OCR
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F

Friday 14 June 2019 – Morning

GCSE (9–1) Physics B (Twenty First Century Science)

J259/02 Depth in physics (Foundation Tier)

Time allowed: 1 hour 45 minutes

7712822163

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

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

J259/02

Please write clearly in black ink. **Do not write in the barcodes.**

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

First name(s) _____

Last name _____

INSTRUCTIONS
- The Data Sheet will be found inside this document.
- Use black ink. You may use an HB pencil for graphs and diagrams.
- Answer **all** the questions.
- Where appropriate, your answers should be supported with working. Marks may be given for a correct method even if the answer is incorrect.
- 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.

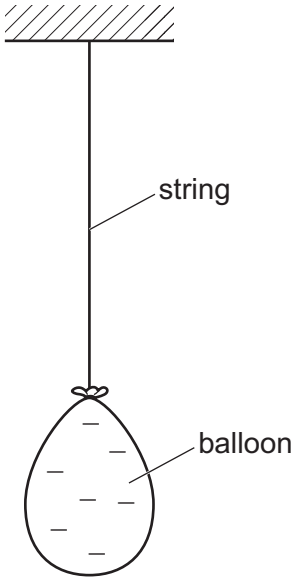
INFORMATION
- The total mark for this paper is **90**.
- The marks for each question are shown in brackets **[ ]**.
- Quality of extended responses will be assessed in questions marked with an asterisk (*).
- This document consists of **28** pages.

Answer **all** the questions.

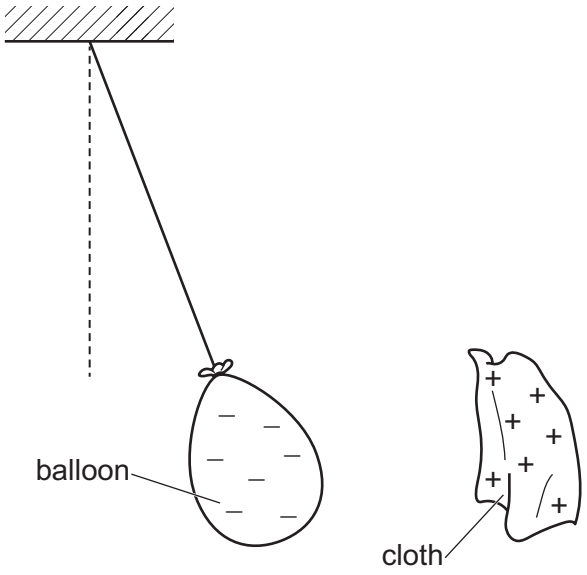
1 This question is about static electricity.

Jack rubs a rubber balloon with a dry cloth. The balloon becomes negatively charged and the cloth becomes positively charged.

He hangs the negatively charged balloon from a long piece of string. The balloon hangs vertically.



He now brings the positively charged cloth close to the balloon. The balloon now hangs at an angle to the vertical.



(a) What is the name of the **field** that surrounds the charged balloon and cloth?

Put a (ring) around the correct answer.

electric **electromagnetic** **gravitational** **magnetic** **[1]**

(b) Explain why the balloon no longer hangs vertically.

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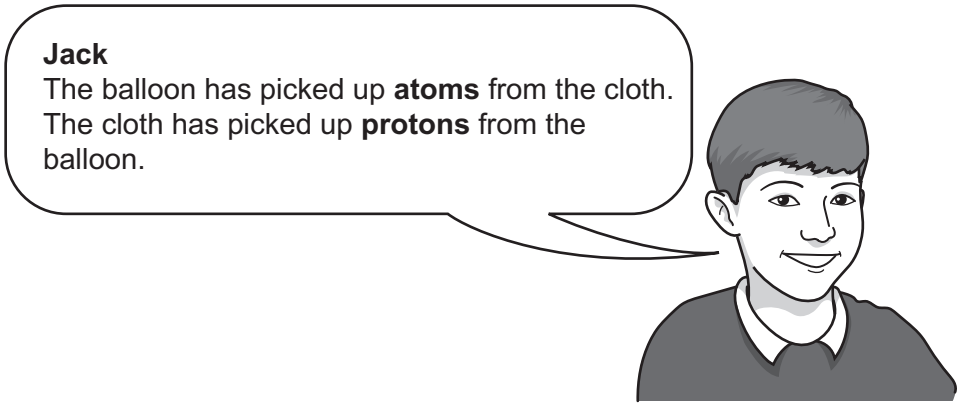
..... **[2]**

(c) Jack makes the following comment to explain the charges on the balloon and the cloth.



Is Jack correct?

☐ Yes

☐ No

Explain your choice.

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.....

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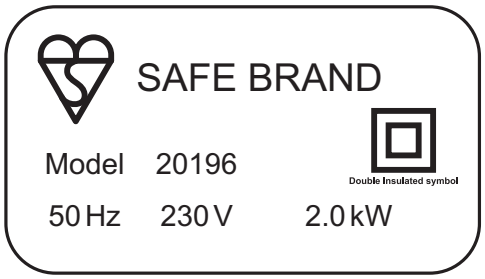
..... **[2]**

2 Kareem is researching a kettle to buy for his grandad.

(a) This is the label for one kettle he found on the Internet.



