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GCSE (9–1) Physics A (Gateway Science)

J249/03 Paper 3, P1 – P4 and P9 (Higher Tier)

Wednesday 23 May 2018 – Afternoon

Time allowed: 1 hour 45 minutes

You must have:
- a ruler (cm/mm)
- the Data Sheet (for GCSE Physics A (inserted))

You may use:
- a scientific or graphical calculator
- an HB pencil

First name	
Last name	

Centre number						Candidate number				

INSTRUCTIONS
- The Data Sheet will be found inside this document.
- Use black ink. You may use an HB pencil for graphs and diagrams.
- Complete the boxes above with your name, centre number and candidate number.
- Answer **all** the questions.
- Write your answer to each question in the space provided. If additional space is required, use the lined page(s) at the end of this booklet. The question number(s) must be clearly shown.
- Do **not** write in the barcodes.

INFORMATION
- The total mark for this paper is **90**.
- The marks for each question are shown in brackets **[ ]**.
- Quality of extended responses will be assessed in questions marked with an asterisk (*).
- This document consists of **24** pages.

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SECTION A

Answer **all** the questions.

You should spend a maximum of 30 minutes on this section.

1 The atomic model has changed over time.

Why did the model need to change over time?

A Models only have a finite lifetime

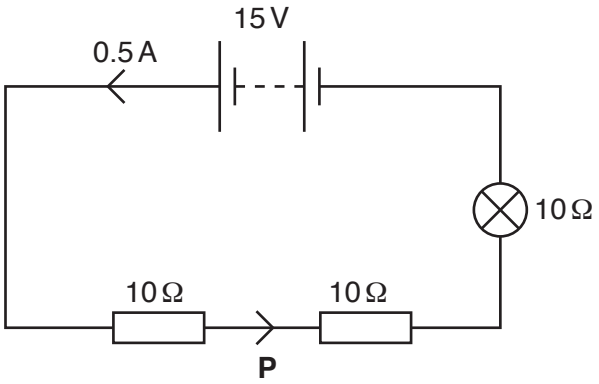
B Computers were invented

C The older models could not explain new evidence

D Peer review

Your answer ☐ **[1]**

2 What is the current at point **P** in the circuit?



A 0.5A

B 7.5A

C 15.0A

D 20.5A

Your answer ☐ **[1]**

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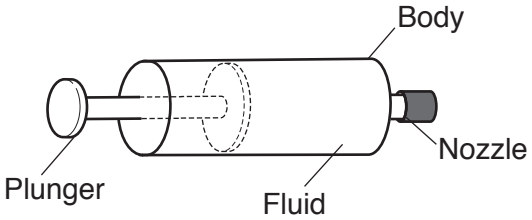
3 A fluid is compressed by pushing the plunger into the body of a sealed syringe.



Which of these statements is true?

A There is a net force towards the plunger.

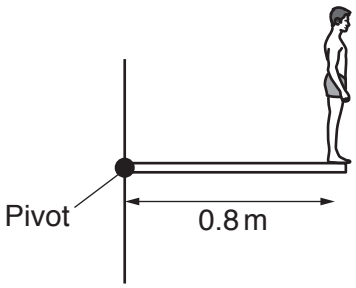
B There is no force towards the nozzle.

C There is a force parallel to all points on the surface of the fluid.

D There is a force at 90° to all points on the surface of the fluid.

Your answer ☐ **[1]**

4 A diver stands on a diving board. He weighs 400 N.



What is the moment of the force provided by the diver around the pivot?

A 320 Nm anti-clockwise

B 320 Nm clockwise

C 500 Nm anti-clockwise

D 500 Nm clockwise

Your answer ☐ **[1]**

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5 Which factor influences whether an object floats or sinks?

A Size of object

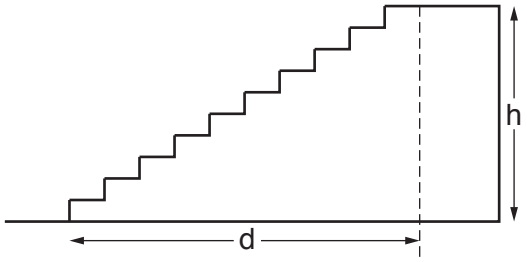
B Depth of water

C Distance from the shore

D Density of object

Your answer ☐ **[1]**

6 A student of weight W runs up a flight of stairs.



She moves a distance d metres horizontally and h metres vertically.

