Surname	Centre Number	Candidate Number
First name(s)		0

wjec cbac

GCSE

S24-3430U30-1

3430U30-1

MONDAY, 17 JUNE 2024 – MORNING

SCIENCE (Double Award)
Unit 3 – PHYSICS 1
FOUNDATION TIER

1 hour 15 minutes

For Examiner's use only		
Question	**Maximum Mark**	**Mark Awarded**
1.	**7**	
2.	**5**	
3.	**10**	
4.	**6**	
5.	**11**	
6.	**6**	
7.	**15**	
Total	**60**	

3430U301
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 page(s) 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 **6**.

JUN243430U30101

Equations

current = $\frac{\text{voltage}}{\text{resistance}}$	$I = \frac{V}{R}$
total resistance in a series circuit	$R = R_1 + R_2$
energy transferred = power × time	$E = Pt$
power = voltage × current	$P = VI$
% 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) × time (h) cost = units used × cost per unit	
wave speed = wavelength × frequency	$v = \lambda f$
speed = $\frac{\text{distance}}{\text{time}}$	

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}

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Answer **all** questions.

1. The information plate from a hairdryer is shown below.

230 V	50 Hz ac
2300 W	

(a) (i) Use the information in the box to complete the sentences below.

I. Mains electricity has a voltage of ..... [1]

II. The power of the hairdryer is ..... [1]

(ii) Use your answers to (i) and the equation:

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

to calculate the current in the hairdryer. [2]

current = ... A

(b) (i) A vacuum cleaner has a current of 2 A.

Circle the correct value for the fuse that should be used in the vacuum cleaner. [1]

1 A 3 A 13 A

(ii) Tick (✓) the box that correctly states the purpose of a fuse: [1]

Fuses are safety features designed to prevent electric shocks ☐

Fuses are safety features designed to prevent fires ☐

Fuses are safety features designed to prevent explosions ☐

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(iii) Circle the device that has the same purpose as a fuse. [1]

earth wire miniature circuit breaker residual current circuit breaker

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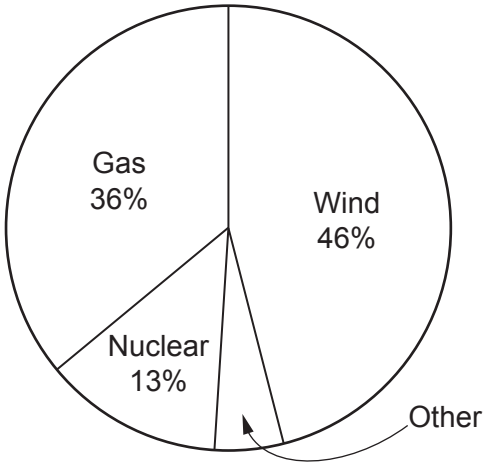
2. On one October day in the UK, most of our electricity was generated from wind, nuclear and gas as shown in the pie chart.



(a) (i) Calculate the total % of the electricity generation that came from wind, nuclear and gas. [1]

total = ... %

(ii) Calculate how much electricity was generated by **other** sources such as biomass, hydroelectric and solar. [1]

electricity from other sources = ... %

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(b) Match the name of the source on the left with a correct statement on the right. [3]

Source	Statement
Wind	Produces radioactive waste
Biomass	Depends on the weather
Nuclear	Uses the energy stored in plants
Gas	Is a fossil fuel

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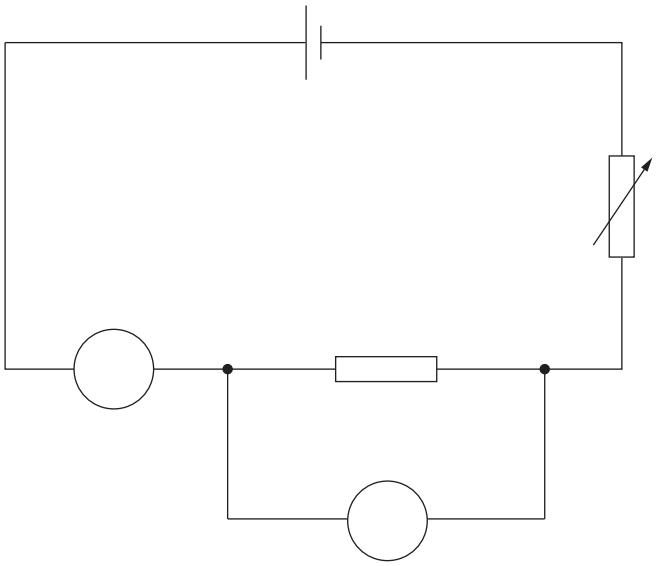
3. Students investigate the I-V characteristic of a resistor.
They set up the following circuit.



