Surname	Centre Number	Candidate Number
Other Names		0

GCSE – NEW

3420U10-1

S18-3420U10-1

PHYSICS – Unit 1:
Electricity, Energy and Waves

FOUNDATION TIER

FRIDAY, 15 JUNE 2018 – MORNING

1 hour 45 minutes

For Examiner's use only		
Question	**Maximum Mark**	**Mark Awarded**
1.	**9**	
2.	**9**	
3.	**13**	
4.	**7**	
5.	**7**	
6.	**10**	
7.	**12**	
8.	**13**	
Total	**80**	

3420U101 01

ADDITIONAL MATERIALS

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

INSTRUCTIONS TO CANDIDATES

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

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.

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 **3*(a)***.

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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 = $\dfrac{\text{energy [or power] usefully transferred}}{\text{total energy [or power] supplied}}$ × 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 = $\dfrac{\text{distance}}{\text{time}}$	
pressure = $\dfrac{\text{force}}{\text{area}}$	$p = \dfrac{F}{A}$
change in thermal energy = mass × specific heat capacity × change in temperature	$\Delta Q = mc\Delta\theta$
thermal energy for a change of state = mass × specific latent heat	$Q = mL$
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	$\dfrac{V_1}{V_2} = \dfrac{N_1}{N_2}$

SI multipliers

Prefix	Multiplier
m	1×10^{-3}
k	1×10^{3}
M	1×10^{6}

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Answer **all** *questions.*

1. *(a)* The diagram below shows **part** of the electromagnetic (em) spectrum.

Microwaves	Infra-red	Visible light	Ultraviolet

Use **only** the regions of the em spectrum **shown in the diagram** to answer the following questions.

(i) Name the region of the em spectrum with the longest wavelength. [1]

....

(ii) Name the region of the em spectrum with the lowest frequency. [1]

....

(b) Name **one** region of the em spectrum not shown in the diagram in part *(a)*. [1]

....

3420U101 03

(c) Waves can either be described as transverse or longitudinal. Sound waves are an example of longitudinal waves whereas visible light waves are transverse.
Tick (✓) the **two** correct statements below. [2]

Ultraviolet waves are longitudinal waves	☐
Longitudinal waves cannot be reflected	☐
Microwaves are transverse waves	☐
In a longitudinal wave the vibration of the particles is parallel to the direction of the wave	☐
Sound waves travel slowly in a vacuum	☐

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(d) The table below gives information about the frequency and wavelength of sound waves in different materials.

Material	Frequency (Hz)	Wavelength (m)
air	170	2
water	170	9
iron	170	29

Use the information in the table to answer the questions below.

(i) Use the equation:

wave speed = frequency × wavelength

to calculate the speed of sound waves in air. [2]

Wave speed = ... m/s

(ii) The sound wave travels from air into water. Its frequency stays the same. Without further calculation explain whether its speed increases, decreases or stays the same. [2]

....

....

....

