GCSE

WJEC GCSE
The Sciences (Double Award)

Approved by Qualifications Wales

Sample Assessment Materials

Unit 6: Physics - Waves, Electricity and Energy
Foundation Tier

Teaching from 2026
For award from 2028

This Qualifications Wales regulated qualification is not available to centres in England.

Made for Wales.
Ready for the world.

WJEC would like to thank the students and teachers of Fitzalan High School, Cardiff and Llanwern High School, Newport for their participation in the creation of these covers.

Contents

Surname	Centre number	Candidate number
First name(s)		0

GCSE

3455U6

The Sciences (Double Award) – Unit 6 Physics – Waves, Electricity and Energy

FOUNDATION TIER
1 hour 15 minutes
SAMPLE ASSESSMENT MATERIALS

Additional materials

A calculator and ruler are permitted.

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 provided at the top of this page.

Answer **all** questions.

For examiner's use only		
Question	**Maximum mark**	**Mark awarded**
1.	**9**	
2.	**13**	
3.	**8**	
4.	**5**	
5.	**13**	
6.	**16**	
Total	**64**	

Write your answers in the spaces in this booklet. If you need more space, use the additional page(s) at the back of this booklet. 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 total number of marks available is **64.**

You should think carefully about how you use your time.

Your responses must be clear, accurate and well presented.

Equations

Speed = $\frac{\text{distance}}{\text{time}}$	
weight = mass × gravitational field strength	W = mg
efficiency = $\frac{\text{useful energy transferred}}{\text{input energy}}$ x 100 OR efficiency = $\frac{\text{useful power output}}{\text{input power}}$ x 100	
units used (kWh) = power (kW) × time (hours) cost = units used × cost per unit	
frequency = $\frac{1}{\text{period}}$	$f = \frac{1}{T}$
wave speed = frequency × wavelength	$v = f\lambda$
V_1 = voltage across the primary coil V_2 = voltage across the secondary coil N_1 = number of turns on the primary coil N_2= number of turns on the secondary coil	$\frac{V_1}{V_2} = \frac{N_1}{N_2}$
work done = force × distance	W = Fd
power = voltage × current	P = VI
total resistance in a series circuit	$R = R_1 + R_2$
current = $\frac{\text{voltage}}{\text{resistance}}$	$I = \frac{V}{R}$
force = mass × acceleration	F = ma

SI multipliers

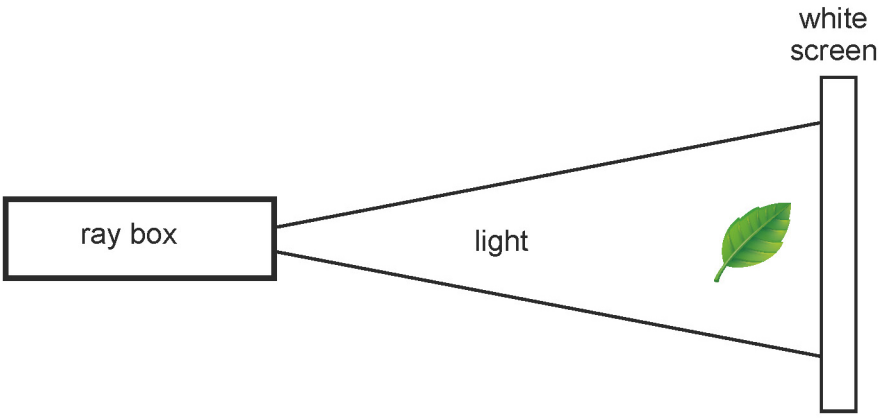
Prefix	Symbol	Conversion factor	Multiplier
milli	m	divide by 1000	1×10^{-3}
centi	c	divide by 100	1×10^{-2}
kilo	k	multiply by 1000	1×10^{3}
mega	M	multiply by 1 000 000	1×10^{6}

Answer **all** questions

Examiner only

1. White visible light from a lamp consists of a mixture of different colours.

A group of students investigate how white light interacts with different filters.
They use a ray box to shine white light at a green leaf and a white screen.
They place different coloured filters in front of the ray box and describe what they see.



Their observations are shown below.

Filter colour	Leaf colour	Screen colour
No filter	Green	White
Red	Black	Red
Green	Green	Green
Blue	Black	Blue

(a) Complete the sentences by <u>underlining</u> the correct term to explain their observations. [3]

The leaf appears green because it (**absorbs** / **reflects** / **transmits**) green light.

When a red filter was placed in front of the ray box, the white screen appears red because the filter (**absorbs** / **reflects** / **transmits**) red light.

When a red filter was placed in front of the ray box, the leaf appears black because it (**absorbs** / **reflects** / **transmits**) red light.