Kareem makes the following comment.

(i) What is the frequency and potential difference (voltage) of the domestic supply in the UK?

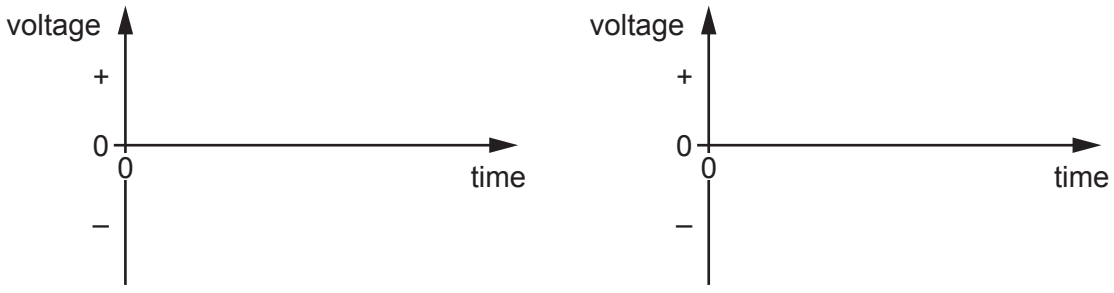
Frequency = ...

Potential difference (voltage) = ...

[1]

(ii) On the axes, sketch a graph for a direct voltage and an alternating voltage.

direct voltage **alternating voltage**



[3]

(iii) The power of the kettle is 2000 W.

How many joules of energy are transferred by the kettle in a time of 1 second?

Energy = ... J **[1]**

(b) The table shows data on three kettles **A**, **B** and **C** found by Kareem.

Kettle	Power (W)	Lifetime of kettle (hours of use)	Total energy transferred (kW h)
A	1500	400	
B	2000	200	400
C	2500	100	250

(i) Calculate the total energy, in kilowatt hours (kW h), transferred by kettle **A** during its lifetime.

Use the equation: energy transferred = power × time

Total energy transferred = ... kW h **[3]**

(ii) Which kettle, **A**, **B** or **C**, will take the longest time to boil **one** litre of water?

Give **one** reason for your answer.

Kettle .....

Reason .....

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

(c) What is the name of the device used to change low-voltage to high-voltage at power stations?

Put a (ring) around the correct answer.

diode **National Grid** **thermistor** **transformer** **[1]**

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3 Sarah investigates what happens when light shines on different coloured cards.

(a) She places two coloured square cards next to each other, as shown in **Fig. 3.1**.

Card **R** is red and card **G** is green.

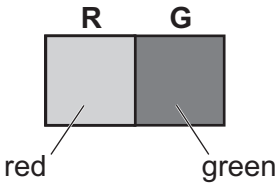


Fig. 3.1

Sarah shines **green** light on both cards.

Fig. 3.2 shows the observed colour of the cards.

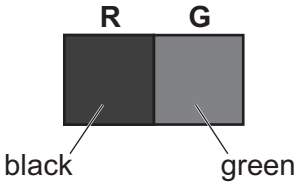


Fig. 3.2

(i) Complete the following sentences about the observation in **Fig. 3.2**.

Use words from the list.

You may use each word once, more than once, or not at all.

absorbs **refracts** **scatters** **transmits**

Card **R** looks black because it ..... the green light.

Card **G** looks green because it ..... the green light. **[2]**

(ii) What colour light can Sarah shine on the red and green cards to make them both appear **black**?

Put a (ring) around the correct colour.

blue **green** **red** **white** **[1]**

(b) Sarah is now investigating the refraction of light.

A narrow beam of green light is incident on a plastic block.

She measures the angle of incidence, *i*, and the angle of refraction, *r*, as shown in **Fig. 3.3**.

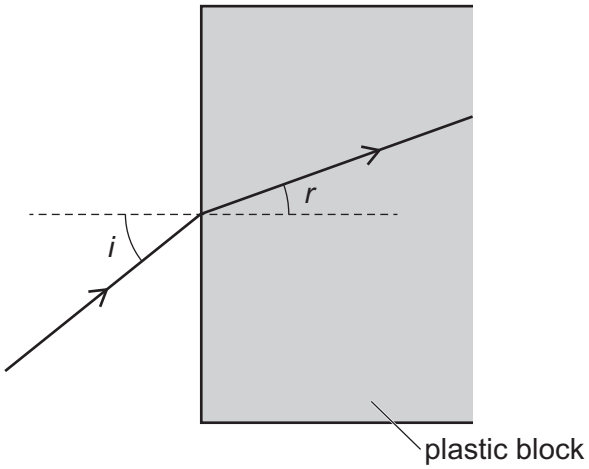


Fig. 3.3

Sarah then draws a graph of angle of refraction, *r*, against angle of incidence, *i*, as shown in **Fig. 3.4**.

