Write your name, centre number and candidate number in the boxes below.

| Surname | Other names |
|---|---|
| | |

Centre number | | | | | |

Candidate number | | | | |

**STEM** | Exam Builder

# Forces and momentum

Time allowed: 1 hour 5 minutes

**Subject code** **0625**

# Physics

## Questions from Paper 3 and Paper 4

**You must have:** a ruler marked in centimetres and millimetres, a protractor, compasses, a pen, an HB pencil and an eraser.

Total marks

**/ 66**

### Instructions

- Answer every question in the space provided on this paper.
- Write in black or dark blue ink. Pencil may be used for diagrams and graphs.
- Fill in your name, centre number and candidate number above.
- Show your working: a correct method can earn marks even if the answer is wrong.

### Information

- This paper has 10 questions worth 66 marks in total.
- The marks for each question or part are shown in brackets, for example [3].

### Advice

- Read every question through once before you write anything.
- Use the marks in brackets to judge how long to spend on each part.
- If you finish early, go back and check your working.

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Print at 100% (Actual size) so diagrams keep their real measurements.

**1** Fig. 2.1 shows a cyclist travelling along a level road.

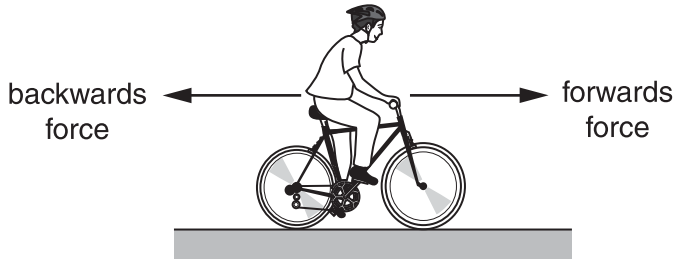



**Fig. 2.1**

**(a)** Describe the movement of the bicycle when the forces shown in Fig. 2.1 are of equal size.

..... [1]

**(b)** Fig. 2.2 shows the forces on the bicycle later in the journey.




**Fig. 2.2**

Determine the size and direction of the resultant force.

size of resultant force = ..... N

direction of resultant force = .....

[2]

**(c)** At the end of the journey the cyclist applies the brakes to stop the bicycle.

Name and describe the force that causes the bicycle to stop.

force .....

description .....

.....

[2]

[Total: 5]

Resultant force, F = ma and circular motion Click for more variations

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2 **(a)** A student has a spring of length 14.0 cm. She stretches the spring by adding different loads to the spring.
She measures the length of the spring for each load. She plots a graph of the results.
Fig. 2.1 shows the graph of her results.