Examiner only

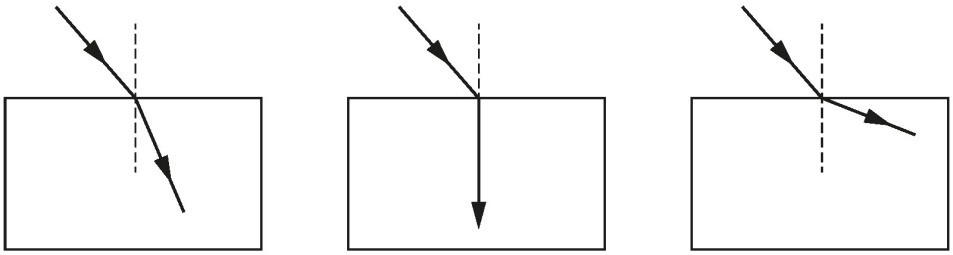
(b) The students repeat their experiment using a yellow filter.
The yellow filter allows red and green light to pass through.
The students make predictions about what they would observe.

Tick (✓) alongside the three correct predictions. [3]

	Tick (✓)
The leaf will appear yellow	
The leaf will appear green	
The leaf will appear black	
The screen will appear red	
The screen will appear yellow	
The screen will reflect red and green light	

(c) Light waves refract when they travel from one medium to another.

Tick (✓) alongside the correct diagram that shows light waves travelling from air to glass. [1]



A B C

(d) In some conditions, light waves can undergo total internal reflection.

Tick (✓) the **two** correct statements about total internal reflection. [2]

	Tick (✓)
Total internal reflection is used in telescopes	
Total internal reflection occurs when light travels from a more to less dense medium	
Total internal reflection occurs when the angle of incidence is greater than the critical angle	
Total internal reflection occurs when light speeds up or slows down	

Examiner only

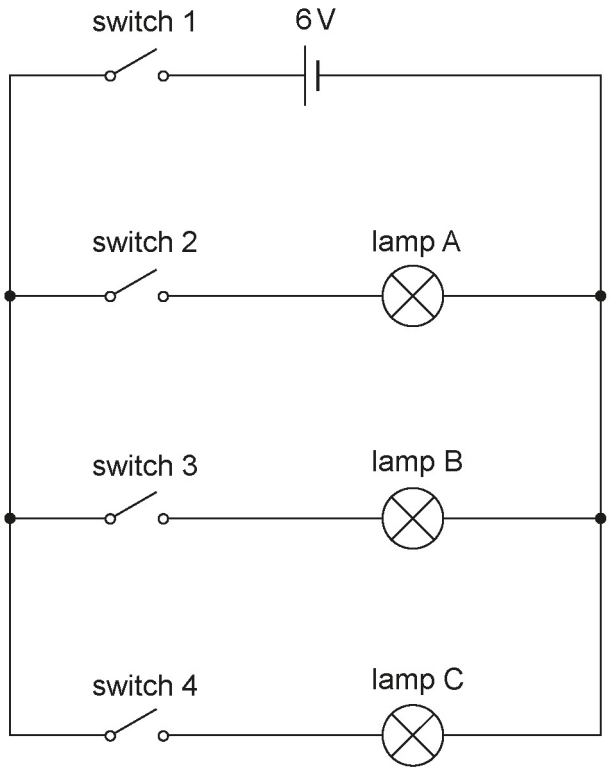
9

Examiner only

2. Elis is designing a circuit for a doll's house.

There are three rooms on the first floor of the doll's house. He decides to put a light in each room.

The circuit diagram below shows how he decided to set up his circuit.



He decides to use a parallel circuit so that he can switch each light on individually.

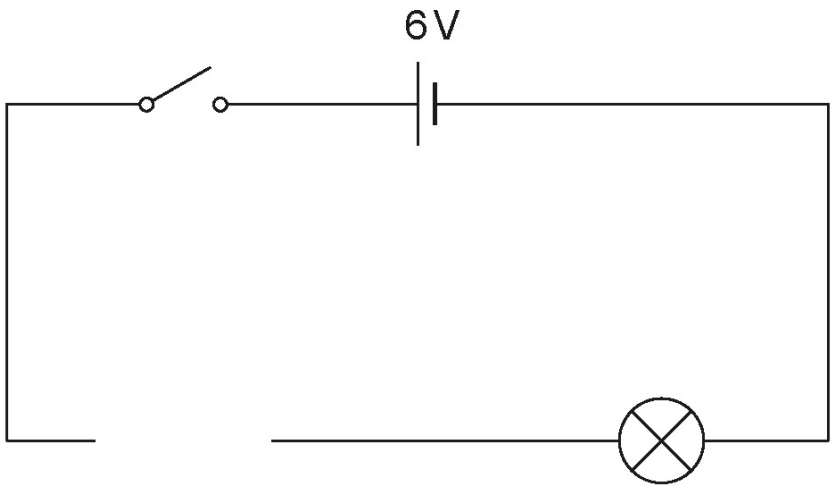
(a) **Complete the table** by placing a tick or a cross in each box to show which lamps will light. [3]

Closed switches	Lamp A	Lamp B	Lamp C
1 and 2	✓	×	……
……..	×	✓	×
2, 3, and 4	…….	…….	…….