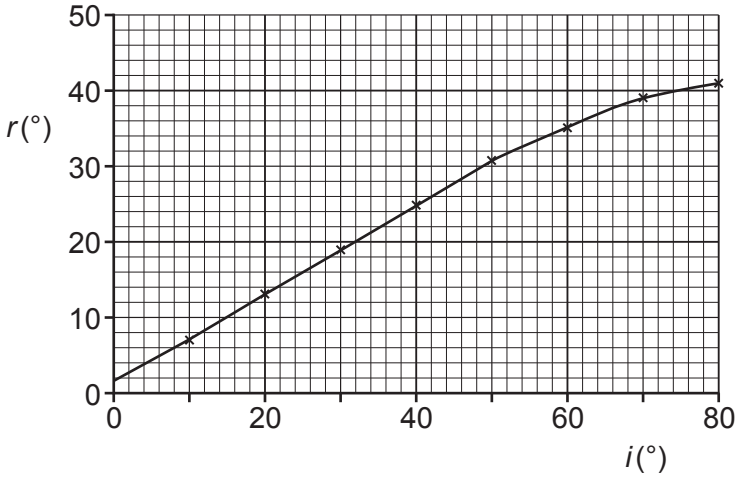
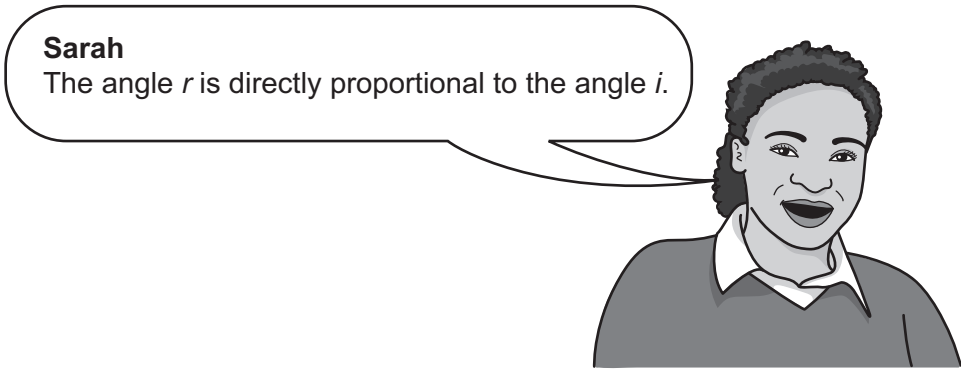


Fig. 3.4

Sarah makes the following hypothesis.



Use **Fig. 3.4** to explain if Sarah is correct.

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

(c) Green light has wavelength 5.6×10^{-7} m and frequency 5.4×10^{14} Hz.

Calculate the **wave speed** of the green light.

Use the equation: wave speed = frequency × wavelength

Give your answer in standard form and to **2** significant figures.

Wave speed = ... m/s **[3]**

4 Large telescopes, on the Earth and in space, have been used to make exciting discoveries.

(a) (i) What is the difference between a planet like the Earth and a star like our Sun?

.....

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

(ii)* In 2010 the star HD10180 was discovered. It is a yellow-colour star like the Sun and it has at least 7 planets orbiting it to create a planetary system.

Scientists believe the star, HD10180, and the planets orbiting it, were formed in a similar way to our Solar System.

Draw a labelled diagram of the HD10180 planetary system, **and** describe how the star and its planets may have been formed.

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

(b) Galaxy GN-z11 is one of the most distant galaxies discovered.

The table shows the data on two other galaxies much closer to us.

Galaxy	Distance from us (m)	Receding speed (km / s)
Tadpole galaxy	3.8×10^{24}	9400
Cigar galaxy	1.1×10^{23}	200

(i) What conclusion can you draw between the distance of a galaxy and its speed?

.....

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

(ii) Write a list of the **three** named galaxies above, in order of increasing red-shift.

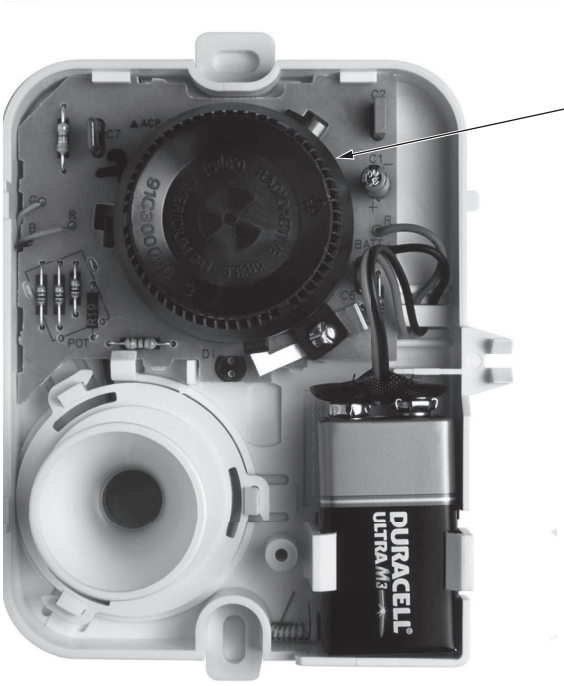
....

lower red-shift higher red-shift

[2]

5 Americium is a radioactive material that emits alpha radiation.

Americium-241, an isotope, is used in many domestic smoke alarms. The radioactive source in the smoke alarm is under a **plastic** case.



