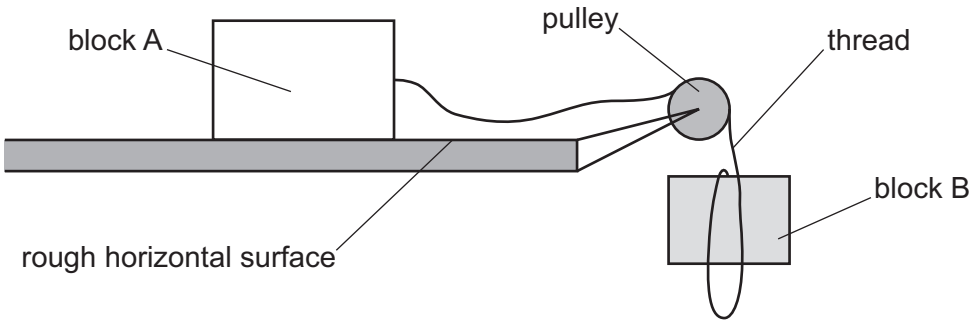
1 Two blocks, A and B, are joined by a thin thread that passes over a frictionless pulley. Block A is at rest on a rough horizontal surface and block B is held at rest, just below the pulley.

The diagram shows the thread hanging loose.



(not to scale)

Block B is released and it falls vertically. The thread remains loose until block B has fallen a distance of 0.45 m.

The mass of block B is 0.50 kg.

The mass of block A is 2.0 kg.

When the thread tightens, it pulls on block A which moves to the right at a speed of 0.60 m / s.

Calculate the impulse exerted on block A as it accelerates from rest to 0.60 m / s.

impulse = ... [3]

[Total: 3]

2 In terms of the momentum of molecules, explain how a gas exerts pressure on the walls of its container.

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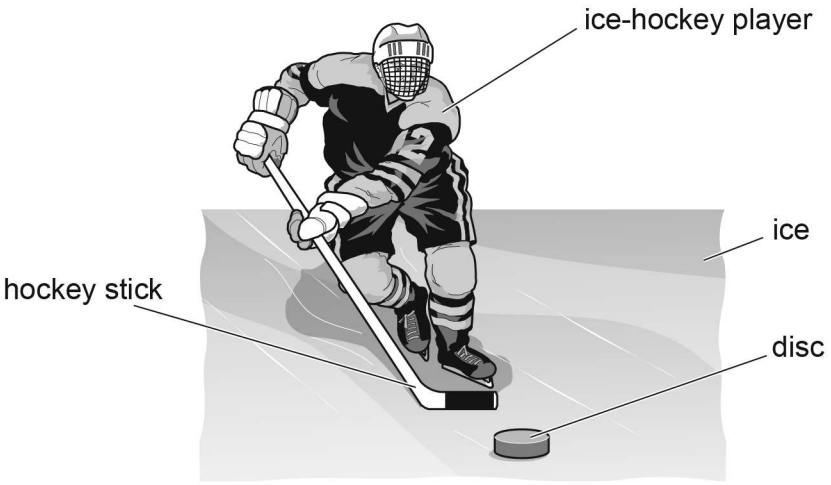
..... [4]

[Total: 4]

3 The diagram shows an ice-hockey player moving on ice. He is preparing to hit the solid disc called a puck.

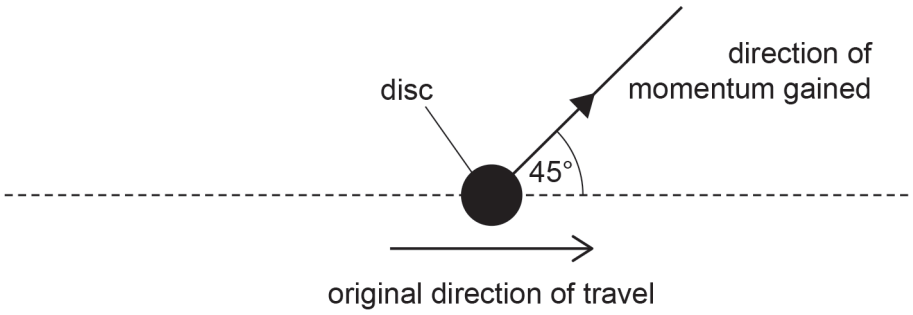


The disc of mass 0.16 kg is moving horizontally across the surface of the ice at a speed of 15 m / s.

