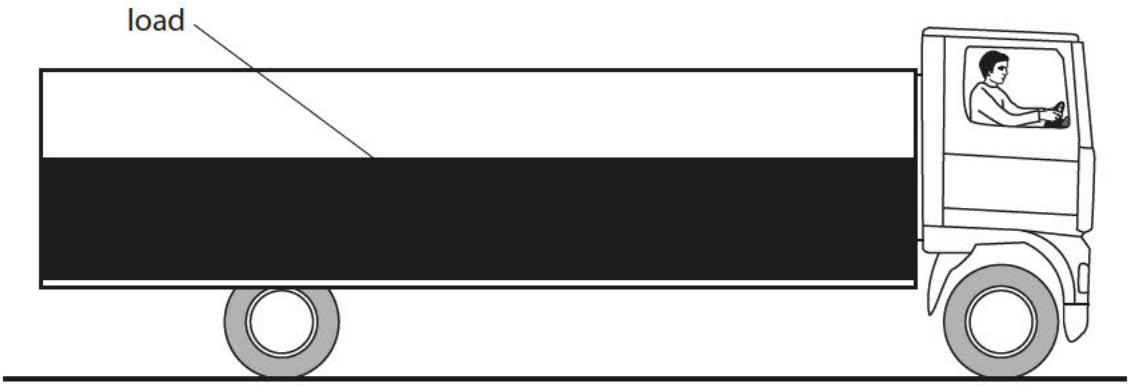
1 A lorry carries a load of hot asphalt – a runny mixture of small stones and tar.



(a) The mass of the lorry and its load is 17 000 kg.

The velocity is 13 m/s.

(i) State the equation linking momentum, mass and velocity.

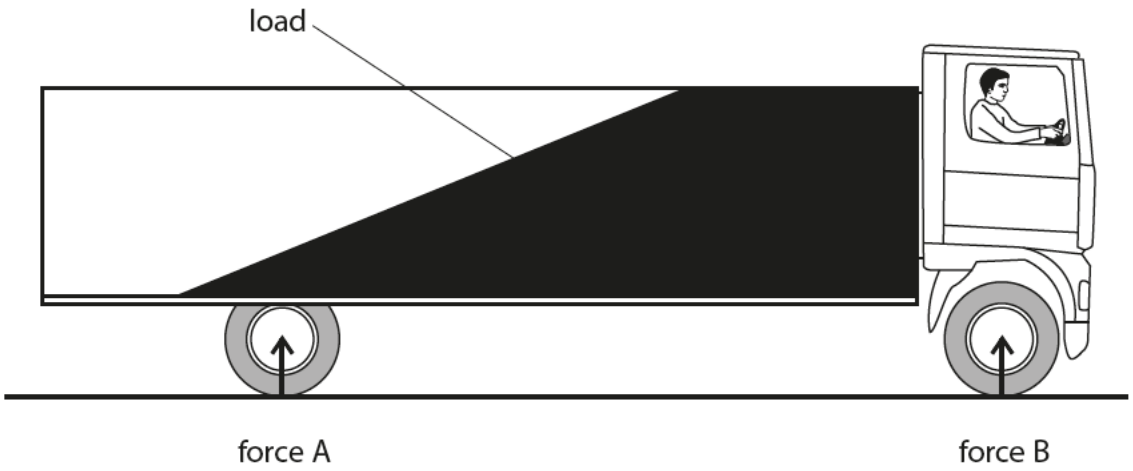
(1)

(ii) Calculate the total momentum of the lorry and its load.

(2)

momentum = ... kg m/s

(b) The lorry stops suddenly and the load slides to the front, as shown below.



Force A and force B are upward forces from the road on the lorry.

(i) Use ideas about momentum to explain why the load slides to the front when the lorry stops suddenly.

(2)

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(ii) Use ideas about moments to explain why force B increases when the load slides to the front.

(3)

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(c) The force on the road from one of the tyres is 53 000 N.

The pressure of the air in this tyre is 390 kPa.

(i) State the equation linking pressure, force and area.

(1)

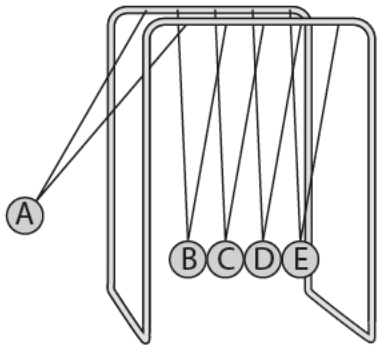
(ii) Calculate the area of this tyre in contact with the road.