(a) Suggest why the alpha radiation from the source cannot do any harm when you are close to the smoke alarm.

.....

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

(b) Explain how you could use a radiation measuring device in the laboratory to show that the smoke alarm is safe.

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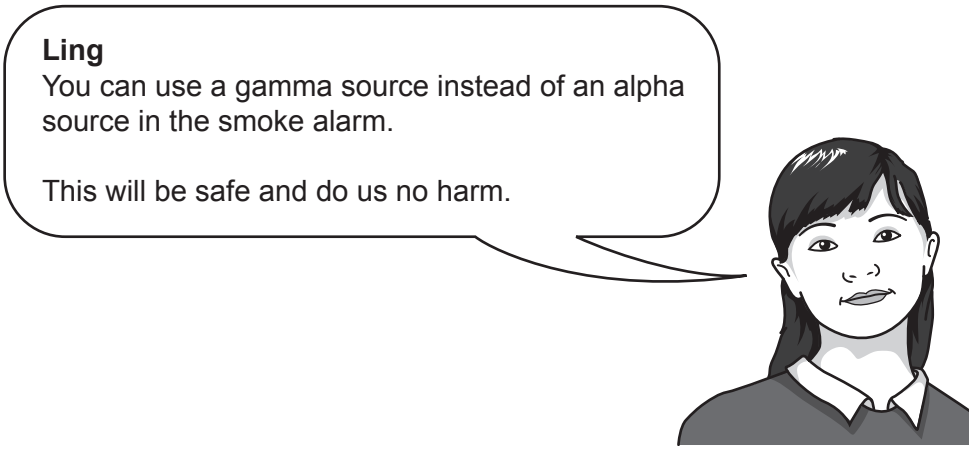
..... **[2]**

(c) Ling makes the following comment.



Discuss why Ling's suggestion is **not** sensible.

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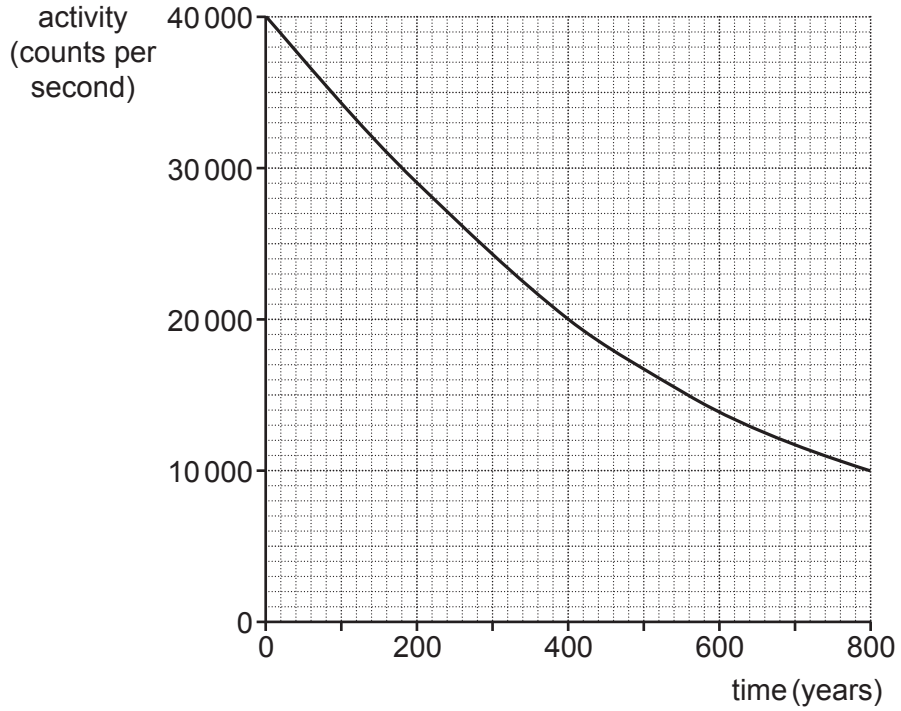
..... **[2]**

(d) Ling finds the activity against time graph for a different radioactive alpha source from the Internet.



(i) Use the graph to determine the half-life of the alpha source.

Show your working on the graph.

Half-life = ... years **[2]**

(ii) The initial activity of the source is 40 000 counts per second.

What is the activity of the source after a time equal to 2 half-lives?

Activity = ... counts per second **[3]**

(iii) On the graph axes above, sketch a graph for another sample of the alpha source that has an initial activity of 30 000 counts per second.

[3]

6 A delivery company uses GPS tracker devices to monitor the position and the speed of their vans.

(a) The distance against time graph of one van travelling along a straight road is shown in **Fig. 6.1**.