Examiner only

Elis decides to add a variable resistor to a circuit to dim the light in another room of the doll's house.

(b) **Add a variable resistor** to the diagram below to show how he could set up his circuit. [1]



(c) When the variable resistor is set to its lowest resistance, the lamp transfers 1000 J of energy in 2 minutes.

Use an equation from page 2 to calculate the power of the lamp. [3]

power = ... W

Examiner only

(d) When the variable resistor has a resistance of 2 Ω, an ammeter connected into the circuit reads 1.2 A.

(i) Use one of the following equations to calculate the voltage across the variable resistor. [2]

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

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

voltage = ... V

(ii) Use your answer to (d)(i) and information from the diagram to calculate the voltage across the lamp when the current is 1.2 A. [2]

voltage = ... V

(iii) Elis changes the resistance of the variable resistor to change the brightness of the lamp.

Complete the following sentences by underlining the correct word or phrase. [2]

When the resistance of the variable resistor increases, the total

resistance of the circuit **(decreases / stays the same / increases)**.

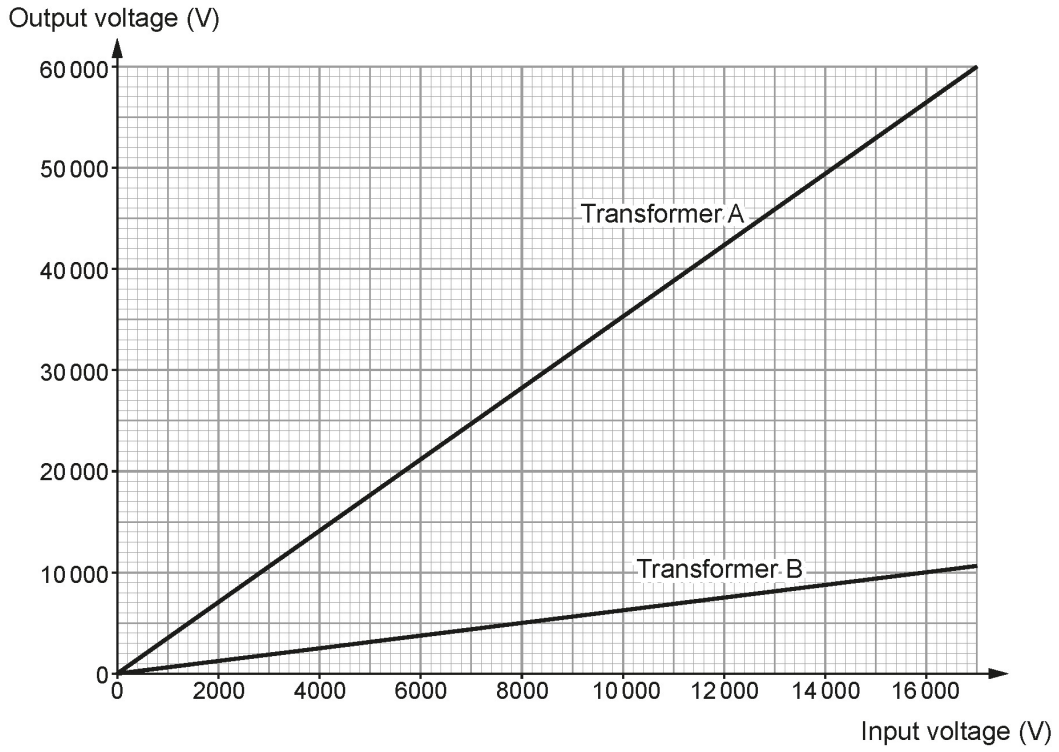
The current in the circuit **(decreases / stays the same / increases)**.

13

Examiner only

3. Transformers are used by the National Grid to change the voltage in the cables when electricity is transmitted across the country.

The graph below shows how the output voltage of two transformers varies with input voltage.



(a) The sentence below describes the relationship between the input voltage and the output voltage of transformer A. Underline the correct words. [2]

As the input voltage increases, the output voltage

(decreases / stays the same / increases) at

(a decreasing / a constant / an increasing) rate.

