Surname	Centre Number	Candidate Number
First name(s)		0

GCSE

3430U30-1

S23-3430U30-1

MONDAY, 19 JUNE 2023 – AFTERNOON

SCIENCE (Double Award)
Unit 3 – PHYSICS 1

FOUNDATION TIER

1 hour 15 minutes

For Examiner's use only		
Question	**Maximum Mark**	**Mark Awarded**
1.	**6**	
2.	**13**	
3.	**6**	
4.	**10**	
5.	**10**	
6.	**9**	
7.	**6**	
Total	**60**	

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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 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 **5(a)**.

CB*(Y21-3430U30-1)

Equations

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

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 diagram shows the 7 regions of the electromagnetic (em) spectrum in order.

$$\longrightarrow$$

gamma rays	**A**	**B**	visible light	infra-red	microwaves	radio waves

(a) Use **only** the words given in the box below to answer the following questions.

cosmic rays	X-rays	ultrasound	water	ultraviolet

(i) Name the region **labelled A.** .... [1]

(ii) Name the region **labelled B.** .... [1]

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(b) (i) Complete the following sentence by underlining the correct word in the bracket. [1]

The arrow shown on the electromagnetic spectrum above represents

increasing (**amplitude** / **wavelength** / **frequency**).

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(ii) Waves in the electromagnetic spectrum all travel at the same speed in a vacuum.

Tick (✓) the **three** correct statements that describe other properties of em waves. [3]

- [ ] All transverse.
- [ ] All ionising.
- [ ] All transfer energy.
- [ ] All longitudinal.
- [ ] All travel through space.
- [ ] All given out by radioactive materials.

6

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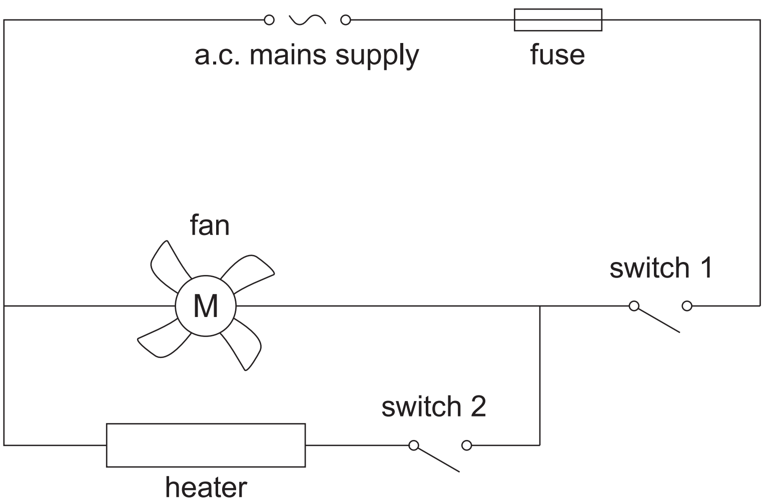
2. The circuit diagram below shows a design for a hairdryer that can blow either cold air or hot air.

The switches in the diagram are in the open position.



(a) Complete the following sentences by underlining the correct phrase in the brackets. [2]

When switch 1 is closed and switch 2 is open the hairdryer blows cold air because

(**only the fan is on** / **only the heater is on** / **the heater and fan are both on**).

The hairdryer blows hot air when the heater and fan are both on. This happens when

(**both switches are open** / **only switch 2 is closed** / **both switches are closed**).

(b) The hairdryer is used to blow hot air.

The current supplied is **6 A** and the mains voltage is 230 V.

(i) Use the equation:

power = voltage × current

to calculate the power of the hairdryer. [2]

power = ... W

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 (3430U30-1) **Turn over.**

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(ii) The following fuses are available.

Tick (✓) **the box** to show the correct fuse that should be used for the hairdryer. [1]

☐ ☐ ☐ ☐

(iii) Complete the following sentence by <u>underlining</u> the correct phrase in the brackets. [2]

Fuses switch off circuits if the
(current is too high / voltage is too high / power is too low)
to prevent **(electric shocks / wires overheating / power cuts)**.

(c) A **different hairdryer** is now used. The power of this hairdryer is **1.5 kW**.

