MENTOR IN REARRANGED & CLASSIFIED • MUHAMMAD RASHED CHOWDHURY • mrc

CLASSIFIED

International Examinations Papers

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PHYSICS-1P

TOPIC- FORCES, MOMENTUM, COLLISIONS, MOMENTS

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1 A student investigates the extension of an elastic band for different forces.

(a) (i) List the laboratory apparatus that the student needs for this investigation.

(3)

(ii) Extension, force and temperature are variables for this investigation.

Draw a line from each variable to its type.

(2)

variable	**type of variable**
extension	control
force	dependent
temperature	independent

(iii) Describe how the student can measure the extension of the elastic band when he adds a force of 12 N.

(2)

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(b) The student obtains this data as he first adds weights to the elastic band (loading) and as he then removes weights from the band (unloading).

Force in N	Extension in cm
	Loading
0	0.0
2	2.3
4	5.3
6	9.8
8	15.3
10	20.0

Force in N	Extension in cm
	Unloading
0	0.0
1	1.4
3	5.0
7	14.8
9	19.1
10	20.0

571-1P-16-11

He plots the loading data on a graph as shown.

(i) Suggest how the student could improve the quality of his data. (2)

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(ii) Draw a curve of best fit through the loading data. (1)

(iii) On the same axes, plot the unloading data. (2)

(iv) Draw a curve of best fit through the unloading data. (1)

(v) The student concludes that the band is an elastic material and that it obeys Hooke's law.

Discuss whether his conclusion is correct.

You should support your argument with data. (3)

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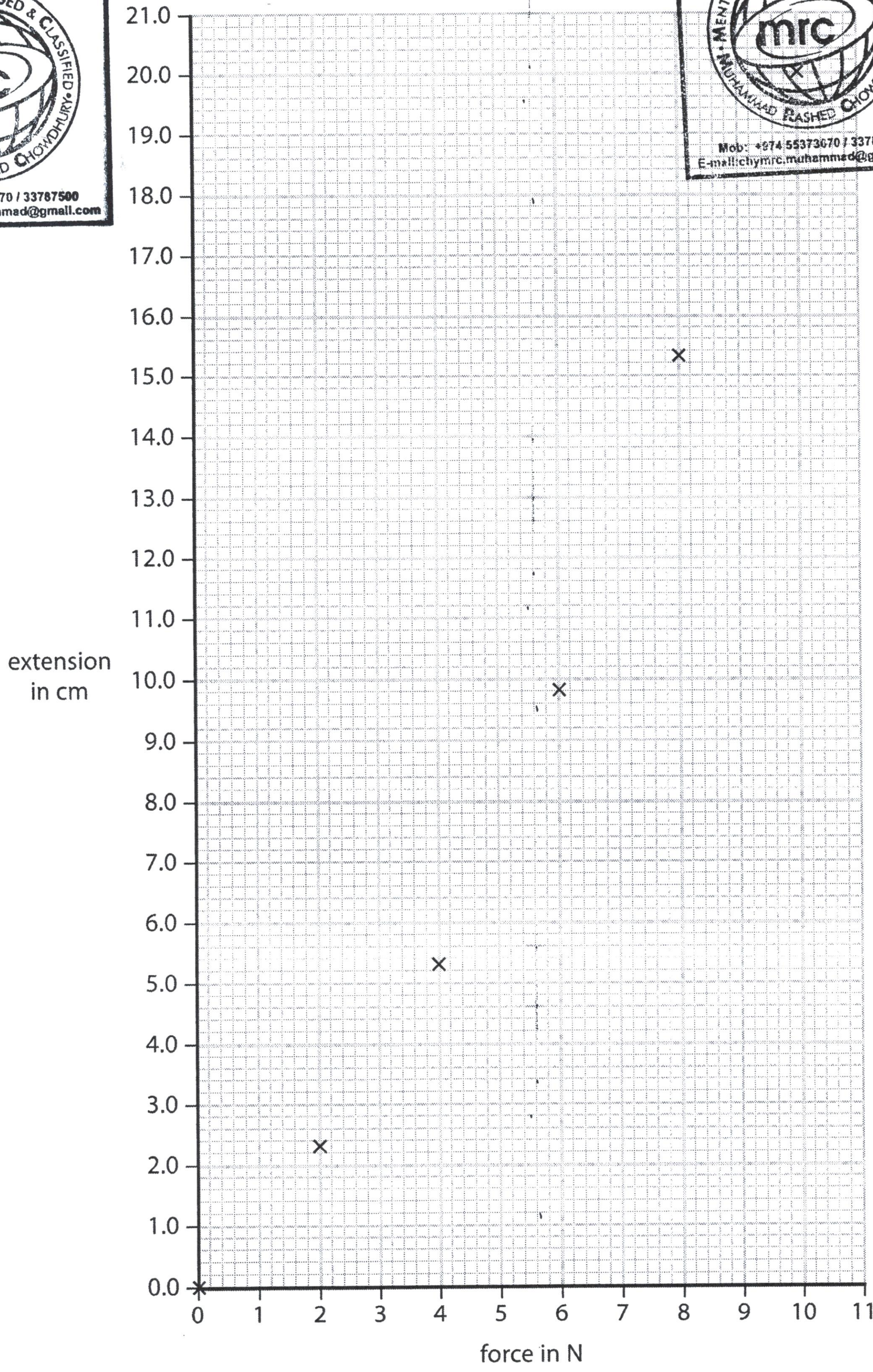
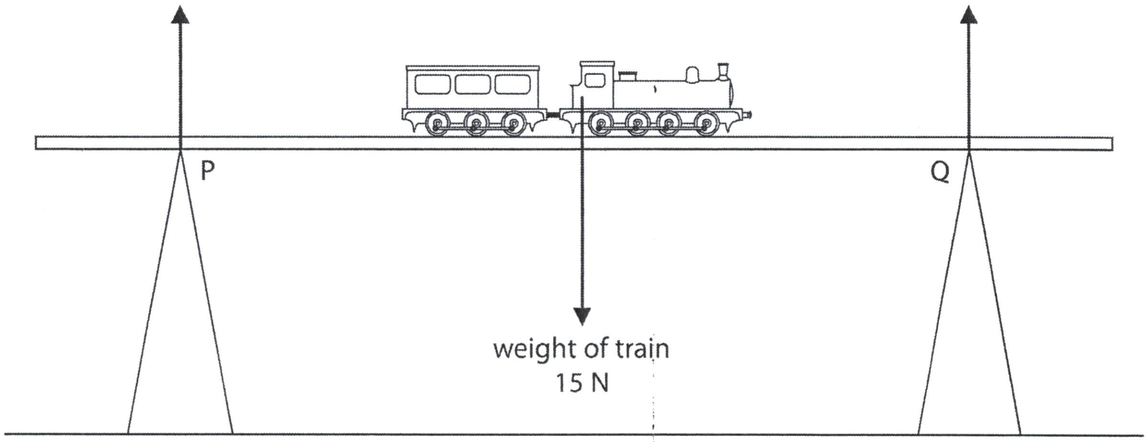


(Total for Question 11 = 16 marks)

2 A toy train is placed on the middle of a bridge on a model railway.



The weight of the train acts through its centre of gravity.

Ignore the weight of the bridge.

(a) Which row of the table shows the correct values for forces X and Y?

	force X	force Y
☐ **A**	7.5 N	7.5 N
☐ **B**	0 N	0 N
☐ **C**	0 N	15 N
☐ **D**	15 N	0 N

(b) Describe how force X changes if the train moves from P to Q.

(2)

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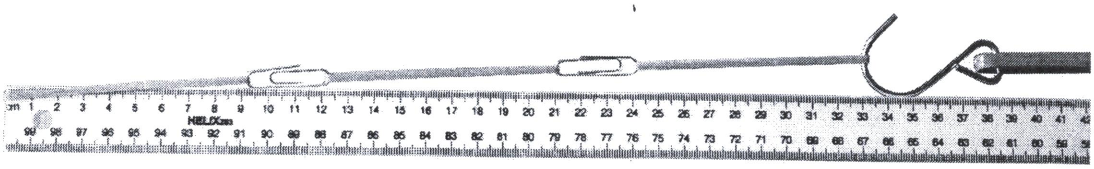
(Total for Question 3 = 3 marks)

3 A student makes chains of elastic bands by joining them together with paperclips.

He uses a newtonmeter to stretch each chain along a metre rule, as shown in photograph **A**.



Photograph A

For each chain, he records

- the number of elastic bands
- the length when the tension is 2 N
- the length when the tension is 1 N

Then he calculates the difference in length for each chain.

