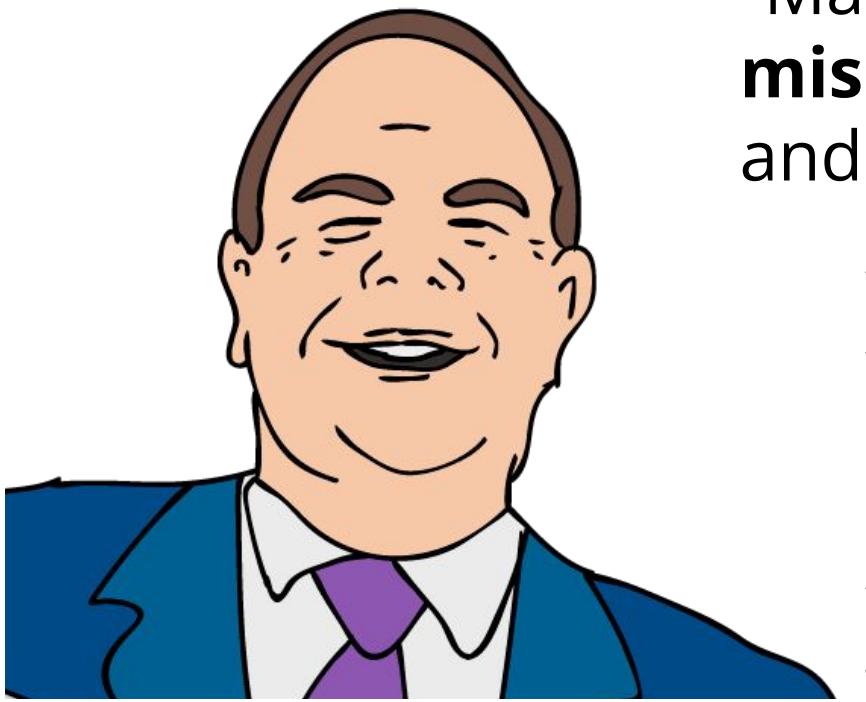
Exam Technique

What are we going to cover?

- **Interpreting questions**
- How to **set out answers**
- Examples of **command words**
- Tried and tested **exam wisdom**

What do the examiners say?



"Many students experienced difficulties by **missing important details** in both questions and their answers."

"There were a number of questions where it was obvious candidates had **not read the question** properly."

"The paper is set so that the questions cover the specification as **widely** as possible and test **as many skills as possible**."

Interpreting Questions

Context – this should help you identify the part of the specification that is relevant to the question

Command words – these tell you what form you must write your answer in

Directions – these tell you specifically what information you need to include in your answer

19 This question is about a simple pendulum made from a length of string attached to a mass (bob). For oscillations of small amplitude, the acceleration a of the pendulum bob is related to its displacement x by the expression

$$a = -\left(\frac{g}{L}\right)x$$

where g is the acceleration of free fall and L is the length of the pendulum.
The pendulum bob oscillates with simple harmonic motion.

(a) (i) Show that the period T of the oscillations is given by the expression

$$T^2 = \frac{4\pi^2}{g}L.$$

[3]

(ii) A student notices that the amplitude of each oscillation decreases over time.
Explain this observation and state what effect this may have on T.

.....

.....

.....

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

(a) (i) Show that the period T of the oscillations is given by the expression

$$T^2 = \frac{4\pi^2}{g}L.$$

$$\omega^2 = \frac{g}{L} \qquad \omega = \frac{2\pi}{T}$$

$$\frac{4\pi^2}{T^2} = \frac{g}{L}$$

$$4\pi^2 = \frac{g}{L}T^2$$

$$T^2 = \frac{4\pi^2 L}{g}$$

[3]

(ii) A student notices that the amplitude of each oscillation decreases over time.
Explain this observation and state what effect this may have on *T*.

Energy is transferred from the pendulum to the air and the retort stand due to air resistance/friction.

This will have no effect on T

[2]

Interpreting Questions

You will find that questions tend to come in **5** different types:

- **Statement Questions.** **~1-2 Marks**
- **Sketch/Plot Questions.** **~1-2 Marks**
- **Calculation Questions.** **~1-3 Marks**
- **Explanation Questions.** **~2-4 Marks**
- **Experimental Analysis Questions.** **~3-6 Marks**

Statement Questions

- Test of **rote learning** – your ability to **remember facts**.
- Questions usually require information from the **specification**.
- May have some **context** from which you will need to extract the **subject** of the question.

Command Words:

- **State**
- **Define**
- **Name**
- **Identify**
- **Describe**

Examples:

- State a property of…
- Name a condition for…
- Identify an assumption used…
- Define the term…

Command Words

Name/State: Give a **simple** one word answer or a short sentence.

- **No justification** or **explanation** is required. You can lose marks for contradictory explanation.
- Make sure to use **scientific terminology precisely** and **correctly**.

3 This question is about collisions between protons and antiprotons.

(a) State the mass and charge of an antiproton.

mass = ... kg

charge = ... C

[2]

3 This question is about collisions between protons and antiprotons.

(a) State the mass and charge of an antiproton.

mass = 1.67×10^{-27} kg

charge = -1.6×10^{-19} C

[2]

Define: Require a **short sentence** or **bullet-point** answer.

- It's worth **memorising** the **standard wording**.
- You can write an **equation** to define a variable **only** if you state what each **variable** in the **equation** stands for.

1 (a) Define what is meant by the *stopping distance* of a vehicle.

.....

.....

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

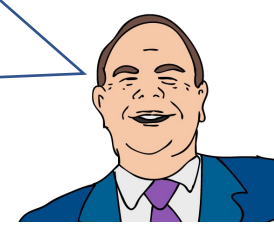
1 (a) Define what is meant by the *stopping distance* of a vehicle.

