Exam Technique

Aims for today

I've chosen year 12 physics topics that have overlap with other topics, can be used to summarise concepts and that are covered by AQA, Edexcel and OCR

Students taking A-Level Physics OR AS Physics: revise in a way that gets you thinking about answering questions in the exam

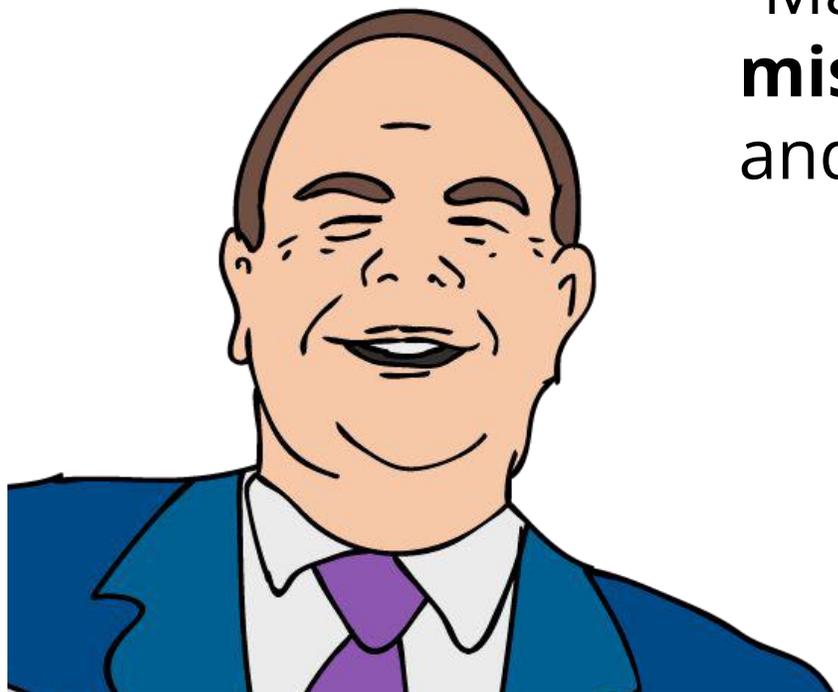Year 12s taking A-Level Physics: using what you've learnt this year, maximise your UNDERSTANDING to give you a good foundation for year 13

Exams this year   No exams this year

What are we going to cover?

- **Interpreting questions**

- How to **set out answers**

- Examples of **command words**

- Tried and tested **exam wisdom**

SNAPREVISE

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

12 A teacher uses a linear air track to provide a frictionless surface for two gliders, each of mass m. She uses this, with a pair of light gates connected to a computer, to investigate a collision between the gliders.

The gliders are each given a small push and travel towards the centre of the track. The gliders collide and move off together.
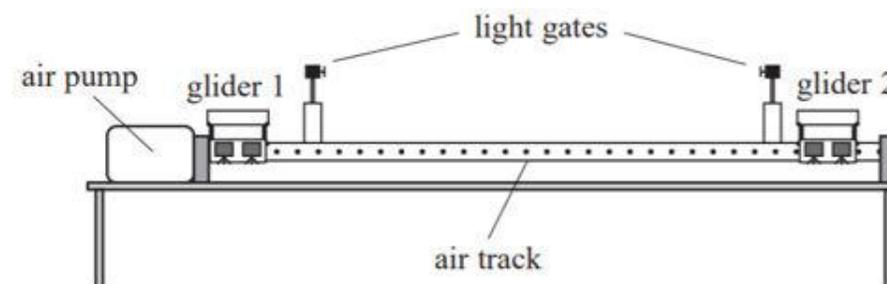
(a) The computer displays the velocity of the gliders as they pass through the light gates.

Calculate the velocity of the gliders after the collision, using the principle of conservation of linear momentum.

(3)

initial velocity of glider 1 = 0.30 m s^{-1} to the right
initial velocity of glider 2 = 0.70 m s^{-1} to the left

Magnitude of velocity = ...

Direction of velocity = ...

momentum before = momentum after

$$p = mv$$

taking right as positive:

$$0.3m - 0.7m = 2mv$$

$$-0.4 = 2v$$

$$v = -0.2$$

Magnitude of velocity = ...

Direction of velocity = ...