(2)

Area = ... m^2

(Total for Question 1 = 11 marks)

2 Newton's Cradle consists of a set of identical solid metal balls hanging by threads from a frame so that they are in contact with each other.



Newton's Cradle

(a) A student initially pulls ball A to the side as shown.

The student releases ball A and it collides with ball B.

(i) State the equation linking momentum, mass and velocity.

(1)

(ii) Each ball has a mass of 100 g.

At the time of collision, ball A has a velocity of 3m/s.

Calculate the momentum of ball A at the time of impact and give the unit.

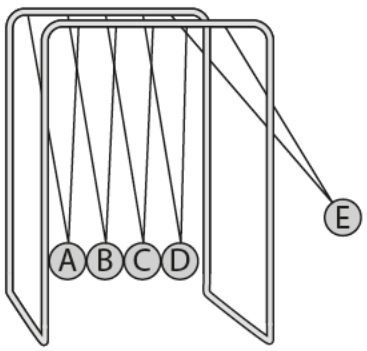
(3)

momentum ..... unit .....

(iii) After the collision, ball A stops.

Ball E moves away.

The other balls remain still.



The momentum of ball E as it moves away is the same as the momentum of ball A at the time of impact.

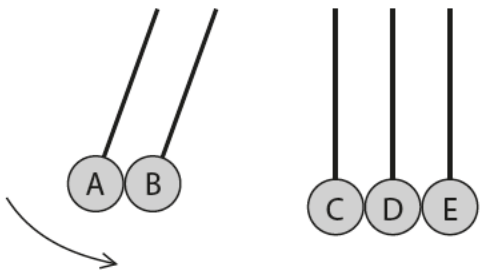
Give the reason for this.

(1)

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(b) The student then releases balls A and B together as shown below.



Predict what will happen to the other balls after the collision and give a reason for your answer.

(2)

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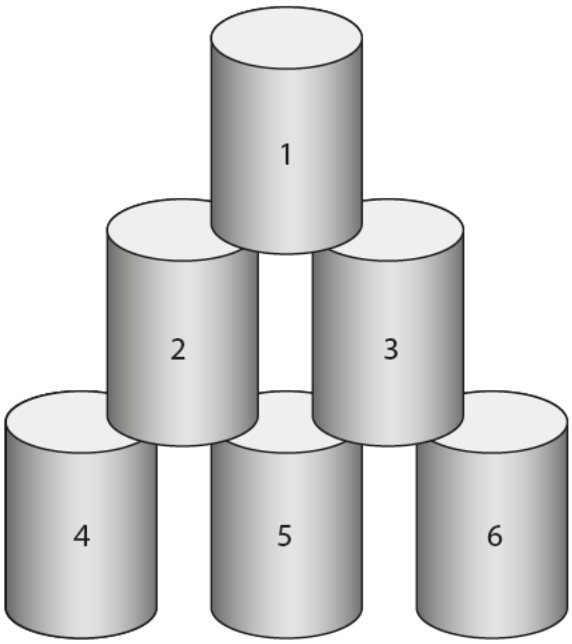
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(Total for Question 2 = 7 marks)

3 A student is playing a game with some empty tins.



(a) He throws a wet cloth of mass 0.15 kg at the tins.

The wet cloth moves at a velocity of 6.0 m/s.

(i) State the equation linking momentum, mass and velocity.

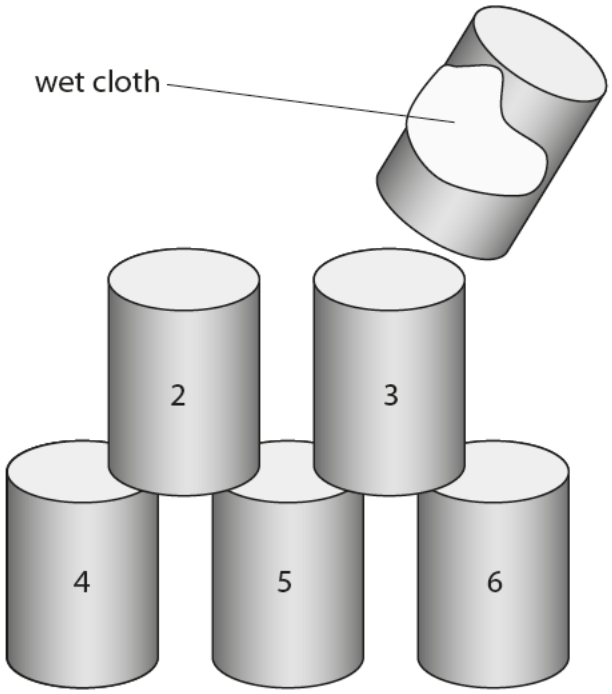
(1)

(ii) Calculate the momentum of the wet cloth and give the unit.

