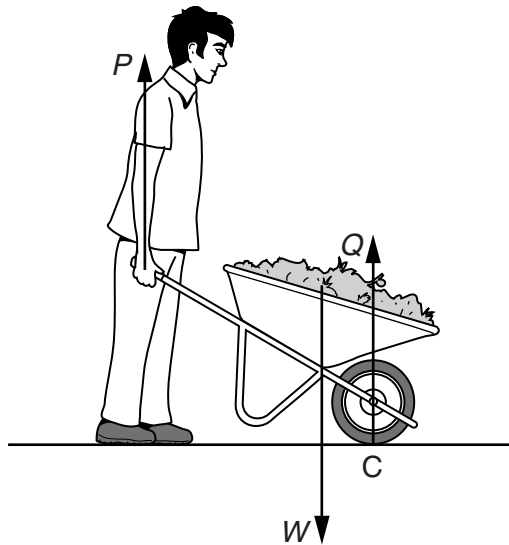


Fig. 1.1

In Fig. 1.1, there are three vertical forces acting on the wheelbarrow.

- P* is the upward force applied by the gardener.
- Q* is the upward force of the ground on the wheel at point C.
- W* is the weight of the wheelbarrow and its contents.

Explain why the force *P* is less than the force *W*

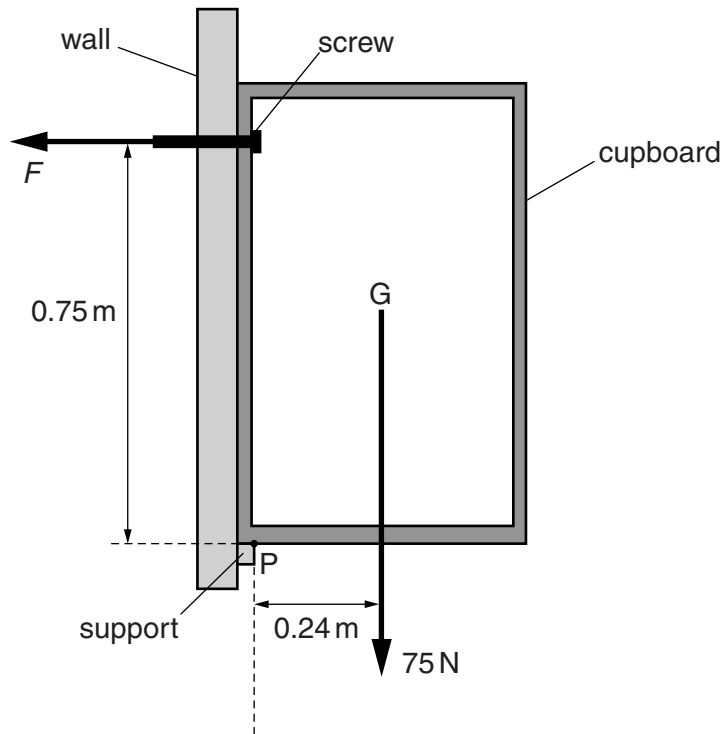
(i) by considering the forces *P*, *Q* and *W*,

- .....
- ..... [2]

(ii) by considering the moments of the forces  $P$  and  $W$  about point  $C$ .

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

(c) Fig. 1.2 shows a kitchen cupboard resting on a support and attached to a wall by a screw.



**Fig. 1.2**

The weight of the cupboard and its contents is  $75\text{ N}$ .  $G$  is the position of the centre of mass of the cupboard.

The clockwise and anticlockwise moments about point  $P$  are equal.

Calculate the force  $F$  exerted by the screw.