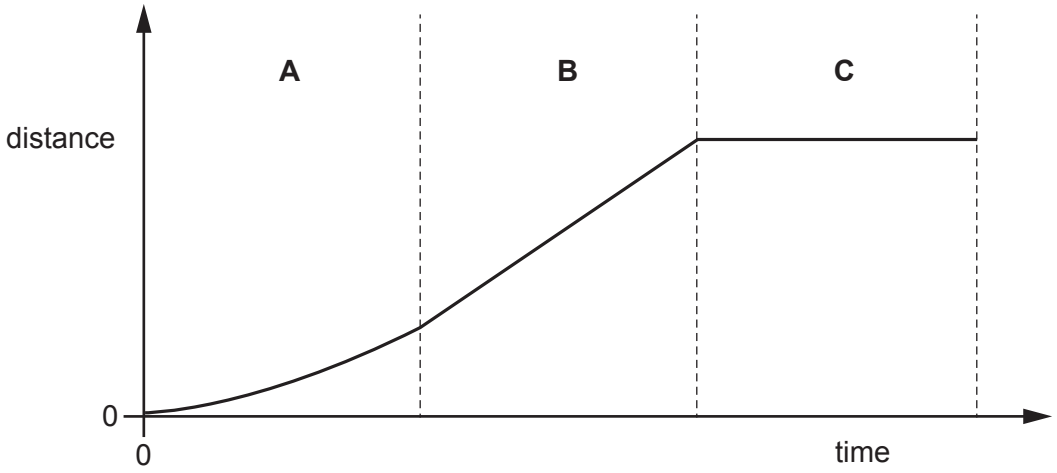


Fig. 6.1

Fig. 6.1 has been divided into three sections **A**, **B**, and **C**.

Complete the table by matching each section, **A**, **B**, or **C**, with the correct type of motion.

Tick (✓) **one** box in each row.

Type of motion	Section A	Section B	Section C
Stationary			
Constant speed			
Accelerating			

[3]

(b) The velocity against time graph of another van is shown in **Fig. 6.2**.

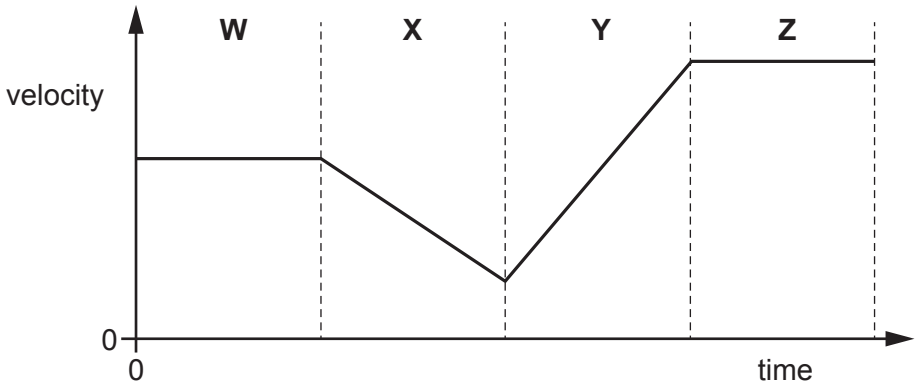


Fig. 6.2

Fig. 6.2 has been divided into four sections **W**, **X**, **Y**, and **Z**.

(i) Identify which section shows the van speeding up.

Explain your answer.

Section: .....

Explanation: .....

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

(ii) Identify which section shows the van slowing down.

Explain your answer.

Section: .....

Explanation: .....

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

(c) Data from the GPS tracker device can be used to calculate a van's average acceleration over the entire journey:

- initial speed = 8.5 m / s
- final speed = 36.5 m / s
- time for acceleration = 5.0 s

Use this information to calculate the average **acceleration** of the van.

Use the equation: acceleration = change in speed ÷ time taken

Give the **correct units** for your answer.

Acceleration = ... Units ..... **[3]**

(d) (i) Estimate the mass of the van, in kilograms (kg).

Mass = ... kg **[1]**

(ii) Estimate the average force acting on the van.

Use your answers from **(c)** and **(d)(i)** to answer the question.

Force = ... N **[3]**

7 Nina is investigating electrical circuits in the laboratory.

(a) Nina is looking for a filament lamp for her torch.

Fig. 7.1 shows a filament lamp that may be suitable.

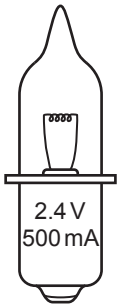
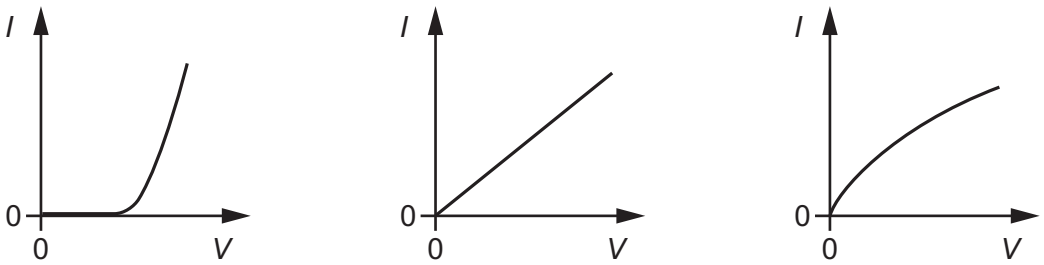


Fig. 7.1

(i) Which current against voltage graph (*I*-*V* characteristic) for a filament lamp is correct?

