AQA

Please write clearly in block capitals.

Centre number | | | | | | Candidate number | | | | |

Surname Matheson

Forename(s) Lewis

Candidate signature

GCSE
COMBINED SCIENCE: TRILOGY

H

Higher Tier
Physics Paper 1H

Wednesday 23 May 2018 Afternoon Time allowed: 1 hour 15 minutes

Materials
For this paper you must have:
- a ruler
- a scientific calculator
- the Physics Equations Sheet (enclosed).

Instructions
- Use black ink or black ball-point pen.
- Fill in the boxes at the top of this page.
- Answer **all** questions in the spaces provided.
- Do all rough work in this book. Cross through any work you do not want to be marked.
- In all calculations, show clearly how you work out your answer.

Information
- The maximum mark for this paper is 70.
- The marks for questions are shown in brackets.
- You are expected to use a calculator where appropriate.
- You are reminded of the need for good English and clear presentation in your answers.

For Examiner's Use	
Question	Mark
1	
2	
3	
4	
5	
6	
TOTAL	

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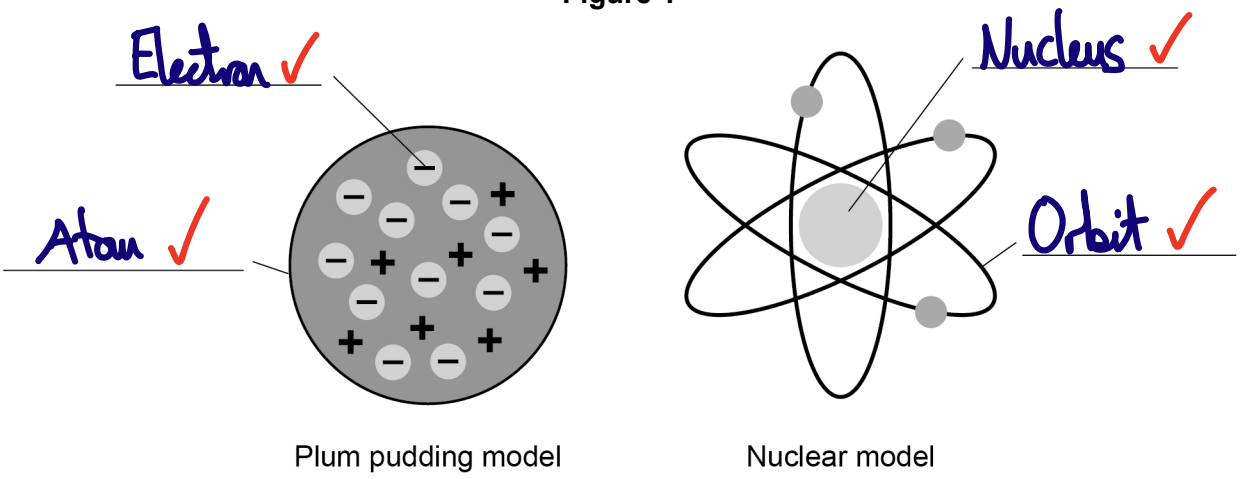
0 1 **Figure 1** shows two models of the atom.

Figure 1



Plum pudding model

Nuclear model

0 1 . 1 Write the labels on **Figure 1**

Choose the answers from the box.

[4 marks]

~~atom~~	~~electron~~	~~nucleus~~
neutron	~~orbit~~	**proton**

0 1 . 2 Explain why the total positive charge in every atom of an element is always the same.

[2 marks]

An atom of that element will always have the same number of protons, which each have a positive charge.

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0 1 . 3 The results from the alpha particle scattering experiment led to the nuclear model.

Alpha particles were fired at a thin film of gold at a speed of 7% of the speed of light.

Determine the speed of the alpha particles.