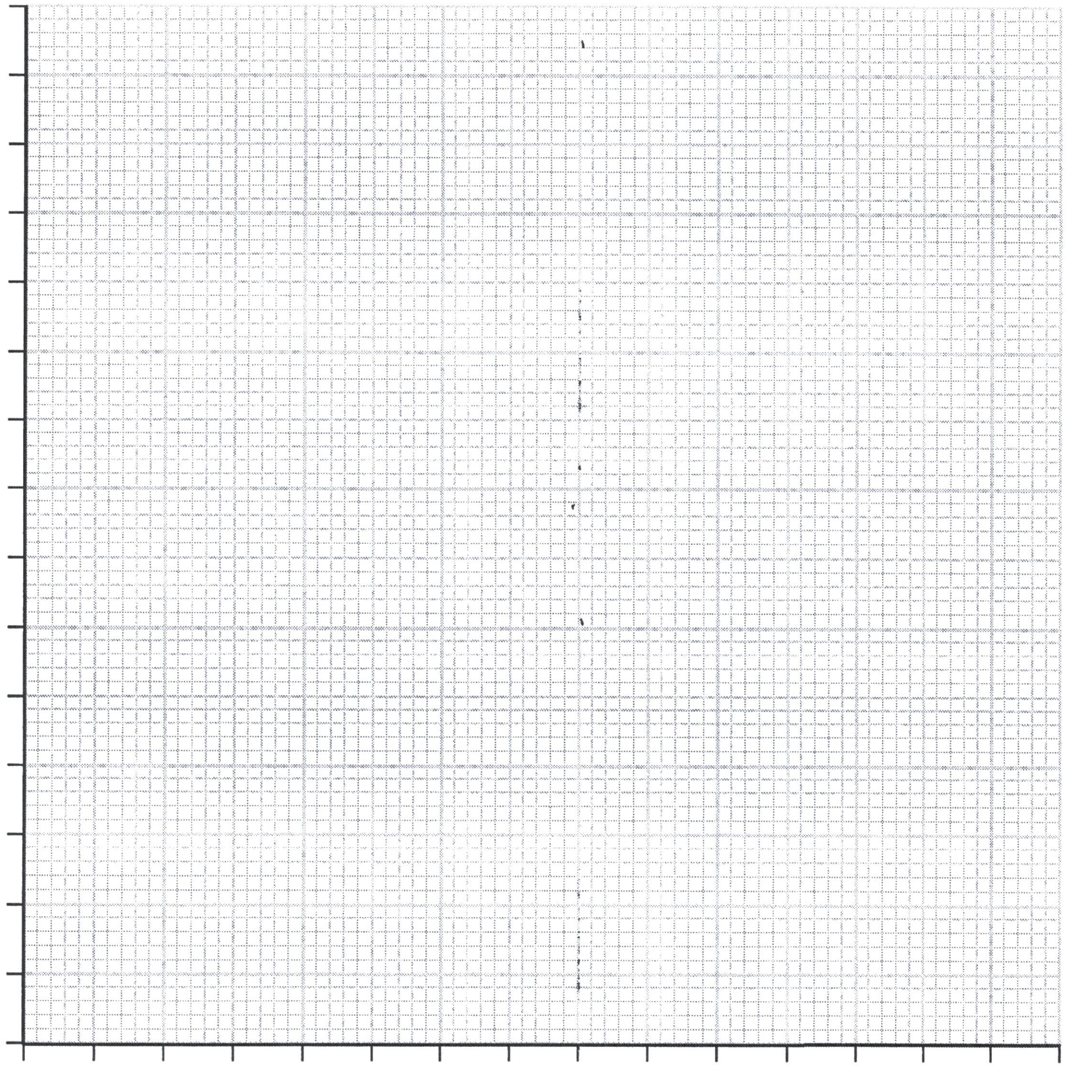
(a) (i) Complete the table by calculating the missing value.

(1)

Number of elastic bands	Length in cm		Difference in length in cm
	When tension = 2 N	When tension = 1 N	
1	8.1	7.5	0.6
2	20.2	18.2	2.0
3	31.7	29.3	2.4
4	43.7	40.3	3.4
5	56.3	51.6	4.7
6	67.6	62.5	

(ii) Use the grid to plot a graph to show the relationship between the number of elastic bands and the difference in length.

(5)



(iii) Describe your line of best fit.

(2)

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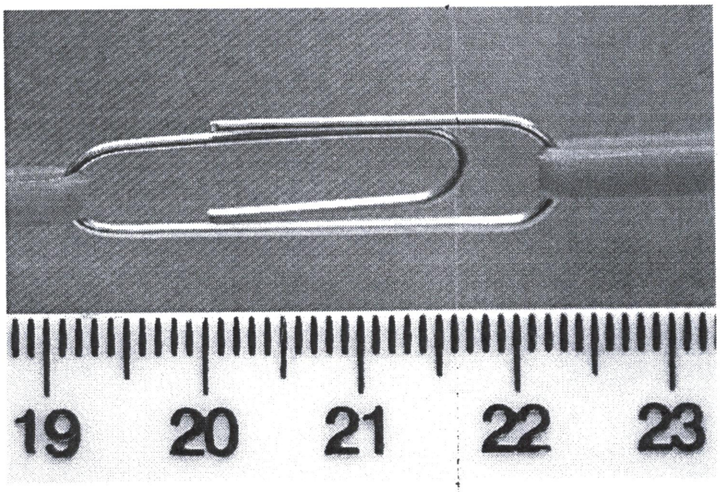
(b) Photograph **B** shows a paperclip in one of the chains against the same metre rule.



Photograph B

Use photograph **B** to estimate the length of this paperclip.

(2)

Length = ... cm

(c) Look again at photograph **A**.

Suggest two ways that the student could improve his measuring technique.

(2)

1 ....

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2 ....

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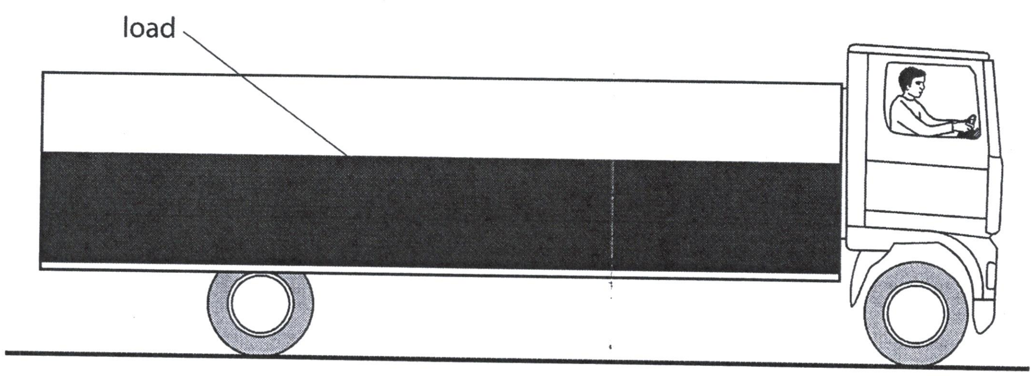
(Total for Question 3 = 12 marks)

4 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.

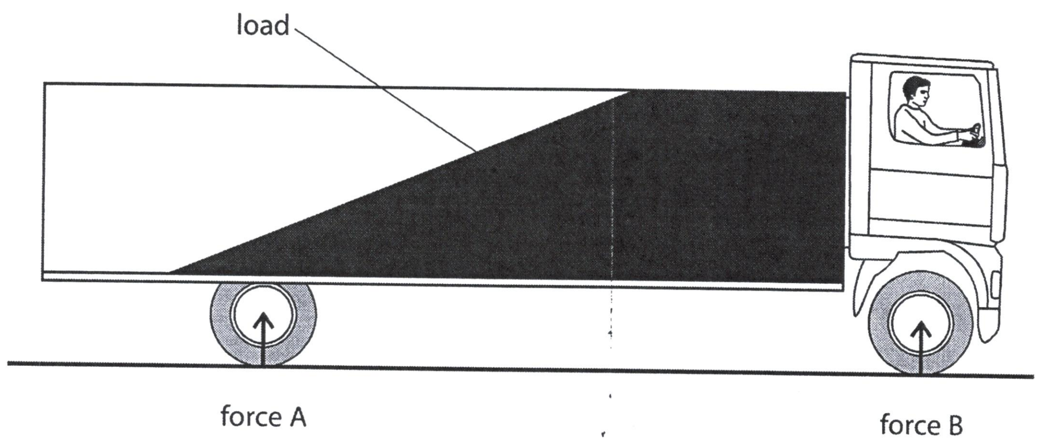
(1)

(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)

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

(3)

(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)

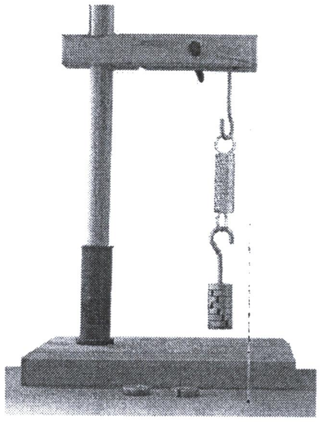
(ii) Calculate the area of this tyre in contact with the road.

(2)

Area = ... m^2

(Total for Question 4 = 11 marks)

5 A student uses this apparatus to investigate forces stretching a spring.



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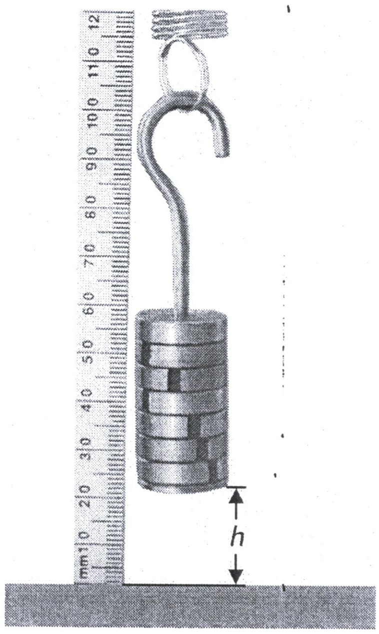
She uses a ruler to measure the vertical distance *h* between the bottom of the mass hanger and the base of the stand.



(a) Suggest two ways that the student can measure distance *h* more accurately.

(2)

1 ....

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....

2 ....

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(b) The student continues her investigation by loading the spring with different masses.

The table shows her results.

Mass in g	Force in N	Distance *h* in cm
20	0.2	4.6
40	0.4	3.9
60	0.6	3.1
80	0.8	2.3
100	1.0	1.6
120	1.2	0.9

(i) Name the dependent variable in this investigation.

(1)

....

(ii) Explain how the force values in the table are calculated.

(2)

....

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....

....

(iii) Plot a graph of distance *h* against force, and draw the line of best fit.

(5)

(iv) Use your graph to find the force for which *h* is zero.

