

Surname	Centre Number	Candidate Number
First name(s)		0



GCSE

3430UC0-1



S25-3430UC0-1

MONDAY, 16 JUNE 2025 – MORNING

SCIENCE (Double Award)

**Unit 3 – PHYSICS 1
HIGHER TIER**

1 hour 15 minutes

For Examiner's use only		
Question	Maximum Mark	Mark Awarded
1.	15	
2.	12	
3.	7	
4.	16	
5.	10	
Total	60	

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01

ADDITIONAL MATERIALS

In addition to this paper you will require a calculator and a ruler.

INSTRUCTIONS TO CANDIDATES

Use black ink or black ball-point pen. Do not use gel pen or correction fluid.

You may use a pencil for graphs and diagrams only.

Write your name, centre number and candidate number in the spaces at the top of this page.

Answer **all** questions.

Write your answers in the spaces provided in this booklet. If you run out of space, use the additional pages at the back of the booklet, taking care to number the question(s) correctly.

INFORMATION FOR CANDIDATES

The number of marks is given in brackets at the end of each question or part-question.

The assessment of the quality of extended response (QER) will take place in question 4(a).



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Equations

current = $\frac{\text{voltage}}{\text{resistance}}$	$I = \frac{V}{R}$
total resistance in a series circuit	$R = R_1 + R_2$
total resistance in a parallel circuit	$\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2}$
energy transferred = power $\times$ time	$E = Pt$
power = voltage $\times$ current	$P = VI$
power = current ² $\times$ resistance	$P = I^2R$
% efficiency = $\frac{\text{energy [or power] usefully transferred}}{\text{total energy [or power] supplied}} \times 100$	
density = $\frac{\text{mass}}{\text{volume}}$	$\rho = \frac{m}{V}$
units used (kWh) = power (kW) $\times$ time (h) cost = units used $\times$ cost per unit	
wave speed = wavelength $\times$ frequency	$v = \lambda f$
speed = $\frac{\text{distance}}{\text{time}}$	

SI multipliers

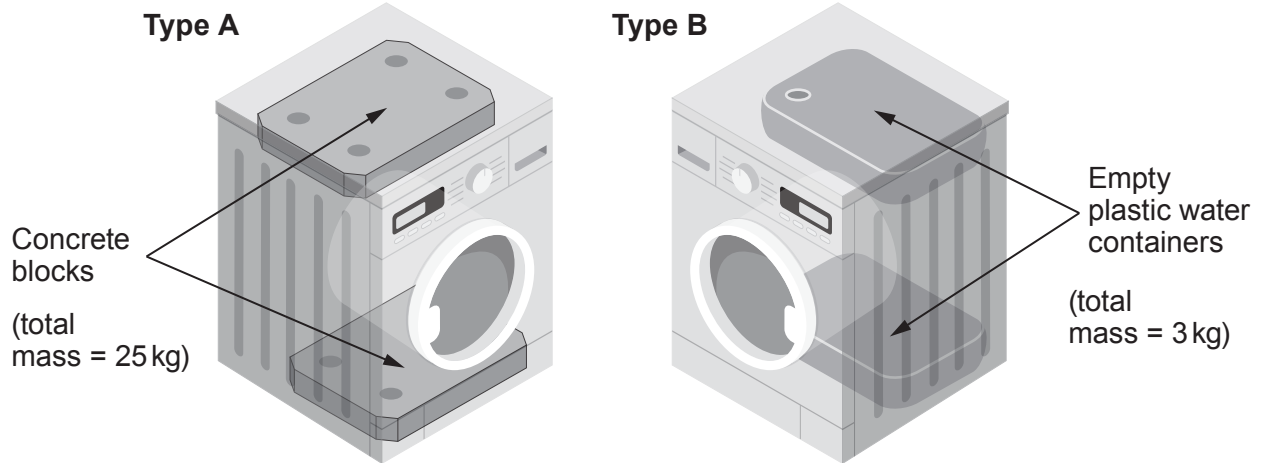
Prefix	Symbol	Conversion factor	Multiplier
pico	p	divide by 1 000 000 000 000	1×10^{-12}
nano	n	divide by 1 000 000 000	1×10^{-9}
micro	μ	divide by 1 000 000	1×10^{-6}
milli	m	divide by 1000	1×10^{-3}
centi	c	divide by 100	1×10^{-2}

kilo	k	multiply by 1000	1×10^3
mega	M	multiply by 1 000 000	1×10^6
giga	G	multiply by 1 000 000 000	1×10^9
tera	T	multiply by 1 000 000 000 000	1×10^{12}



Answer **all** questions.