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…
- Define the term…
- Name a condition for…
- Identify an assumption used…
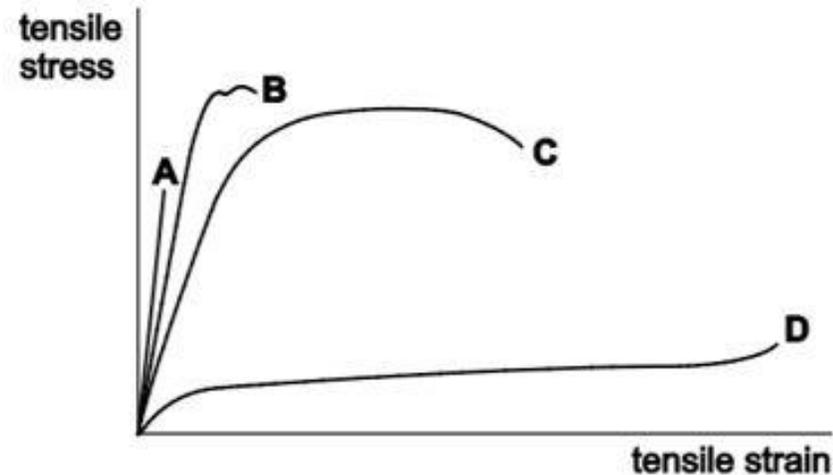- Describe what is meant by…

Command Words – Statement Questions

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**.

Figure 5 shows the tensile stress–tensile strain graphs for four materials, **A**, **B**, **C** and **D**, up to their breaking stress.

Figure 5

State what is meant by tensile stress and tensile strain.

[2 marks]

tensile stress **force exerted per cross-sectional area**

tensile strain **extension per original length**

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

This question is about a laser pen.

(a) Define the terms *phase difference* and *coherence*.

5 This question is about a laser pen.

(a) Define the terms *phase difference* and *coherence*.
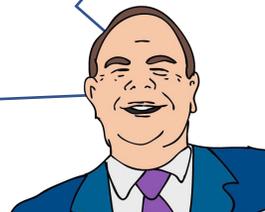
difference in degrees/radians/angle between

phase difference ....

points on the same wave or similar points on two waves

....

constant / fixed phase difference

coherence ....

... **[2]**

"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."

Identify: Select **key information**, sometimes from **possible options** in the question.

- **Look carefully** at the **context** of the question.

- **Consider** all the **possible options**

- You might be able to select the correct answer by **eliminating** the incorrect answers.

Some of the predicted energy levels are shown in **Figure 9**.

Figure 9

0
− 0.54 eV
− 0.85 eV

− 1.51 eV

not to scale

− 3.40 eV
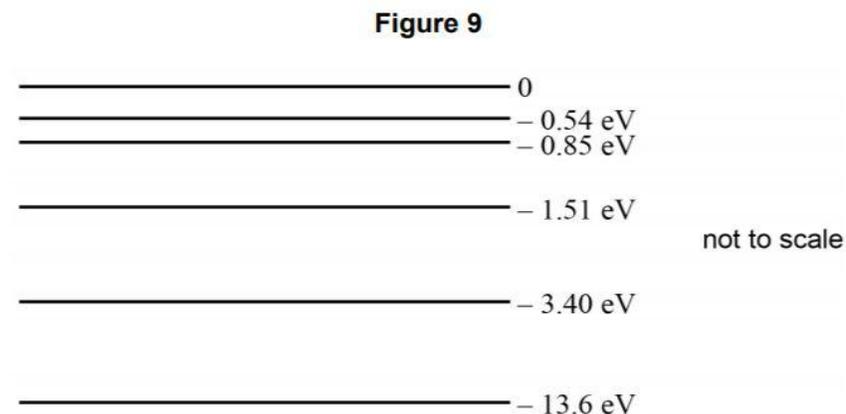
− 13.6 eV

Identify the state of an electron in the energy level labelled 0.

[1 mark]

Identify the state of an electron that is in the energy level labelled −13.6 eV.

[1 mark]

0 7

In a discharge tube a high potential difference is applied across hydrogen gas contained in the tube. This causes the hydrogen gas to emit light that can be used to produce the visible line spectrum shown in **Figure 8**.

Figure 8

410   430   486   656
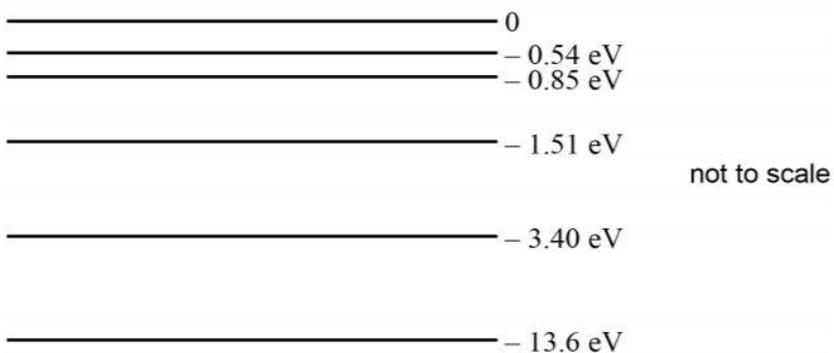
wavelength λ / nm

The visible line spectrum in **Figure 8** has been used to predict some of the electron energy levels in a hydrogen atom.