(3)

Momentum = ... unit.....

(iii)The wet cloth sticks to tin 1.



The mass of tin 1 is 0.050 kg.

The cloth and tin 1 move away together.

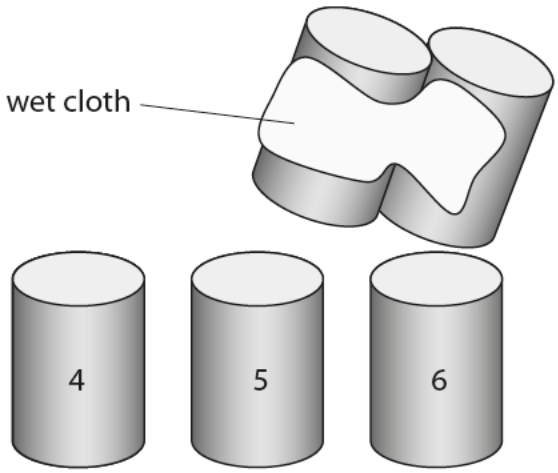
Calculate their velocity.

(2)

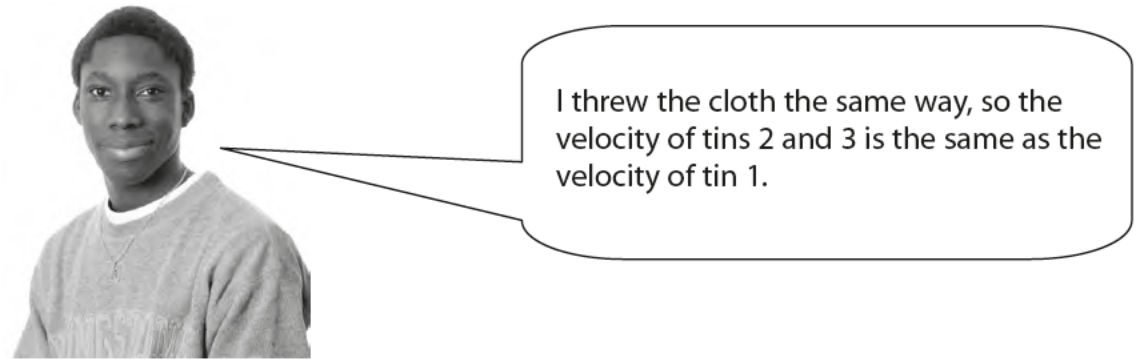
Velocity = ... m/s

(b) The student throws a bigger wet cloth at the remaining tins.

This wet cloth sticks to tins 2 and 3 and they move away together.



The student concludes



Do you agree with this conclusion?

Explain why.

(2)

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(Total for Question 3 = 8 marks)

4 Some cars have a pedestrian airbag for safety.

If a pedestrian is hit and lands on the front of the car, the airbag inflates.



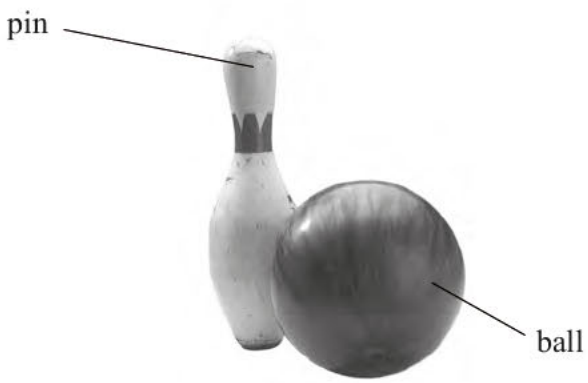
©volvocars

Use ideas about momentum to explain how this airbag can reduce injuries to pedestrians.