Examiner only

(b) Transformer A is connected to a 10 000 V input voltage.

(i) Use the graph to determine the output voltage of transformer A. [1]

Output voltage = ... V

(ii) Transformer A has 2000 turns on the primary coil.

Circle the correct number of turns on the secondary coil. [1]

100 2000 7000

(c) Step-up and step-down transformers are used by the national grid.

(i) Tick (✓) the **two** correct statements to describe the purpose of a step-up transformer in the National Grid. [2]

	Tick (✓)
Step-up transformers decrease the voltage and increase the current.	
Step-up transformers increase the voltage and decrease the current.	
Step-up transformers reduce the energy loss due to heating.	
Step-up transformers make the transmission of electricity safer.	

(ii) Carys states that transformer **B** must be a step-up transformer because the voltage increases.

Explain whether Carys is correct. [2]

……...

……...

……...

……...

Examiner only

8

Examiner only

4. A battery powered toy car travels 4 m along a level surface.

The thrust force produced by the car is 25 N.

(a) (i) Use an equation from page 2 to calculate the work done by the thrust force. [2]

work done = ... J

(ii) Work done measures the energy transferred between stores.

When the car is moving, not all this work done is transferred to the useful kinetic store. Which conclusion below explains why?

Tick (✓) the correct conclusion. [1]

	Tick (✓)
Because a friction force acts	
Because the thrust force runs out	
Because of the weight of the car	

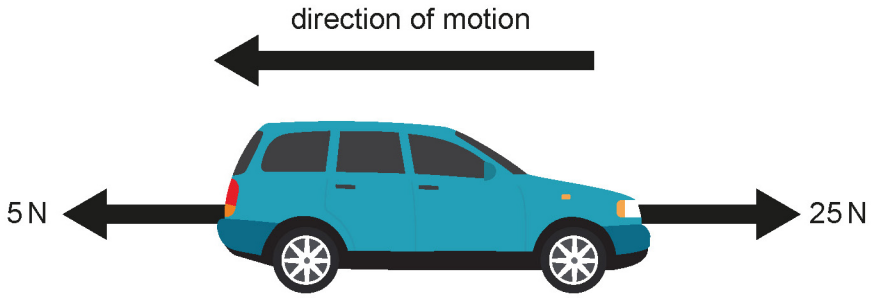
(iii) After 4 m the car is switched off and rolls to a halt.

Complete the sentence below about the car's journey. [1]

In this journey, energy is transferred from the ..... store in the battery to the thermal store.

Examiner only

(b) The diagram shows the horizontal forces acting on the car at one point as it slows down.



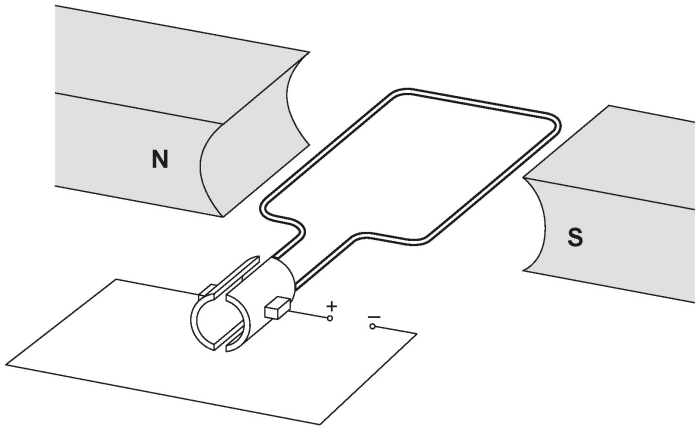
Determine the resultant force acting on the car. [1]

Resultant force = ... N

5

Examiner only

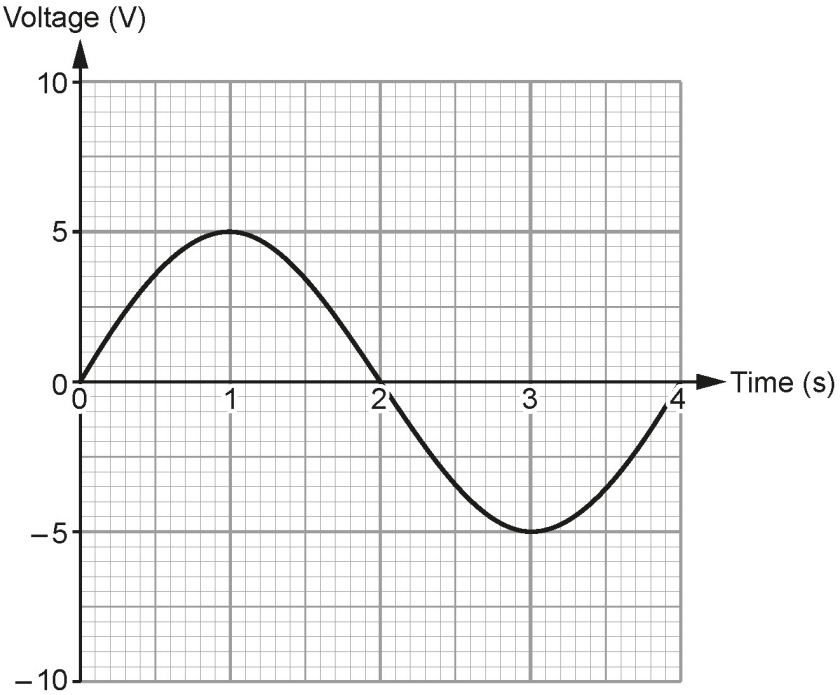
5. The diagram below shows a simple AC generator.