Speed of light = 300 000 000 m/s

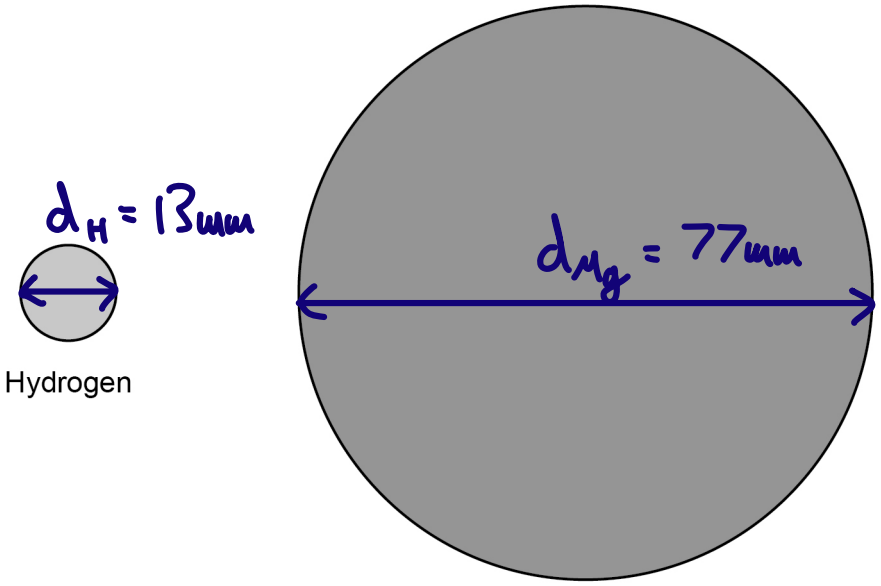
[2 marks]

$V = 0.07 \times c = 0.07 \times 300\,000\,000 = 21\,000\,000$ ✓

Speed = 2.1×10^{7} ✓ m/s

0 1 . 4 **Figure 2** shows two atoms represented as solid spheres.

Figure 2



A hydrogen atom has a radius of 2.5×10^{-11} m

Determine the radius of a magnesium atom.

Use measurements from **Figure 2**

[2 marks]

$\frac{r_H}{d_H} = \frac{r_{Mg}}{d_{Mg}}$ $r_{Mg} = 2.5 \times 10^{-11} \times \frac{75}{13} = 1.4 \times 10^{-10}$

Radius = 1.4×10^{-10} ✓✓ m

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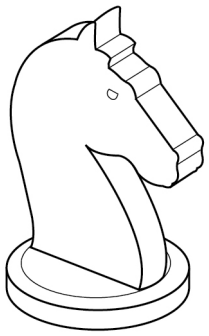
0 2 A student wanted to determine the density of the irregular shaped object shown in **Figure 3**

Figure 3



0 2 . 1 Plan an experiment that would allow the student to determine the density of the object.

[6 marks]

- Use a mass balance to record the mass in g. ✓
- Fill a eureka can with water until comes out of the spout. ✓
- Place an empty measuring cylinder under the spout then place the object in the eureka can ✓ Make sure it is fully submerged. ✓
- Measure volume in ml of displaced water, where 1 ml = 1 cm^3 ✓
- Calculate density as mass divided by volume. ✓

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0 2 . 2 Another student did a similar experiment.

He determined the density of five common plastic materials.

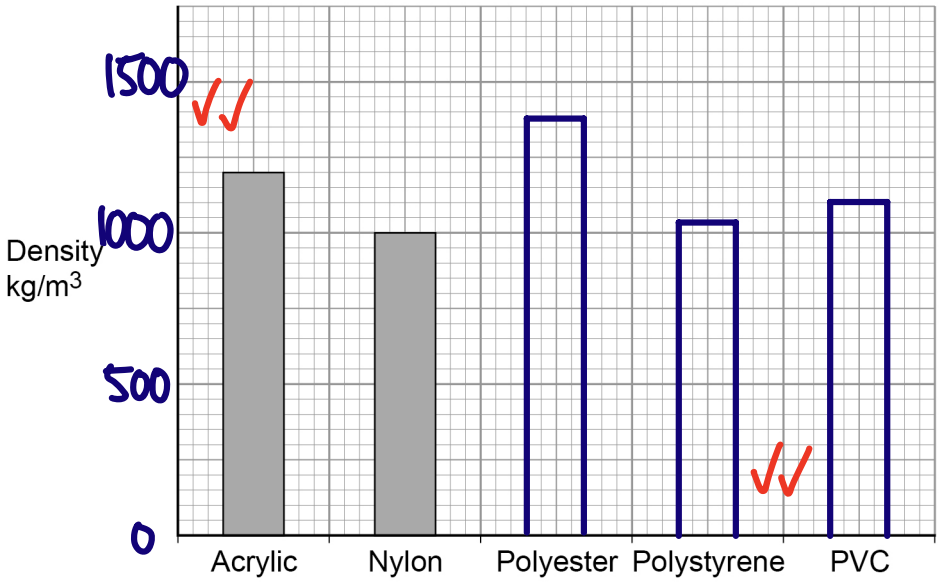
Table 1 shows the results.