(2)

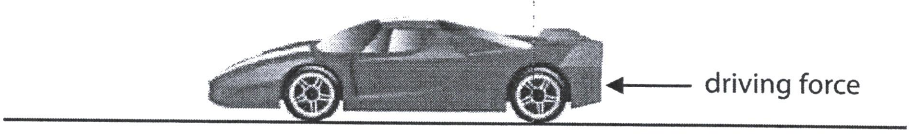
force = ... N

(v) Explain whether the spring obeys Hooke's law.

(2)

(Total for Question 5 = 14 marks)

6 The diagram shows the driving force on a sports car as it moves along a race track.



(a) Name **two** forces that oppose the driving force.

(2)

1 ....

2 ....

(b) The car has a mass of 1400 kg.

The acceleration of the car is 5.5 m/s^2.

(i) State the equation linking force, mass and acceleration.

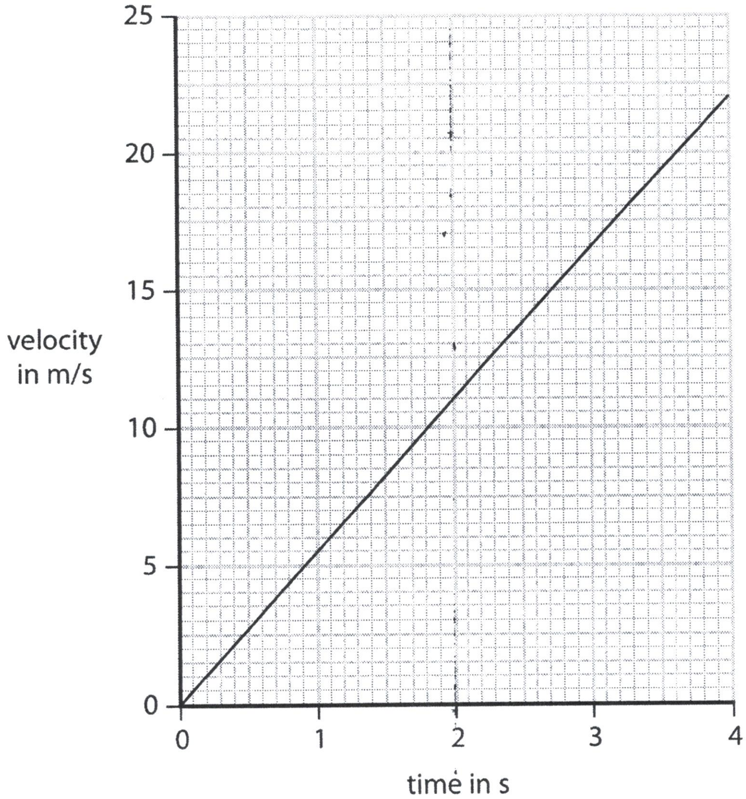
(1)

(ii) Calculate the force causing this acceleration.

(2)

Force = ... N

(c) Graph **1** shows how the velocity of the car changes with time.



Graph **1**

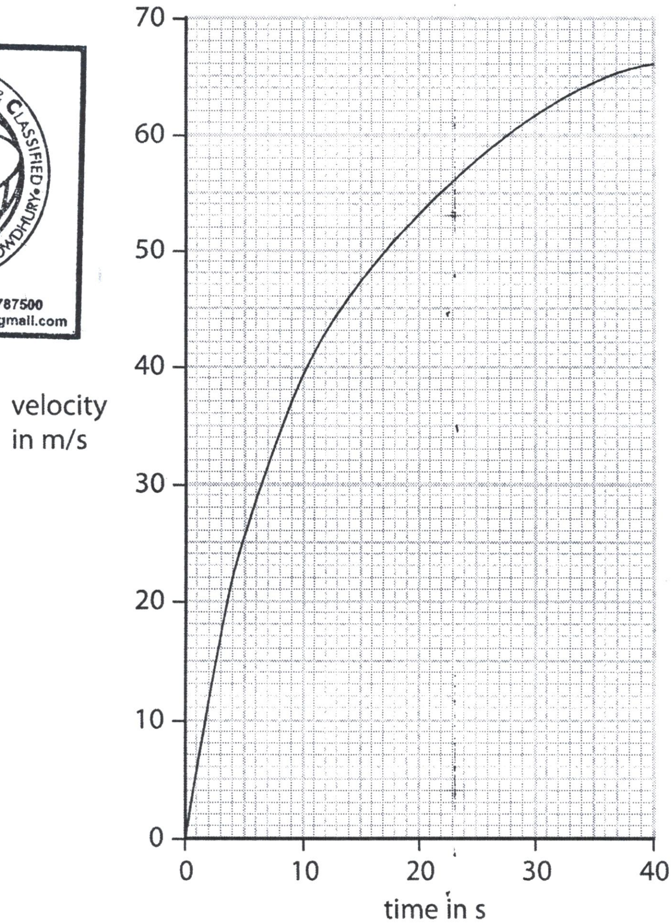
Calculate the distance that the car travels in the first four seconds.

(3)

Distance = ... m

QUESTION 16 CONTINUES ON THE NEXT PAGE

(d) As the car travels further along the track, its acceleration changes as shown in graph **2**.



Graph **2**

(i) Which feature of graph **2** shows that the acceleration changes?

(1)

....

(ii) The acceleration changes even though the driving force does **not** change.

Suggest **two** possible reasons for this change in acceleration.

(2)

1 ....

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2 ....

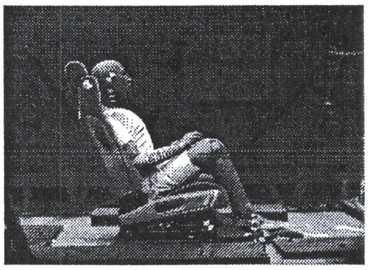
....

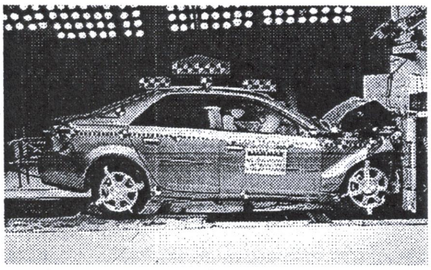
(Total for Question 16 = 11 marks)

TOTAL FOR PAPER = 120 MARKS

7 Scientists test the safety features of a car by crashing it into a large block of concrete.

A dummy is placed in the driver's seat and the scientists video the crash.





(a) In one test, the dummy and the car travel at 8 m/s.

The mass of the dummy is 72 kg.

Calculate the momentum of the dummy.

(2)

Momentum = ... kg m/s

(b) In another test, the momentum of the dummy changes by 920 kg m/s in a time of 0.17 s.

Calculate the average horizontal force acting on the dummy during this time.

(2)

Average force = ... N

(c) These tests help to make our roads safer.

(i) State **two** factors that affect the stopping distance of a car driven on a road.

(2)

1 ....

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2 ....

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(ii) Use ideas about momentum to explain how the crumple zone of a car helps to reduce injuries during a crash.

(3)

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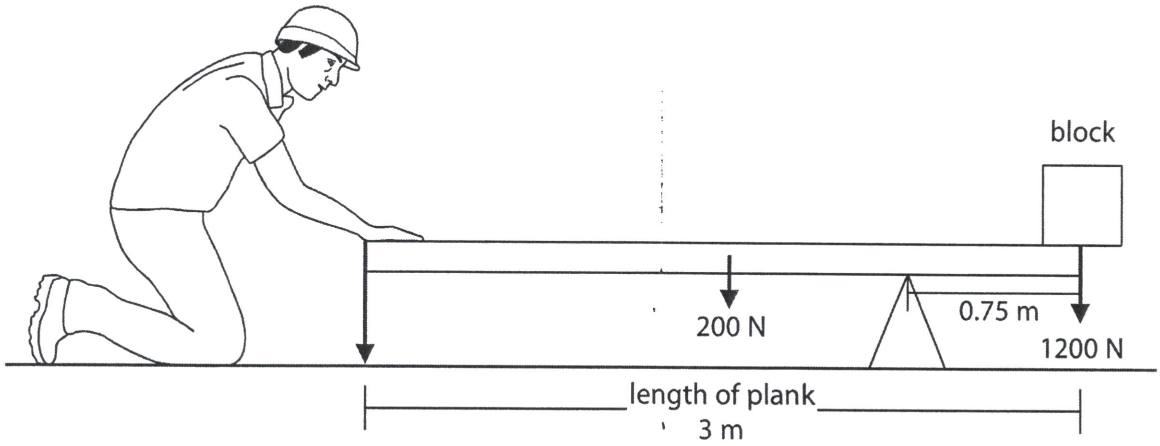
(Total for Question 7 = 9 marks)

8 A man uses a uniform plank to lift a block.

He holds the plank horizontal.



The arrows on the diagram represent three forces on the plank.

(a) Complete the table to identify the missing force.

(1)

Force	Name of force
F	force of man pushing down on the plank
1200 N	weight of block
200 N	

(b) (i) State the equation linking moment, force and perpendicular distance from the pivot.

(1)

(ii) Calculate the clockwise moment of the block about the pivot.