What is the work done against gravity running up the stairs?

A $W \times d$

B $W \times h$

C $(W \times d) + (W \times h)$

D $W \times \frac{h}{d}$

Your answer ☐ **[1]**

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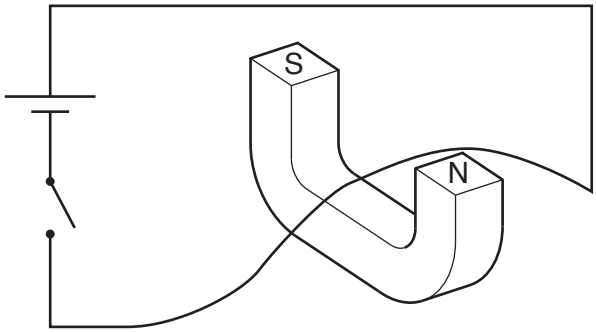
7 A wire is placed inside a horseshoe magnet.



Which direction will the wire move when the switch is closed?

A Downwards

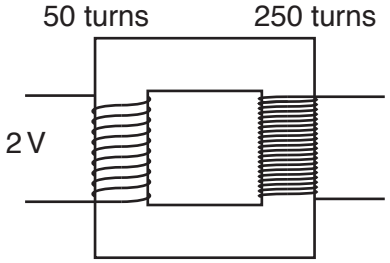
B Left

C Right

D Upwards

Your answer ☐ **[1]**

8 What output voltage does the transformer produce?



A 0.2 V

B 0.4 V

C 5 V

D 10 V

Your answer ☐ **[1]**

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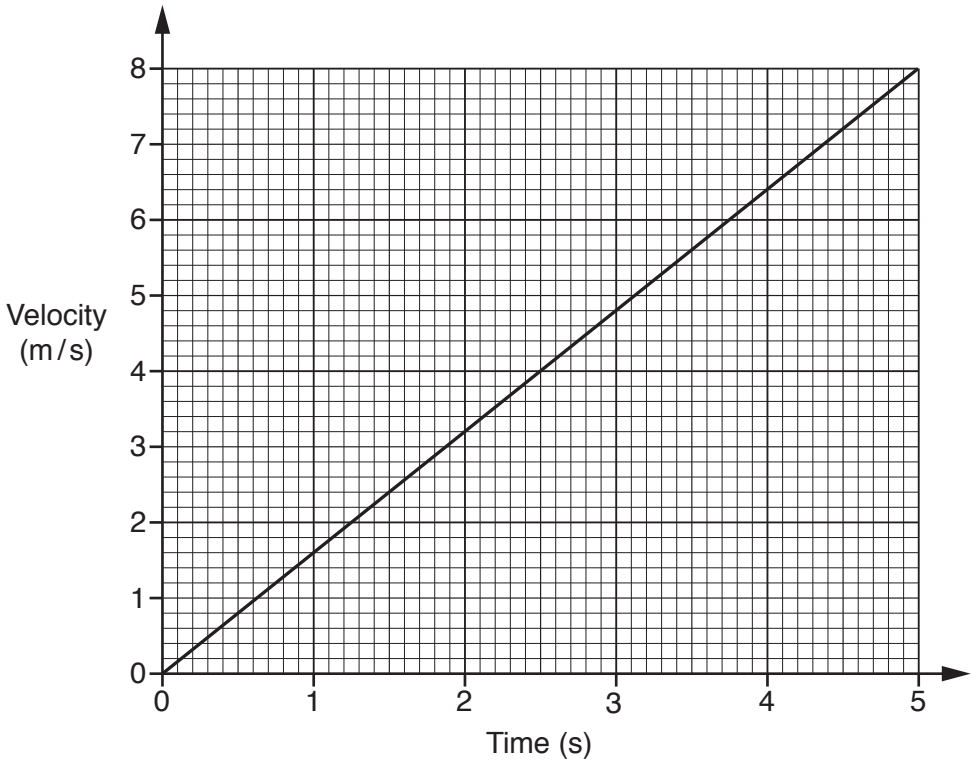
9 Look at the velocity-time graph of an object.



What is the distance travelled by the object in 5s?