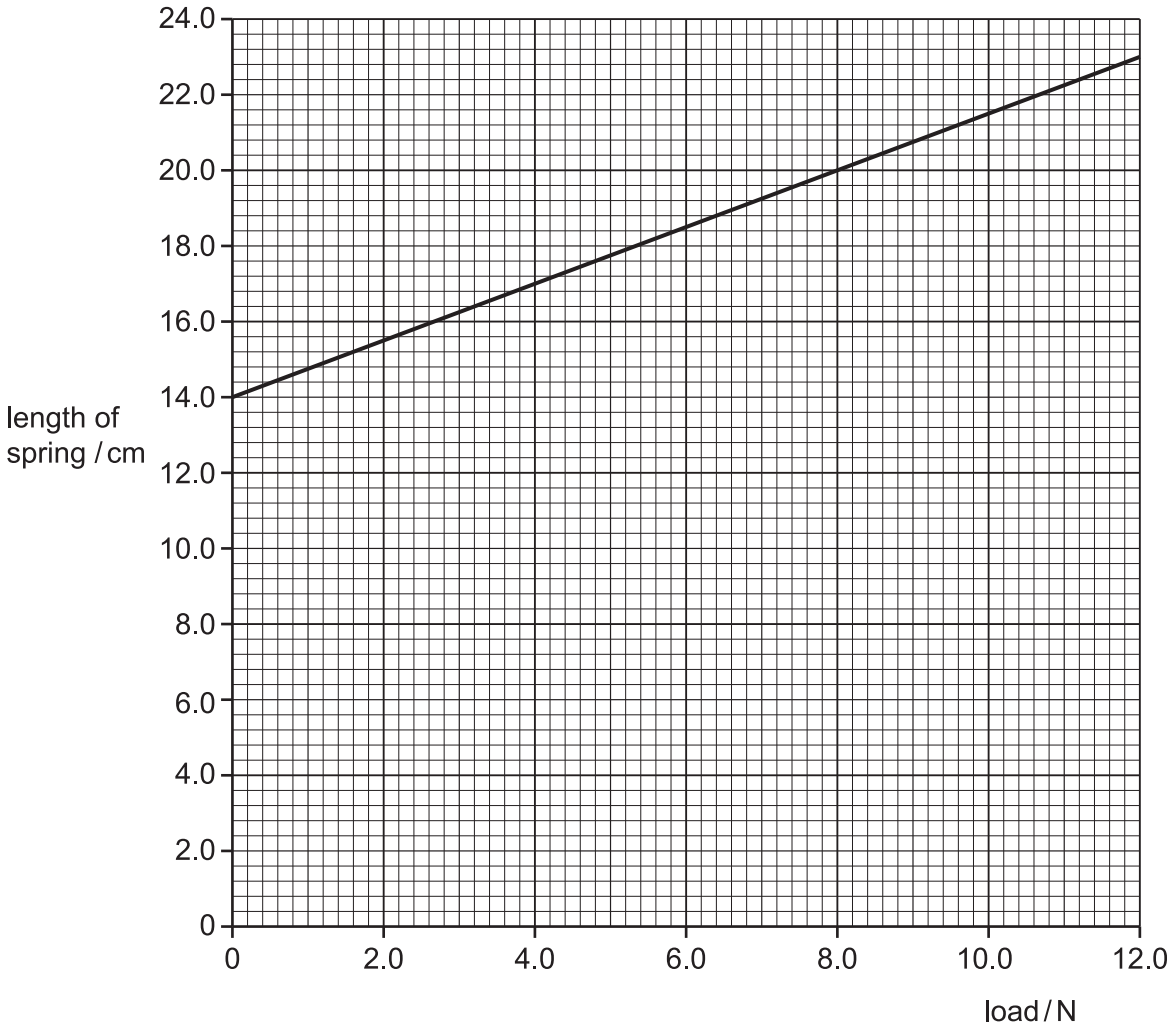



**Fig. 2.1**

**(i)** Use the graph to determine the length of the spring when the student adds a load of 8.0 N to the spring.

length of spring = ..... cm [1]

**(ii)** Use the graph to determine the load added to the spring when the **extension** of the spring is 7.0 cm.

load for an extension of 7.0 cm = ..... N [2]

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**(b)** Complete the sentence about effects of forces. Choose a word from the box.

| charge | mass | power | shape | velocity |
|---|---|---|---|---|

A load stretching a spring is an example of a force changing the size and the ..... of an object. [1]

**(c)** A clamp stand used in the experiment has a weight of 8.6 N.
Calculate the mass of the clamp stand.

mass of clamp stand = ..... kg [3]

[Total: 7]

Springs and Hooke's law Click for more variations

**3** A cricket ball is travelling at a speed of 25 m / s horizontally through the air. The mass of the ball is 0.14 kg.

A player catches the ball and the ball comes to rest.

**(a)** Calculate the change in momentum of the ball during the catch.

change in momentum = ..... [2]

**(b)** The player's hands are in contact with the moving ball for 9.7 ms.

Calculate the horizontal force exerted by her hands to bring the ball to rest.

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force = ..... [3]

[Total: 5]