(i) Use the equation:

units used (kWh) = power (kW) × time (h)

to calculate the units used (kWh) by this hairdryer in **2 hours**. [2]

units used = ... kWh

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(ii) The cost per unit of electrical energy is 30 p.
Use your answer to part (c)(i) and the equation:

cost = units used × cost per unit

to calculate the cost of using this hairdryer for 2 hours. [2]

cost = ... p

(iii) State the cost of using this hairdryer for **double** the time. [1]

cost = ... p

(iv) Tick (✓) **the box** that correctly shows the power of the 1.5 kW hairdryer in watts (W). [1]

☐ 1 500 000 W

☐ 1 500 W

☐ 1.5 W

☐ 0.015 W

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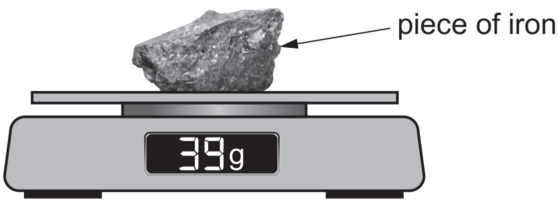
13

3. Peter carries out an experiment to find the density of iron.

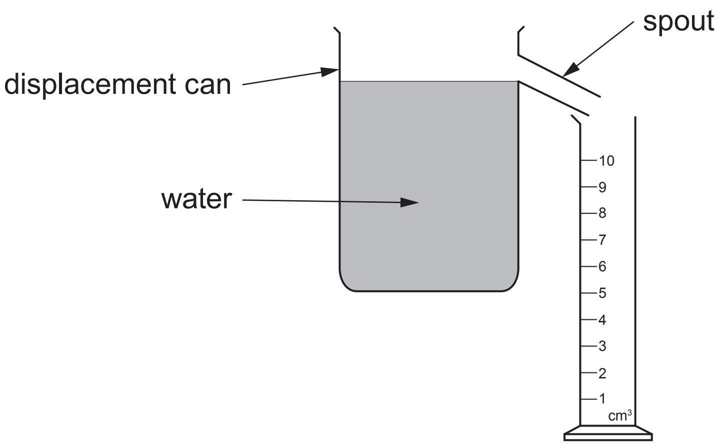
Stage 1

- He uses a balance to measure the mass of a piece of iron.



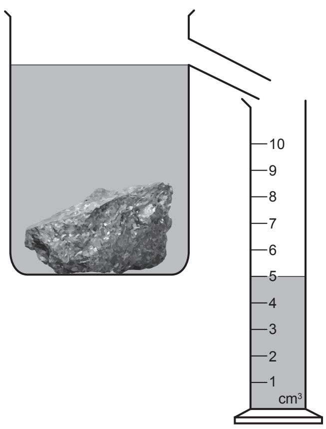
Stage 2

- He fills a displacement can with water.
- He waits until water stops flowing from the spout.
- He then places an empty measuring cylinder under the spout.



Stage 3

- He carefully lowers the iron into the water.
- He collects the water displaced in the measuring cylinder.



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Use information from the diagrams to answer the following questions.

(i) State the mass of the iron. mass = ... g [1]

(ii) State the volume of the iron. volume = ... cm^3 [1]

(iii) I. Use the equation:

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

to calculate the density of iron. [2]

density = ...

II. Underline the correct unit that should be used for the density above. [1]

g/cm^3 **g/cm^2** **cm^2/g** **cm^3/g**

(iv) State **one** change to the apparatus that would improve the accuracy of the measurement of the **mass** of the iron. [1]

....

6

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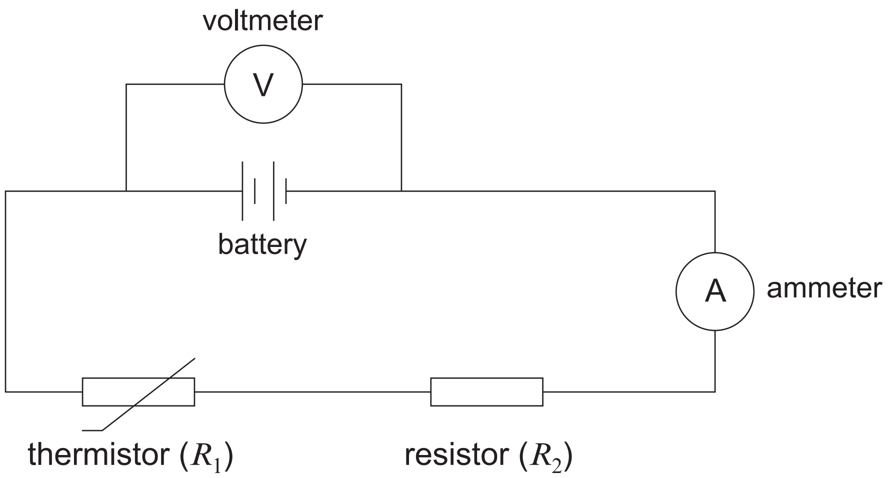
4. Students set up the temperature sensing circuit shown below.