1. Washing machines (type A) contain concrete blocks, of total mass 25 kg, to stop them vibrating too much.
A new type of washing machine (type B) replaces the concrete blocks with empty plastic water containers of total mass 3 kg.



- (a) (i) Calculate the difference in mass of the two types of washing machine. [1]

difference in mass = kg

- (ii) A lorry transports **35 type A washing machines** from a warehouse to a shop. For this journey it releases 0.085 g of carbon dioxide (CO₂) **for every kilogram** of mass it carries.

- I. Use your answer from part (i) to calculate the reduction in CO₂ emissions if the lorry transports 35 type B washing machines instead of type A. [2]

reduction in CO₂ emissions = g

- II. Each year in the UK, **3 500 000** type A washing machines are transported by lorry over similar journeys.
Use your answer from part (ii)I to calculate the reduction in the mass of CO₂ produced if 3 500 000 type B washing machines are transported instead of type A. [2]

reduction in the mass of CO₂ = g



- (b) The 3 kg empty plastic containers in a type B washing machine have a total volume of 0.022 m^3 .
Before the machine is used for the first time the containers are filled with water.
Evelyn suggests that the containers will not have enough mass, when filled with water, to replace the 25 kg concrete blocks.

Use the equation:

$$\text{mass} = \text{density} \times \text{volume}$$

to decide if Evelyn is correct.

Water has a density of 1000 kg/m^3 .

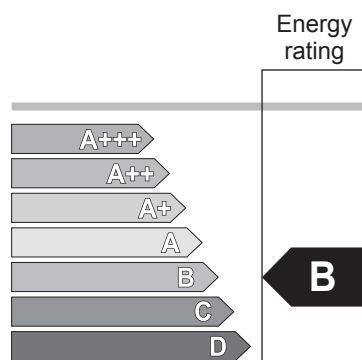
Space for calculation.

[3]

- (c) The table below shows the number of units of electricity (kWh) used per wash for washing machines manufactured from the year 1990 onwards.

Year	kWh per wash
1990	1.34
1995	1.29
2000	1.19
2005	1.15
2010	1.11
2015	1.06
2020	1.04

- (i) A washing machine manufactured in 2010 had this energy rating label attached.



Explain how the label for a washing machine manufactured in 1995 would have been different. [2]

- (ii) A family uses a washing machine that was manufactured in 1990. They are considering changing it. Use an equation from page 2 to calculate the **money saved per wash** if they used a 2020 washing machine instead. One unit of electricity (kWh) costs 30p. [2]

money saved per wash = p

- (iii) The family uses the 1990 washing machine **5 times each week**. A 2020 washing machine costs £350 and has an expected lifetime of 12 years. A salesperson suggests that they should buy this washing machine as a replacement because its payback time is less than its expected lifetime. Explain whether you agree with the salesperson. (52 weeks = 1 year) [3]
Space for calculation.