Momentum and impulse Click for more variations

**4** Fig. 1.1 shows a force–extension graph for a spring.

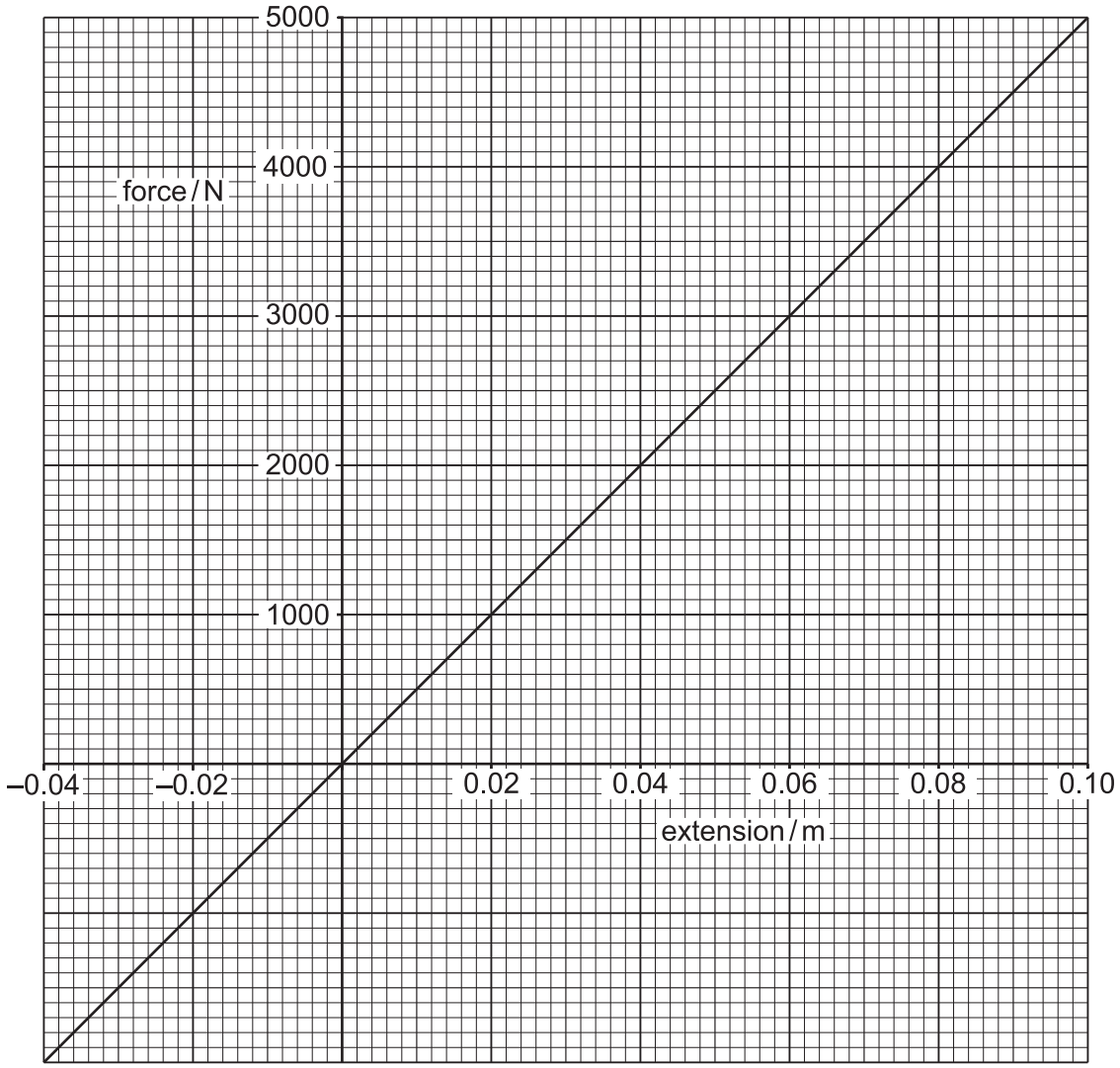



**Fig. 1.1**

**(a)** Calculate the spring constant *k* of the spring.

*k* = ..... [2]

**(b)** A student states that the spring has **not** reached the limit of proportionality when a force of 4500 N is applied to it.

State how the graph shows that this statement is true.

.....

..... [1]

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**(c)** Springs can be compressed by forces. The spring described by Fig. 1.1 is compressed by a force $F$ and has an extension of $-0.025\,\text{m}$.

Determine $F$.

$F$ = ..... [2]

**(d)** State whether force is a scalar quantity or a vector quantity. Explain your answer.

.....

..... [1]

[Total: 6]

Springs and Hooke's law Click for more variations

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5 Fig. 3.1 shows a collision at very slow speed between two cars travelling along a straight road.