(2)

moment = ... Nm

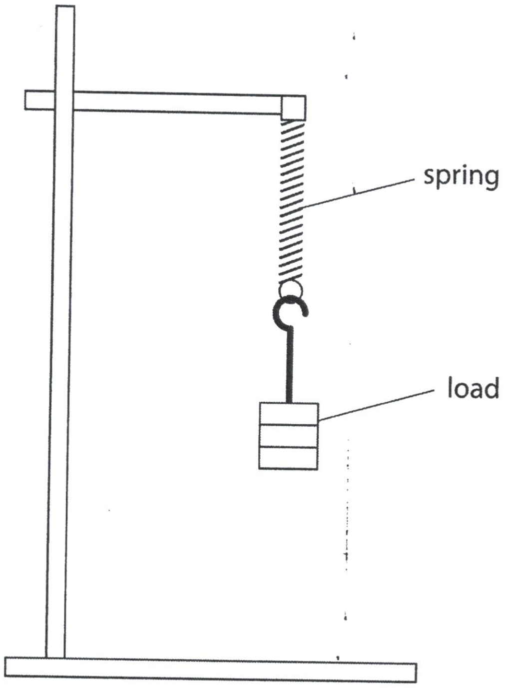
(c) Calculate the force of the man pushing down on the plank.

(4)

force = ... N

(Total for Question 8 = 8 marks)

9 A student investigates how the extension of a spring varies when he hangs different loads from it.



(a) Write a plan for the student's investigation.

Your plan should include details of how the student can make accurate measurements.

You may add to the diagram to help your answer.

(5)

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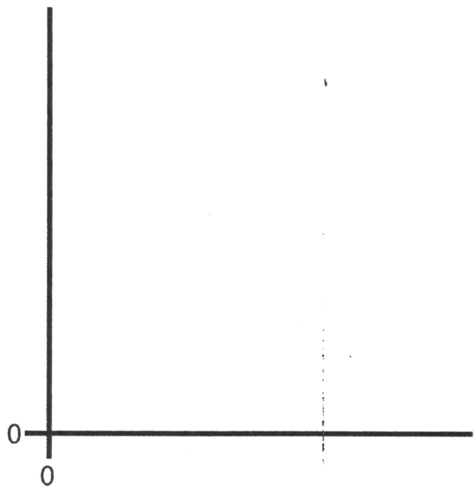
(b) The student finds that the spring obeys Hooke's law.

Draw a graph on the axes to show the Hooke's law relationship.

Label the axes.

(3)



(c) The student concludes that the spring shows elastic behaviour.

Explain what is meant by the term **elastic behaviour**.

(2)

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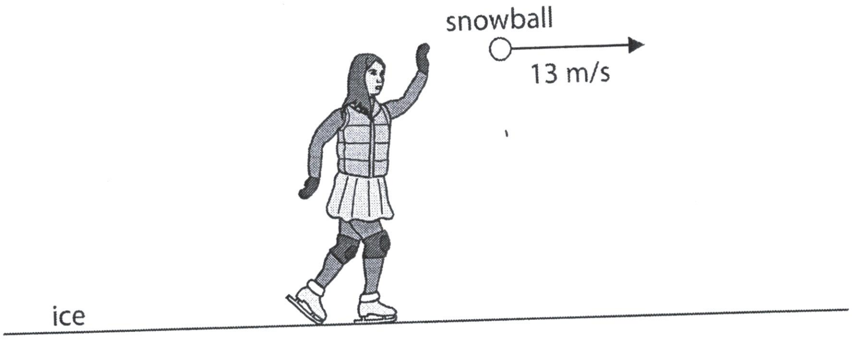
(Total for Question 9 = 10 marks)

10 An ice skater throws a 0.23 kg snowball with a velocity of 13 m/s.



(a) (i) State the equation linking momentum, mass and velocity. (1)

(ii) Calculate the initial momentum of the snowball. (2)

initial momentum = ... kg m/s

(b) When the skater throws the snowball forwards, she slides backwards on the ice.

Explain why she moves in this direction. (3)

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(c) The skater wears soft knee pads that compress easily.

Explain how the pads protect her knees when she falls on the ice.

(3)

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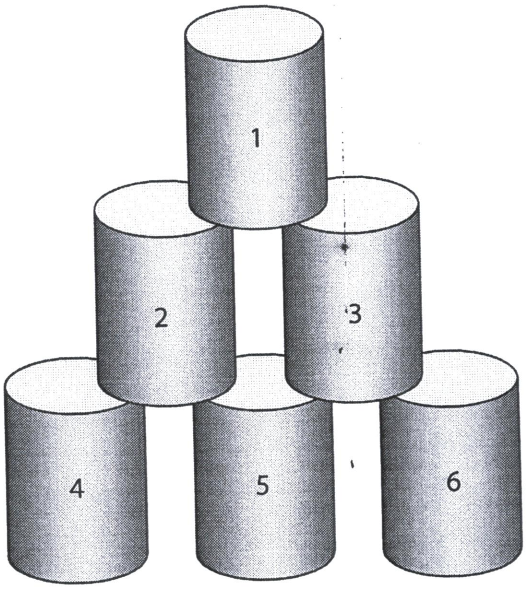
(Total for Question 5 = 9 marks)

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



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

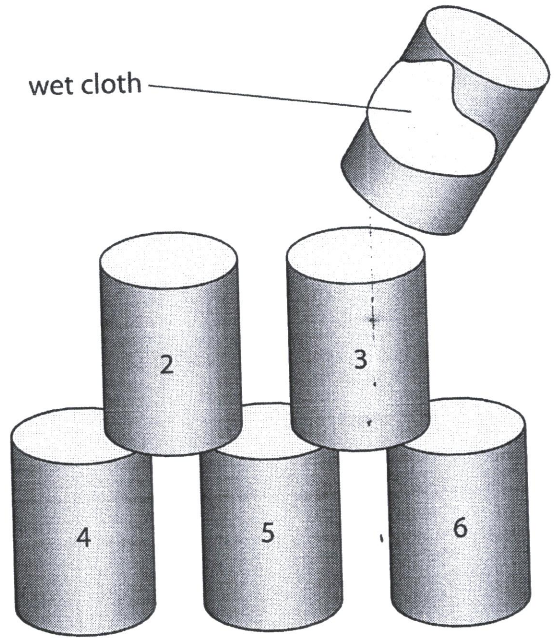
The wet cloth moves at a velocity of 6.0 m/s.

(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.

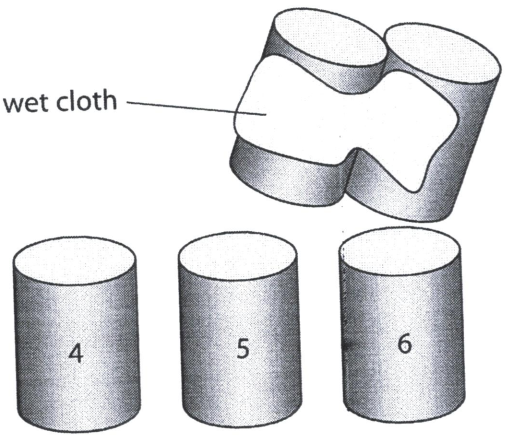
Calculate their velocity.

(2)

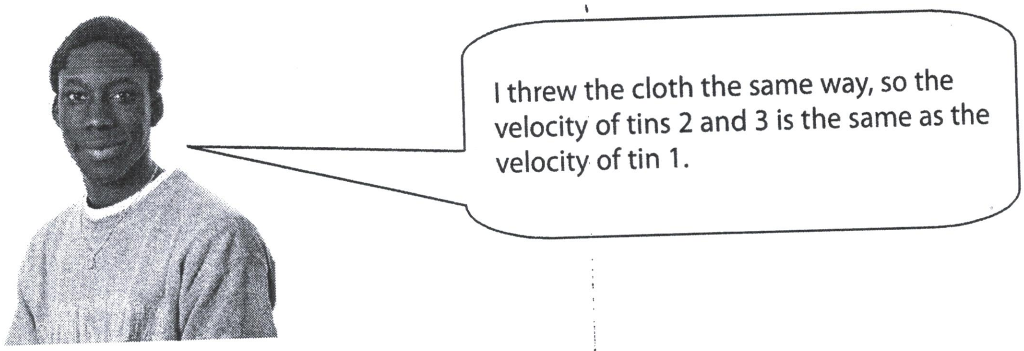
Velocity = ... m/s

(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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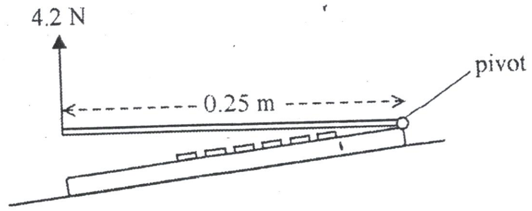
(Total for Question 9 = 8 marks)

12 The diagram shows the side view of a laptop computer.



A student opens the computer with an upward force of 4.2 N.

The force is applied 0.25 m from the pivot.

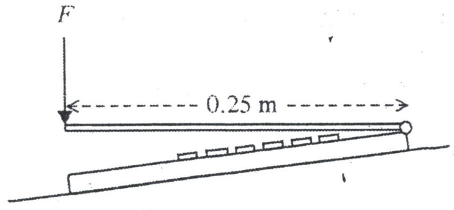
(a) (i) State the equation linking moment, force and distance.
(1)

(ii) Calculate the moment of the force that opens the computer.
(2)

Moment = ... N m

(b) The student finds that 4.2 N is the **minimum** upward force needed to open the computer.

Then the student applies a downward force, F, to close the computer.