(a) Calculate the magnitude of the momentum of the disc.

magnitude of momentum = ... [2]

(b) The hockey player strikes the disc with his hockey stick and the momentum of the disc changes. The disc gains momentum of 3.0 kg m / s at 45° to the original direction of travel of the disc, as shown in the diagram.



(view from above)

(i) State the magnitude of the impulse exerted on the disc and the direction, in degrees, of the impulse relative to the original direction of travel.

magnitude of impulse = ...

direction of impulse: ..... ° to original direction [1]

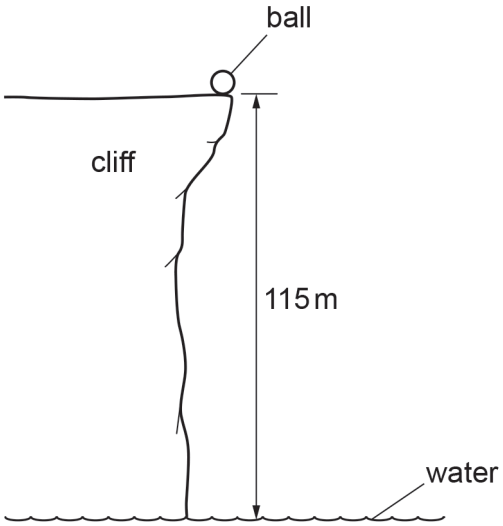
(ii) Determine the magnitude of the new momentum of the disc and its new direction relative to the original direction of travel by drawing a scale diagram.

magnitude of new momentum = ...

direction of new momentum: ..... ° to original direction [4]

[Total: 7]

4 The diagram shows a cliff edge with water below it.



A ball falls over the edge of the cliff. The mass of the ball is 160 g. The height of the cliff is 115 m.

(a) Calculate the vertical speed of the ball as it hits the water. Air resistance can be ignored.

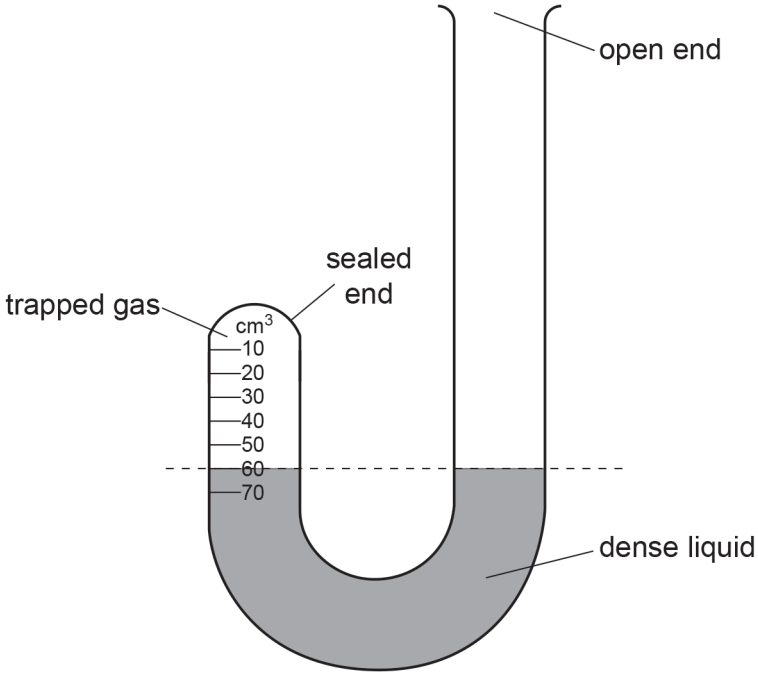
speed = ... [3]

(b) Calculate the vertical momentum of the ball as it hits the water.

momentum = ... [2]

[Total: 5]

5 The diagram shows gas trapped in the sealed end of a tube by a dense liquid.



Explain, in terms of the momentum of its molecules, why the trapped gas exerts a pressure on the walls of the tube.

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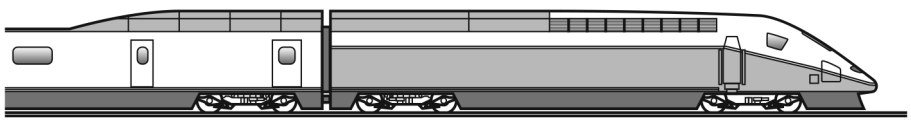
..... [3]

[Total: 3]

6 The diagram shows a train.



The total mass of the train and its passengers is 750 000 kg. The train is travelling at a speed of 84 m / s. The driver applies the brakes and the train takes 80 s to slow down to a speed of 42 m / s.