The distance travelled by a vehicle from when the driver sees a hazard until it stops.

stopping distance = thinking distance + braking distance

[1]

"When asked to explain or define a scientific term do not take words directly from the stem of the question as you have not demonstrated to the examiner any additional knowledge."



Write: Usually refers to **nuclear equations** or **particle diagrams**.

- Give your answer in the **form** that the question asks for.
- Include any **key details** shown in the **question** in your answer (**e.g:** mass numbers, chemical symbols).
- When writing an **equation** make sure that the two **sides** are **balanced**.

1 A stationary uranium-238 nucleus $\left({}^{238}_{92}\mathrm{U}\right)$ decays into a nucleus of thorium-234 by emitting an alpha-particle.

(a) The chemical symbol for thorium is Th. Write a nuclear equation for this decay. **[2]**

$$^{238}_{92}\mathrm{U} \rightarrow {}^{234}_{90}\mathrm{Th} + {}^{4}_{2}\alpha$$

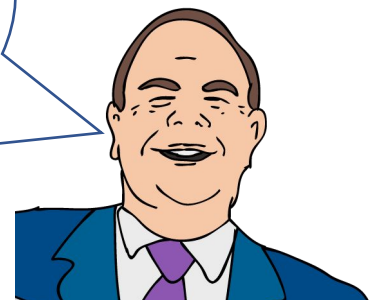
Sketch/Plot Questions

- Test your ability to show simple information in **sketches** and **graphs** and to accurately **plot data**.
- Can also include **determining values** from the **gradient** or **intercept** of your graph.
- Practise **drawing** and **labelling** circuit diagrams or force diagrams.

Command Words:

- **Sketch**
- **Plot**
- **Label**
- **Draw**

"If a candidate is to attain full marks a sketch should be drawn carefully showing all important features (e.g: constant amplitude, time period etc.)."



Sketch: Make a simple **diagram** to show a **relation**.

- Show all **detail** required by the **context** and important **features**.
- You may want to also use a **sketch** to **supplement** another answer.

16 (a) Sketch the electric field around a positive point charge.

(3)

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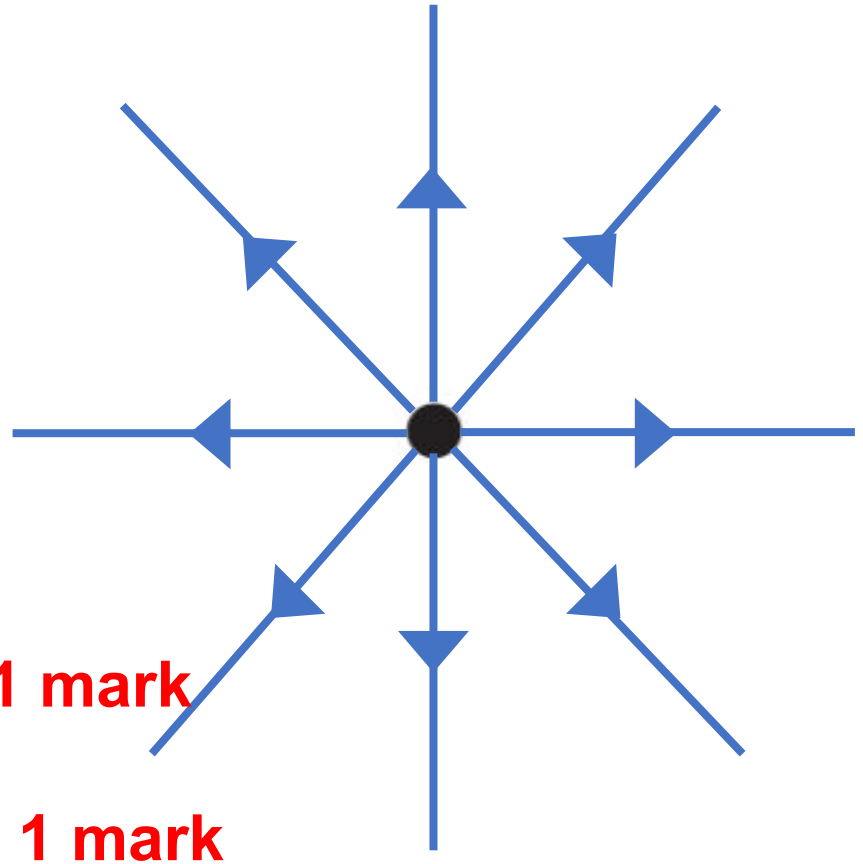
(3)