(a) **Complete the circuit** by labelling the ammeter and voltmeter with their correct symbols. [1]

(b) The students' results are given in the table below.

Voltage (V)	Current (A)
0	0.00
2	0.04
3	0.06
5	0.10
8	0.16
10	0.20

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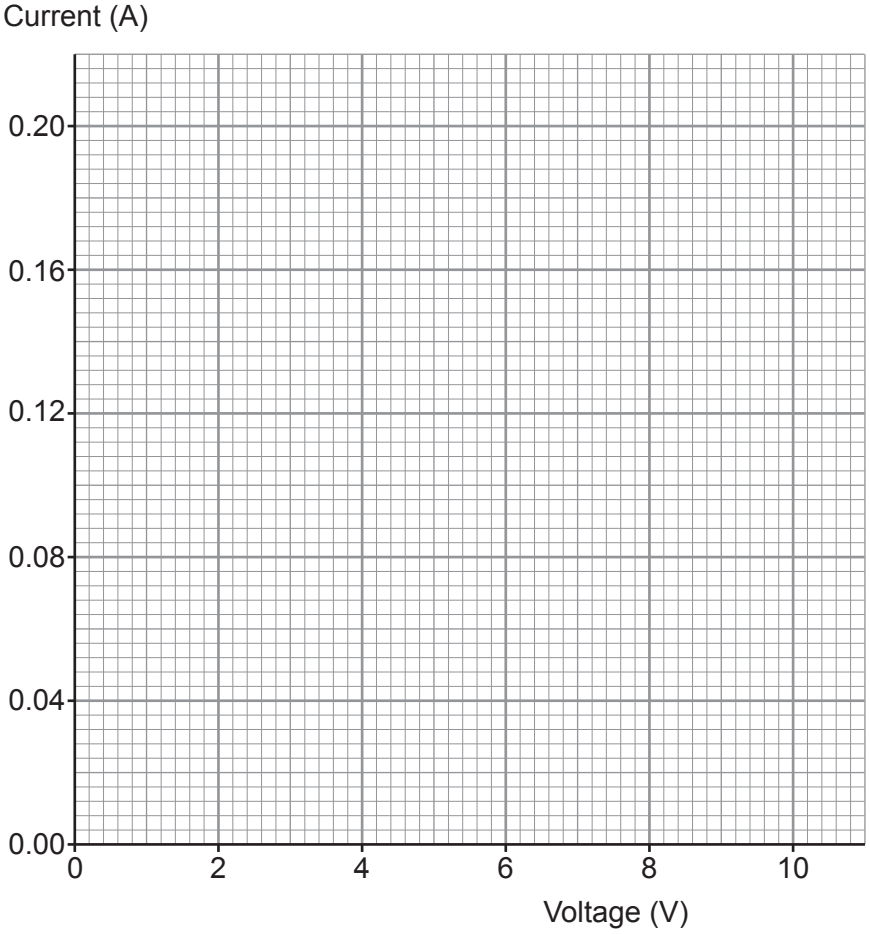
(i) Plot the data on the grid below and draw a suitable line. [3]



(ii) Use the graph to determine the current at 4 V. [1]

current = ... A

(iii) Use the equation:

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

to determine the resistance of the resistor at 4 V. [2]

resistance = ... Ω

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(iv) Sally suggests that the resistance of the resistor is constant.
Use the graph to explain whether you agree. [1]

.....

.....