(a) At a temperature of 20 °C the resistance of the thermistor (R_1) is 300 Ω.

The resistor (R_2) has a fixed resistance of 50 Ω.

(i) Use the equation:

$$R = R_1 + R_2$$

to calculate the total resistance (R) of the circuit at 20 °C. [1]

total resistance = ... Ω

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(ii) A photograph of the voltmeter used in the circuit is shown below.

State the voltage shown on the voltmeter. [1]

voltage = ... V

(iii) Use an equation from page 2 and your answers from parts (i) and (ii) to calculate the current in the circuit. [2]

current = ... A

(iv) State the ammeter reading. [1]

ammeter reading = ... A

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(b) Complete the following sentences by underlining the correct phrase or word. [3]

As the (**temperature** / **power** / **voltage**) of the thermistor is increased to 50 °C its resistance decreases. The total resistance in the circuit (**increases** / **stays the same** / **decreases**) and the circuit current (**increases** / **stays the same** / **decreases**).

(c) (i) State how the original circuit could be changed to become a light sensing circuit. [1]

....

(ii) Give a reason for your answer. [1]

....

10

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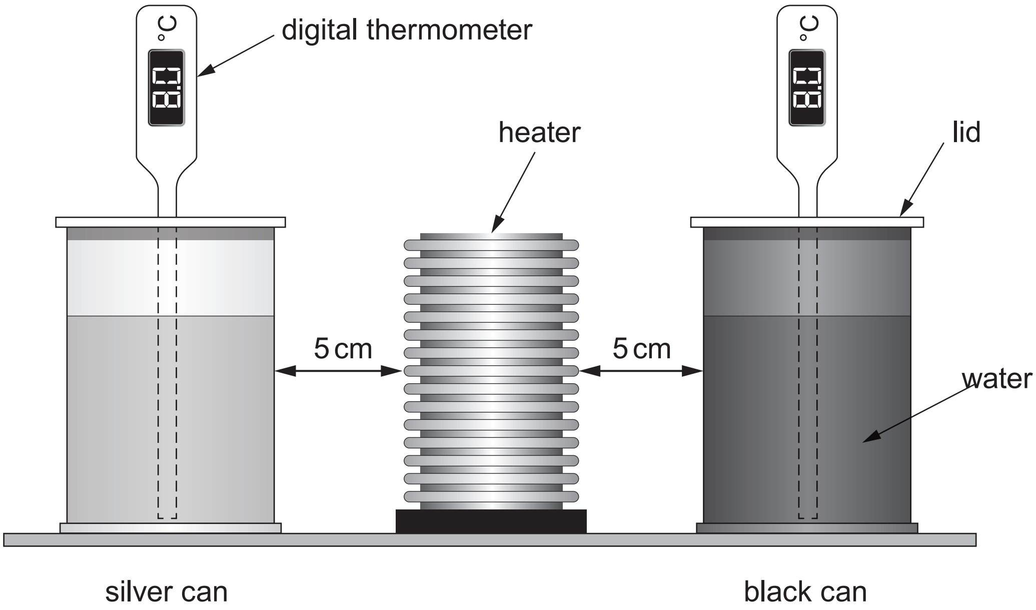
5. A pupil sets up an experiment to investigate the absorption of heat radiation.

The diagram shows the apparatus set up **before** the heater was turned on for 8 minutes.

Two identical aluminium cans were both filled with 200 cm^3 of water and a digital thermometer was inserted through a small hole in the lid.

One can was painted black and the other painted silver.



(a) In the experiment several variables were controlled in order to make a valid conclusion.

Use the information above to describe how this was achieved.