Table 1

Plastic material	Density in kg/m^3
Acrylic	1200
Nylon	1000
Polyester	1380
Polystyrene	1040
PVC	1100

Figure 4 shows the results plotted in a bar chart.

Figure 4



Complete **Figure 4**

You should:

- Write the correct scale on the y-axis.
- Draw the bars for polyester, polystyrene and PVC.

[4 marks]

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0 2 . 3 The student is given a piece of a different plastic material.

The student determined the density of the material three times.

Table 2 shows the results.

Table 2

	Density in kg/m^3
1	960
2	1120
3	1040

Determine the uncertainty in the student's results.

[2 marks]

Half the range = (1120 - 960)/2 = 80 ✓

Uncertainty = 80 ✓ kg/m^3

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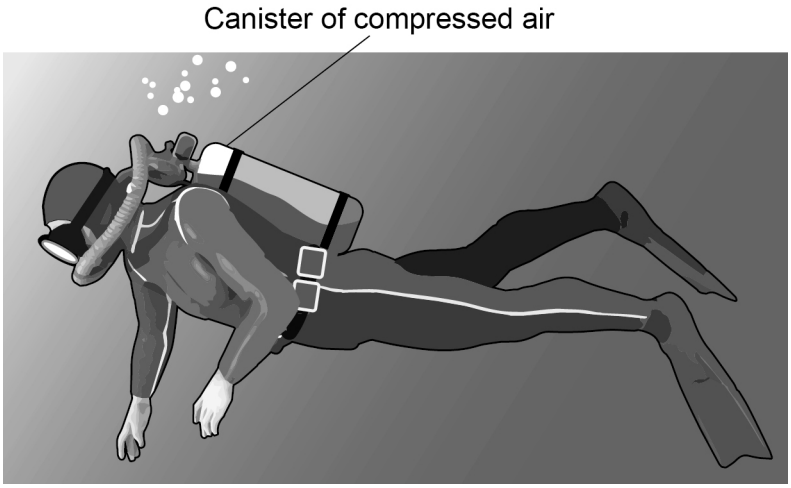
0 3 **Figure 5** shows a diver.

The diver is using a canister of compressed air so that he can breathe underwater.

Figure 5



0 3 . 1 Which **two** sentences describe the movement of the air particles in the canister?

[2 marks]

Tick **two** boxes.

They vibrate about a fixed position.	
They move in random directions.	✓
The motion of all the particles is predictable.	
They move with a range of different speeds.	✓
They move in circular paths.	

0 3 . 2 The temperature of the air inside the canister increases.

What happens to the movement of the air particles?

[1 mark]

The mean speed increases. ✓

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0 3 . 3 It could be dangerous if the temperature of the air inside the canister increased by a large amount.

Explain why.

[2 marks]

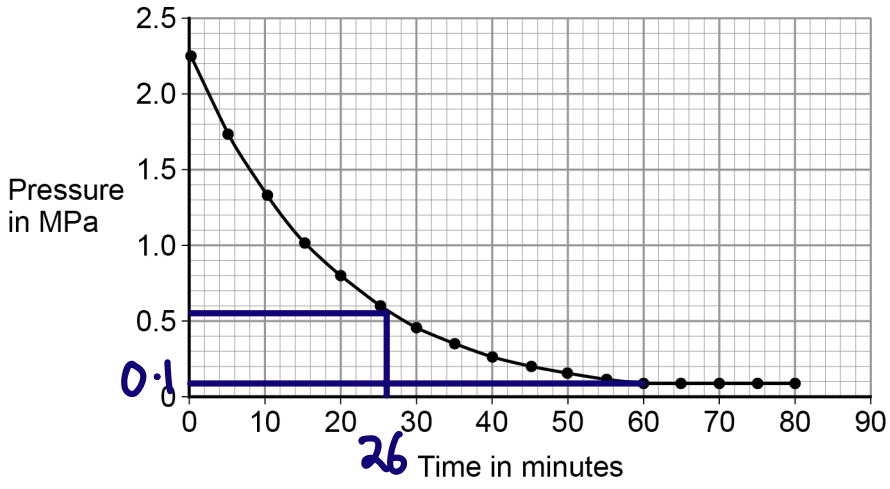
Temperature is proportional to the pressure, ✓
so it could explode. ✓

A canister of air was tested to find out how the pressure changed when it was used by a diver.