(v) In the circuit, the resistance of the variable resistor is set at 25 Ω.
Use your answer to part (b)(iii) and an equation from page 2 to calculate the total resistance of the circuit. [2]

total resistance = ... Ω

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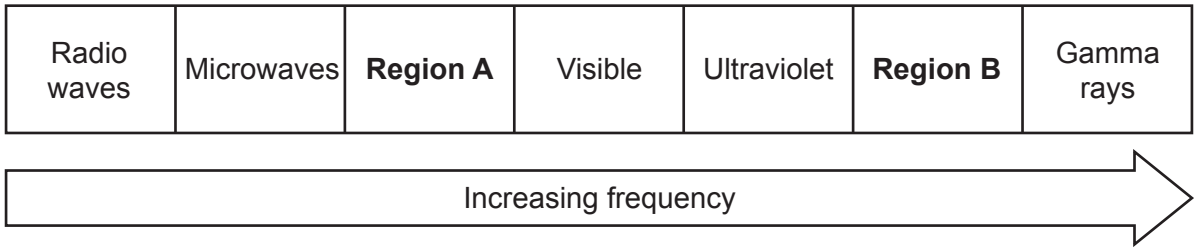
4. The diagram shows some of the regions in the electromagnetic (em) spectrum in order of increasing frequency.



(a) Name region A and region B. [2]

Region A is .....

Region B is .....

(b) Tick (✓) the boxes next to the **3** correct statements below: [3]

em waves all travel at different speeds in a vacuum. ☐

Gamma rays transfer the least energy. ☐

Region A has a longer wavelength than visible light. ☐

em waves are all transverse waves. ☐

Radio waves are a type of ionising radiation. ☐

Microwaves are used to send mobile phone signals. ☐

(c) Some regions of the em spectrum are ionising.
State why ionising radiation is harmful. [1]

.....

6

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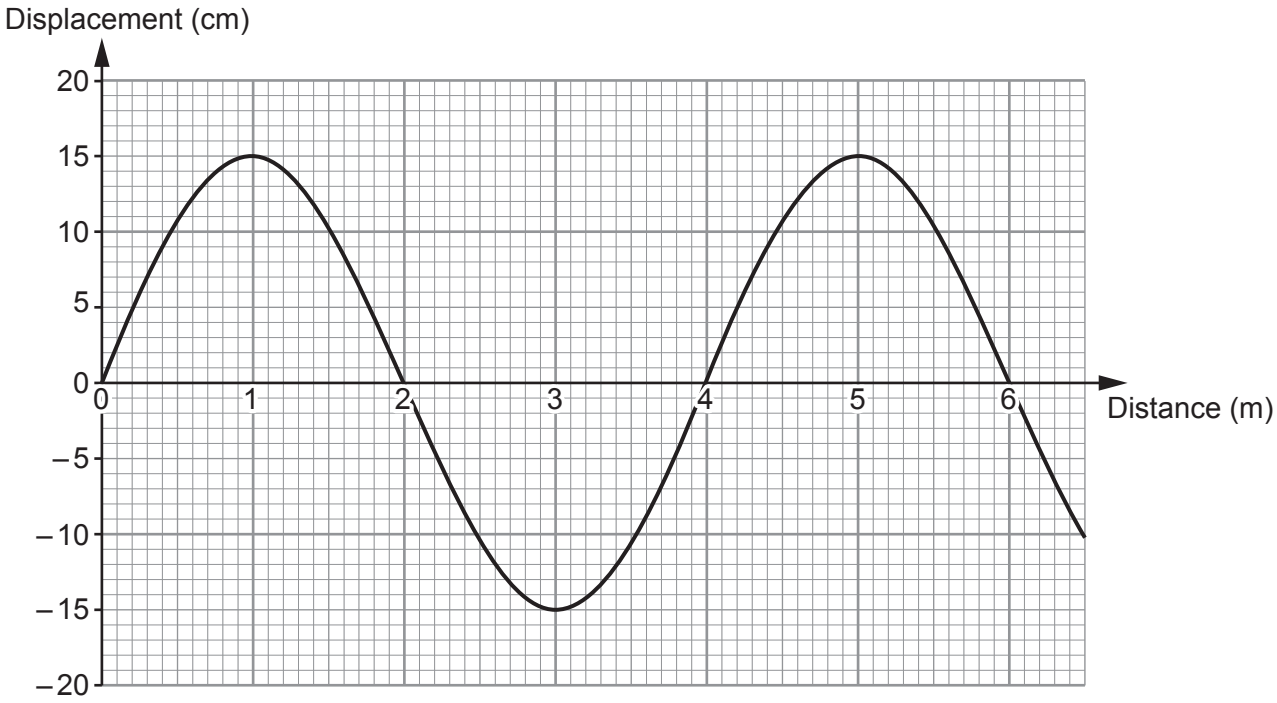
5. (a) The diagram shows a water wave.