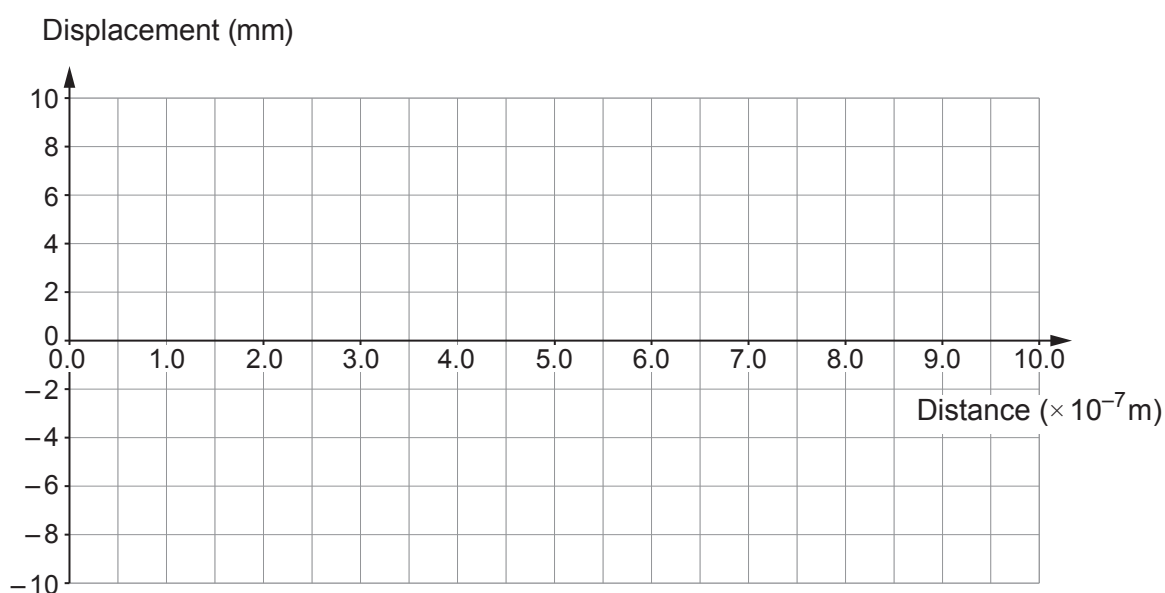
2. (a) (i) Describe the meaning of the term transverse wave.

[1]

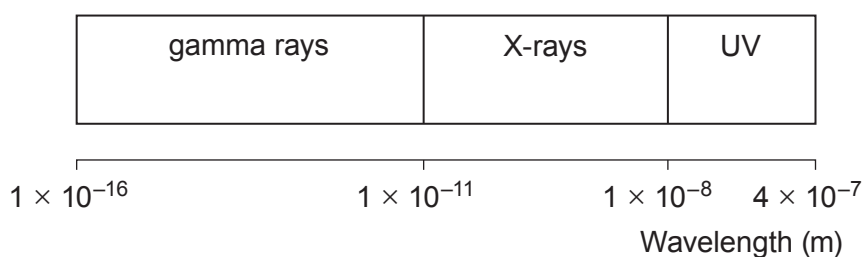
- (ii) On the grid below, draw a wave with a wavelength $4.0 \times 10^{-7} \text{ m}$ and amplitude 8 mm.

At least one complete wave, **starting from the origin**, must be drawn.

[2]



- (b) The diagram shows the three ionising radiations that form part of the electromagnetic (em) spectrum.



- (i) Use information on the diagram to explain why ultraviolet (UV) is the **lowest** energy radiation shown.

[2]



- (ii) Gamma rays are emitted by some radioactive materials.
Use information from the diagram opposite and an equation from page 2 to
calculate the **highest** frequency of gamma rays shown.
(Speed of gamma rays, $c = 3 \times 10^8$ m/s.) [3]

highest frequency = Hz

- (iii) All em waves are transverse.
State **one** other property that all em waves have in common. [1]