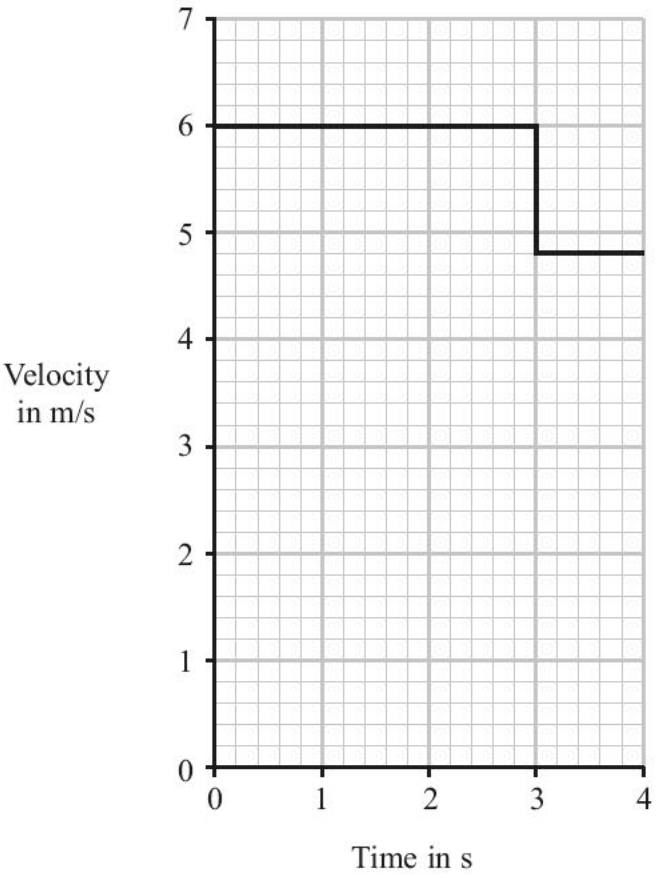
(4)

(Total for Question 4 = 4 marks)

5 A bowling ball rolls for 3 s and hits a pin.



The graph shows how the velocity of the ball changes with time.



(a) How can the graph be used to find the distance that the ball rolls before it hits the pin?

(1)

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.....

(b) The mass of the ball is 6.4 kg.

(i) State the equation linking momentum, mass and velocity.

(1)

(ii) Calculate the momentum of the ball before it hits the pin.
Give the unit.

(3)

Momentum ..... Unit .....

(c) (i) What is the velocity of the ball after it hits the pin?

(1)

Velocity ..... m/s

(ii) After the collision, the ball and the pin have the same velocity.

Calculate the mass of the pin.

(3)

Mass ..... kg

(Total for Question 5 9 marks)

6 Two students, Jenny and Cho, are investigating motion.

Jenny walks in a straight line.

Cho measures the distance Jenny has walked at 10 s intervals.

(a) State **two** measuring instruments the students should use.

(2)

1 .....

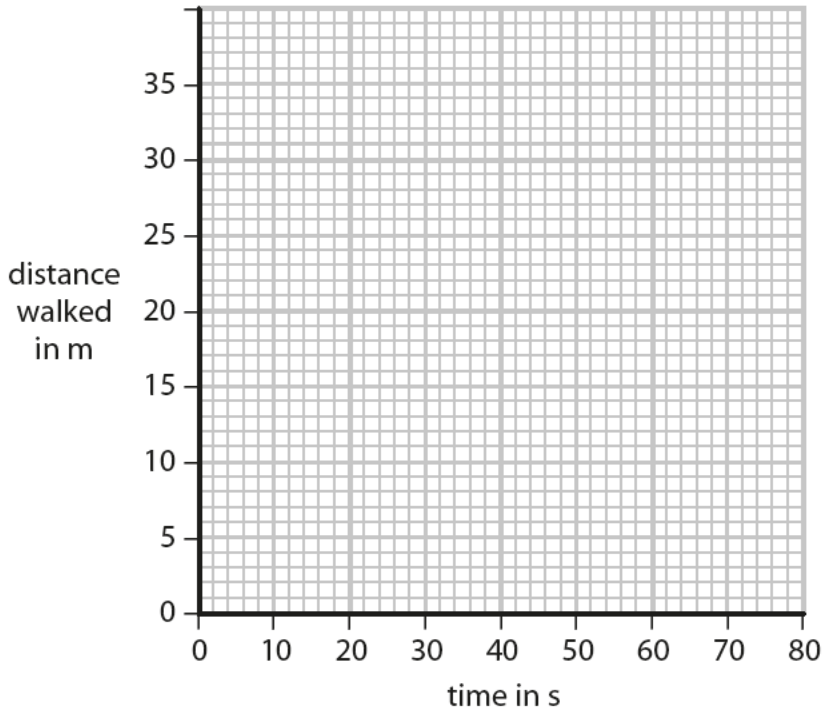
2 .....

(b) The table shows their measurements.

Time in s	Distance walked in m
0	0
10	14
20	19
30	24
40	28
50	30
60	31

Draw a graph of distance against time for this data.

(3)



(c) How far had Jenny walked after 35 s?

(1)

Distance walked = ... m

(d) (i) Describe how Jenny's speed changed during the investigation.

(1)

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(ii) What feature of the graph shows this change?

(1)

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(Total for Question 6 = 8 marks)