(i) State the wavelength of the wave. ..... m [1]

(ii) The wave speed is 6 m/s.
Use the equation:

$$\text{frequency} = \frac{\text{wave speed}}{\text{wavelength}}$$

to determine the frequency of the wave.
Give the correct unit with your answer. [3]

frequency = ...

unit = ...

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(b) Students investigate the speed of water waves.
They measure the time taken for the waves to travel 100 cm in different depths of water.
Their results are shown below:

Depth of water (cm)	Time (s)			Mean time (s)	Mean wave speed (cm/s)
	Trial 1	Trial 2	Trial 3		
0.5	4.57	4.58	4.52	4.56	21.9
1.0	3.22	3.24	2.61	3.02	33.1
1.5	2.61	2.62	2.64	2.62	38.1
2.0	2.29	2.28	2.24	2.27	44.1
2.5	2.01	2.02	1.98	2.00	50.0

(i) State the independent variable in this experiment. [1]

.....

(ii) The students conclude that one of the time values they had recorded is anomalous.
Circle the anomalous result in the table. [1]

(iii) Explain how you know that this result is anomalous. [1]

.....

.....

(iv) Determine a more accurate value for the mean time for the depth in which there is an anomalous result. [2]

mean time = ... s

(v) State a conclusion about the relationship between **depth of water** and **wave speed**. [1]

.....

.....

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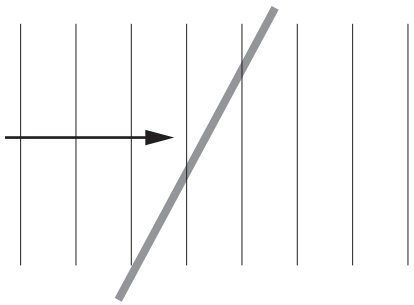
(c) Water waves refract when their speed decreases at a boundary between deep and shallow water.
Tick (✓) the box next to the diagram that correctly shows the refraction of these water waves. [1]

DEEP SHALLOW



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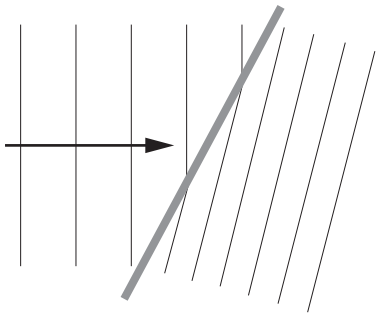

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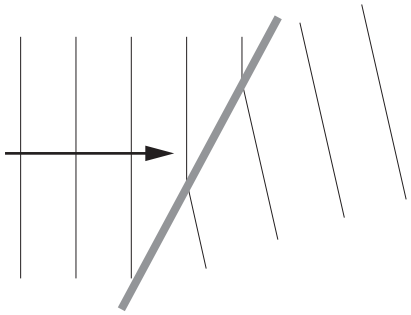

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6. Joanne moves into an old house and has **up to £1500** to spend on improving the insulation. She finds the following information about different types of insulation.

Type of insulation	Cost to buy (£)	Estimated annual savings (£)	Estimated payback time (years)	Estimated annual reduction in CO_2 emissions (kg)
additional loft	425	25	17	55
cavity wall	1200	300	4	670
floor	1500	75	20	180
draught proofing	225	45	5	120

Explain which **two** types of insulation she should fit to her house.
Include in your answer:

- The advantages of insulating the house
- The two types of insulation she should fit
- The reasons why she should choose these two types of insulation. [6 QER]

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7. Volac is a dairy food manufacturing company based in Felinfach in West Wales.
Volac use a combined heat and power biomass power station.
It produces some of the electricity and heat for the factory.
The biomass power station burns wood produced locally.
Data about the biomass power station is given below.