A 0.63 m

B 1.6 m

C 20 m

D 40 m

Your answer ☐ **[1]**

10 Which statement is equivalent to the mass of an object?

A The ratio of acceleration over force

B The ratio of force over acceleration

C The ratio of velocity over acceleration

D The ratio of displacement over acceleration

Your answer ☐ **[1]**

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11 Which does **not** increase the magnetic effect of a solenoid?

A Increasing the cross-sectional area of the solenoid

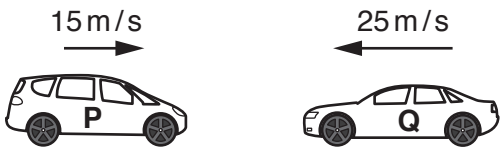
B Increasing the current in the solenoid

C Increasing the number of turns on the solenoid

D Putting a soft iron core in the solenoid

Your answer ☐ **[1]**

12 Two cars head towards each other on a road.



What velocity does the driver of car **Q** see car **P** travelling towards him at?

A 10 m/s

B 15 m/s

C 25 m/s

D 40 m/s

Your answer ☐ **[1]**

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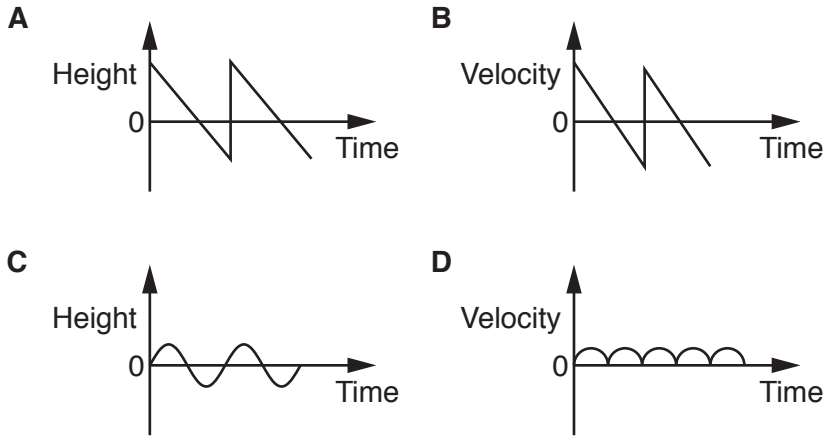
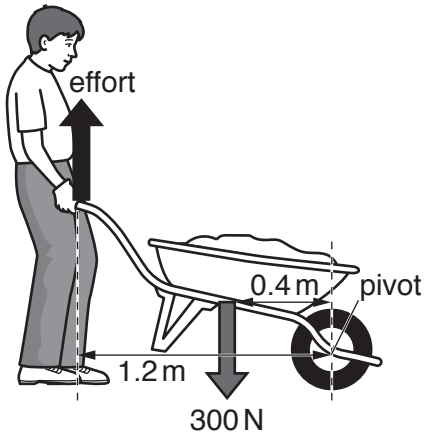
13 Which graph shows a bouncing ball?



Your answer ☐ **[1]**

14 A man lifts a load using a wheelbarrow.



What is the effort needed to lift the load using the wheelbarrow?

A 100 N

B 120 N

C 250 N

D 144 N

Your answer ☐ **[1]**

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15 A 0.5 m length of wire is placed inside four different magnetic fields.

Magnetic Field	Force on wire (N)	Current in wire (A)
A	2.0	0.1
B	2.0	0.2
C	4.0	0.1
D	4.0	0.4

Which magnetic field has the **greatest** magnetic flux density?

Your answer ☐ **[1]**

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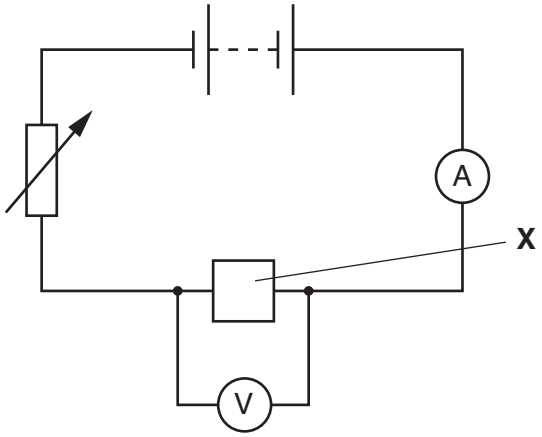
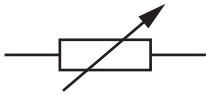
SECTION B

Answer **all** the questions.