In your answer include
- **three** variables that were controlled
- an explanation of why each was controlled. [6 QER]

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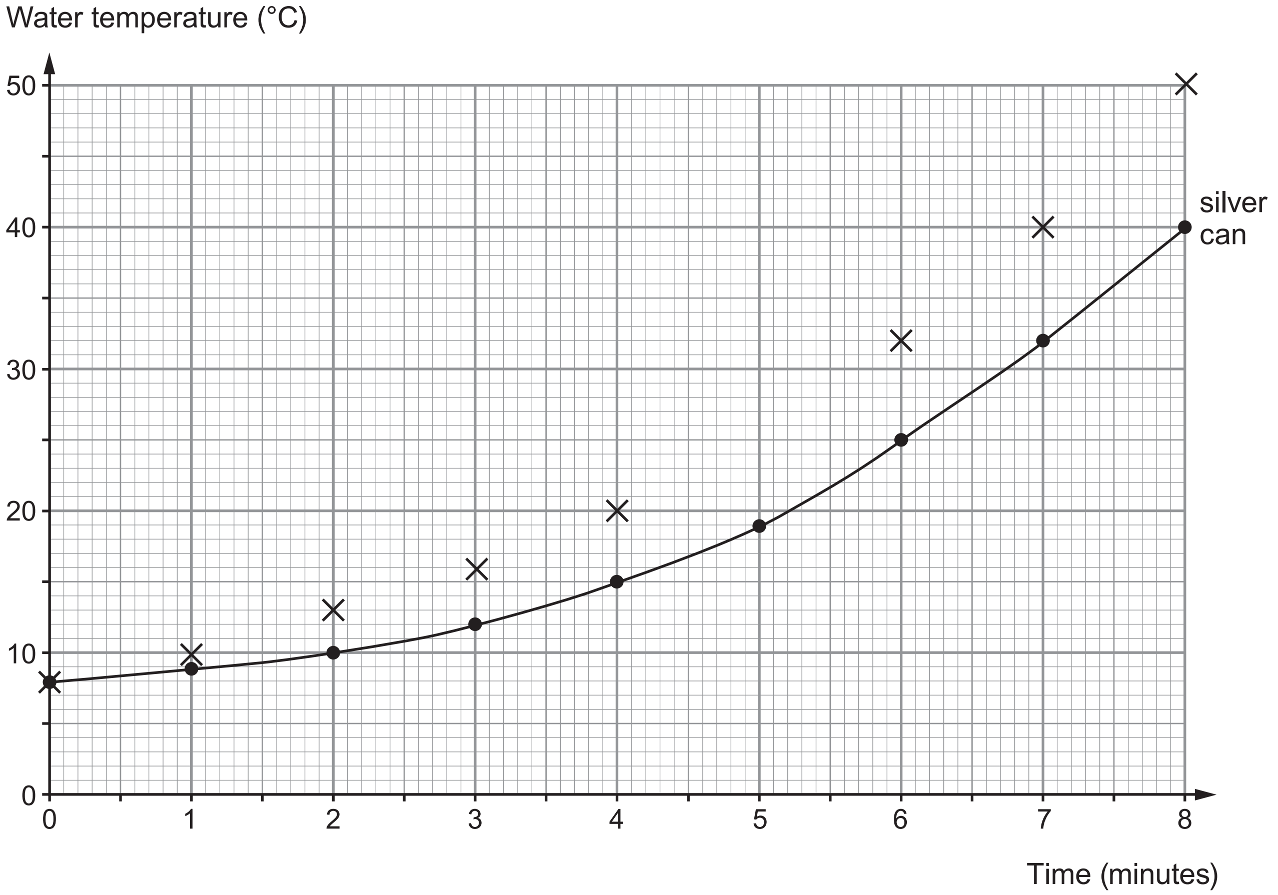
(b) Each minute, the temperature of the water in each can was measured.

The data, for the silver can, have been plotted on the grid below and its best fit curve drawn.

Apart from one result, the data points for the black can were also plotted on the grid.



(i) At **5 minutes** the water temperature in the black can was **25 °C**.

Plot this missing data point on the grid above **and** add the line of best fit. [2]

(ii) Compare the temperature rise in the black can with the temperature rise in the silver can.

Explain your answer in terms of heat radiation. [2]