- Air was allowed to escape from the canister.
- The pressure of the air in the canister was recorded every 5 minutes for 80 minutes.

Figure 6 shows the results.

Figure 6



0 3 . 4 Estimate the atmospheric pressure.

Use **Figure 6**

[1 mark]

Atmospheric pressure = 0·1 ✓ MPa

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0 3 . 5 Divers can safely stay underwater until the pressure of the air in the canister has reduced to 25% of its original value.

Determine the maximum time the diver can safely stay underwater.

Use **Figure 6**

[3 marks]

$0.25 \times 2.25 = 0.56$ MPa ∴ 26 minutes

Time = 26 minutes

0 3 . 6 What happens to the volume of the air when it is released from the canister?

[1 mark]

It increases

10

Turn over for the next question

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0 4 The Chernobyl disaster was a nuclear accident that happened in 1986

Radioactive isotopes were released into the environment.

The radioactive isotopes emitted alpha, beta and gamma radiation.

0 4 . 1 What is an alpha particle?

[1 mark]

Tick **one** box.

- 2 charged particles and 2 neutral particles. ☑
- 2 charged particles and 4 neutral particles. ☐
- 4 charged particles and 2 neutral particles. ☐
- 4 charged particles and 4 neutral particles. ☐

0 4 . 2 Which statement about beta radiation is true?

[1 mark]

Tick **one** box.

- It is the fastest moving type of radiation. ☐
- It is the type of radiation with a negative charge. ☑
- It is the type of radiation with the greatest mass. ☐
- It is the type of radiation with the greatest range in air. ☐

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0 4 . 3 Which statement about gamma radiation is true?

[1 mark]

Tick **one** box.

It is a low frequency electromagnetic wave. ☐

It causes the charge of the nucleus to change. ☐

It causes the mass of the nucleus to change. ☐

It has a very long range in air. ☑ ✓

Question 4 continues on the next page

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Table 3 shows the half-lives of two of the radioactive isotopes that contaminated the environment.

Table 3

Isotope	Half-life
Caesium–137	30 years
Iodine–131	8 days

0 4 . 4 A soil sample was taken from the area around Chernobyl in 1986

The soil sample was contaminated with equal amounts of caesium–137 and iodine–131

Explain how the risk linked to each isotope has changed between 1986 and 2018

Both isotopes emit the same type of radiation.

[4 marks]

The risk from iodine-131 is now significantly lower ✓ than caesium-137 ✓, because it has a much shorter half-life of only 8-days so will almost have completely decayed. ✓
About half of the caesium will remain as it is just over one half-life between 1986 to 2018. ✓

0 4 . 5 Determine the year when the activity of the caesium–137 in the soil sample will be 1/32 of its original value.

[3 marks]