Put a (ring) around the correct answer.



[1]

(ii) Calculate the amount of charge flowing through the filament lamp when it is used for 60 s.

Use the equation: charge = current × time

Charge = ... C **[3]**

(iii) The base of the filament lamp has '2.4 V, 500 mA' stamped on it.

Calculate the power of the filament lamp at 2.4 V.

Power = ... W **[3]**

(b) Nina connects up the following circuit using two identical filament lamps.

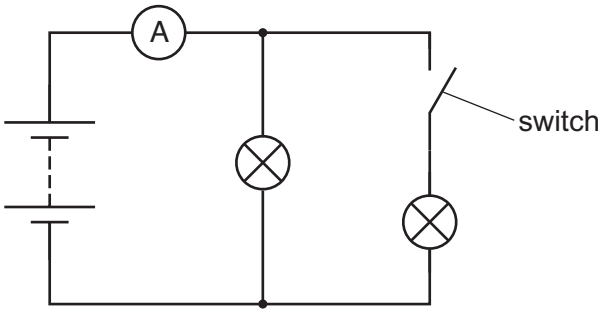


Fig. 7.2

The switch is currently open.

Explain what happens to the ammeter reading when the switch is then **closed**.

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

(c) **(i)** What is the name of the electrical component that conducts current in **only one** direction?

Tick (✓) **one** box.

Diode	☐
Lamp	☐
Light-Dependent Resistor (LDR)	☐
Thermistor	☐

[1]

(ii) Draw an electrical symbol for your answer to **(c)(i)**.

[1]

8 This question is about gears and levers.

(a) A wristwatch with its back cover removed is shown in **Fig. 8.1**.

Fig. 8.1

You can see some of the gears inside the wristwatch.

Two gears **Q** and **R** are shown in **Fig. 8.2**.

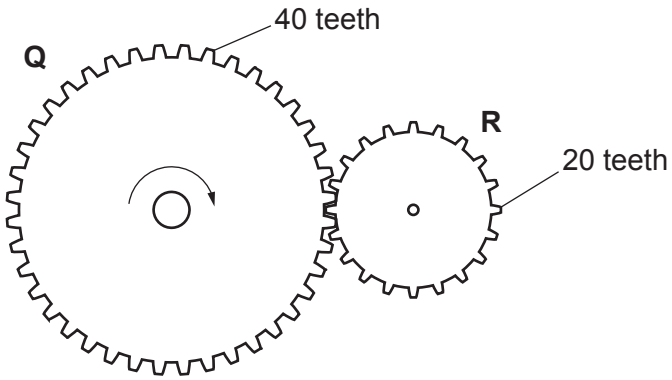

Fig. 8.2

The gear **Q** has 40 teeth and gear **R** has 20 teeth. Both gears have the same size teeth.

The gear **Q** moves in a clockwise direction.

Gear **Q** rotates at 6 revolutions per minute.

(i) On **Fig. 8.2**, show the direction of rotation of gear **R**. **[1]**

(ii) How many revolutions are completed by gear **R** in one minute?

Number of revolutions = ... per minute **[2]**

(b) The lid of a can of paint has a lip which makes it easier to open, using a lever.

The diagram below shows a screwdriver placed under the lip.

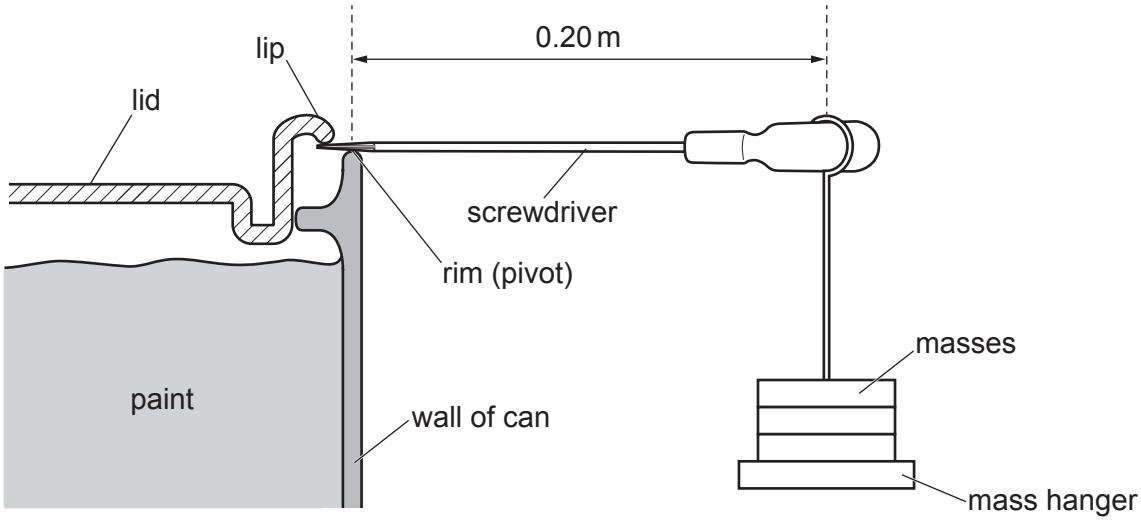

Fig. 8.3

In an experiment, masses are added to the mass hanger to open the lid.