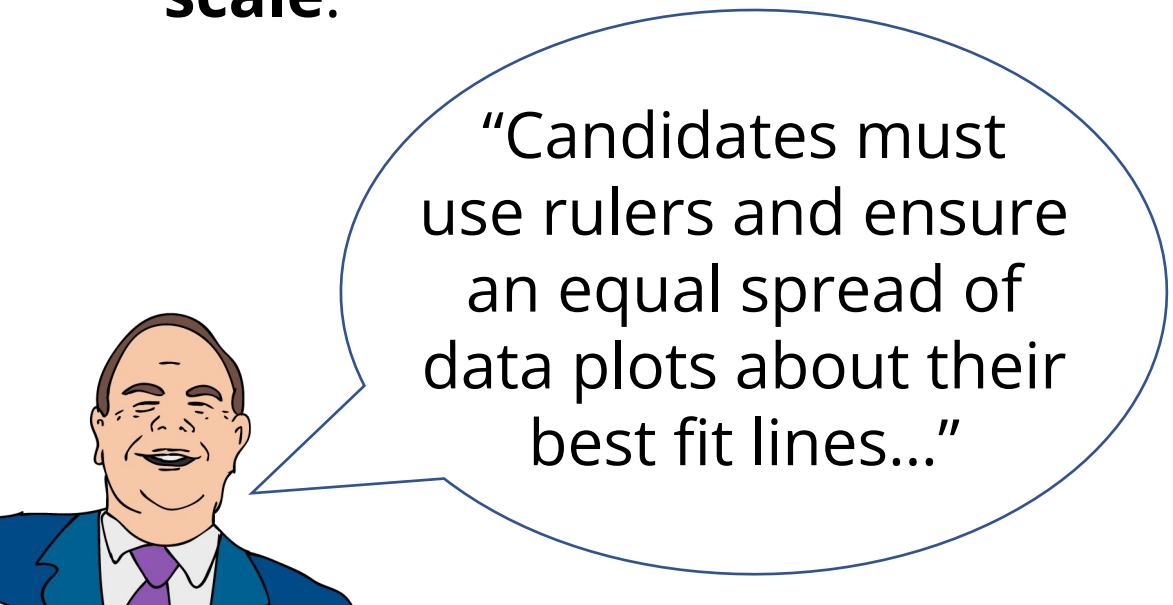
Radial field – 1 mark

Uniform density of lines – 1 mark

Arrows pointing outwards – 1 mark

Plot: Involves drawing a **graph**, sometimes through **data-points** that you need to **plot**.

- Always make sure that the **axes** are **labelled** correctly with **units** if necessary and use a **suitable scale**.



The student adds mass *m* to the lower spring and measures the new length *L* of the two-spring combination.

The student determines the weight *F* of the mass added to the spring.

The student's results are shown in Fig. 2.2.

m/g	*F*/N	*L*/cm	
0	0	12.0	
50	0.49	13.0	
100	0.98	13.8	
150	1.47	14.8	2.8
200	1.96	15.6	3.6
250	2.45	16.6	4.6

Fig. 2.2

(a) Complete the table shown in Fig. 2.2 by calculating and recording values of the extension *e*/cm of the spring combination. **[1]**

(b) On Fig. 2.3 plot a graph of *e*/cm (*y*-axis) against *F*/N (*x*-axis). Draw the straight line of best fit. **[4]**

(c) Determine the gradient of the straight line of best fit.

m/g	*F*/N	*L*/cm	
0	0	12.0	
50	0.49	13.0	
100	0.98	13.8	
150	1.47	14.8	2.8
200	1.96	15.6	3.6
250	2.45	16.6	4.6

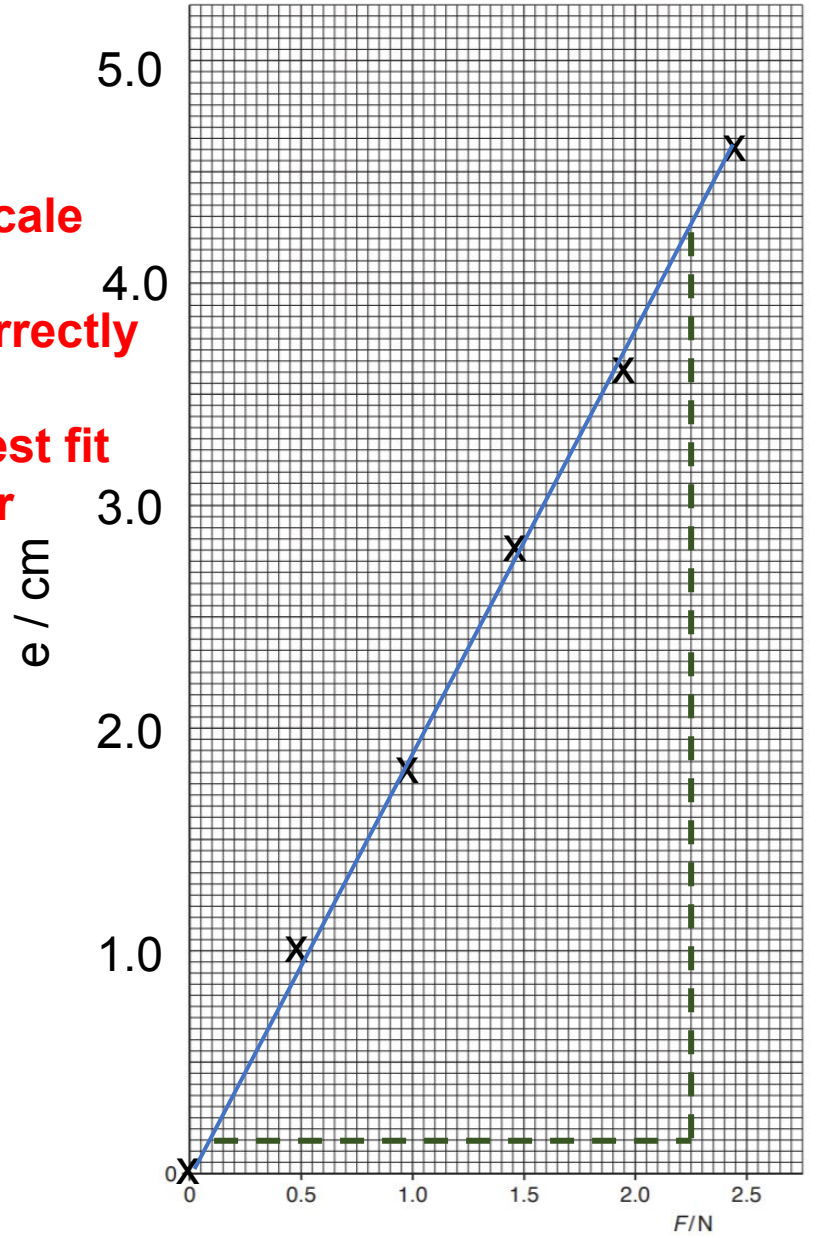
Fig. 2.2

y-axis label

Sensible y-axis scale

Points plotted correctly

Straight line of best fit drawn with a ruler



$$\text{Gradient} = \frac{\Delta y}{\Delta x} = \frac{4.25-0.15}{2.25-0.10} = 1.9\ \text{cmN}^{-1}$$