The energy levels predicted from the visible line spectrum are those between 0 and −3.40 eV in the energy level diagram.

Some of the predicted energy levels are shown in **Figure 9**.

Figure 9

————— 0
————— − 0.54 eV
————— − 0.85 eV

————— − 1.51 eV
                          not to scale

————— − 3.40 eV

————— − 13.6 eV

Identify the state of an electron in the energy level labelled 0.

[1 mark]

Ionised $\Rightarrow n = \infty$

Identify the state of an electron that is in the energy level labelled −13.6 eV.

[1 mark]

Ground state $\Rightarrow n = 1$

Sketch/Plot Questions

- Test your ability to show simple information in **sketches** and **graphs** and accurately **plot data**.

- Can also include **determining values** from the **gradient** or **intercept** of your graph.

- May include **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.)."
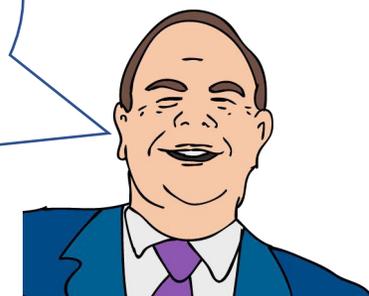
Sketch: Make a simple **diagram** to show a **relation**.

- Show all necessary **detail** and important **features**.

- You may want to also use a **sketch** to **supplement** another answer.

5 (a) A loudspeaker mounted on a bench is emitting sound of frequency 1.7 kHz to a microphone. Fig. 5.1 shows an illustration of the bulk movement of the air at one instant of time.

Fig. 5.1

The maximum displacement of the air particles from their mean positions is 2.0×10^{-6} m.

The speed of sound in air at 17°C is 340 m s^{-1}.

(i) On Fig. 5.2, sketch the sinusoidal variation of the displacement of the air with distance between **C** and **R**.
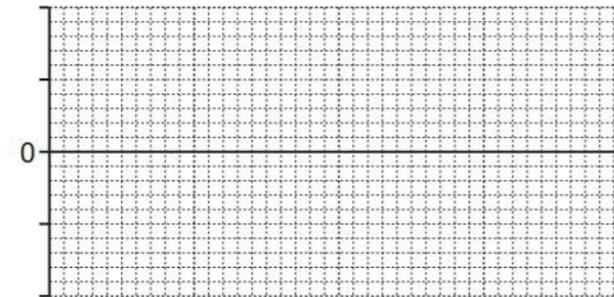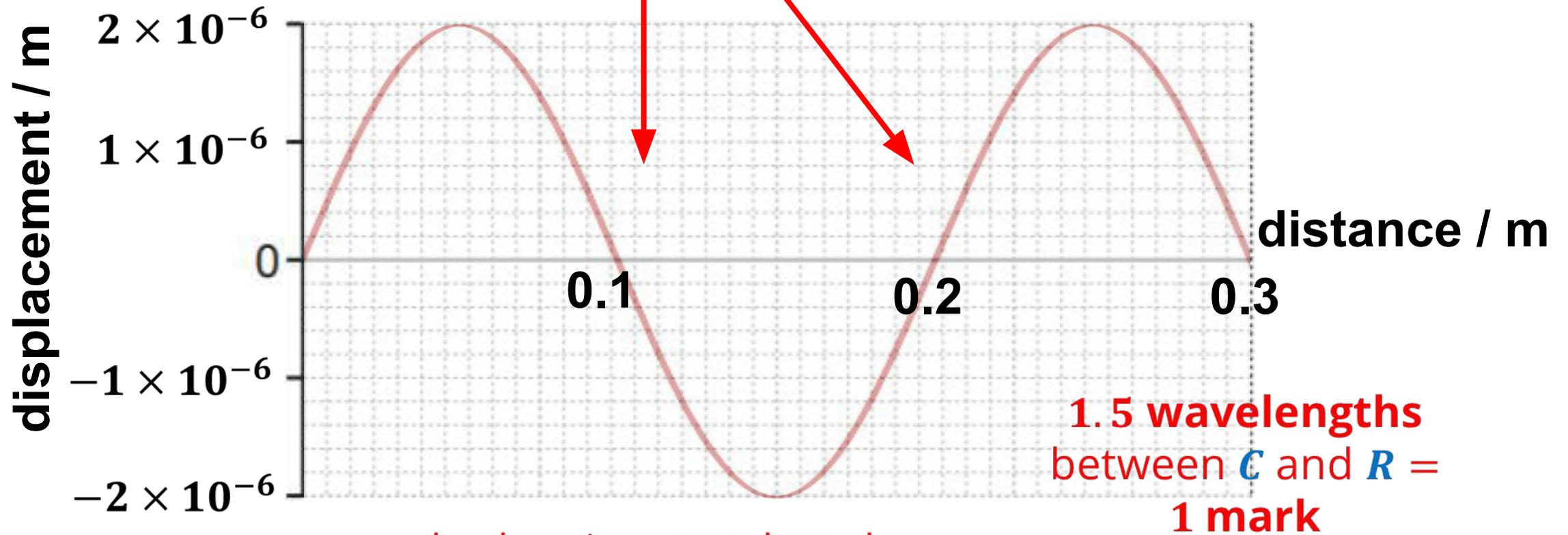