The mass hanger hangs at a distance of 0.20 m from the rim (pivot) of the can.

A total weight of 32 N of the hanging masses opens the lid.

Calculate the moment of this force.

Moment = ... Nm **[3]**

9* Kai is doing experiments in the laboratory to determine the density of the two different liquids, **E** and **F**.

He uses a measuring cylinder placed on a balance.

He then pours different volumes of liquid **E** into the measuring cylinder, and records the balance reading, as shown in **Fig. 9.1**. The balance reading is equal to the total mass of the measuring cylinder and the liquid.

He then empties the measuring cylinder, and repeats the same procedure with liquid **F**.

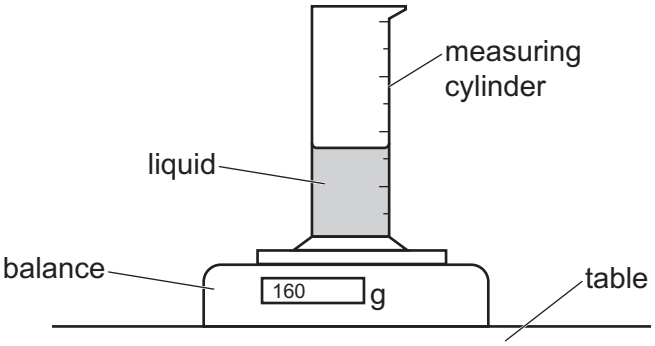

Fig. 9.1

Kai's results are shown in **Fig. 9.2**.

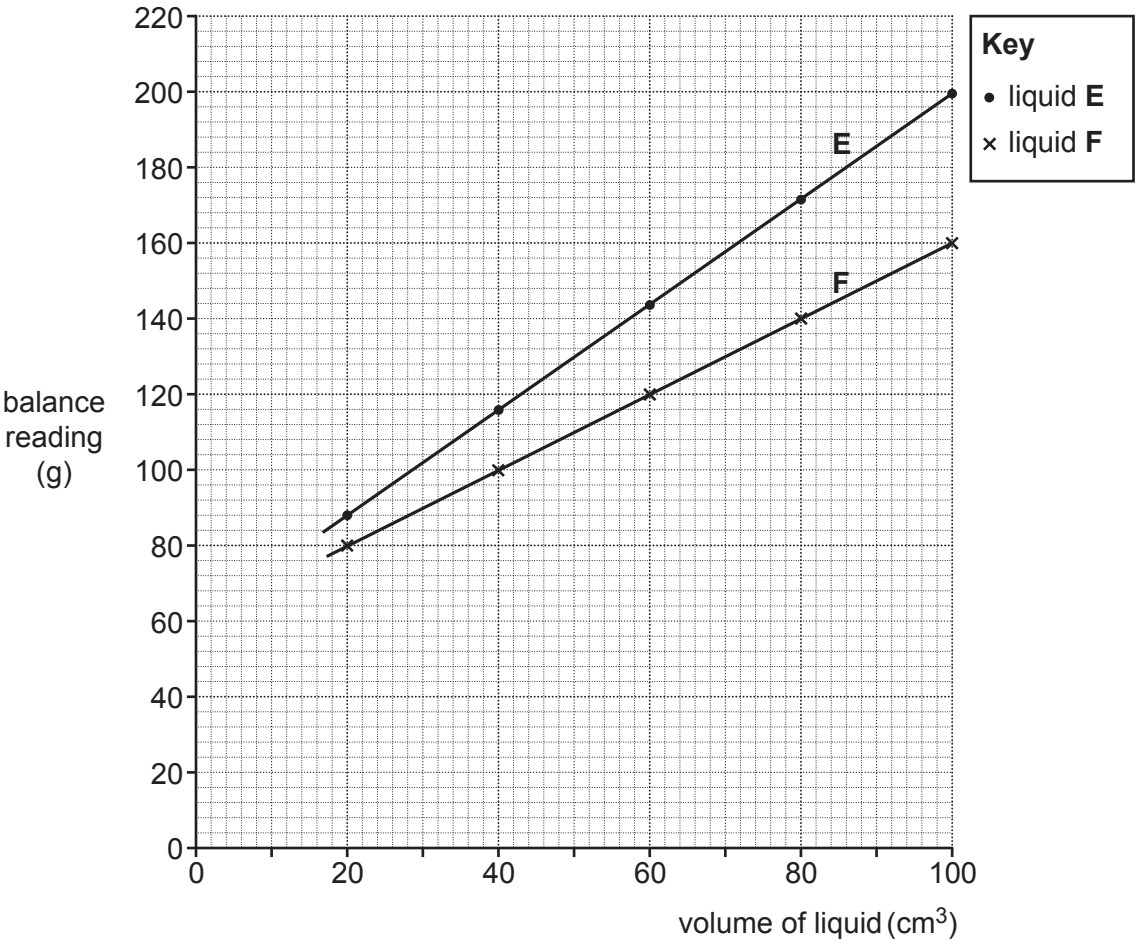

Fig. 9.2

Compare the density of the liquids **E** and **F**.