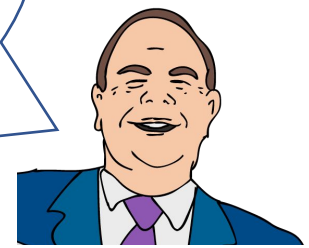
Calculation Questions

- Test **quantitative** understanding.
- Include simple **rearranging** and **derivations** of **equations**.
- May require **interpreting** data sets, figures and graphs to obtain **values** of the **variables** required for the **calculation**.

Command Words

- **Calculate**
- **Show That**
- **Determine**
- **Deduce**

"It is good practice to summarise all data by writing it in the answer space along with the relevant formula to be used. Too often the working is absent, making it difficult to award any compensatory marks."



Calculate: work out a **numerical** answer **mathematically**, usually using an **equation** in your formula book.

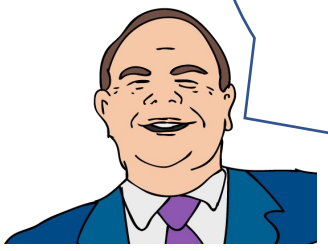
- Include the correct **units** and **significant figures** in your answer.

(c) Estimate the internal energy of the air in a room of volume 24 m^3 at a temperature of about 20°C. Assume that the air behaves as an ideal gas at atmospheric pressure. Here are some useful formulae and data. *There are several ways to make this estimate. You do NOT need to use all of the information.*

formulae:
$pV = nRT$ is the equation of state of n moles of an ideal gas
kinetic energy of n moles of an ideal gas = $\frac{3}{2} nRT$

data:
$R = 8.31\ J\ mol^{-1}\ K^{-1}$
density of air = $1.3\ kg\ m^{-3}$
molar mass of air = $0.030\ kg\ mol^{-1}$
atmospheric pressure = $1.0 \times 10^5\ Pa$

internal energy = ...J [3]



"Lower ability candidates often omitted a step within the calculation and were not able to obtain full marks."

$$U = \frac{3}{2}nRT = \frac{3}{2}pV$$

$$= \frac{3}{2} \times 1.0 \times 10^5 \times 24$$

$$= 3.6 \times 10^6 \text{ J}$$

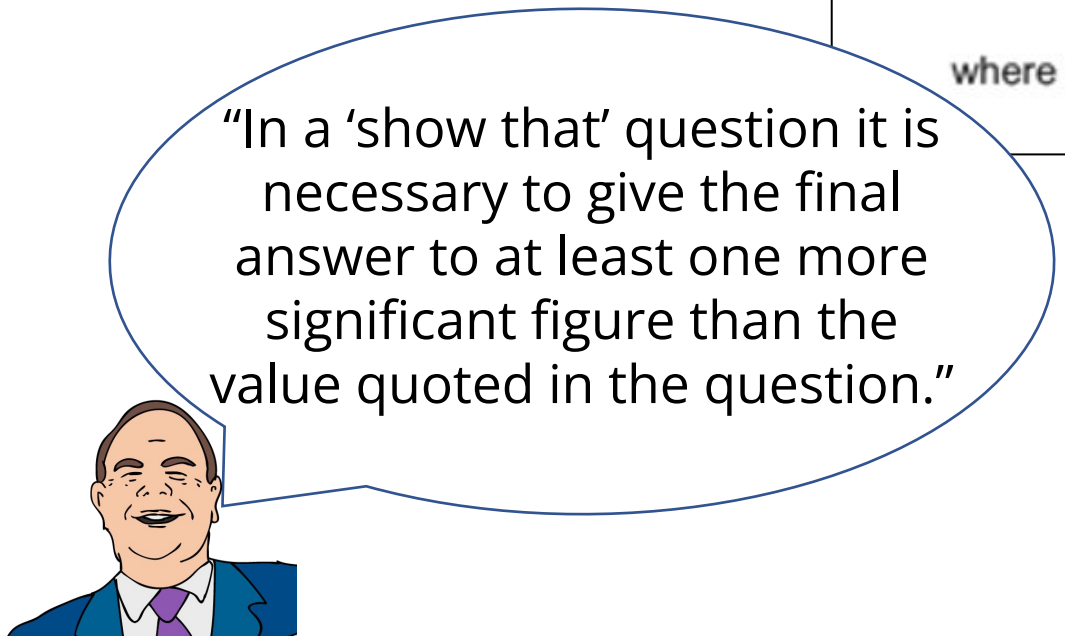
Show that: indicates a **calculation** or **derivation** in which the **answer** is provided for you – you'll sometimes need the **answer** for a **subsequent part**.

- Show every **step** of your **working**.