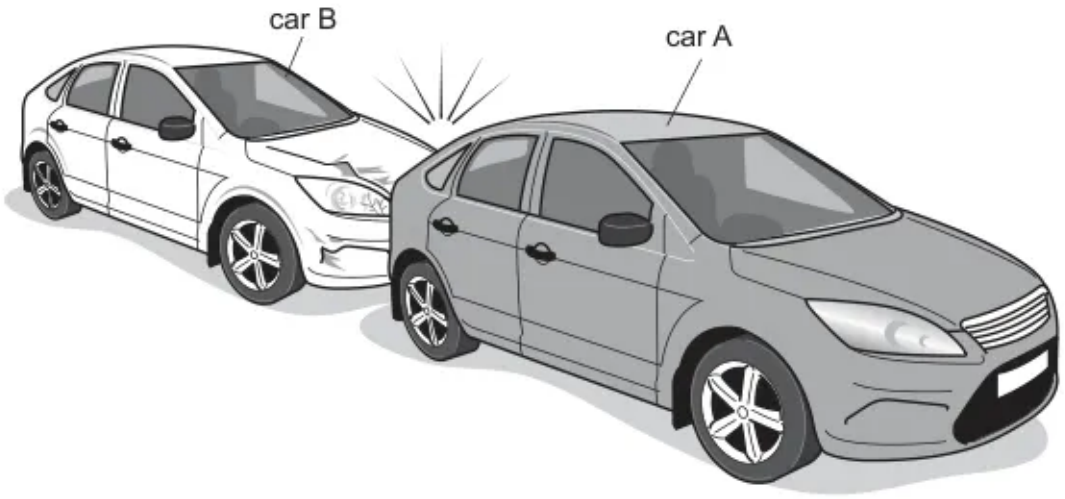



**Fig. 3.1**

Car B, of mass 800 kg, is moving at 2.0 m/s and collides with car A, of mass 1000 kg, which is stationary. After the collision, both cars travel in the same direction as the initial direction of car B.

**(a)** After the collision, car A moves at 1.3 m/s.

Show that the speed of car B after the collision is approximately 0.4 m/s.

[3]

**(b) (i)** Calculate the impulse exerted by car A on car B.

impulse = ..... [2]

**(ii)** State the impulse exerted by car B on car A.

impulse = ..... [1]

[Total: 6]

Momentum and impulse Click for more variations

**6** **(a)** Define impulse.

.....

..... [1]

**(b)** Fig. 2.1 shows a rocket and its exhaust gases.

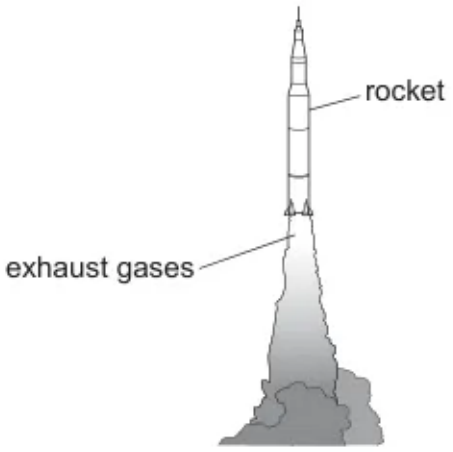



**Fig. 2.1**

The exhaust gases are emitted from the rocket with a velocity of 1400 m/s and at a rate of 2800 kg/s.

**(i)** Show that the force exerted on the rocket by the exhaust gases is 3900 kN.

State the equation you use.

[2]

**(ii)** Calculate the maximum mass that this force can lift from the ground. Ignore air resistance.

maximum mass = ..... [3]

[Total: 6]

Mass and weight Click for more variations

7 **(a)** Describe an experiment to determine the spring constant of a spring.

State:

- the apparatus you need
- details of how to take measurements
- how to calculate the spring constant

You may use the space below to draw a **labelled** diagram as part of your answer.

.....

.....

.....

.....

.....

.....

.....

..... [4]

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**(b)** Fig. 2.1 shows a baby in a baby bouncer. The baby bouncer consists of a holder suspended from a spring. The baby pushes his feet on the ground and bounces gently up and down.