Fig. 5.2

1 Label the axes and include sensible scales.
2 On Fig. 5.2, mark one point where air particles are moving at maximum speed. Label it **X**.
3 On Fig. 5.2, mark one point where air particles are moving at maximum speed but travelling in the opposite direction to the air particles in **2**. Label it **Y**.

[4]

y scale showing amplitude of $2 \times 10^{-6} \mathrm{m} = $ **1 mark**

X and Y positions **= 1 mark**

displacement / m

2×10^{-6}

1×10^{-6}

0

-1×10^{-6}

-2×10^{-6}

distance / m

0.1   0.2   0.3

1.5 wavelengths between C and $R = $ **1 mark**

x scale showing wavelength of $0.2 \mathrm{m} = $ **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**.
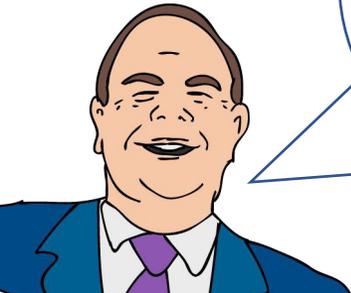
"There were major difficulties on drawing a suitable straight line of best fit; it is expected that there should be a balance of points about the line"

(c) The student measures the resistance R of the conducting putty for different length L. The volume of the conducting putty is kept constant.

The student's results are shown in Table 5.2.

L/m	R/Ω	$L^2/10^{-3}\,m^2$
0.049	14	2.4
0.060	21	3.6
0.069	28	4.8
0.081	37	
0.090	46	8.1
0.099	57	9.8

Table 5.2

(i) Complete the table for the missing value of L^2. [1]

(d) Fig. 5.3 shows the graph of R (y-axis) against L^2 (x-axis).

(i) Plot the missing data point and draw the straight line of best fit. [2]

(ii) Determine the gradient of the line of best fit.

L/m	R/Ω	$L^2/10^{-3}\,m^2$
0.049	14	2.4
0.060	21	3.6
0.069	28	4.8
0.081	37	
0.090	46	8.1
0.099	57	9.8