0	1
1	1/2
2	1/4
3	1/8
4	1/16
5	1/32

5 half-lives ✓ ∴ 5 × 30 = 150 years ✓

1986 + 150 = 2136

Year = 2136 ✓

10

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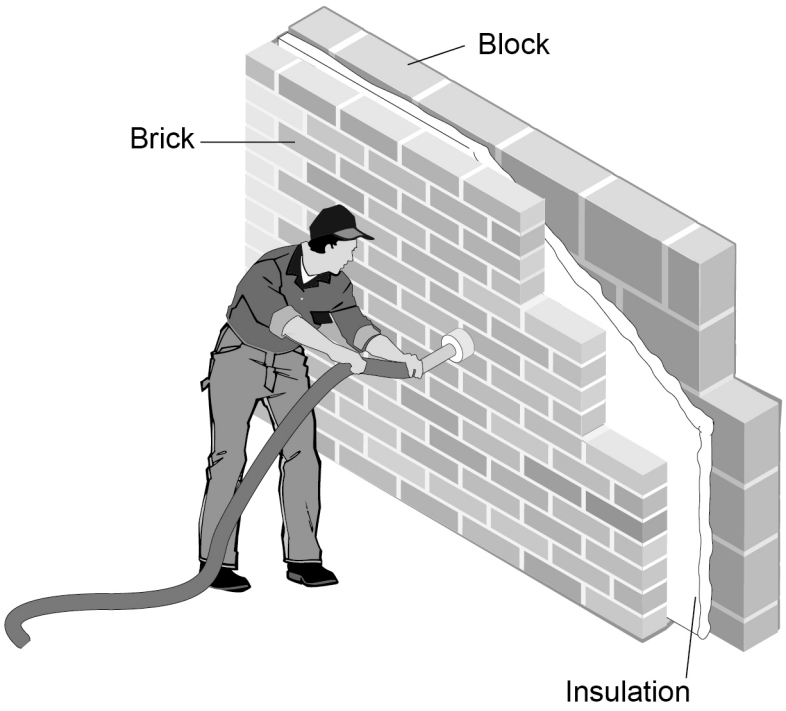
0 5 **Figure 7** shows cavity wall insulation being installed in the wall of a house.

Figure 7



0 5 . 1 Explain how the wall reduces unwanted energy transfers.

[3 marks]

The wall is made of three layers which are thick ✓, and the insulation has a low thermal conductivity ✓, which all reduce the rate of conduction. ✓

Question 5 continues on the next page

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0 5 . 2 The cavity insulation was tested.

- The heating inside the house was switched off.
- The temperature inside the house was measured every 20 minutes for 2 hours.

Table 4 shows the results.

Table 4

Time in minutes	Temperature in °C
0	25.0
20	20.8
40	17.4
60	14.5
80	12.1
100	10.0
120	8.4

Determine the temperature inside the house after 30 minutes.

[2 marks]

$\Delta\theta = 20.8 - 17.4 = 3.4$

$20.8 - (\Delta\theta/2) = 20.8 - 1.7 = 19.1$ ✓

Temperature = 19.1 ✓ °C

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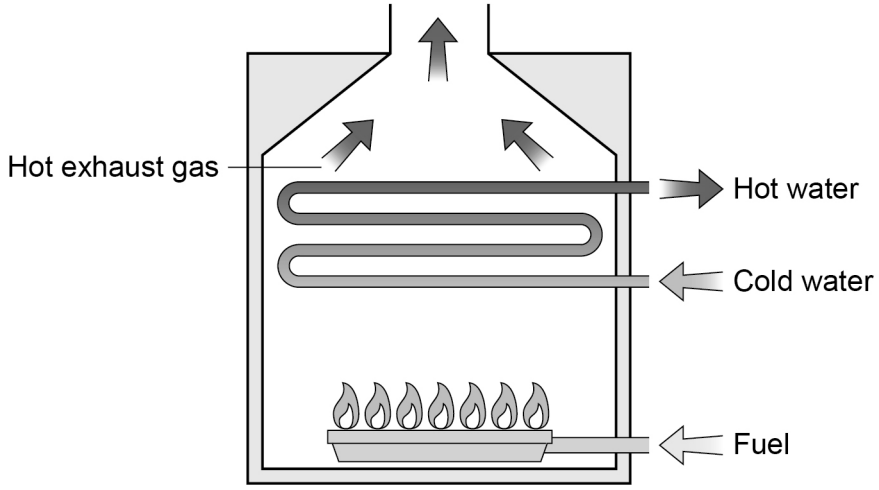
0 5 . 3 **Figure 8** shows the gas boiler used to heat the house.

Figure 8



Describe how different energy stores are changed by the boiler.

[3 marks]

The chemical energy ✓ store of the fuel is transferred to the thermal store of the water ✓ and the air. ✓

0 5 . 4 To heat the house, the boiler transfers 15 MJ of energy in 10 minutes.

Calculate the power of the boiler.

Write any equation that you use.

[4 marks]

$P = \frac{E}{t} = \frac{15 \times 10^6}{10 \times 60} = 25000$ ✓ ✓ ✓

Power = 25 000 ✓ W

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Turn over for the next question

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0 6 A student built a circuit using filament lamps.