Jacob is investigating how the output depends on the speed of the rotation. He uses a data logger to measure the output voltage of the generator before changing the speed of the rotation.

The data logger produced the graph below for his first attempt.

Graph A



(a) (i) State the independent variable for this investigation. [1]

……

Examiner only

(ii) Jacob uses the same coil throughout the experiment.

State **one** other control variable for this investigation **and** describe how it could be controlled. [2]

……

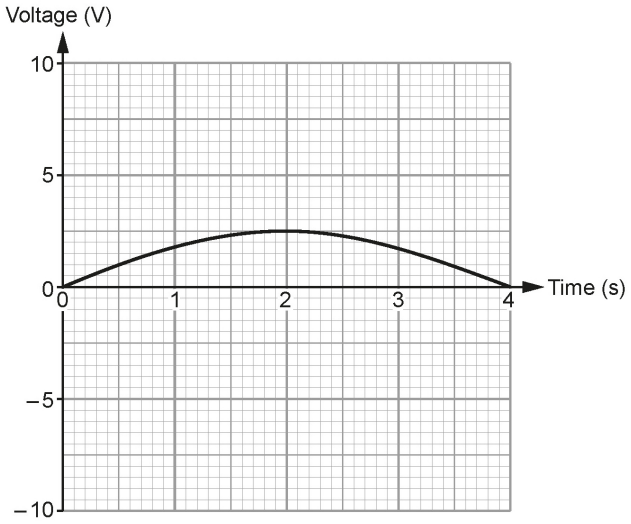
……

……

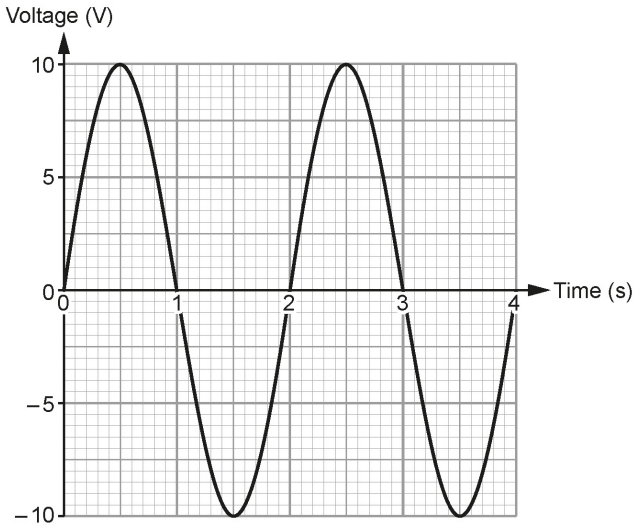
……

(b) Jacob repeated the experiment with different speeds of rotation.
The graphs are shown below.