Gradient $= \dfrac{\Delta y}{\Delta x} = \dfrac{55-14}{(9.6-2.4)\times 10^{-3}} = 5700\ \Omega m^{-2}$
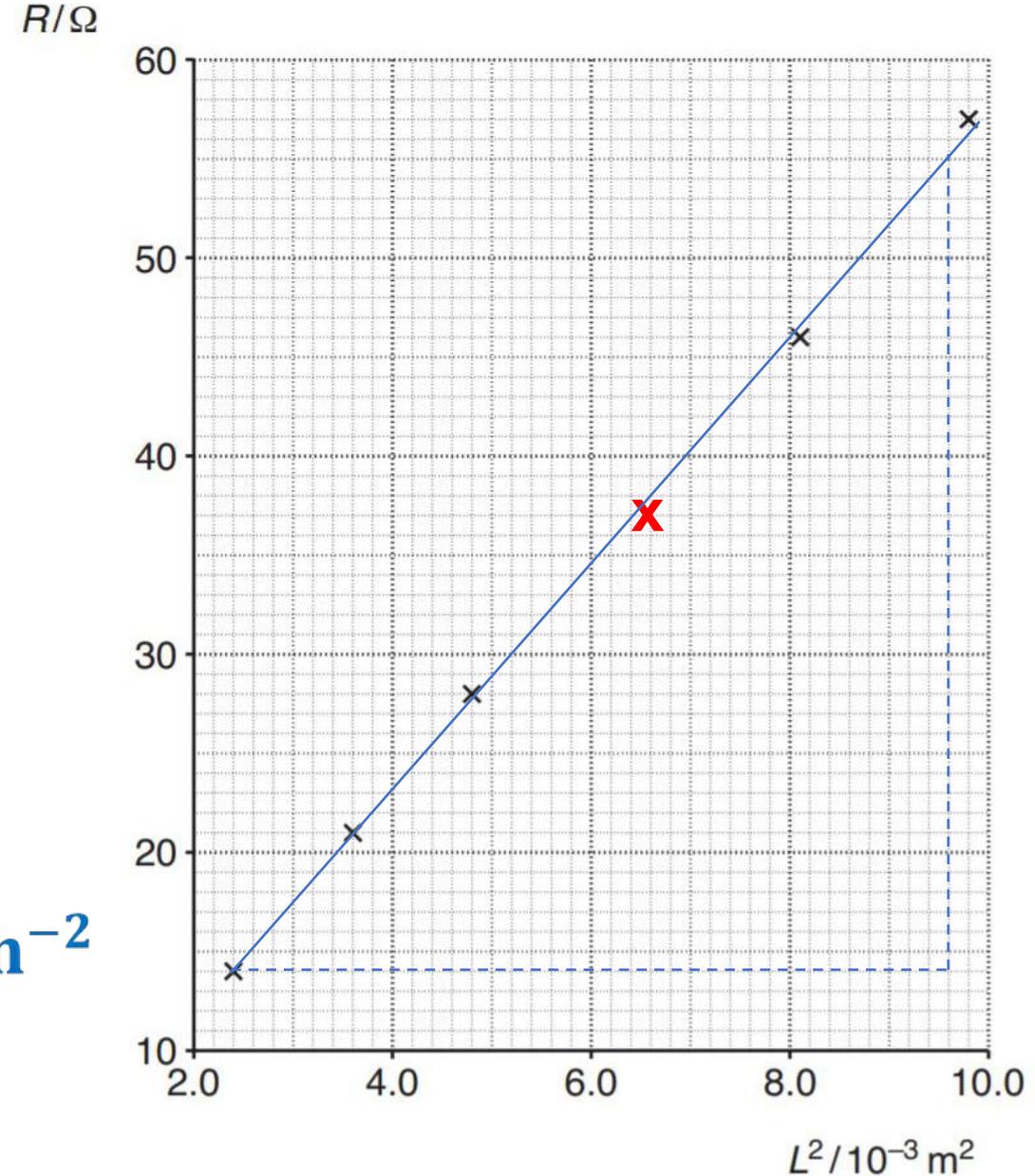
Calculation Questions

- 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

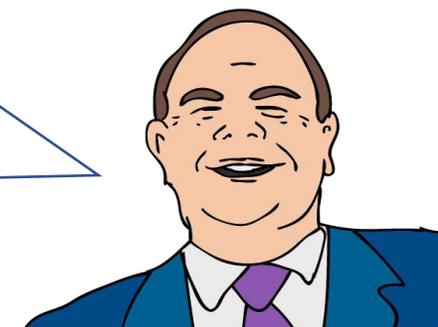- **Calculate**
- **Show That**
- **Determine**
- **Deduce**

"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.

"The most common way to lose marks was using an inappropriate number of significant figures; there should be the same number of SF in the answer as in the data."

4   A skydiver of mass 70 kg, jumps from a stationary balloon and reaches a speed of 45 m s^{-1} after falling a distance of 150 m.

(a)   Calculate the skydiver's
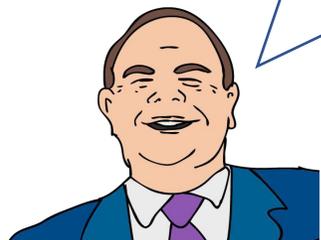
(i)   loss of gravitational potential energy,

(2 marks)

4 A skydiver of mass 70 kg, jumps from a stationary balloon and reaches a speed of $45 \, \text{m s}^{-1}$ after falling a distance of 150 m.