Your answer should include calculations and a detailed analysis of **Fig. 9.2**.

Use the equation: density = mass ÷ volume

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

10 Lyla and Alex are investigating two identical light-dependent resistors (LDRs). A torch is used as a light source by Lyla, and Alex decides to use a table lamp.

Each light source is placed above the LDR.

The resistance of the LDR is determined for different numbers of identical sheets of tracing paper placed on the LDR, as shown in **Fig. 10.1**.

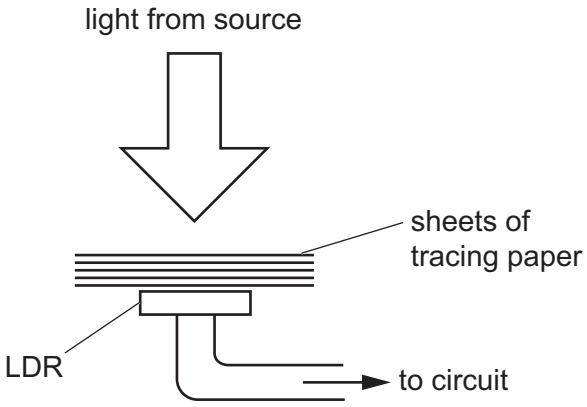

Fig. 10.1

Lyla's and Alex's results are shown in **Fig. 10.2**.

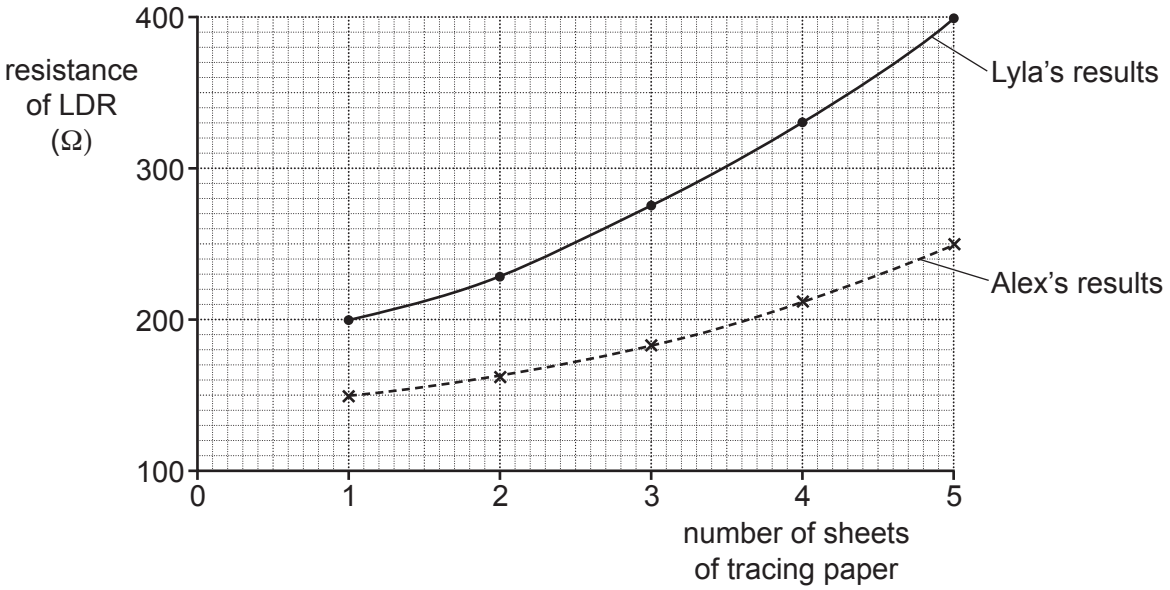

Fig. 10.2

(a) Use **Fig. 10.2** to explain how the **light intensity** affects the resistance of the LDR.

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.....

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

(b) The LDR is connected to a cell, an **ammeter** and a **voltmeter**.

The meter readings from the ammeter and voltmeter are used to determine the resistance of the LDR.

Complete **Fig. 10.3** to show the likely circuit connected by Lyla and Alex.

Fig. 10.3

[2]

(c) Lyla and Alex worked in different parts of the laboratory to conduct their investigations.

Both used identical sheets of tracing paper and identical LDRs but their results were different.

(i) Suggest **one** thing that must be kept the same to get identical results.

.....

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

(ii) Suggest **one** improvement that needs to be made to get identical results.

.....

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

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).