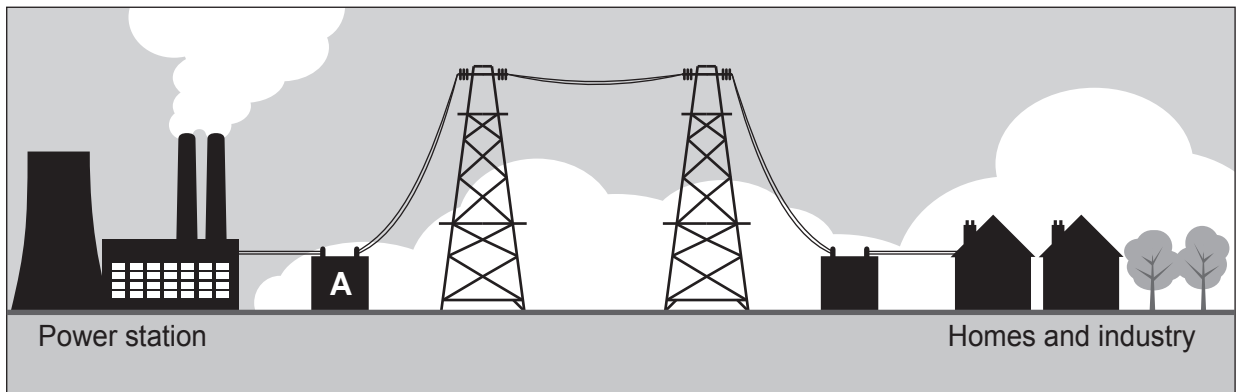
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- (c) Radio waves are used to transmit information between Earth and a rover on the surface of Mars.
A signal is sent from Earth to the Mars rover and it is sent back immediately.
The time difference between sending the signal and receiving it back is 364 seconds.
Use an equation from page 2 to calculate the distance between Earth and Mars.
(Speed of radio waves, $c = 3 \times 10^8$ m/s.) [3]

distance = m



3. The diagram shows part of the National Grid.



- (a) State the type of transformer at A **and** explain how it helps to transfer electrical energy from the power station to homes and industry efficiently. [3]

Type of transformer at A =

Explanation:

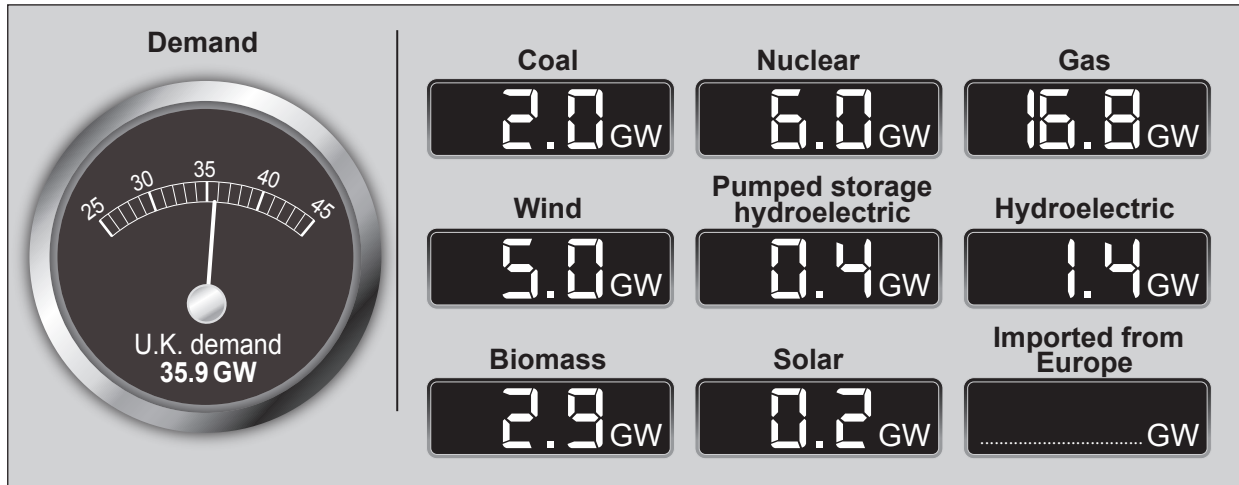
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- (b) (i) At 11:00 am on 3 October 2018, the following displays were observed at the UK National Grid Control Centre.
The Control Centre monitors the demand for electricity in the UK.
The demand is shown on the left.
The various power sources used to meet the demand are shown on the right.
Sometimes electricity is imported from Europe.



Use this information to calculate the percentage of electricity imported from Europe at this time.

[3]

% of electricity imported from Europe =

- (ii) At 11:03 am, a sudden increase in demand of 0.9 GW is detected.
Europe is unable to supply any extra electricity to the UK.
Give **one** reason why pumped storage hydroelectric would be used to ensure that demand is met.