0 6 . 1 Sketch a current potential difference graph for a filament lamp on **Figure 9**

[2 marks]

Figure 9

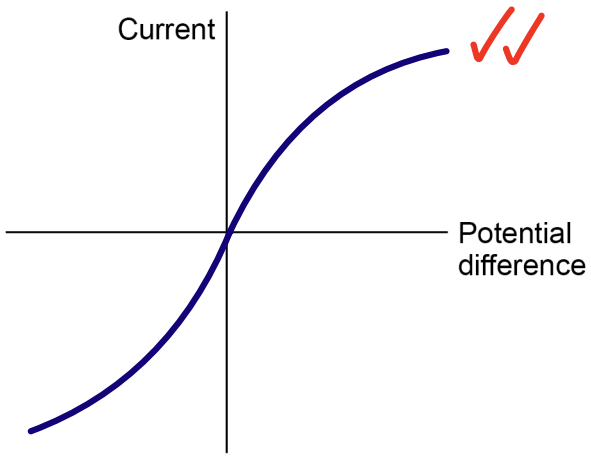

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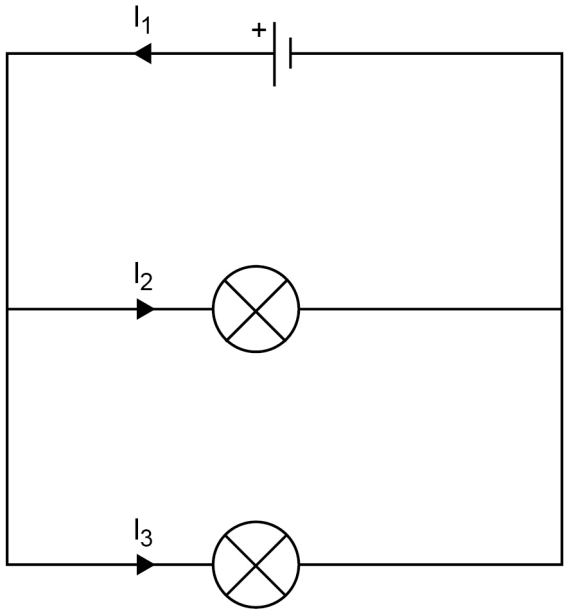
Figure 10 shows the circuit with two identical filament lamps.

Figure 10



0 6 . 2 Compare the currents I_1, I_2 and I_3

[2 marks]

$I_1 = I_2 + I_3$ ✓ $I_2 = I_3$ ✓

Question 6 continues on the next page

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0 6 . 3 Calculate the charge that flows through the cell in 1 minute.

Each filament lamp has a power of 3 W and a resistance of 12 Ω

Write any equations that you use.

Give the unit.

[6 marks]

$P = I^2R \quad 3 = I^2 \times 12$ ✓ $\quad I^2 = 0.25$ ✓ $\quad I = 0.5$ ✓

$I_{cell} = 2 \times I_{lamp} = 2 \times 0.5 = 1.0\,A$ ✓

$Q = It = 1.0 \times (1 \times 60) = 60\,C$

Charge = 60 ✓

Unit = C ✓

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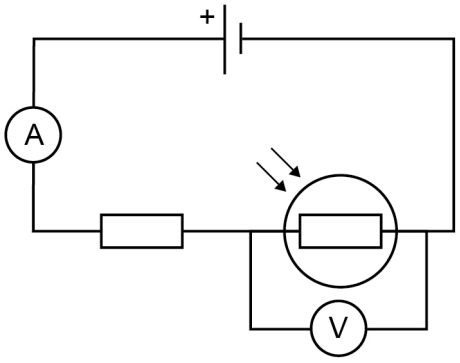
0 6 . 4 The student builds a different circuit.

Figure 11 shows the circuit.

Figure 11



Explain how the readings on both meters change when the environmental conditions change.

[6 marks]

As light intensity increases ✓, the resistance of the LDR decreases. ✓

This means the total resistance of the circuit decreases, so the current will increase ✓, as the potential difference across the cell remains the same. So the reading on the ammeter increases. ✓

As resistance of the LDR decreases, it has a lower share of the total potential difference ✓ so the reading on the voltmeter decreases. ✓

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END OF QUESTIONS

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