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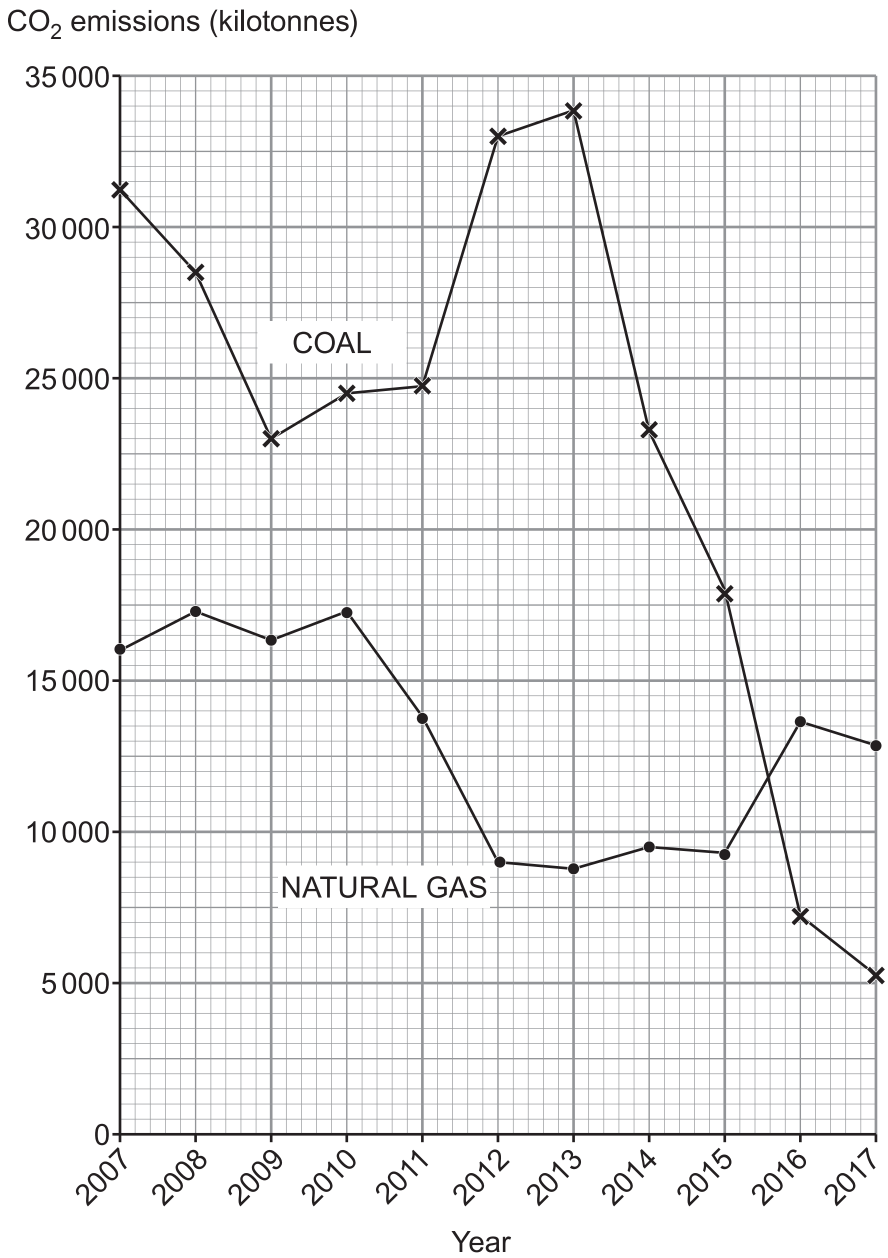
10

6. The UK government wants to reduce the CO_2 emissions from power stations.

The graphs below show the CO_2 emissions from coal and natural gas power stations between the years 2007 and 2017.



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(a) Look at the data for **2012**. Calculate the difference in the emissions of CO_2 from coal and natural gas. [2]

difference = ... kilotonnes of CO_2

(b) Between the years 2014 and 2015, the emission of CO_2 from coal fell by 5500 kilotonnes.

State between which other years the emission of CO_2 from coal fell **at the same rate**.[1]

Years .... and ....

(c) State **two** benefits of reducing CO_2 in the atmosphere. [2]

1. ....

2. ....

(d) (i) Nuclear power stations provide up to 20% of the present UK demand for electricity.

Gas provides up to 50%.

One student, Seren, says that a graph for the CO_2 emissions from nuclear power stations would be the same shape as for gas but always lower.