(i) Show that the escape velocity v of a gas molecule on the surface of Pluto is given by the equation

$$v = \sqrt{\frac{2GM}{r}}$$

where M is the mass of Pluto and r is its radius. **[2]**



(i) Show that the escape velocity v of a gas molecule on the surface of Pluto is given by the equation

$$v = \sqrt{\frac{2GM}{r}}$$

m – Mass of gas molecule.

where M is the mass of Pluto and r is its radius.

$$KE = \frac{1}{2}mv^2 \qquad GPE = \frac{GMm}{r}$$

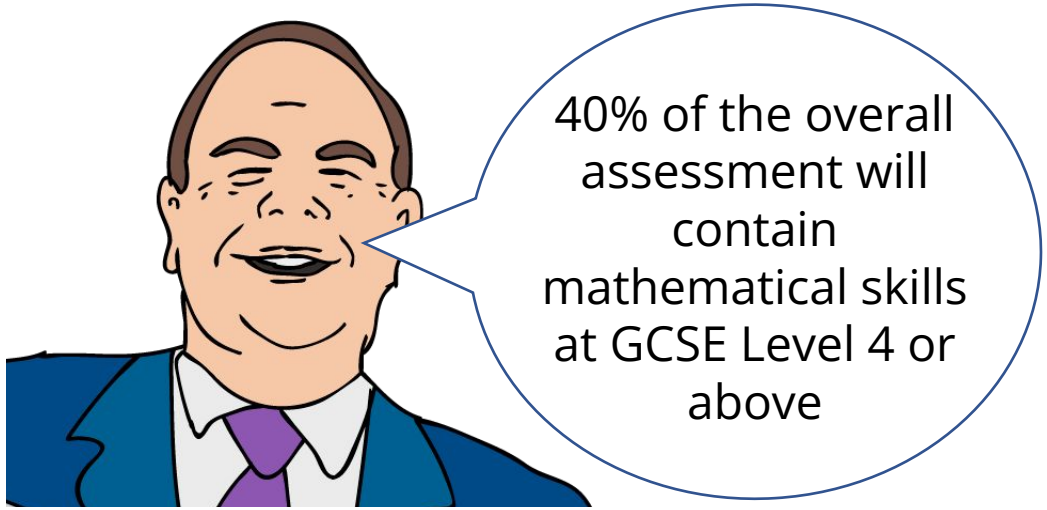
$$\frac{1}{2}mv^2 = \frac{GMm}{r}$$

$$v^2 = \frac{2GM}{r}$$

$$v = \sqrt{\frac{2GM}{r}}$$

[2]

Top Tips: Maths



Make sure you can:

- **Rearrange** the subject of an equation (try the **triangle method** if you find this difficult)
- Use **standard form.**
- Use **trigonometry** and **resolve vectors.**
- Understand **logarithms.**

Look out for:

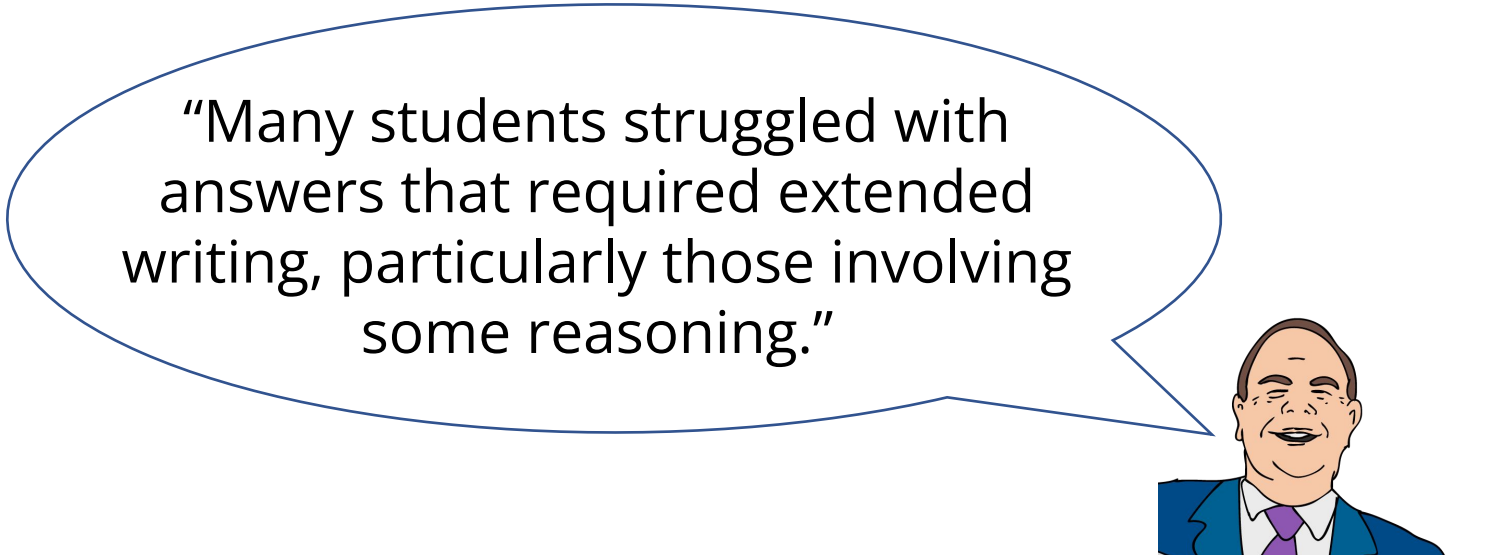
- **Units** (and practise **conversions**)
- Does your answer make sense?
- Correct number of **significant figures**
- **Signs** (particularly in **vector calculations**).

Explanation Questions

- **Test** of your **qualitative understanding** of **physical phenomena**.
- Question can include a **reference point** which your **answer** should be **centred around**.
- May be **combined** with **statement questions**.