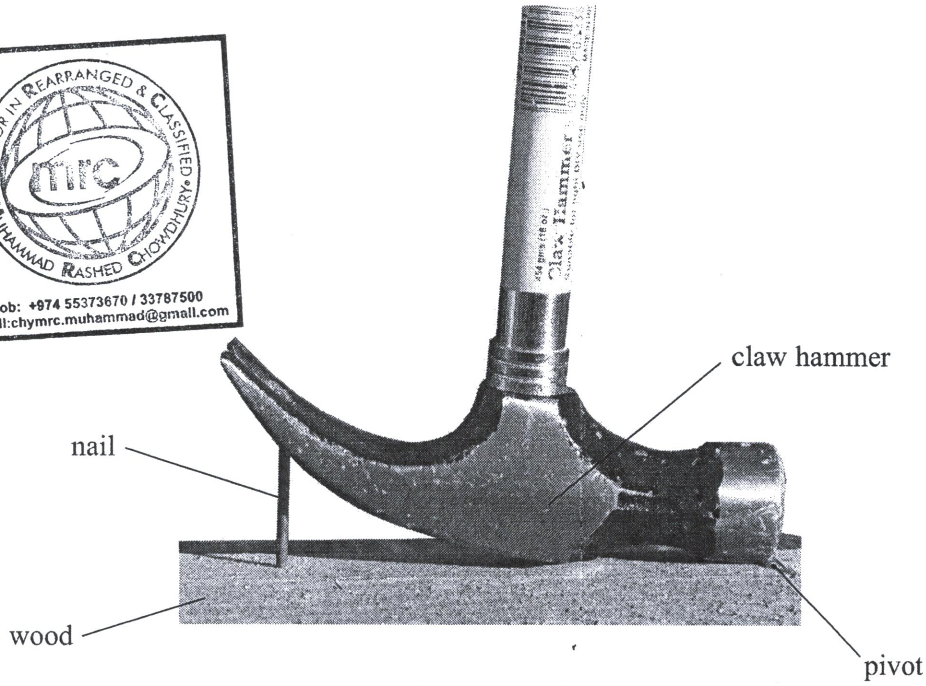


Explain why the minimum force needed to close the computer is likely to be **less** than 4.2 N.

(2)

(Total for Question 5 = 5 marks)

13 Photograph **C** shows how a student can use a claw hammer to pull a nail from a piece of wood.



Photograph C

(a) The mass of the hammer is 0.454 kg.

(i) Calculate the weight of the hammer.

(2)

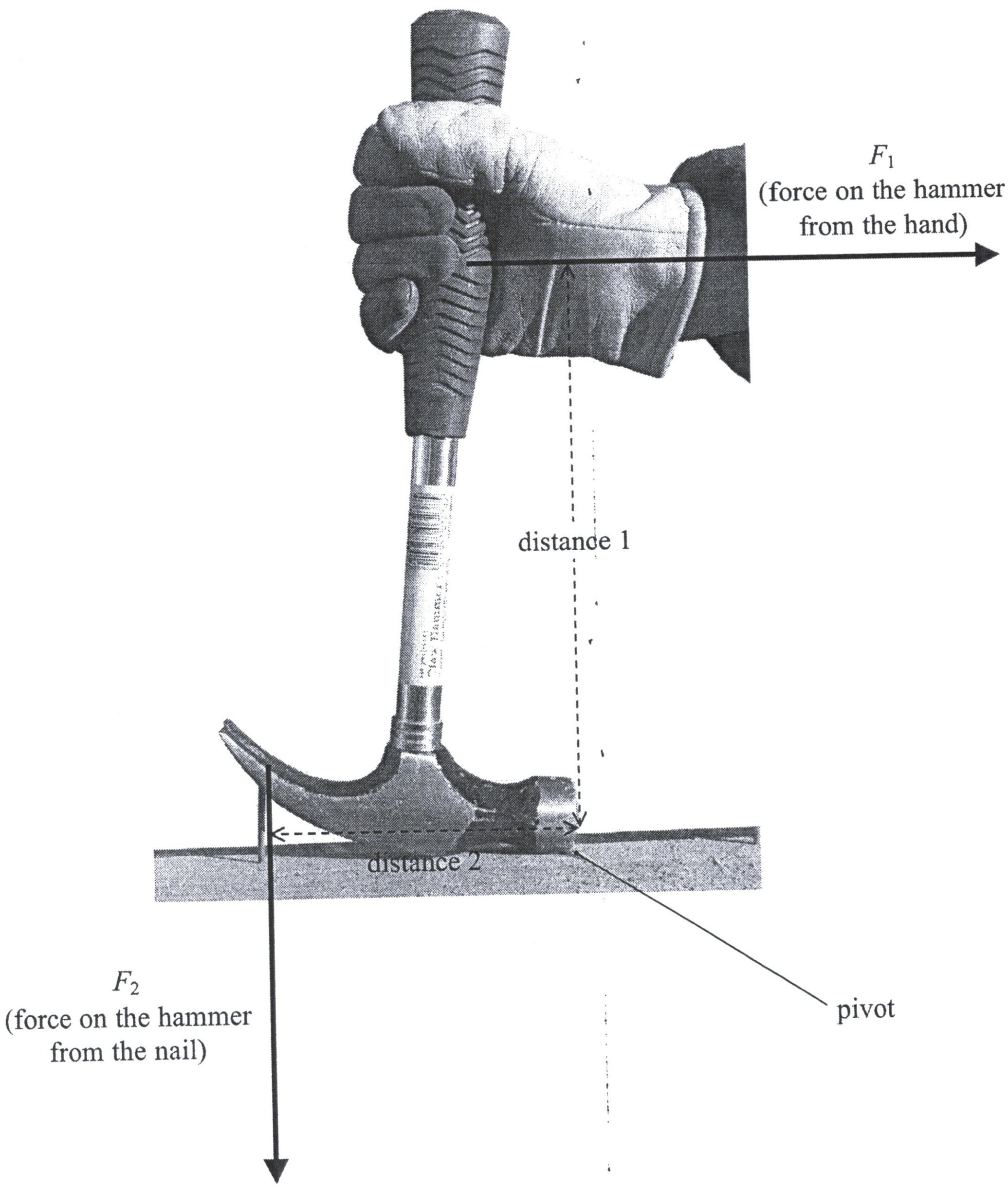
Weight = ... N

(ii) From what point does this weight act?

(1)

....

(b) Photograph **D** shows the directions of two other forces on the hammer.



Photograph D

(i) Draw an arrow on photograph **D** to show the force on the nail from the hammer.

(2)

(ii) Suggest **two** ways that the student could increase the moment on the hammer.

(2)

1 ....

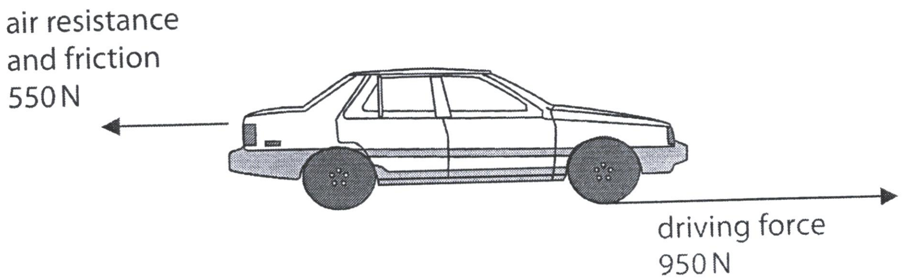
....

2 ....

....

(Total for Question 5 = 7 marks)

4 The diagram shows the horizontal forces on a car travelling to the right along a level road.



(a) How can you tell that the car is accelerating? (1)

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....

(b) (i) State the relationship between acceleration, change in velocity and time. (1)

(ii) The car accelerates for 6.0 s.

The velocity of the car increases from 15 m/s to 24 m/s.

Calculate the acceleration of the car. (2)

acceleration = ... m/s^2

(c) Describe how the horizontal forces on the car change when the driver applies the brakes. (2)

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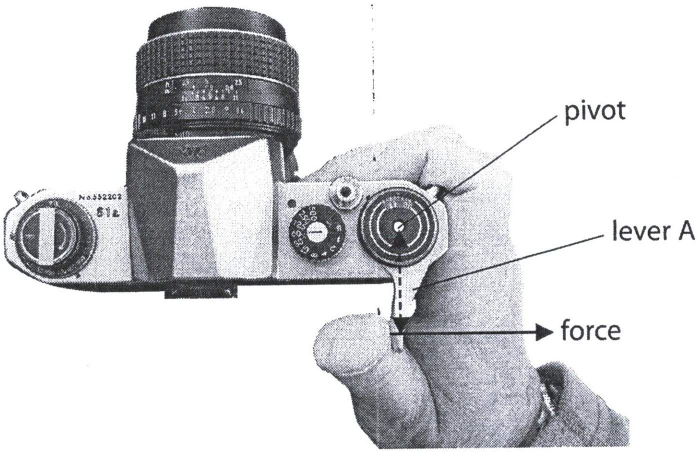
(Total for Question 4 = 6 marks)

5 Photograph **C** shows a student using an old camera that uses film.



Photograph **C**

(a) The film is pulled through the camera using lever A.

The student pushes on lever A with a force of 7.0 N.

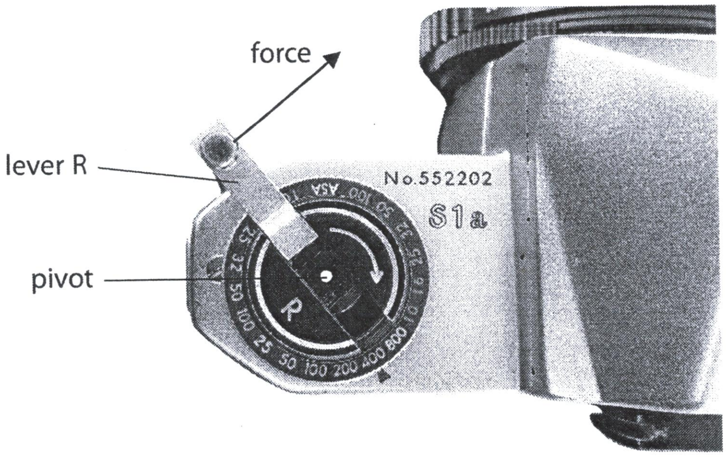
The force is applied 0.04 m from the pivot.