Graph B



Graph C



Examiner only

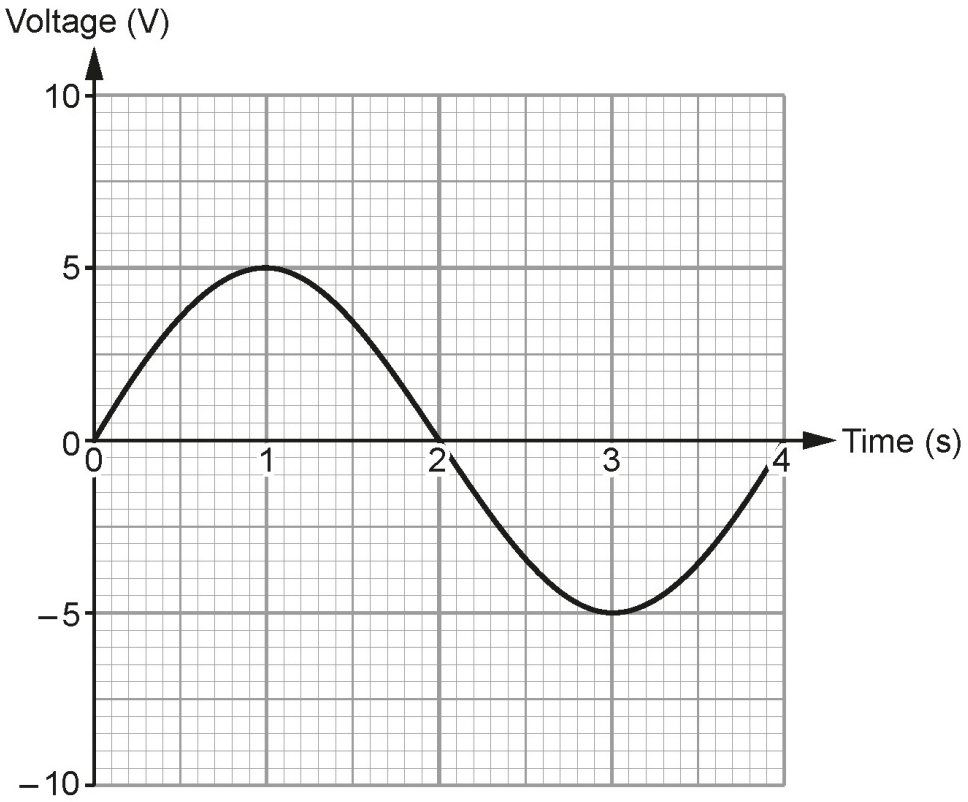
When analysing his results, Jacob makes the following statements.
His teacher says that only three are correct.

Tick (✓) the **three** correct statements. [3]

When the time for one rotation doubles, the maximum voltage doubles.	
The time taken for one complete rotation in graph **B** is 4 s.	
When the speed of rotation doubles the output voltage doubles.	
The maximum voltage in graph **C** is double the maximum voltage in graph **B**.	
The frequency of the AC voltage in graph **C** is double the frequency of graph **A**.	
The speed of rotation in **B** was half the speed of rotation in **A**.	

(c) Another student repeats the experiment but uses a coil with **more turns**.

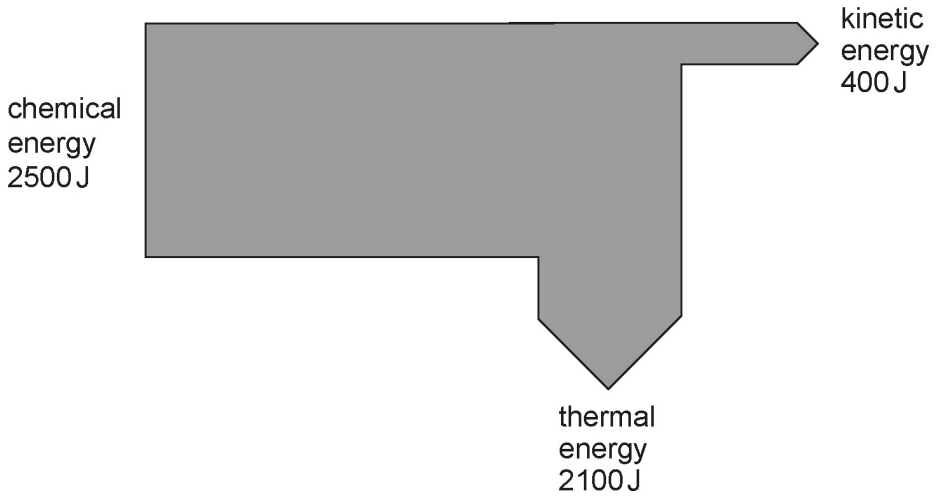
Complete the graph below to show how their results would be different. [2]



Examiner only

(d) A farmer in Brecon uses a petrol generator to power their clippers.

The diagram below shows the energy transfer per second for the generator.



Use an equation from page 2 to calculate the efficiency of the generator. [2]

efficiency = ……..... %

Examiner only

(e) The generator can produce 230 V with a maximum current of 10.5 A.
One of the farmers states that they could use the generator to boil a kettle for their tea.

A label on the kettle has the following information:

2800 W
230 V
50 Hz

Use the equation:

power = voltage × current

to explain whether the farmer is correct. [3]

……

……

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……

……

13

Examiner only

6. Students in a school in Pembrokeshire investigate background radiation in their area.

They measure the background radiation in the same place in their classroom.

Each time they measure for 2 minutes.
Some of their results are given in the table.