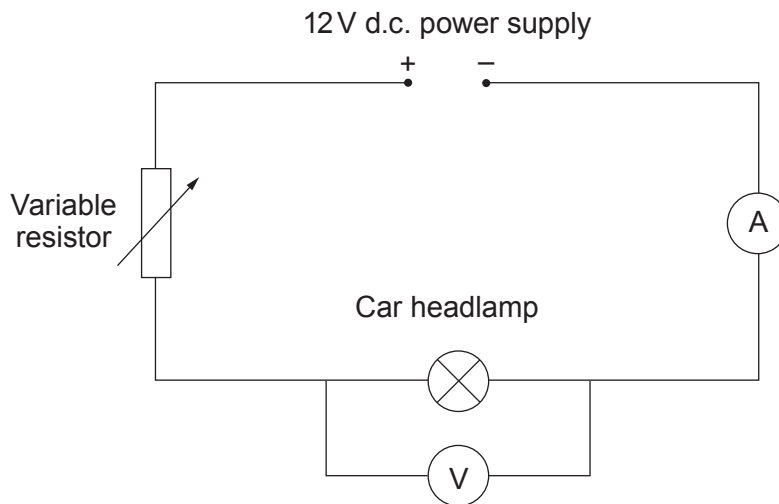
[1]

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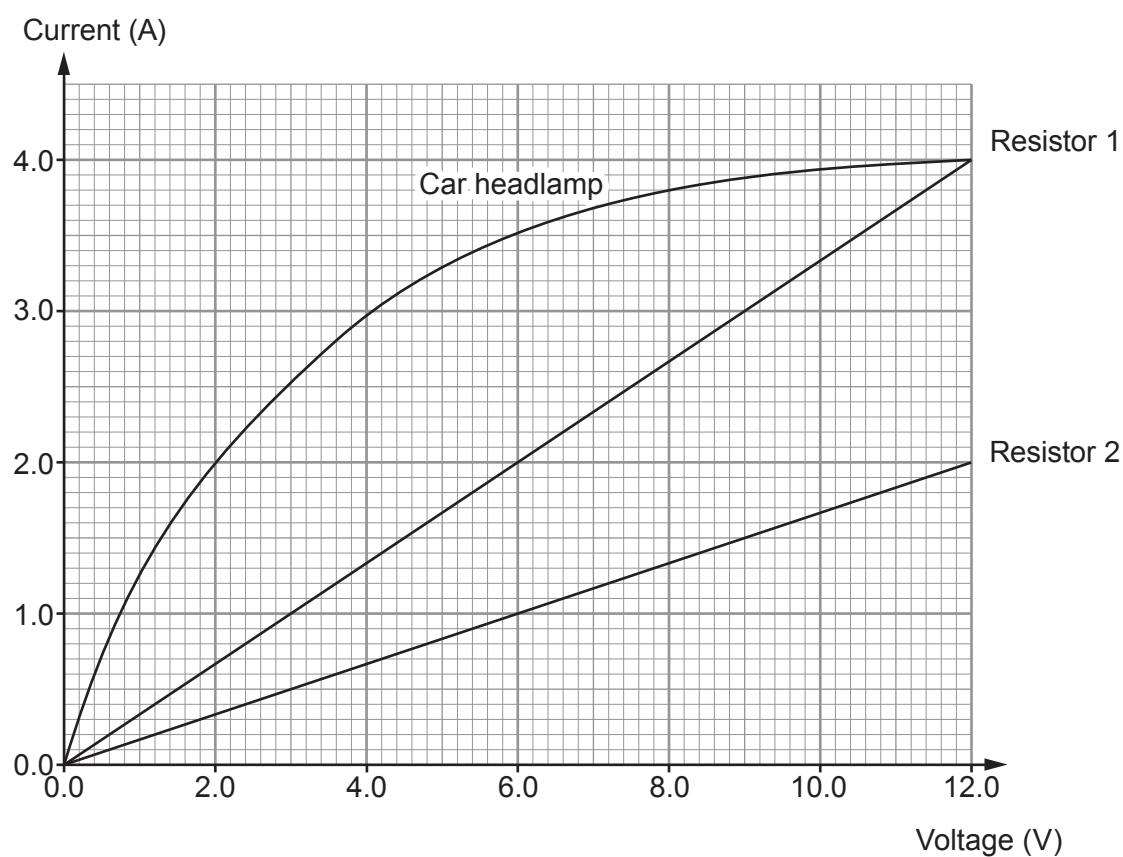
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- Include in your answer:



- (b) The graph shows the variation of current with voltage for the 12V car headlamp and two resistors.