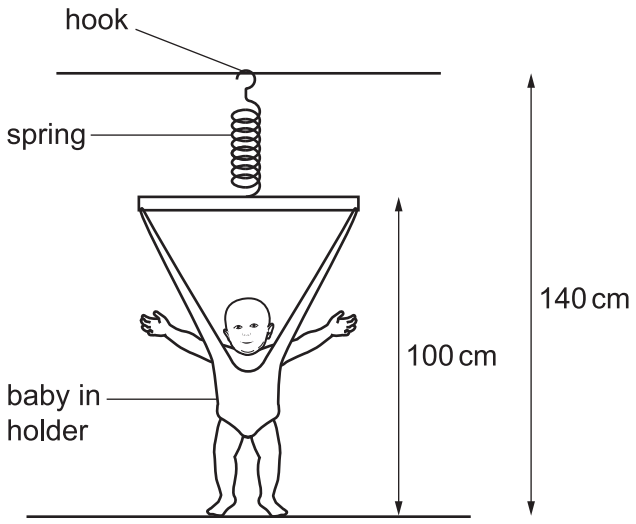



**Fig. 2.1**

**(i)** Two springs Q and R are tested to determine their spring constants.

Each spring is tested up to its limit of proportionality.

Define 'limit of proportionality'.

.....

..... [1]

**(ii)** Table 2.1 shows the results of the tests.

| spring | spring constant / N/cm |
|---|---|
| Q | 7.8 |
| R | 1.1 |

**Table 2.1**

The total weight of the baby and the holder is 120 N.

Calculate the extension of each spring for this weight.

extension of spring Q = .....

extension of spring R = .....

[1]

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**(iii)** The unstretched length of each spring is 25 cm.

State and explain which spring would be more suitable for the baby bouncer in Fig. 2.1.

spring .....

explanation .....

.....

[1]

[Total: 7]

Springs and Hooke's law Click for more variations

**8** Trolley A and trolley B are on a horizontal, frictionless bench. Trolley A moves to the right with a constant velocity $u = 0.44\,\text{m/s}$. Trolley B is stationary.

Fig. 2.1 shows trolley A before it collides with trolley B.

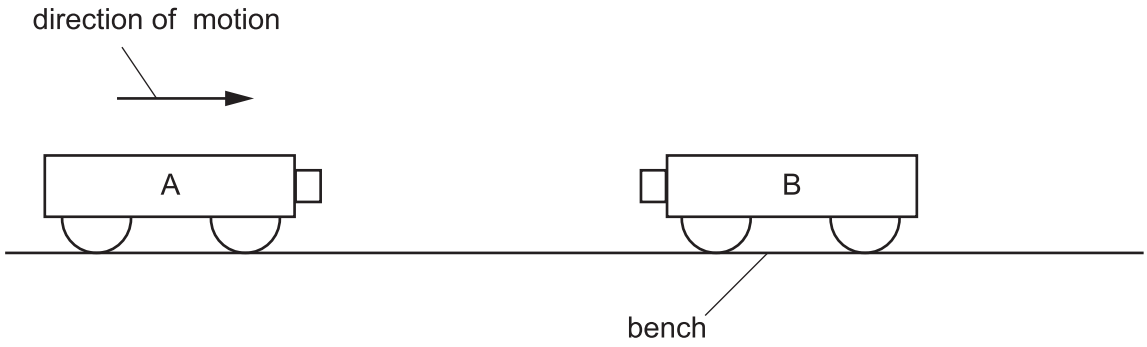



**Fig. 2.1** (not drawn to scale)

**(a)** State the momentum of trolley B before the collision. Explain your answer.

statement .....

explanation .....

.....

[1]

**(b)** After the collision, the two trolleys are joined together and travel with a constant velocity $v = 0.18\,\text{m/s}$ to the right. The mass of trolley A is 0.75 kg.

Calculate the mass of trolley B.

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mass of trolley B = ..... [3]

**(c)** **(i)** The trolleys move onto a rough surface which exerts a constant force $F$ on the trolleys and brings them to rest in 2.6 s.

Calculate $F$.

$F$ = ..... [2]

**(ii)** A different rough surface exerts a smaller resistive force on the trolleys. State how this affects the time taken to bring the trolleys to rest. Explain your answer.

statement .....

explanation .....

.....

[1]

[Total: 7]

Momentum and impulse Click for more variations

**9** **(a)** A truck moves with a constant acceleration. The speed of the truck increases from 13 m/s to 22 m/s. The time taken for this increase in speed is 4.5 s. The mass of the truck is 3700 kg.