16 A student builds a circuit to investigate the resistance of component **X**.



(a) **(i)** What is the name of this component?



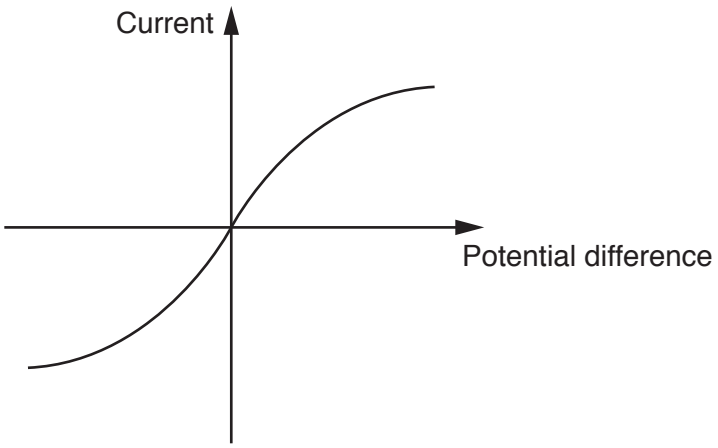
..... **[1]**

(ii) Why is this component needed in this circuit?

..... **[1]**

(b) The student uses the circuit to take current and potential difference readings.

The student plots a graph of her results.



(i) Look at the graph. What is component **X** in the circuit?

..... **[1]**

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(ii) The resistance of component **X** varies as the potential difference changes.

Describe how the graph shows this and explain why this happens.

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..... **[3]**

(c) Component **X** has a resistance of 16 Ω when a current of 0.25 A flows.

(i) Calculate the potential difference across component **X**.

Use the equation: Potential difference = Current × Resistance

Answer = ... V **[2]**

(ii) Calculate the power of component **X** when a current of 0.25 A flows.

Answer = ... W **[3]**

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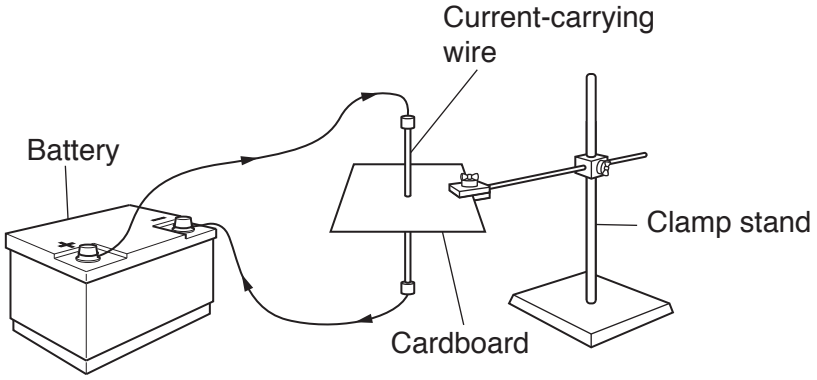
17 A student sets up an experiment to investigate the magnetic field around a current-carrying wire.



(a) **(i)** Describe how the student could use this experiment and a compass to investigate the magnetic field produced by the wire.

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..... **[3]**

(ii) Draw the shape of the field which would be found around **this** wire.

[2]

(b) The behaviour of a magnetic compass is evidence that the core of the Earth is magnetic. Explain why.

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

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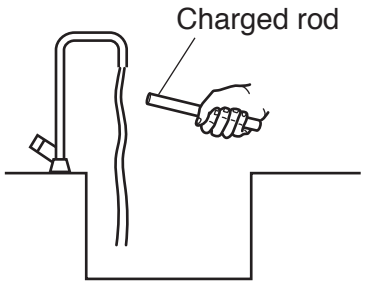
18 This question is about electrostatic charges.

A charged rod is brought towards a gentle stream of water from a tap.



(a) Explain how the charged rod affects the stream of water.

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..... **[3]**

(b) **(i)** Write down the conditions needed for charge to flow through a conductor.

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

(ii) Calculate the charge that flows past a point in a circuit with a 5.0 A current for five minutes.