$F = \dots\dots\dots$  [3]

[Total: 9]

4 Fig. 2.1 shows a tanker lorry full of liquid.

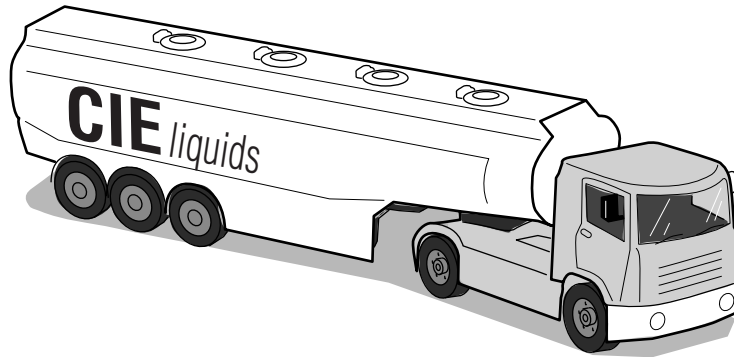


Fig. 2.1

The tanker delivers the liquid and drives away empty.

(a) (i) Compare the acceleration of the empty tanker with the acceleration of the full tanker for the same resultant force. Tick **one** box.

acceleration of full tanker is less than acceleration of empty tanker

acceleration of full tanker is the same as acceleration of empty tanker

acceleration of full tanker is more than acceleration of empty tanker

[1]

(ii) Explain your answer.

.....

.....

.....

..... [2]

- (b)** The empty tanker has a weight of 50 000 N. The forward force is 6000 N and the total resistive force is 2000 N.

Calculate the acceleration.

acceleration = ..... [3]

[Total: 6]



- 5 Fig. 2.1 shows a model fire engine used by a student to take measurements of force and motion.

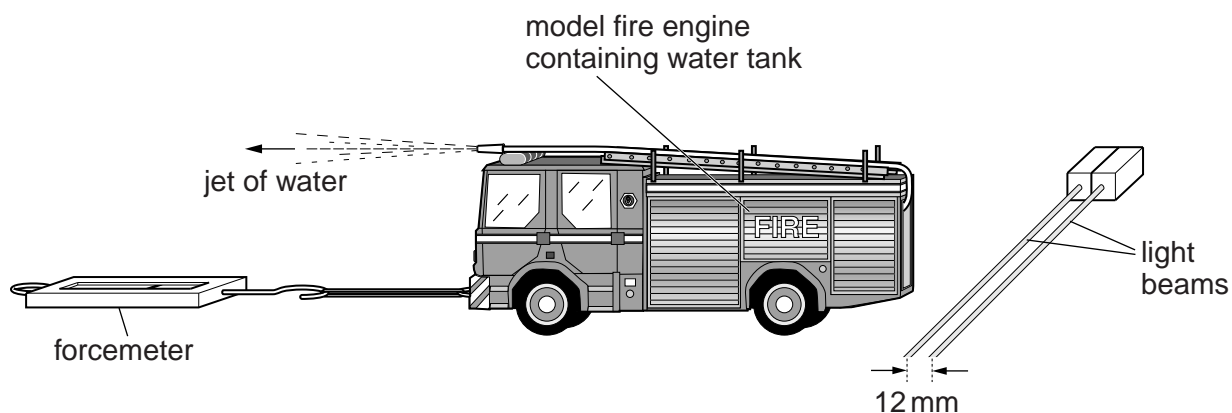


Fig. 2.1

The model projects a jet of water forwards. The forcemeter holds the model stationary. It indicates a force of 0.060 N acting on the model.

The forcemeter is now disconnected and the model accelerates to the right at  $0.030 \text{ m/s}^2$ .

- (a) The back of the model breaks a pair of light beams and the time to pass between them is measured electronically. The beams are 12 mm apart and the second beam is broken 0.080 s after the first.

The student times with a stopwatch how long it takes from the release of the model until the beams are cut.

Calculate the time he measures.

time measured = ..... [4]

- (b) This experiment is carried out with the water tank in the model nearly full.

Calculate the mass of the model including the water in the tank.

mass = ..... [2]

- (c) The student repeats the experiment with the same force but with the water tank nearly empty.

State and explain how the acceleration will compare to that of the first experiment.

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

[Total: 8]