Command Words:

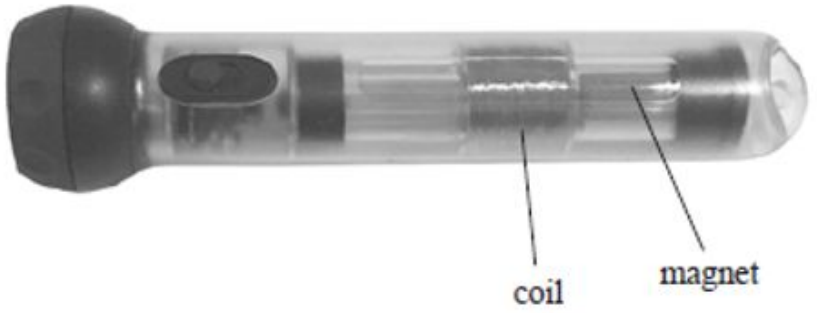
- **Explain**
- **Describe**
- **Suggest**
- **Discuss**
- **Evaluate**



Explain: Give a **step-by-step** chain of **logical reasoning** to show **how** or **why** a physical **phenomenon** or **effect** occurs.

- The question may **reference** a specific **law**, **variable** or a **figure**. Make sure you **centre** your answer around this if they do.
- You can use **bullet-points** to make your answer clearer.

15 The photograph shows a torch with batteries that are recharged by shaking the torch.

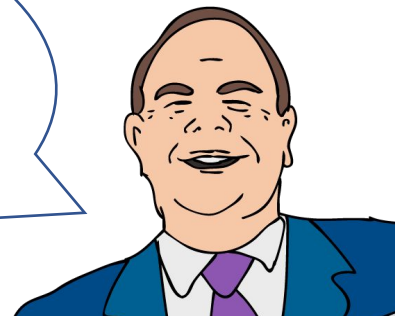


Inside the torch is a coil of wire and a magnet that can move freely through the coil in alternate directions when the torch is shaken. The coil is connected to a rechargeable battery.

(b) Explain, with reference to Lenz's law, how the magnet does work as it enters the coil.

(4)

"The use of bullet points should be encouraged."



(b) Explain, with reference to Lenz's law, how the magnet does work as it enters the coil.

(4)

- Lenz's law states that the direction of an induced e.m.f. is always in opposition to the change that causes it.
- Therefore the induced current in the coil produces a magnetic field to oppose the motion of the magnet.
- Therefore there is a force on the magnet in the opposite direction to its motion.
- As work = force x distance, work is done as the magnet moves.

Describe: Write **what** will happen or what a **figure**, **diagram** or **graph** shows.

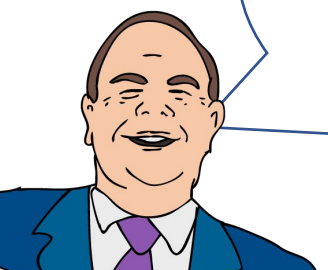
- Show how a process will **progress** in a series of **separate stages**.

This question is about the fission of uranium.

0 4 . 3 A slow-moving neutron is in collision with a nucleus of an atom of the fuel which causes fission.

Describe what happens in the process.

[3 marks]



"The number of lines given for the answer is indicative of the length of answer expected for the question."

0 4 . 3 A slow-moving neutron is in collision with a nucleus of an atom of the fuel which causes fission.

Describe what happens in the process.

[3 marks]

The neutron is absorbed to form U-236.

This causes the nucleus of the uranium to split into two daughter nuclei.

This also releases several fast-moving neutrons.

Experimental Analysis Questions

- Test of **applied** and **experimental skills** in **unseen contexts**.
- May ask you to **analyse** and **evaluate** (including **comparing**) data, figures and methods.
- Longer questions can ask you to **plan** and describe your own experiment, including by **drawing diagrams**.

Command Words:

- **Evaluate/Discuss**
- **Criticise**
- **Plan**
- **Determine a Method**

Evaluate/Discuss: **Comment** on and **analyse** the **accuracy** of the **information** given in the question.

- Give a well-developed line of **reasoning** which is **clear** and **logically structured**.
- Present **relevant information** to support your claims.

22 (a)* A student conducts an experiment to confirm that the uniform magnetic flux density B between the poles of a magnet is 30 mT.

A current-carrying wire of length 5.0 cm is placed perpendicular to the magnetic field.

The current I in the wire is changed and the force F experienced by the wire is measured. Fig. 22.1 shows the graph plotted by the student.

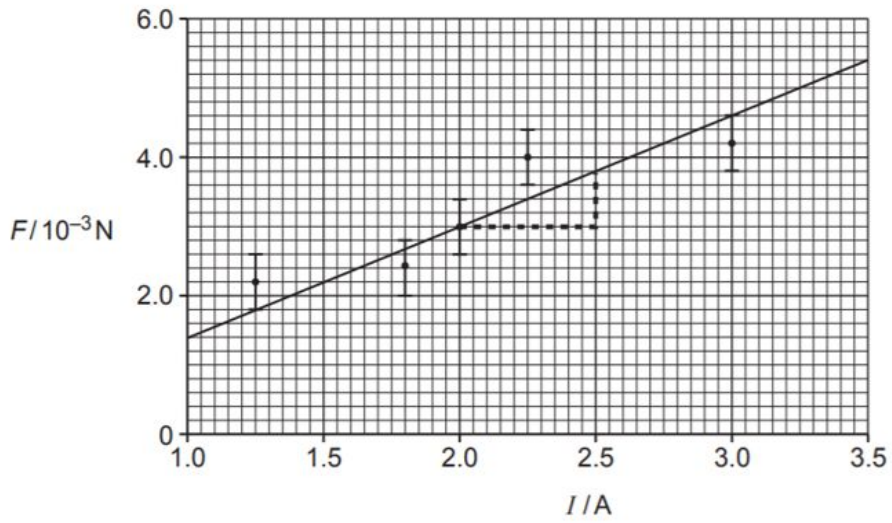


Fig. 22.1

The student's analysis is shown on the graph of Fig. 22.1 and in the space below.