Answer = ... C **[4]**

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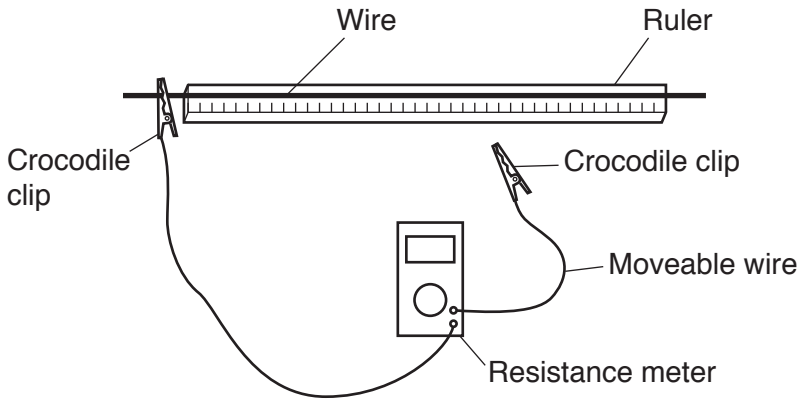
19 Two students investigate the resistance of a wire.

They tape a length of wire to a metre ruler and connect it to a resistance meter using crocodile clips.



Look at their results.

Length of wire (cm)	Resistance (Ω)			
	Attempt 1	**Attempt 2**	**Attempt 3**	**Mean**
25	8.8	8.3	8.5	8.533
50	16.2	16.1	16.4	16.4
75	23.5	23.8	18.7	23.7
100	30.8	31.1	31.0	31.0

(a) (i) Describe the pattern shown by these results.

Use data in your answer.

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

(ii) The students made **two** mistakes when they recorded their results and completed the table.

Identify the mistakes **and** explain what they should have done.

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

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(iii) The students have correctly handled an error in their results.

Identify the error and explain how it was correctly handled.

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

(iv) The students plan to plot a graph of mean resistance against length.

What would you expect a graph of these results to look like?

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

(b) **(i)** The actual mean resistance values are more than expected.

Suggest **two** possible errors with the experiment.

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

(ii) For **one** of the errors, suggest how the experimental procedure could be improved.

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..... **[1]**

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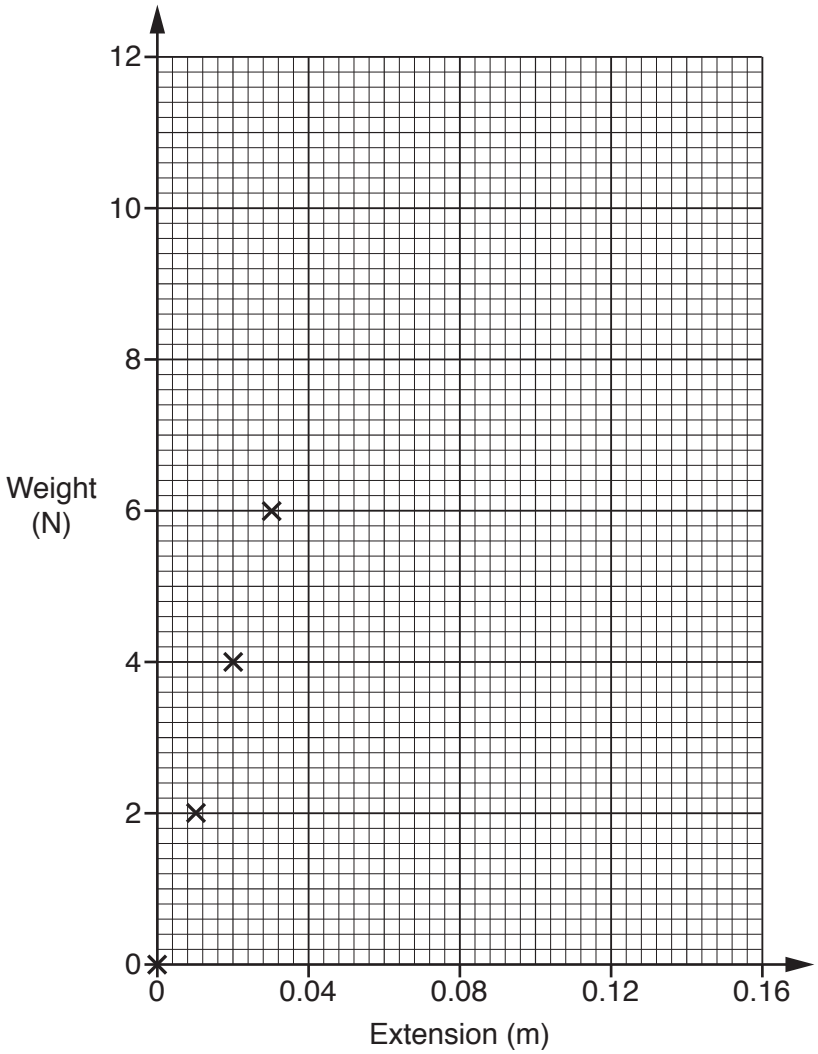
20 A student hangs a length of copper wire from the ceiling.