Counts in 2 minutes						
Trial 1	Trial 2	Trial 3	Trial 4	Trial 5	Trial 6	Mean
82	78	81	79	21	77	……

(a) (i) One result was recorded incorrectly and is anomalous.
Circle the anomalous result in the table.

Explain how you know this result is anomalous. [2]

……

……

……

……

(ii) The rest of the results were recorded correctly.

State why the results vary. [1]

……

……

(iii) **Complete the table** by calculating an appropriate mean for the number of counts in 2 minutes. [2]

Space for working.

(iv) Calculate the mean count rate in the classroom in **counts per second**. [2]

Examiner only

count rate = …… cps

(b) The class compare their mean count rate to the typical mean count rate for background radiation in Wales and they find that their result is higher.

(i) Seren suggests that their value is higher because of a systematic error in the apparatus they used.

Suggest what they could do confirm if their findings are correct. [2]

……

……

……

……

(ii) She states that the measurement is different because some parts of Pembrokeshire have above average levels of radon gas.

Suggest why some parts of Pembrokeshire have above average levels of radon gas. [1]

……

……

(c) (i) Radon, Rn, decays by alpha decay to form Polonium, Po.

Complete the decay equation below for this decay. [2]

$$^{222}_{86}\mathrm{Rn} \longrightarrow \text{\_\_\_\_\_}\,\mathrm{Po} + {}^{4}_{2}\mathrm{He}$$

(ii) Explain why a very high level of radon gas is a health concern. [2]

Examiner only

……

……

……

……

(iii) Radon-220 is another isotope of radon.

State what is meant by the term isotope. [2]

……

……

……

……

16

END OF PAPER

Question number	Additional page, if required. Write the question number(s) in the left-hand margin.
	…… ……

Examiner only

GCSE THE SCIENCES (DOUBLE AWARD)
UNIT 6

Physics – Waves, Electricity and Energy

Foundation Tier

MARK SCHEME

Guidance for examiners

Generic marking principles

- Marks awarded are always whole marks (not half marks, or other fractions).
- Answers should only be judged on the quality of spelling, punctuation and grammar when these features are specifically assessed by the question as indicated by the mark scheme. The meaning, however, should be unambiguous.
- Marks should be awarded using the full range of marks defined in the mark scheme for the question (however; the use of the full mark range may be limited according to the quality of the candidate responses seen).
- Marks awarded are based solely on the requirements as defined in the mark scheme. Marks should not be awarded with grade thresholds or grade descriptors in mind.

Positive marking

It should be remembered that candidates are writing under examination conditions and credit should be given for what the candidate writes, rather than adopting the approach of penalising candidates for any omissions. It should be possible for a very good response to achieve full marks and a very poor one to achieve zero marks. Marks should not be deducted for a less than perfect answer if it satisfies the criteria of the mark scheme.

For questions that are objective or points-based, the mark scheme should be applied precisely. Marks should be awarded as indicated and no further subdivision made.

Mark schemes often list points which may be included in candidates' answers. The list is not exhaustive. The inclusion of *'Credit any other valid response.*' (or similar instruction) within mark schemes allows for the possible variation in candidates' responses. Credit will be given for correct and relevant alternative responses which are not recorded in the mark scheme. Credit should be given according to the accuracy and relevance of candidates' answers.

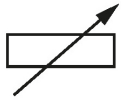
Appropriate terminology is reflected in exemplar responses in mark schemes. However, unless there is a specific requirement within a question, candidates may be awarded marks where the answer is accurate but expressed in their own words.

Marking abbreviations

The following may be used in marking schemes or in the marking of scripts to indicate reasons for the marks awarded.

ecf = error carried forward
bod = benefit of doubt

Question		Marking details	Marks available						
			AO1	AO2	AO3	Total	Maths	Enquiry Skills	Connections Relationships
1.	(a)	**reflects** **transmits** **absorbs**	3			3		3	
	(b)	Ticks alongside statements 2, 5 and 6 The leaf will appear green The screen will appear yellow The screen will reflect red and green light			3	3		3	
	(c)	**A**		1		1			
	(d)	Ticks alongside statements 2 and 3 Total internal reflection occurs when light travels from a more to less dense medium Total internal reflection occurs when the angle of incidence is greater than the critical angle	2			2			
		Question 1 total	**5**	**1**	**3**	**9**	**0**	**6**	**0**