(i) State the equation linking moment, force and distance. (1)

(ii) Calculate the moment of the force that turns lever A and give the unit. (3)

Moment = ... unit ....

(b) When all the film has been used, it is pulled back through the camera using lever R.



Photograph **D**

The force acting on lever R is only 0.02 m from its pivot.

Explain why the minimum force needed to turn lever R is likely to be more than 7 N.

(2)

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(Total for Question 5 = 6 marks)

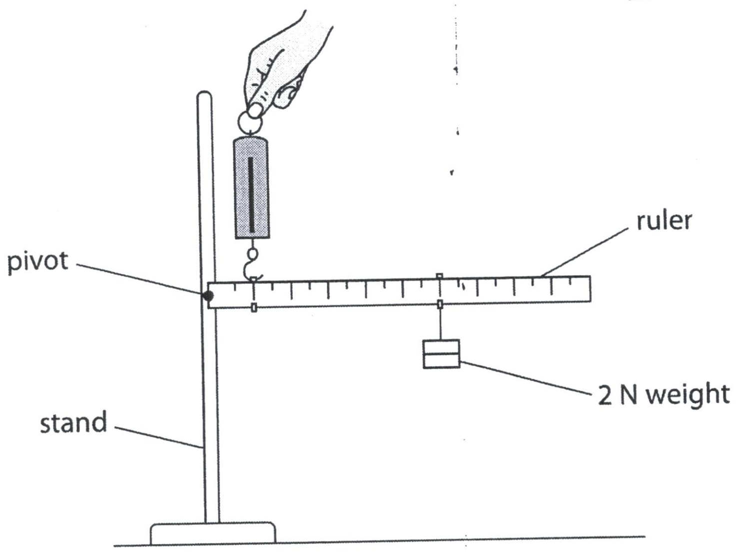
16 A student investigates the principle of moments.

He connects a ruler to a stand with a pivot.

He hangs a 2 N weight from the 60 cm mark on the ruler.

He uses a forcemeter to hold the ruler horizontal.

The scale on the forcemeter reads from 0 N to 10 N.



(a) How could the student check that the ruler is horizontal? (2)

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....

(b) (i) State the equation linking moment, force and distance from the pivot. (1)

(ii) Calculate the moment of the 2 N weight.

State the unit. (3)

Moment = ... Unit ....

(c) The student holds the ruler horizontal with the forcemeter at the 10 cm mark.

He expects the reading on the forcemeter to be 12 N.

The actual reading is 10 N.

(i) Explain why the correct reading should be **larger** than 12 N.

(2)

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(ii) Explain why the actual reading is only 10 N.

(1)

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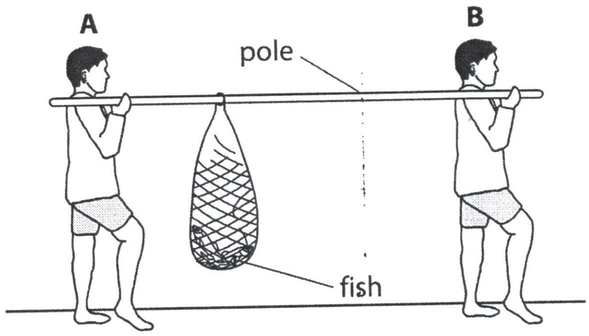
(d) A picture in the student's textbook shows two fishermen using a pole to carry some fish.



Fisherman **A** and fisherman **B** feel different forces on their shoulders.

Use ideas about moments to explain why fisherman **A** feels the larger force.

(3)

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(Total for Question 5 = 12 marks)

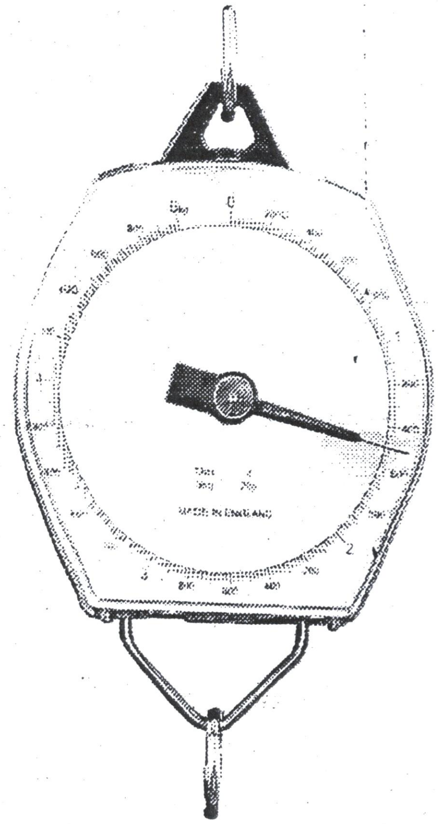
Forces, Momentum, Collisions, Moments

17 A student wants to use a weighing scale to find the weight of her school bag.

She has a weighing scale marked in kilograms instead of newtons.

The weighing scale is not working properly.

With nothing hanging from it, the weighing scale shows 1.5 kg.



(a) What is the weight of a 1.5 kg mass?

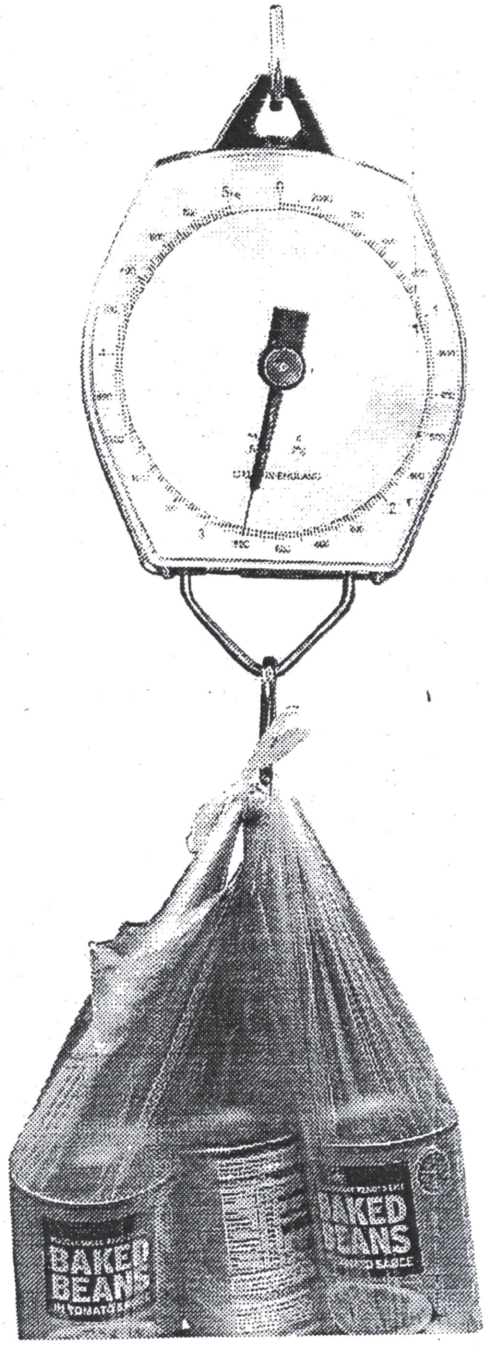
(1)

Weight = ... N

(b) The student decides to check the weighing scale.

She has no accurate weights.

Instead, she puts some tins of beans in a plastic bag and hangs it from the scale.



Her readings are shown in the table.

Number of tins of beans	0	1	2	3	4	5	6
Scale reading (in kg)	1.5	2.0	2.3	2.8	3.7	3.5	3.[illegible]

(i) Draw a graph to show how the scale reading varies with the number of tins of beans.

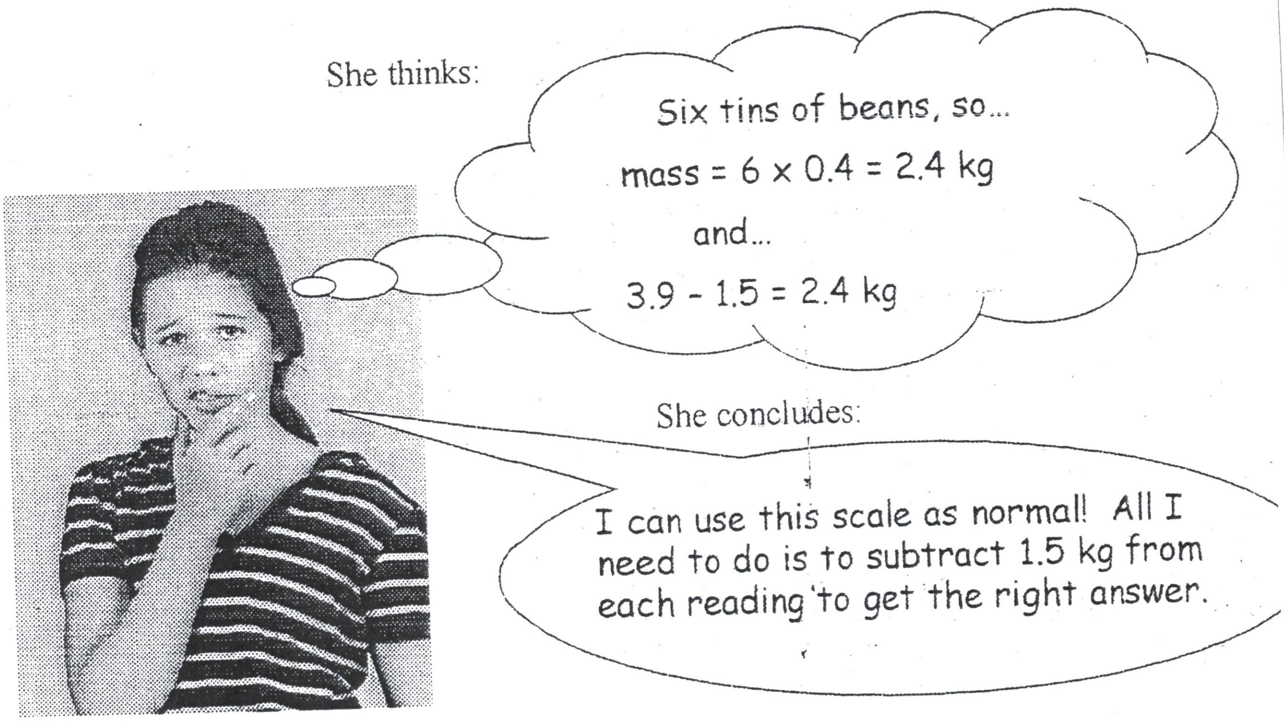
(5)

(ii) Circle the anomalous point on your graph.