(a) Calculate the impulse applied to the train as it slows down.

impulse = ... [3]

(b) Calculate the average resultant force applied to the train as it slows down.

force = ... [2]

[Total: 5]

7 An aeroplane of mass 2.5×10^5 kg lands with a speed of 62 m / s, on a horizontal runway at time $t = 0$. The aeroplane decelerates uniformly as it travels along the runway in a straight line until it reaches a speed of 6.0 m / s at $t = 35$ s.

(a) Calculate the deceleration of the aeroplane in the 35 s after it lands.

deceleration = ... [2]

(b) Calculate the resultant force acting on the aeroplane as it decelerates.

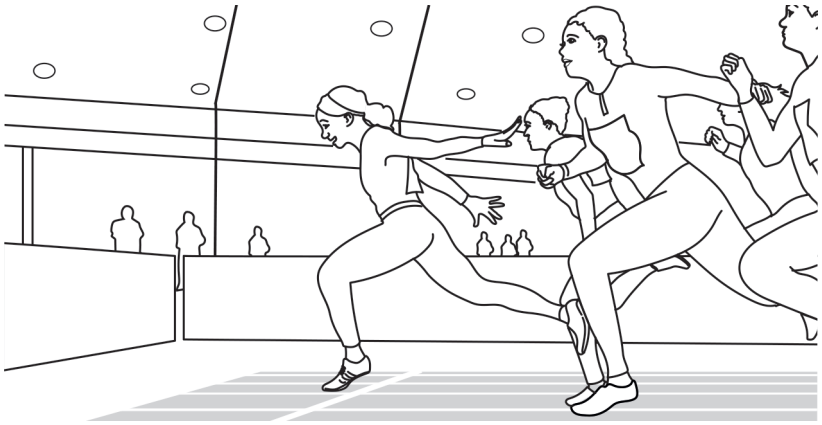
force = ... [2]

(c) Calculate the momentum of the aeroplane when its speed is 6.0 m / s.

momentum = ... [2]

[Total: 6]

8 The diagram shows an athlete crossing the finishing line in a race. As she crosses the finishing line, her speed is 10.0 m / s. She slows down to a speed of 4.0 m / s.



(a) The mass of the athlete is 71 kg. Calculate the impulse applied to her as she slows down.

impulse = ... [3]

(b) Define *impulse* in terms of *force* and *time*.

.....

..... [1]

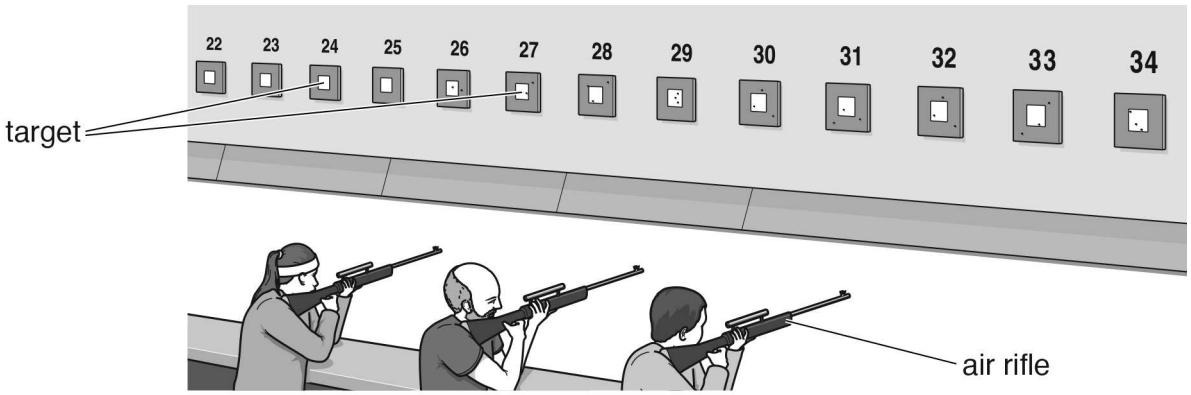
(c) The athlete takes 1.2 s to slow down from a speed of 10.0 m / s to a speed of 4.0 m / s.

Calculate the average resultant force applied to the athlete as she slows down.

force = ... [2]

[Total: 6]

9 The diagram shows a shooting competition, where air rifles fire soft metal pellets at distant targets.



When an air rifle is fired, it exerts an impulse of 0.019 N s on the pellet.

Define *impulse*.

.....

..... [1]

[Total: 1]