**(i)** Calculate the resultant force acting on the truck.

resultant force = ..... [3]

**(ii)** The engine of the truck provides the forward force on the truck. State **two** forces acting on the truck in the opposite direction to the forward force.

.....

.....

..... [2]

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**(b)** Fig. 2.1 shows a car as it travels round a circular racing track.

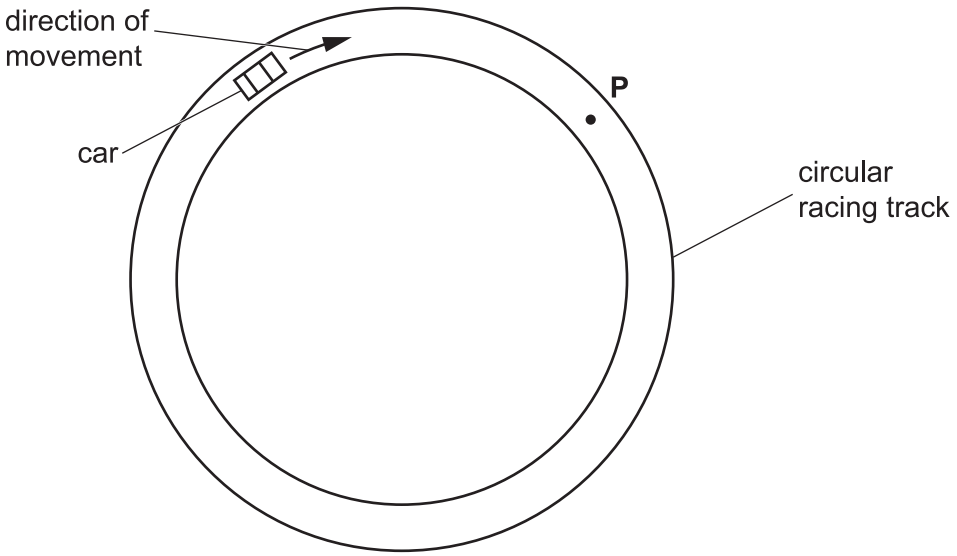



**Fig. 2.1**

**(i)** The car travels at constant speed.

On Fig. 2.1, draw an arrow to show the direction of the force acting on the car. [1]

**(ii)** A different car travels around the same track and slides off the track at point P.

State **two** possible reasons that cause the car to slide off the track.

.....

.....

.....

..... [2]

[Total: 8]

Resultant force, F = ma and circular motion Click for more variations

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**10** Fig. 2.1 shows an object of mass 2.0 kg on a bench. This object is connected by a cord, passing over a pulley, to an object of mass 3.0 kg.

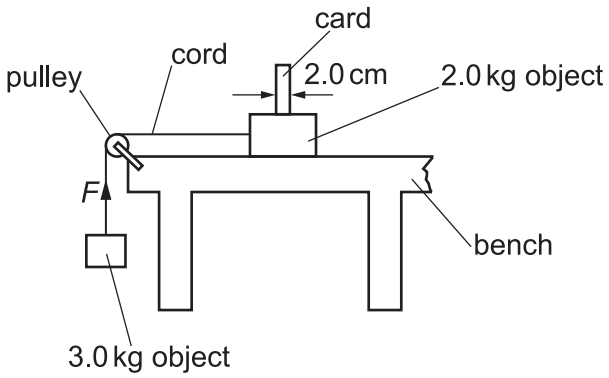



**Fig. 2.1**

The 2.0 kg object is released from rest and accelerates at 4.0 m / s$^2$.

**(a)** Calculate the resultant force acting on the 2.0 kg object.

force = ..... [2]

**(b)** Calculate the upward force *F* exerted by the cord on the 3.0 kg object.

force *F* = ..... [3]

**(c)** The objects have a constant acceleration.

**(i)** Show that the speed of the objects 0.80 s after release is 3.2 m / s.

[2]

**(ii)** A card, of width 2.0 cm, is fixed to the 2.0 kg object. As the 2.0 kg object moves to the left, the card passes through a beam of light that is perpendicular to the card.

Using the speed given in **(c)(i)**, calculate the time taken for the card to pass through the beam of light.

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time = ..... [2]

[Total: 9]

Resultant force, F = ma and circular motion Click for more variations