(1)

(c) The student notices that the label on each tin says 'contains 0.4 kg of beans'.

She remembers that six tins of beans gave a scale reading of 3.9 kg.



She hangs her school bag from the weighing scale.
The scale reading is 5.0 kg.
She also concludes that her school bag must have a mass of exactly 3.5 kg.

Suggest reasons why the student's conclusions might be **incorrect**.

(4)

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18 A car travels at 20 m/s.

The mass of the car is 1500 kg.

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

(1)

(ii) Calculate the momentum of the car.

(2)

momentum = ... kg m/s

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

(1)

(b) A truck of mass 10 000 kg is moving with a velocity of 4.5 m/s.

A car of mass 1500 kg has the same momentum as the truck.

Calculate the velocity of the car.

(3)

velocity = ... m/s

20 (a) State the principle of moments.

[2]

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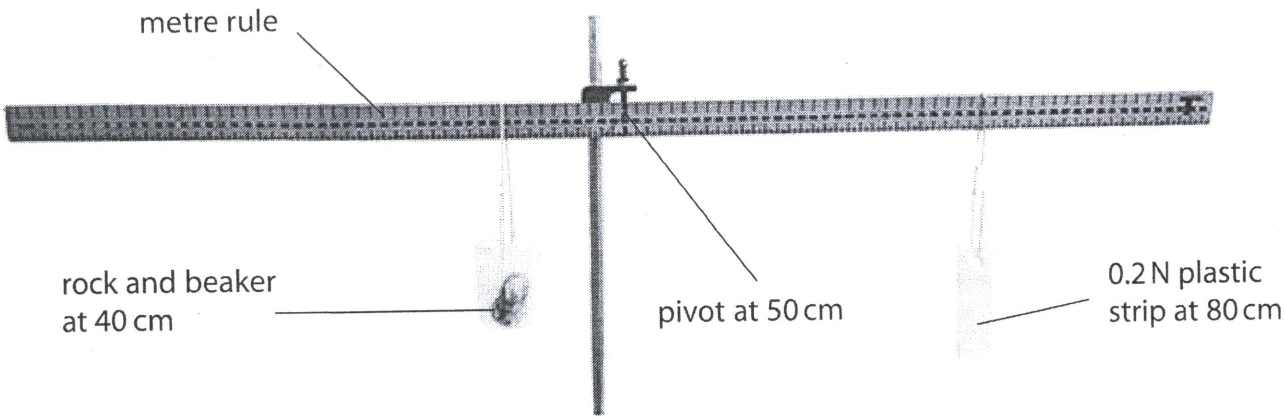
(b) A student uses the principle of moments to find the weight of a rock.
This is the student's method.

- he balances a metre rule at its mid-point on a pivot
- he hangs a beaker from the 40 cm mark on the rule
- he places the rock in the beaker
- he then hangs a 0.2 N plastic strip from the rule on the other side of the pivot
- he adjusts the position of the plastic strip until the rule balances



(i) Describe how the student could use an electronic balance to check that the plastic strip weighs 0.2 N.

[2]

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(ii) Suggest how the student could improve the precision of one of his measurements.
(1)

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(iii) State the equation linking moment, force and perpendicular distance from the pivot.
(1)

(iv) Use the principle of moments to calculate the force acting on the metre rule at the 40 cm mark.
(3)

force = ... N

(v) Suggest a reason why the weight of the rock will be different from your calculated force.
(1)

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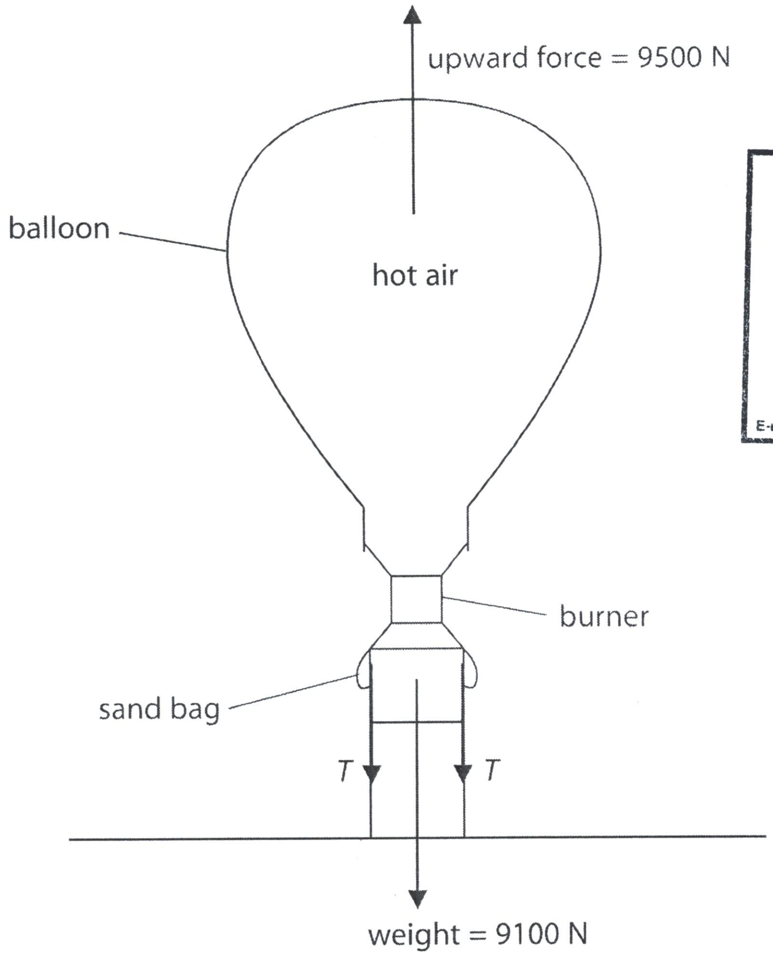
(Total for Question 2 = 10 marks)

21 A hot-air balloon is tied to the ground by two ropes.

The diagram shows the forces acting on the balloon.

The tension *T* in each rope is 200 N.



The ropes are untied and the balloon starts to move upwards.

(a) State the value of the force acting downwards on the balloon immediately after the ropes are untied and before the balloon starts moving.

force downwards = ... N

(b) (i) State the relationship between unbalanced force, mass and acceleration.

DO NOT WRITE IN THIS AREA

1PR- JN- 16

(ii) The balloon has a total mass of 910 kg.

The initial unbalanced force on the balloon is 400 N upwards.

Calculate the initial acceleration.

(2)

initial acceleration = ... m/s²

(c) Explain how the upward acceleration of the balloon changes during the first few seconds of its flight.

(3)

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(d) While the balloon is still accelerating, the pilot controls the balloon by pouring some sand from the bags.

Explain how this affects the upward acceleration of the balloon.

(2)

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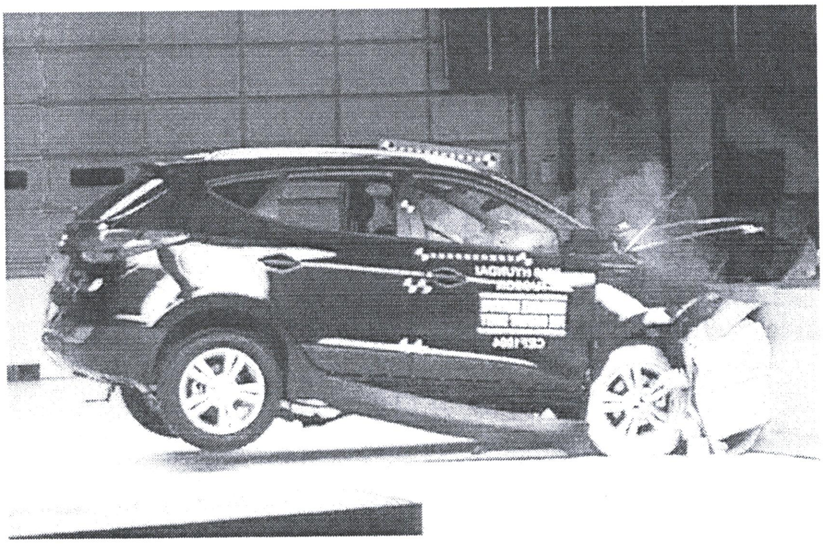
(Total for Question 11 = 9 marks)

22 In a crash test, a car runs into a wall and stops.



(Author: Brady Holt, 2010)

The momentum of the car before the crash is 22500 kg m/s.

The car stops in 0.14 s.

(i) Calculate the average force on the car during the crash.

(2)

average force = ... N

(ii) Use ideas about momentum to explain how seat belts can reduce injuries to passengers during a crash.