She adds weights to the bottom of the wire and measures the extension of the wire.

Look at a table of some of her results.

Weight (N)	Extension (m)
0	0
2	0.01
4	0.02
6	0.03
8	0.04
10	0.08
12	0.16

(a) **(i)** Plot the values on the graph. Some have been done for you.



[2]

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(ii) Draw a line of best-fit on the graph. **[1]**

(iii) Describe **and** explain the shape of the graph.

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..... **[3]**

(b) Calculate the spring constant for the 0 – 6 N part of the graph.

Use the equation: Force = Spring constant × Extension

Answer = ... N/m **[3]**

(c) Calculate the work done in stretching the wire to 0.04 m.

Answer = ... J **[2]**

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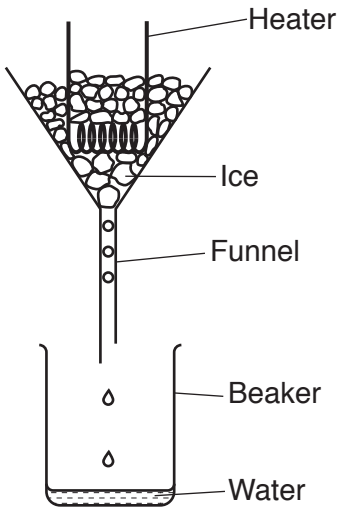
21 Two students design an experiment to find the specific latent heat of water.

They set up their equipment as shown in the diagram.



The students also have access to a power supply, a voltmeter, an ammeter, a stop-clock and a top-pan balance.

(a)* Explain how the students could use this equipment to determine an accurate value for the specific latent heat of water.

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..... **[6]**

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(b) The students find that 250 g of ice takes 95 kJ of energy to change state.

Calculate the specific latent heat.

Answer = ... J/kg **[3]**

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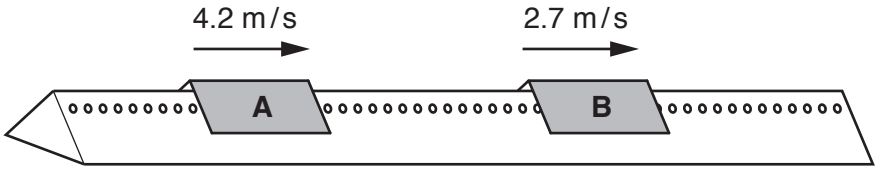
22 A student investigates collisions of trolleys on a horizontal airtrack.

(a) Write down the **two** quantities involved with motion which are conserved during an elastic collision.

.....

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

Trolley **A** has a mass of 2 kg. Trolley **B** has a mass of 2.5 kg.



(b) **(i)** Calculate the **momentum** of each trolley.

Trolley **A** = ... kg m/s

Trolley **B** = ... kg m/s
[3]

(ii) The two trolleys collide and stick together after the collision. Use your answers to **(b)(i)** to calculate the **speed** of the combined trolleys after the collision.

Record your answer to **2** significant figures.

Answer = ... m/s **[3]**

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23 A student wants to find out the depth of a well.

She thinks that she can calculate this by dropping a stone into the well and timing how long it takes to hear the stone splash at the bottom.

(a) **(i)** Explain how she could use this measurement to find the depth of the well.

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..... **[3]**

(ii) It takes 2.2 seconds for the stone to drop from rest and splash into the water at the bottom.

What is the speed of the stone when it hits the water?

Answer = ... m/s **[2]**

(b) Describe the motion of the stone as it falls.

Assume it does not reach terminal velocity.

Use a free body diagram to help you.

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..... **[4]**

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END OF QUESTION PAPER

ADDITIONAL ANSWER SPACE

If additional space is required, you should use the following lined page(s). The question number(s) must be clearly shown in the margin(s).

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