Cost to build the biomass power station = £38 million (£38 000 000) Estimated annual savings on energy bills = £3.75 million (£3 750 000)

(a) (i) Calculate the expected payback time for the biomass power station. [2]

payback time = ... years

(ii) State **one** reason why this payback time may change. [1]

.....

(b) Seren states that burning wood produces CO_2 so it is harmful to the environment.
Explain whether you agree with Seren. [2]

.....

.....

.....

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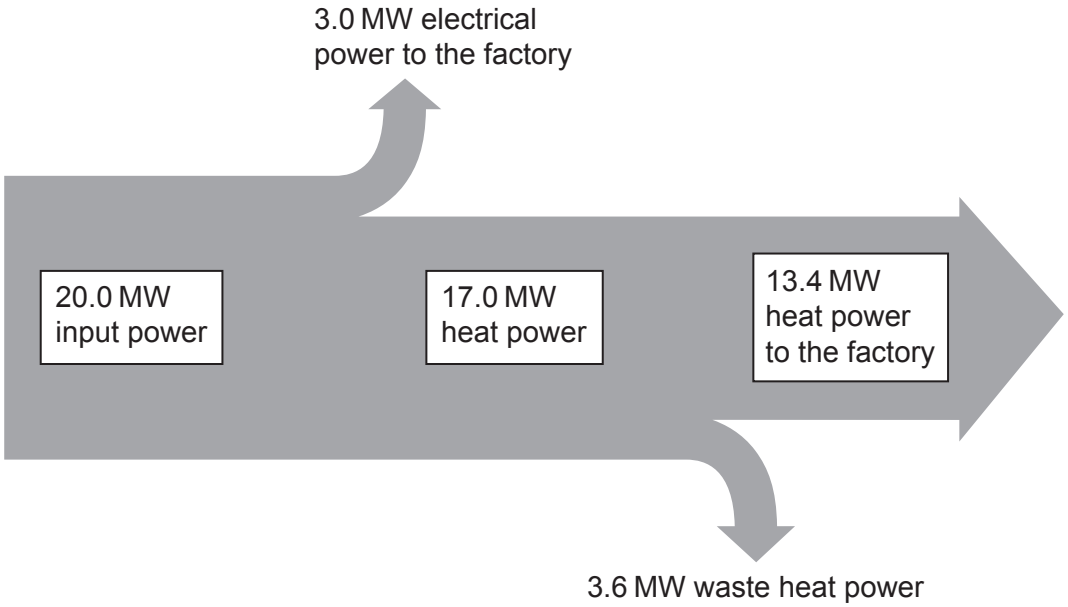
(c) A Sankey diagram for the biomass power station is shown below.



(i) Calculate the **total** useful output power from the biomass power station. [1]

useful output power ..... MW

(ii) Evan states that the biomass power station is only 15% efficient.
Explain whether you agree. Include a calculation. [2]

.....

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(d) (i) The input power to the biomass power station is 20.0 MW.
Use an equation from page 2 to calculate how much energy is transferred by burning wood in the power station every 60 minutes.
Give your answer in MJ. [3]

energy transferred every 60 minutes = ... MJ

(ii) Burning 1 tonne of the wood used in the biomass power station produces 2880 MJ of energy.
Calculate how many tonnes of wood the biomass power station burns every 60 minutes. [1]

mass of wood burned every 60 minutes = ... tonnes

(iii) The wood used in the biomass power station has a density of 500 kg/m^3.
Use the equation:

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

to determine the volume of wood burned every 60 minutes.
1 tonne = 1000 kg. [2]

volume of wood burned every 60 minutes = ... m^3

(iv) An average tree produces 5 m^3 of wood.
Calculate how many trees are burned every 60 minutes. [1]

number of trees burned every 60 minutes = ...

END OF PAPER

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

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