(3)

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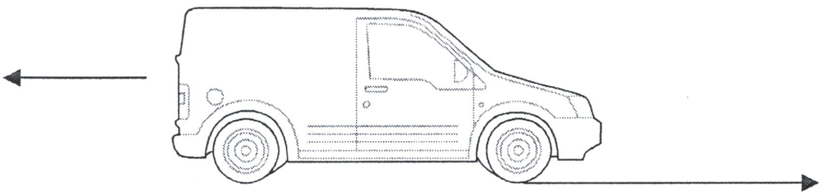
23 (a) Which of these quantities is a scalar?

(1)

- ☐ **A** acceleration
- ☐ **B** energy
- ☐ **C** force
- ☐ **D** velocity

(b) The diagram shows the horizontal forces acting on a van at a particular instant, as it accelerates.

air resistance and friction 1250 N



driving force 8000 N

(i) Calculate the resultant horizontal force acting on the van.

(1)

resultant force = ... N

(ii) State the equation linking resultant force, mass and acceleration.

(1)

(iii) The mass of the van is 2500 kg.

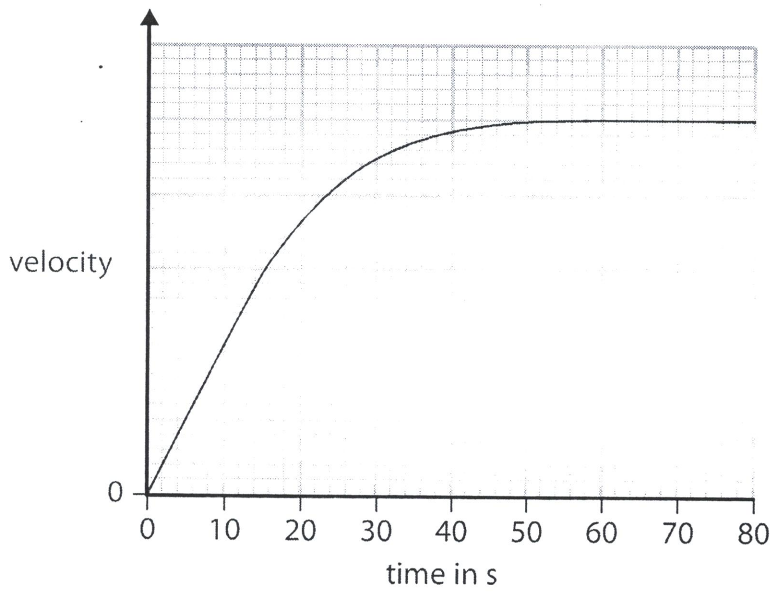
Calculate the acceleration of the van.

Give the unit.

(3)

acceleration = ... unit ....

(c) The graph shows how the velocity of a van changes with time.



Explain the shape of the graph.

Use ideas about forces in your answer.

(5)

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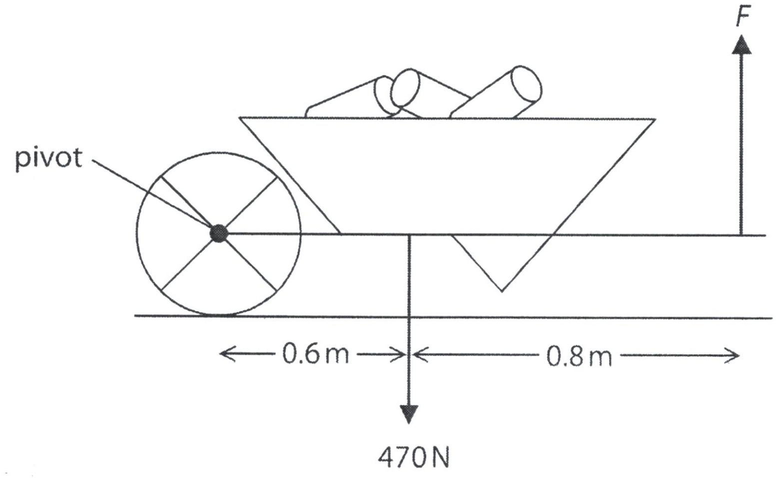
(Total for Question 6 = 11 marks)

24 The man stops and holds the wheelbarrow horizontally, as shown.



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The man exerts a total upward force of *F* N.

The weight of the loaded wheelbarrow is 470 N.

(i) Mark X on the diagram to indicate the centre of gravity of the loaded wheelbarrow.

(1)

(ii) State the equation linking moment, force and perpendicular distance from the pivot.

(1)

(iii) Calculate the force *F*.

(4)

force *F* = ... N

(Total for Question 5 = 10 marks)

25 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)

26 (a) A student measures the weight of a cannonball as 50 N.

(i) Name a piece of equipment he could use to measure the weight.

(1)

....

(ii) State the equation relating weight, mass and *g*.

(iii) Calculate the mass of the cannonball.

(2)

mass = ... kg

(b) Describe how the student could find the density of the cannonball.

You should include details of any further measurements he would need to make.

(3)

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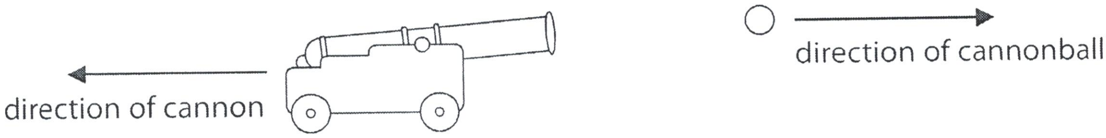
(c) A cannonball is fired from a cannon.

When the cannonball is fired, the cannon moves in the opposite direction, as shown in the diagram.



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Using ideas about momentum, explain why the cannon moves in the opposite direction to the cannonball.

(3)

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(Total for Question 6 = 10 marks)

Forces, Momentum, Collisions, Moments

27 Cars have a number of features that make them safer in a collision.

(a) Apart from seat belts, name two safety features that reduce the risk of serious injury in a car crash.

(2)

1 ....

2 ....

(b) Photograph A shows a person wearing a seat belt.

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Photograph A

(i) Using ideas of momentum and force, explain how a seat belt reduces the risk of serious injury in a car crash.

(4)

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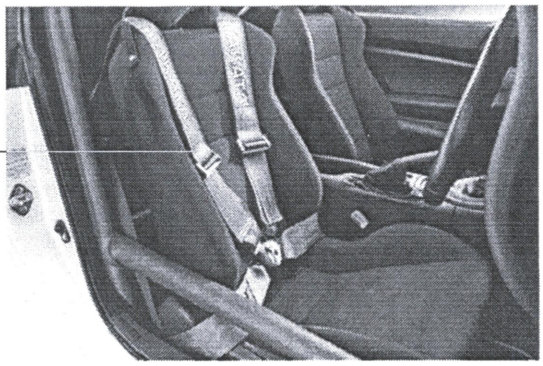
(ii) Photograph B shows a full-body harness used in a racing car.

full-body harness



Photograph B

Suggest why a full-body harness is used in a racing car, instead of an ordinary seatbelt.

(1)

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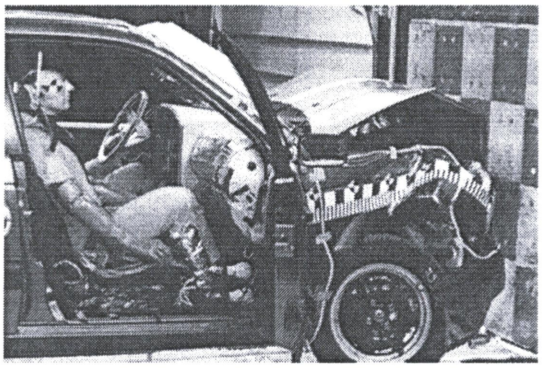
(c) Photograph C shows a crash-test dummy in a car. The car has crashed into a concrete wall.



Photograph C

State what happens to the momentum of the car during the crash.

(1)

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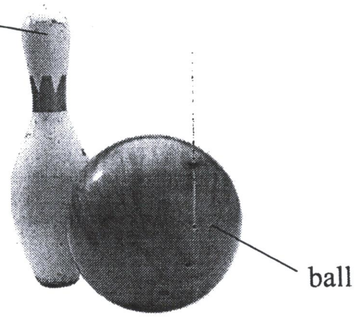
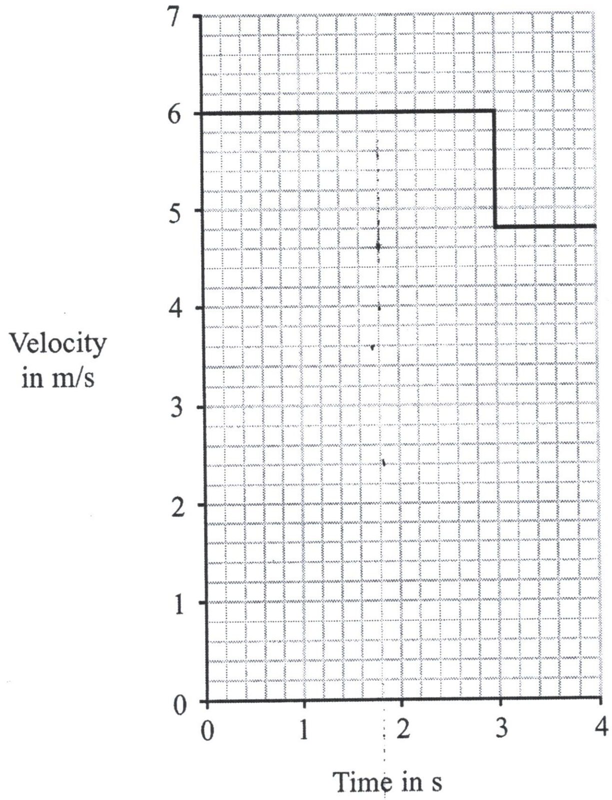
(Total for Question 7 = 8 marks)

8 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 8 = 9 marks)