9

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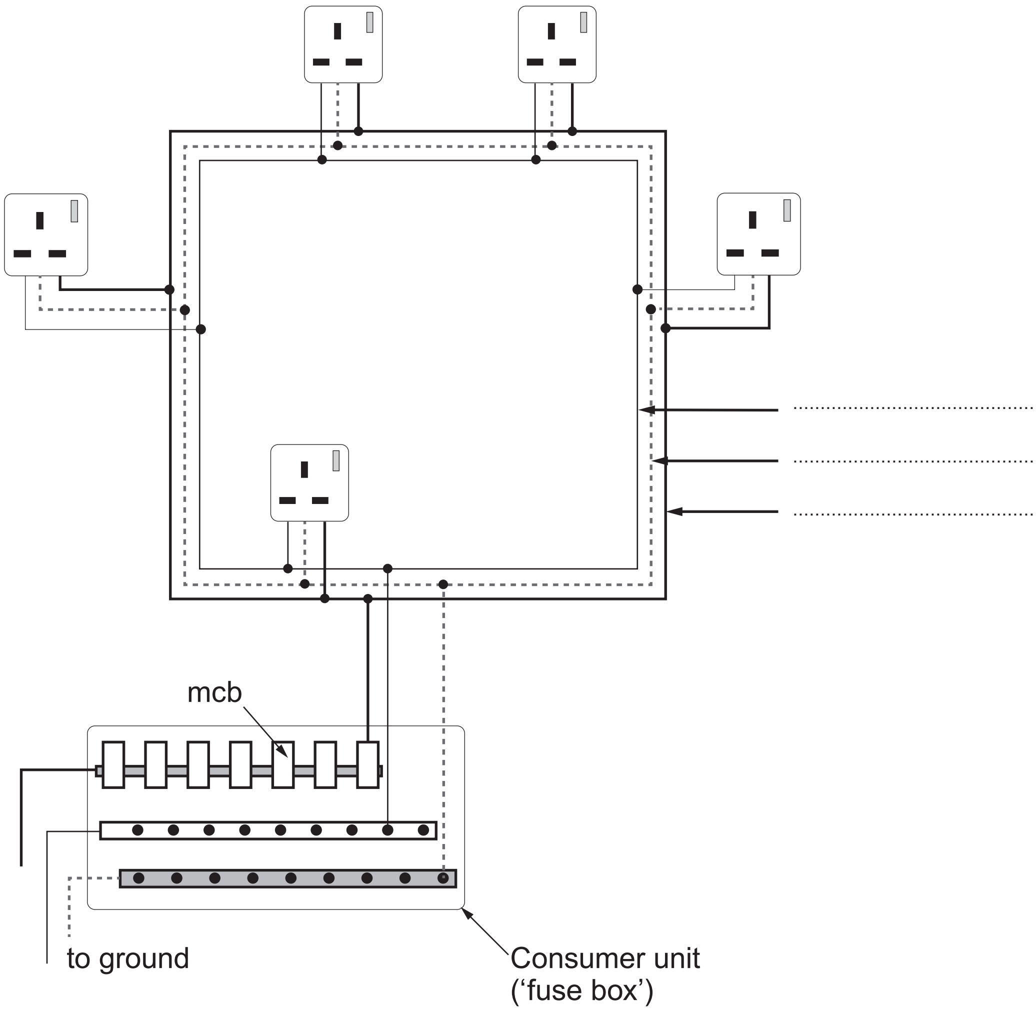
2. The diagram below shows a ring main circuit for a house.



(a) (i) **Label** the earth, neutral and live wires on the diagram above. [2]

(ii) Underline a word in each bracket to correctly complete the sentences below. [3]

The ring main is a looped **(double / parallel / series)** circuit. The cables in the ring main can be made **(thinner / thicker / longer)** because there are 2 paths for the **(voltage / current / power)**.

3420U101
05

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(b) A 1.2 kW kettle is plugged into the ring main. It is used for 0.5 hours in a day.
Use equations from page 2 to answer the following questions.

(i) Calculate the number of units (kWh) the kettle uses each day. [2]

Units used = ... kWh

(ii) Calculate the cost of using the kettle each day if electricity costs 15 p per unit. [2]

Cost = ... p

9

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3. Rhys and Elliot have a small piece of an unknown metal. The metal has an **irregular shape**. To identify the metal they find its density and compare the value to known values of the density of common metals.

(a) Describe a method they could use to find the density of the metal. [6 QER]

3420U101
07

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(b) The table below gives data on the density of some common metals.

Metal	Density (g/cm^3)
aluminium	2.70
copper	8.96
gold	19.32
iron	7.87
tin	7.26

(i) Rhys and Elliot calculate the density of their metal to be 8.1 g/cm^3.
State which metal the irregular shape is most likely to be. Give a reason for your answer. [2]

....

....

(ii) Rhys and Elliot are not confident that they can correctly identify the metal. Suggest why they think this. [1]

....

....

(iii) The table below shows their results.

Mass (g)	Volume (cm^3)	Density (g/cm^3)
65	8	8.1

Suggest how Rhys and Elliot could get a more accurate value for the density. [1]

....

....

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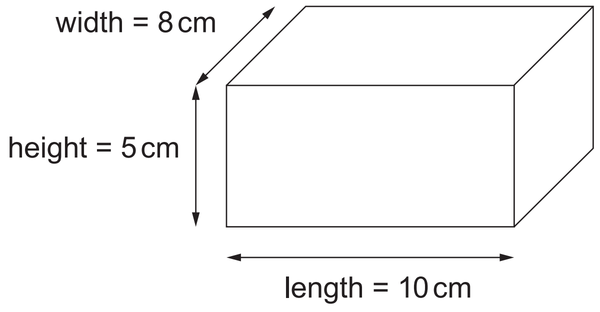
(c) The boys notice that gold has a high density of 19.32 g/cm^3 and they are interested in the mass of a gold block.