(a) Calculate the skydiver's

(i) loss of gravitational potential energy,

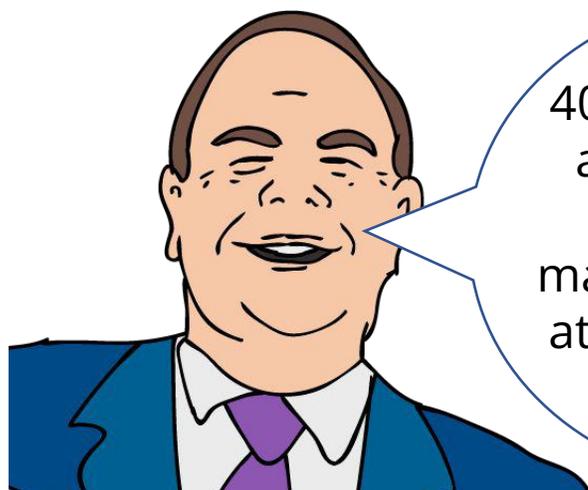"Lower ability candidates often omitted a step within the calculation and were not able to obtain full marks."

$$\Delta E_G = mg\Delta h$$

$$= 70 \, \text{kg} \times 9.81 \, \text{ms}^{-1} \times 150 \, \text{m}$$

$$= 103005 \, \text{J}$$

$$= 100000 \, \text{J} \, (\text{to } 2 \, \text{s.f.})$$

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.**
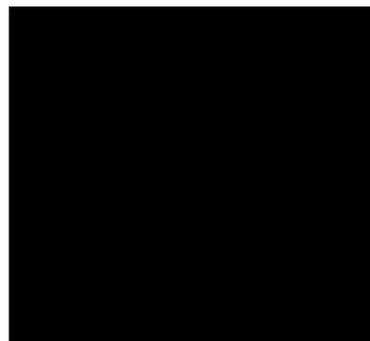
40% of the overall assessment will contain mathematical skills at GCSE Level 4 or above

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

Show that: indicates a **calculation** or **derivation** in which the **answer** is provided for you.

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

"In a 'show that' question it is necessary to give the final answer to at least one more significant figure than the value quoted in the question."

A '**show that**' question sometimes means that you'll need the **answer** for a **subsequent part**.

3   In a hockey match a hockey ball is hit 18.0 m from the front of the goal. The ball leaves the hockey stick with initial velocity v at an angle θ to the horizontal ground. The ball passes over the goal at a maximum height of 2.0 m as shown in Fig. 3.

path of the ball

hockey goal

hockey ball

v

θ

2.0 m

18 m

(Not to scale)

Fig. 3

(a)   The initial vertical component of the velocity of the ball is 6.3 m s^{-1}. Air resistance has negligible effect on the motion of the ball.

(i)   Show that the time t taken for the ball to reach the maximum height is about 0.6 s.

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path of the ball

hockey goal

hockey ball

v

θ
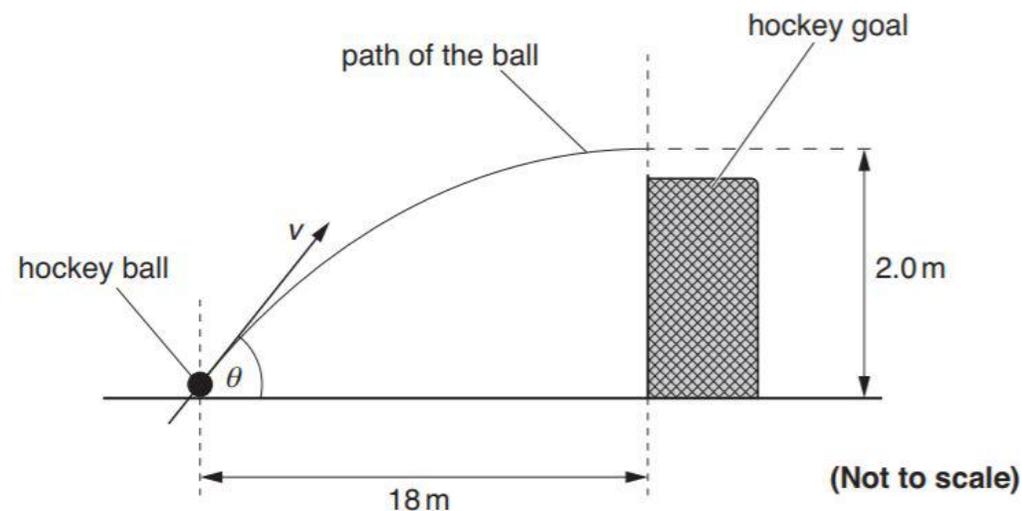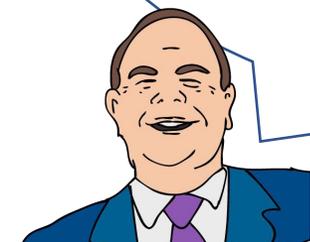
2.0 m