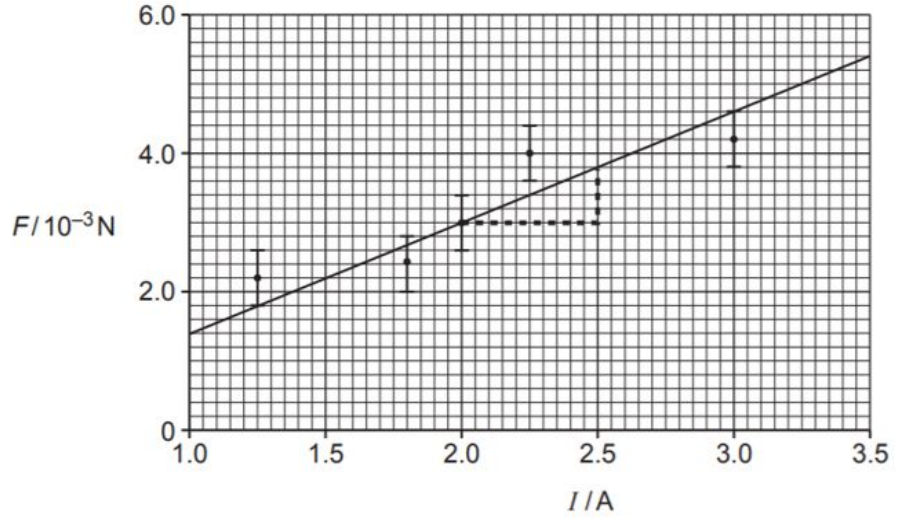
$F = BIL$

$\text{gradient} = BL = \dfrac{(3.8 - 3.0) \times 10^{-3}}{2.5 - 2.0} = 0.0016$

$B = \dfrac{0.0016}{0.05} = 0.032\,\text{T} = 32\,\text{mT}$

This is just 2 mT out from the 30 mT value given by the manufacturer, so the experiment is very accurate.

Evaluate the information from Fig. 22.1 and the analysis of the data from the experiment.



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$$B = \frac{0.0016}{0.05} = 0.032\,\text{T} = 32\,\text{mT}$$

This is just 2 mT out from the 30 mT value given by the manufacturer, so the experiment is very accurate.

Evaluate the information from Fig. 22.1 and the analysis of the data from the experiment.

Evaluation of Fig 22.1

- The straight line misses one error bar.
- Too few data points were plotted.
- Some plots should have been repeated as they appear to be random errors
- The triangle used to calculate the gradient is too small
- No error bars shown for current
- Current measured at irregular intervals
- No origin shown

Analysis

- The value of B is close to the accepted value (7% difference)
- Maximum/minimum gradient lines could have been used to determine the absolute or percentage uncertainty in B
- F against I graph should be a straight line with gradient = BL

Level 3 (5–6 marks)
Clear evaluation of Fig. 22.1 **and** clear analysis

There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated.

Level 2 (3–4 marks)
Some evaluation of Fig. 22.1 **and** some analysis

There is a line of reasoning presented with some structure. The information presented is in the most part relevant and supported by some evidence.

Level 1 (1–2 marks)
Limited evaluation of Fig. 22.1 **or** limited analysis

There is an attempt at a logical structure with a line of reasoning. The information is in the most part relevant.

0 marks
No response or no response worthy of credit.

Plan/Determine a Method:

Clearly describe and explain how to **conduct an experiment**. Discuss any **uncertainty** in your method.

- Use **experimental terminology**, (**e.g:** the names of **apparatus**).
- You may need to draw a **diagram** to illustrate your answer or **plot** a **graph** and **line of best fit** to determine a **variable** from **data**.

4 (a)* You are given an unmarked sealed square box which has four identical terminals at each corner.

Fig 4.1 shows the circuit diagram for the contents of the box with the four terminals labelled **A**, **B**, **C** and **D**.

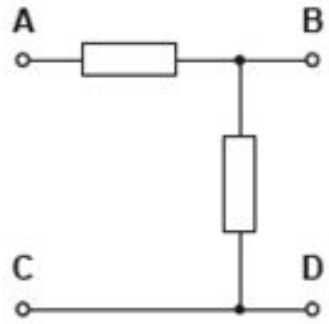


Fig. 4.1

One of the resistors in the box has resistance 220 Ω. The other resistor has resistance 470 Ω. Two of the terminals are connected by a wire.

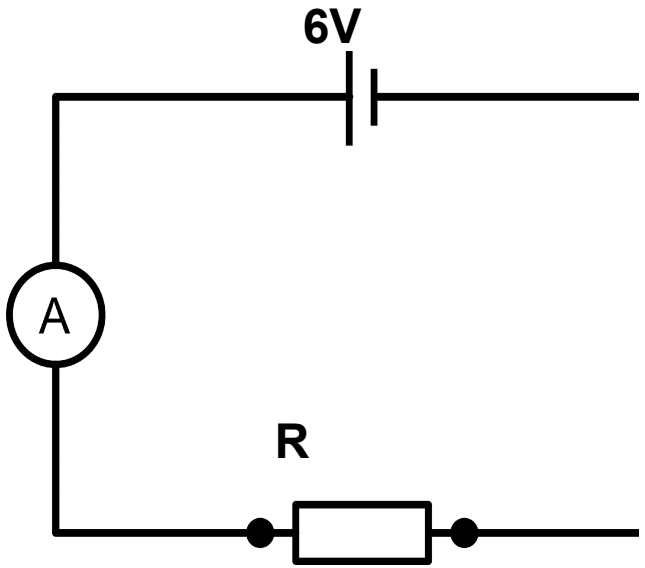
The four terminals on your unmarked sealed box are **not** labelled.