Question			Marking details	Marks available						
				AO1	AO2	AO3	Total	Maths	Enquiry Skills	Connections Relationships
2.	(a)		<table><tr><th>Closed switches</th><th>Lamp A</th><th>Lamp B</th><th>Lamp C</th></tr><tr><td>1 and 2</td><td>✓</td><td>×</td><td>×</td></tr><tr><td>1 and 3</td><td>×</td><td>✓</td><td>×</td></tr><tr><td>2, 3, and 4</td><td>×</td><td>×</td><td>×</td></tr></table> (1) For each correct row		3		3		3	
	(b)		 correct symbol added to the gap	1			1		3	
	(c)		Conversion $2 \times 60 = 120$ [s] (1) Substitution: $\frac{1000}{120}$ (1) = 8.3 [W] (1)	1	1 1		3	3		3
	(d)	(i)	1.2×2 (1) = 2.4 [V] (1)	1	1		2	2		
		(ii)	6 – 2.4 (1) (**ecf**) = 3.6 [V] (1)		2		2	1		
		(iii)	Increases (1) Decreases (1)		2		2			
			Question 2 total	**3**	**10**	**0**	**13**	**6**	**4**	**3**

Question			Marking details	Marks available						
				AO1	AO2	AO3	Total	Maths	Enquiry Skills	Connections Relationships
3.	(a)		Increases (1) A constant (1)		2		2			
	(b)	(i)	35 000 [V]		1		1	1		
		(ii)	7000		1		1	1		
	(c)	(i)	Ticks in boxes 2 and 3 Step-up transformers increase the voltage and decrease the current (1) Step-up transformers reduce the energy loss due to heating (1)	2			2			
		(ii)	Output voltage is lower than input voltage (1) For a step-up transformer, output voltage is higher than input voltage so incorrect (1)			2	2			
			Question 3 total	**2**	**4**	**2**	**8**	**2**	**0**	**0**

Question			Marking details	Marks available						
				AO1	AO2	AO3	Total	Maths	Enquiry Skills	Connections Relationships
4.	(a)	(i)	Work done = 4 × 25 (1) Work done = 100 [J] (1)	1	1		2	2		
		(ii)	Because a friction force acts			1	1			1
		(iii)	Chemical	1			1			1
	(b)	25 – 5 = 20 [N]			1		1			1
Question 4 total				**2**	**2**	**1**	**5**	**2**	**0**	**3**

Question			Marking details	Marks available						
				AO1	AO2	AO3	Total	Maths	Enquiry Skills	Connections Relationships
5.	(a)	(i)	Speed of the rotation		1		1		1	
		(ii)	Strength of the magnet (1) Use the same magnet / same distance between the magnets (1)		2		2		2	
	(b)		Ticks in boxes 3, 5 and 6 When the speed of rotation doubles the output voltage doubles (1) The frequency of the AC voltage in graph **C** is double the frequency of graph **A**. (1) The speed of rotation in **B** was half the speed of rotation in **A**. (1)			3	3		3	
	(c)		Sine wave with the same period (1) With a higher voltage (1)		2		2	2	2	
	(d)		Selection of 400 (1) $\frac{400}{2500} \times 100 = 16[\%]$ (1)		2		2	2		2
	(e)		230×10.5 (1) $= 2415$ [W] (1) Which is less than 2800 [W] so they are incorrect (1)			3	3	3		
Question 5 total				**0**	**7**	**6**	**13**	**7**	**8**	**2**

Question			Marking details	Marks available						
				AO1	AO2	AO3	Total	Maths	Enquiry Skills	Connections Relationships
6.	(a)	(i)	Trial 5, 21, circled (1) It doesn't follow the pattern / is very different to the other values (1)			2	2		2	
		(ii)	Because decay is random	1			1		1	
		(iii)	82 + 78 + 81 + 79 + 77 = 397 (1) $\frac{397}{5}$ = 79.4 (1)		2		2	2	2	
		(iv)	$\frac{79.4 \text{ ecf}}{120}$ = 0.662 [cps] (1)		2		2	2	2	
	(b)	(i)	Repeat with a different detector (1) Take readings over a longer period (1)			2	2		2	
		(ii)	Due to different types of rock / more granite	1			1		1	
	(c)	(i)	218 (1) 84 (1)		2		2			
		(ii)	Radon can be breathed in / enters lungs (1) and the alpha [it emits] is very ionising (1)		2		2			
		(iii)	An atom of the same element with the same number of protons but a different number of neutrons.	2			2			
			Question 6 total	**4**	**8**	**4**	**16**	**4**	**10**	**0**

SUMMARY OF MARKS ALLOCATED TO ASSESSMENT OBJECTIVES

Question	AO1	AO2	AO3	TOTAL MARK	MATHS	Enquiry Skills	Connections Relationships
1	5	1	3	9	0	6	0
2	3	10	0	13	6	4	3
3	2	4	2	8	2	0	0
4	2	2	1	5	2	0	3
5	0	7	6	13	7	8	2
6	4	8	4	16	4	10	0
TOTAL	**16**	**32**	**16**	**64**	**21**	**28**	**8**