18 m

(Not to scale)
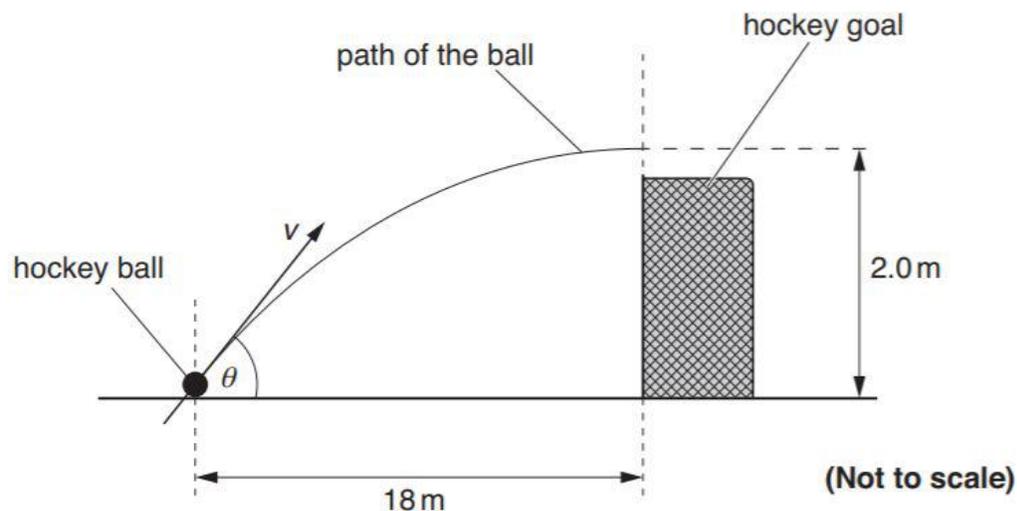
Fig. 3

(a) The initial vertical component of the velocity of the ball is 6.3 m s^{-1}. Air resistance has negligible effect on the motion of the ball.

(i) Show that the time t taken for the ball to reach the maximum height is about 0.6 s.

Maximum height when

$$v = 0 \text{ ms}^{-1}$$

$$v = u + at$$

$$t = \frac{v - u}{a} = \frac{0 - 6.3}{-9.81}$$

$$t = 0.642 \text{s}$$

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**

"Many students struggled with answers that required extended writing, particularly those involving some reasoning."
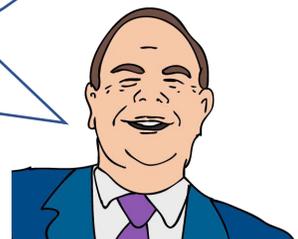
Explain: Give a **step-by-step** chain of **logical reasoning** to show **how** or **why** a physical **phenomenon** or **effect** occurs.

- 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 break down the problem into **smaller parts**.

"The use of bullet points should be encouraged."
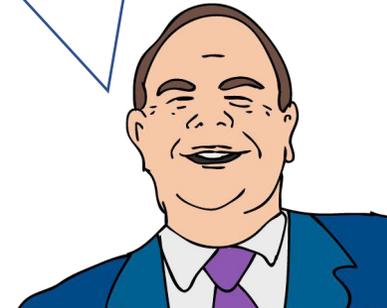
5 The diagram shows some energy levels, in eV, of an atom.

energy/eV		level
−0.1	————————————	n = 4
−3.1	————————————	n = 3
−12.4	————————————	n = 2
−18.6	————————————	n = 1 (ground state)

Photons of specific wavelengths are emitted from these atoms when they are *excited* by collisions with electrons.

You may be awarded marks for the quality of written communication in your answer.

(a) Explain

(ii) why the emitted photons have specific wavelengths.

(3 marks)

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(a) Explain

 (ii) why the emitted photons have specific wavelengths.

(3 marks)

- Energy of each emitted photon corresponds to the difference in energy between two levels

- Wavelength of the photon is given by its energy, through the equation $\lambda = \dfrac{hc}{E}$

- Since E can only take specific values, the wavelength must also only take specific values

Describe: Write **what** will happen or what you can see that a **figure**, **diagram** or **graph** shows.

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

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

12 A simple catapult consists of a rubber strip connected to two fixed points as shown. It is used to launch a ball of mass m. When pulled back, the rubber strip extends by Δx and has a tension T. When launched, the ball is given a velocity v.

fixed point

rubber strip

ball

fixed point

(a) Describe, in terms of work done and energy transfers, what happens immediately after the rubber strip is released to launch the ball.

(4)

(a) Describe, in terms of work done and energy transfers, what happens immediately after the rubber strip is released to launch the ball.

(4)

- Work is done by the rubber strip on the ball.

- The initial elastic potential energy of the rubber strip transfers to kinetic energy of the ball.

- Some potential energy is transferred to thermal energy in the rubber strip.