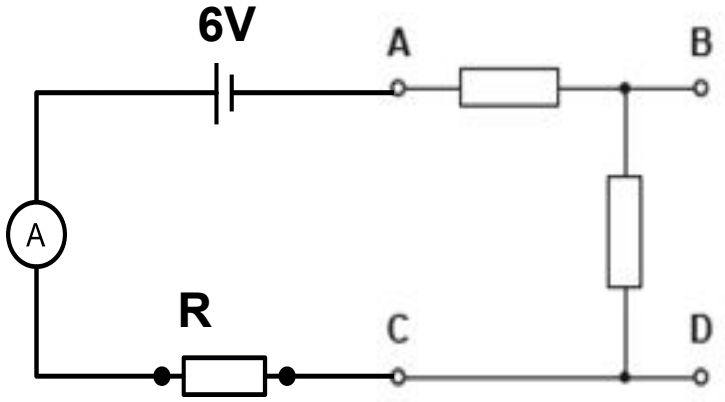
You are given a 6.0 V d.c. supply, a 100 Ω resistor (labelled R) and a digital ammeter.

Plan an experiment to determine the arrangement of the components and identify which terminal of your unmarked sealed box is **A**, **B**, **C** and **D**.

A space has been left for you to draw circuit diagrams to illustrate your answer.

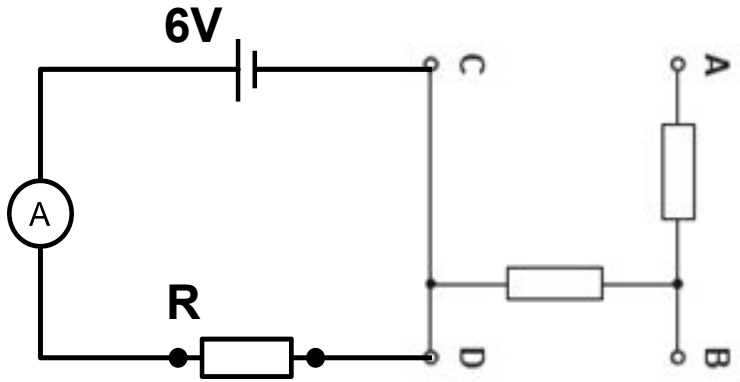
- Connect the circuit to each pair of terminals in turn.
- R limits the current when connecting across CD.
- CD will have the smallest total resistance the largest current since V = IR.
- Once CD is known, A and B can be identified.





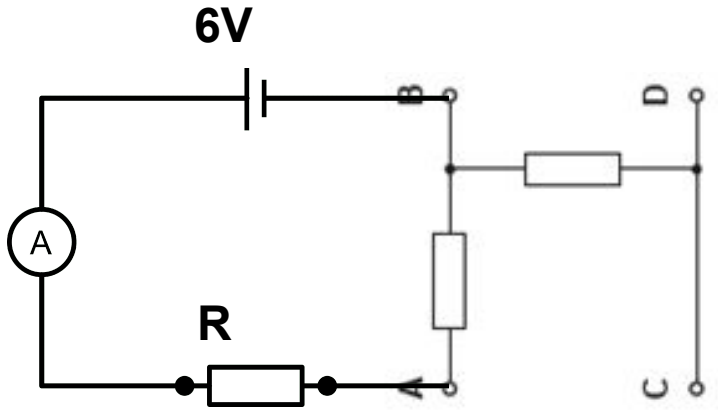
AC: Resistance = 100 + 220 + 470 = 790 Ω

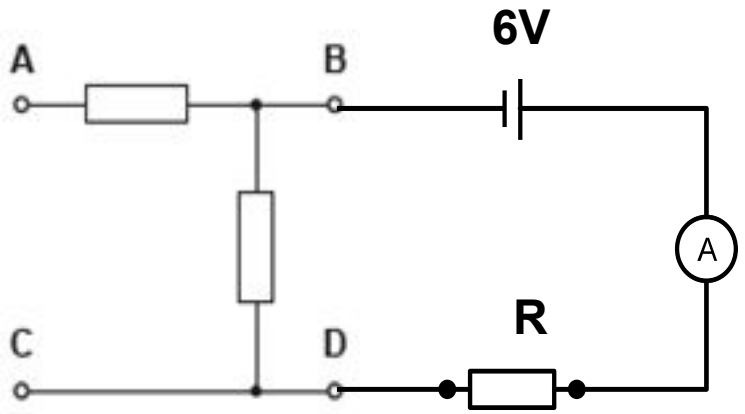
Current = 6 V / 790 Ω = 7.6 mA



CD: Resistance = 100 Ω

Current = 0.06 A





To identify AB and BD:

Across 220 Ω resistor,

Resistance = 320 Ω, Current = 19 mA

Across 470 Ω resistor,

Resistance = 570 Ω, Current = 11 mA

Level 3 (5 - 6 marks)
Clear planning and correct identification of terminals and position of components

There is a well-developed line of reasoning which is clear and logically structured. The information presented is clear relevant and substantiated.

Level 2 (3 – 4 marks)
Clear planning and correct identification of some components / terminals

There is a line of reasoning presented with some structure. The information presented is in the most part relevant and supported by some evidence.

Level 1 (1 – 2 marks)
Some planning and/or an attempt at identifying component / terminals

There is an attempt at a logical structure with a line of reasoning. The information is in the most part relevant.

0 marks
No response or no response worthy of credit.

How do you set out a longer written answer?

- **Remember** you're not writing an essay: no need for **full sentences**.
  - **Bullet points** ✔ (number your thoughts).
  - **Subheadings** ✔
  - A **well-labelled diagram** (✔ if appropriate).
  - If you're short on time, just jot down **equations**.

- Leave the question and **come back** if you're drawing a blank, another question might give you some ideas.