Explain whether you agree with Seren. [2]

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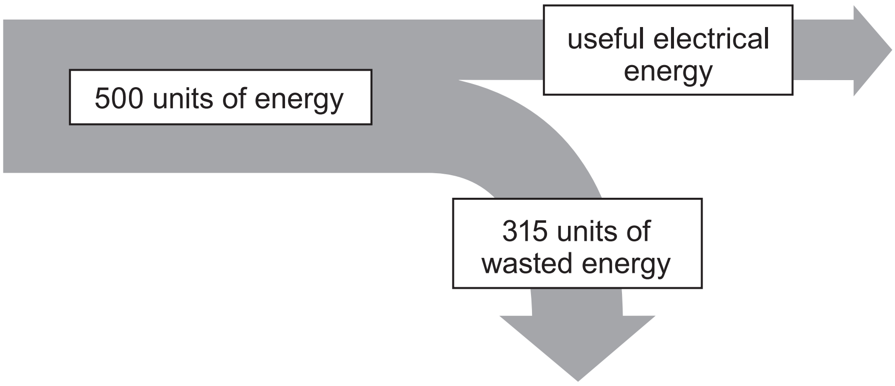
Examiner only

(ii) The Sankey diagram shows the energy input and output for a power station.



Seren looks at the diagram and calculates that the power station is 63% efficient.

Explain whether you agree with Seren. [2]

Space for calculation.

....

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9

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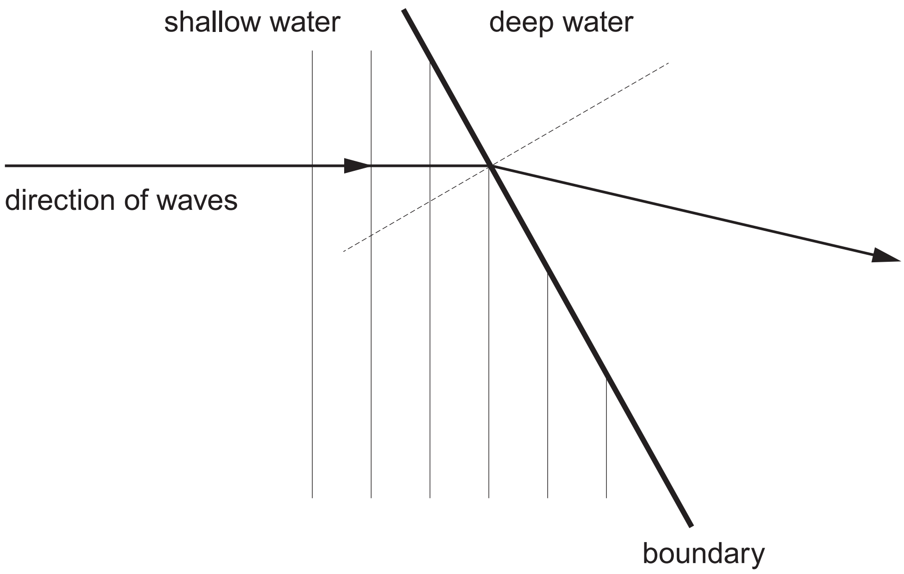
7. Students study refraction of waves in a ripple tank.

They set up the tank to show waves going from shallow water into deeper water.

The diagram shows a number of wavefronts approaching a boundary between shallow and deep water.

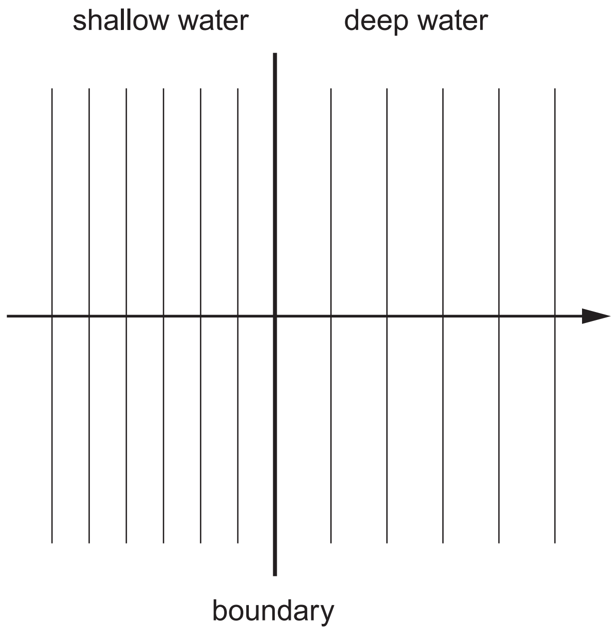
The first four wavefronts have reached the boundary.



(a) **Complete the diagram** to show the wavefronts in the deep water. [3]

Examiner only

(b) In a separate experiment, the wavefronts pass over the boundary in the way shown below.



Sam says that the speed of the waves is greater in deep water than shallow water.

Explain whether you agree with his statement. [3]

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....

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END OF PAPER

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

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