- (i) Use the equation:

$$\text{current} = \frac{\text{voltage}}{\text{resistance}}$$

to calculate the resistance of the car headlamp when it has the same value as Resistor 1.

State the unit of resistance.

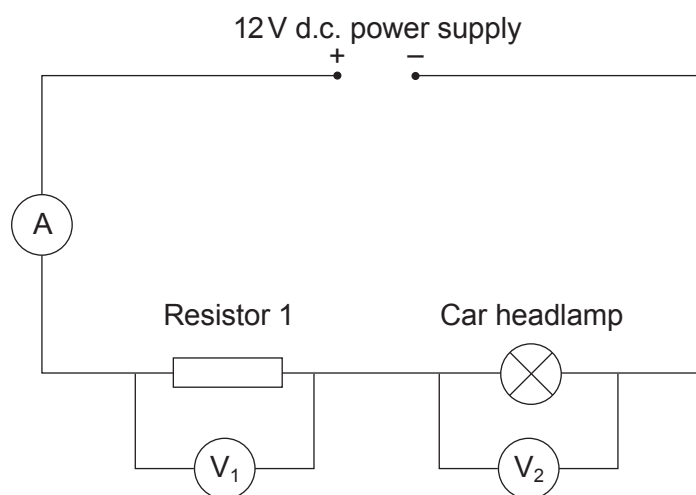
[3]

resistance of car headlamp =

unit of resistance =



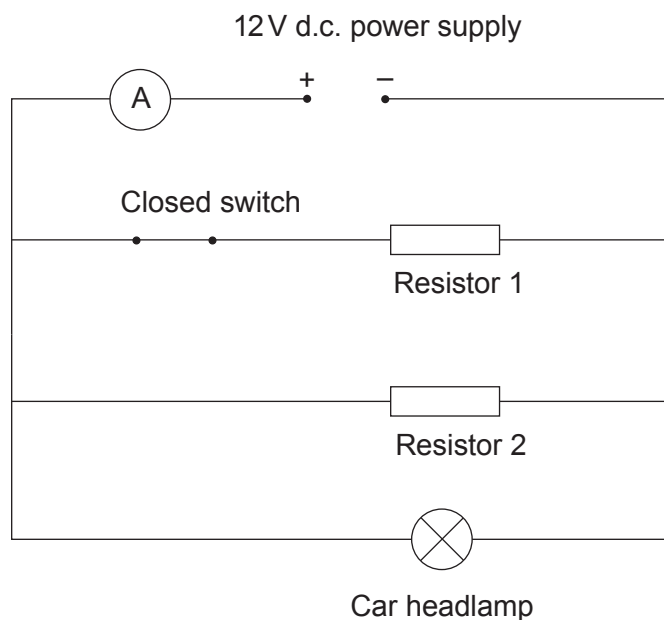
- (ii) The following circuit is constructed using resistor 1 and the car headlamp. The ammeter has a reading of 2.8 A.



Without calculation, use information from the graph to state the readings on the two voltmeters, V_1 and V_2 . [2]

V_1 reading = V V_2 reading = V

- (iii) In the following circuit, each of the components is connected in parallel with the power supply.



- I. State the value of the voltage across the car headlamp. V [1]



- II. Use values from the graph to calculate the current through the ammeter. [2]

current = A

- III. George predicts that if the switch were opened, the reading on the ammeter would not change.
Explain whether he is correct. [2]