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.

9   A student has been learning about the photoelectric effect.

(a) The student was asked by his teacher to explain the photoelectric effect. He gave the following explanation:

> Light above a certain threshold is able to free electrons from a metal, because the light gives energy to electrons in the metal.
> Some of this energy is used to release the electrons from the metal and the rest becomes kinetic energy of the freed electron.

Discuss whether the student's answer fully explains the photoelectric effect.

(4)

Discuss whether the student's answer fully explains the photoelectric effect.

(4)

The student's answer could be improved by:

- Including the idea that 'threshold' refers to a minimum frequency

- Stating that <u>photons</u> have an energy given by hf

- Recognising that the energy used to release electrons is called the <u>work function</u>

- Including the idea that one <u>photon</u> is absorbed by one electron

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**

- **Comment on**

- **Criticise**

- **Plan**

- **Determine a method**

Plan/describe 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 pieces 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**.

6 (a)* A student wishes to determine experimentally the breaking stress of a metal in the form of a thin wire.

Describe with the aid of a diagram how this experiment can be safely conducted, and how the data can be analysed to determine the breaking stress of the metal.

....

....

....

....

....

....

Level 3 (5–6 marks)
Clear procedure, measurements **and** 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 procedure, some measurements 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.
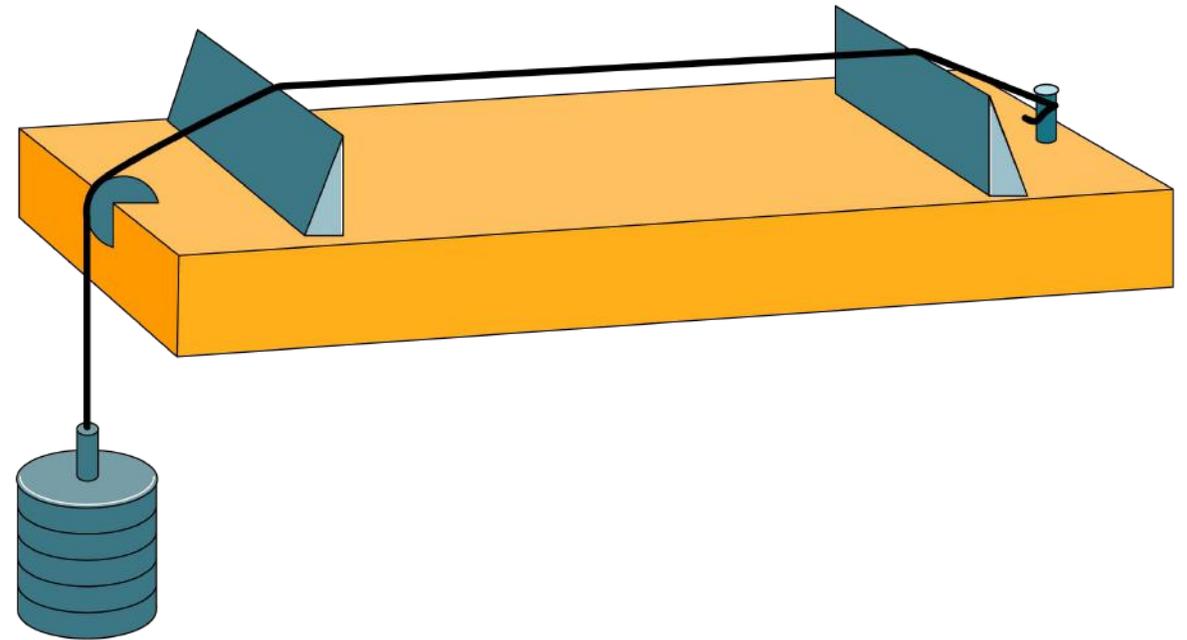
Level 1 (1–2 marks)
Limited procedure and limited measurements
or limited analysis

The information is basic and communicated in an unstructured way. The information is supported by limited evidence and the relationship to the evidence may not be clear.

0 marks
No response or no response worthy of credit.

Procedure
- Attach the fixed end of the wire securely
- Incrementally increase the load until the wire breaks
- Use a safety screen & goggles to protect eyes

Measurement
- Measure the mass added
- Use a micrometer to measure the diameter of the wire several times, then take an average
- Repeat the experiment several times

Analysis
- Force = mg
- Cross-sectional area of the wire $A = \pi r^2 = \pi \left(\frac{d}{2}\right)^2$
- Breaking stress = max force / cross-sectional area

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**

"(Candidates) should be cautious about writing very long answers, as this can increase the possibility of contradicting themselves and can reduce the clarity and coherence of their answers."