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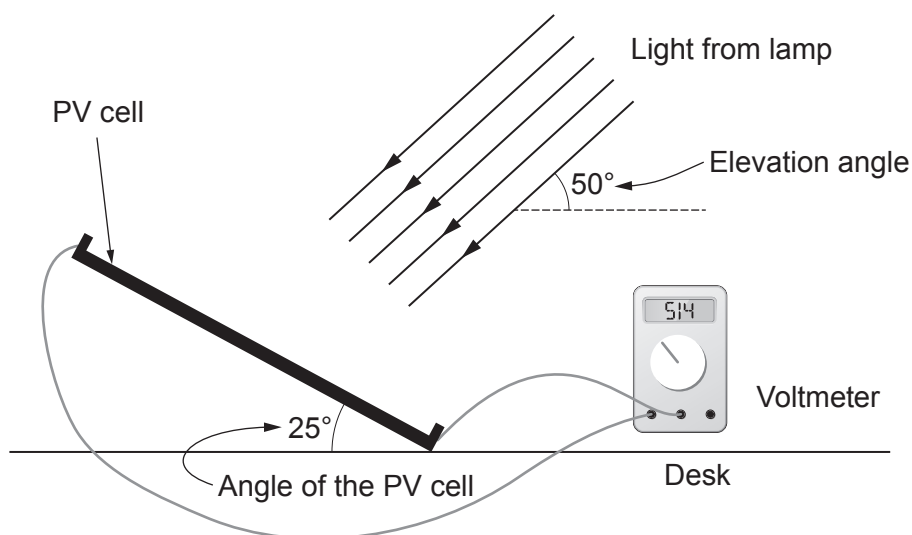
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16



5. A group of students carries out an experiment to investigate if the angle of a photovoltaic (PV) cell effects its output voltage. The apparatus is set up as shown with the PV cell at an angle of 25° with the horizontal desk. The lamp is fixed in position at an elevation angle of 50° to the horizontal.



Students change the angle of the PV cell to the desk and record the voltage.

Angle of PV cells ($^\circ$)	Voltage (mV)			
	Trial 1	Trial 2	Trial 3	Mean
25	514	517	432	
30	530	529	537	532
35	543	541	544	543
40	551	552	547	550
45	543	543	545	544
50	533	531	535	533
55	516	518	522	519

- (a) (i) **Complete the table** above for the missing mean voltage when the PV cell is at an angle of 25° to the desk. [2]
The circled result in Trial 3 is an anomaly.
Space for calculation.



- (ii) To find the uncertainty in a mean value, the following equation can be used:

$$\text{uncertainty} = \frac{(\text{maximum value} - \text{minimum value})}{2}$$

Using data in the table, calculate the uncertainty in the mean voltage for an angle of **55°**. [2]

uncertainty = mV

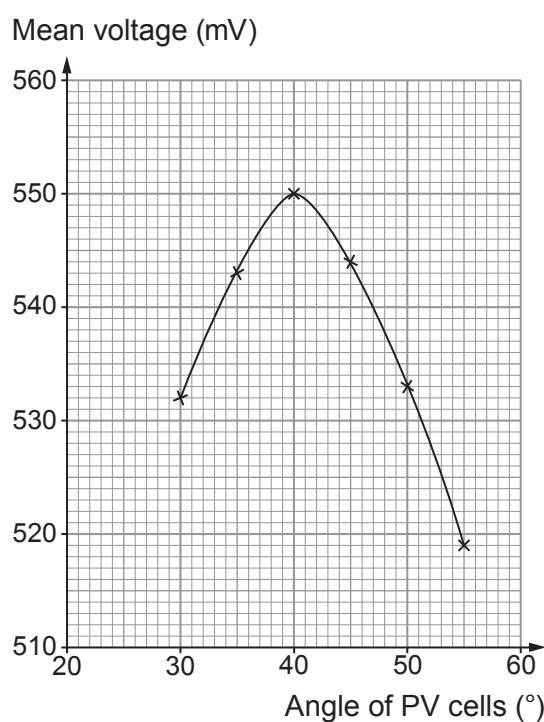
- (iii) Explain for which angle the readings are **most** repeatable for this group of students. [2]

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- (iv) The graph shows the data collected from the experiment for this group of students.



Students in the group thought that the maximum mean voltage would occur when the angle of the PV cells is the same as the elevation angle. Explain whether their results agree with this prediction. [2]

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- (b) The students compared their results with other groups of students in the class. Their maximum voltage obtained varied from 400–600 mV. Suggest **two** reasons why the values varied. [2]

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