(i) Use the equation:

$$\text{volume} = \text{length} \times \text{height} \times \text{width}$$

to calculate the volume of the gold block shown above. [1]

3420U101 09

Volume = ... cm^3

(ii) Use the equation:

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

to calculate the mass of the gold block. [2]

Mass = ... g

13

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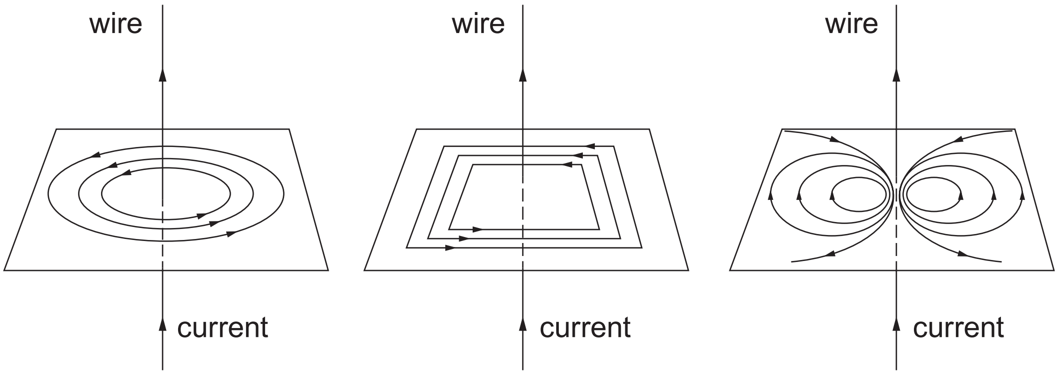
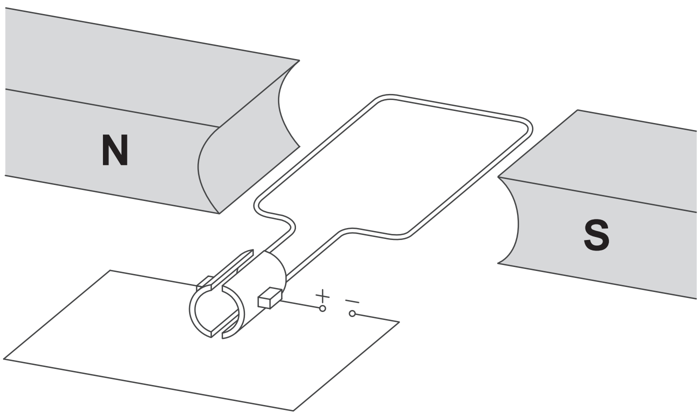
4. *(a)* Tick (✓) the box below the diagram which correctly shows the magnetic field pattern around a current-carrying straight wire. [1]



☐ ☐ ☐

(b) The diagram below shows a simple electric motor. When there is a current in the coil it experiences a force due to the magnetic field and starts to spin.



(i) State **one** way in which the coil could be made to spin in the opposite direction. [1]

....

(ii) State **two** ways in which the coil could be made to spin faster. [2]

1. ....

2. ....

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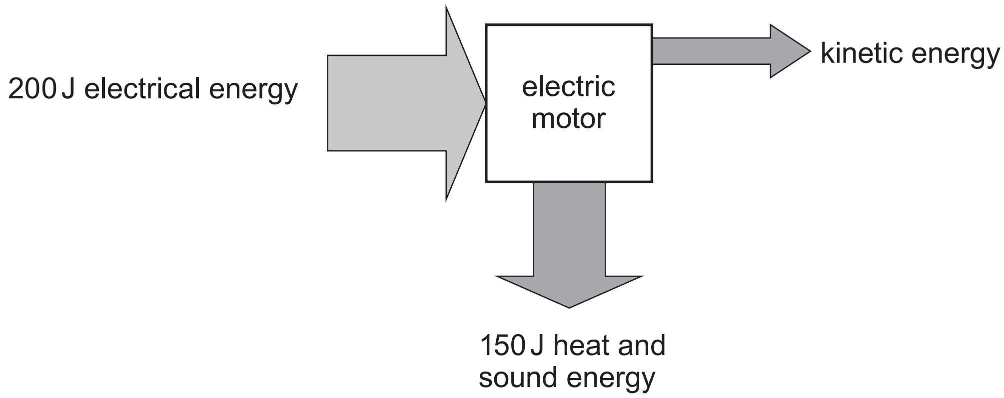
(c) A simple electric motor transfers energy as shown in the Sankey diagram below.



(i) Calculate how much useful energy the motor produces. [1]

Useful energy = ... J

(ii) Use an equation from page 2 to calculate the % efficiency of the motor. [2]

% efficiency = ...

7

3420U101 11

Turn over.

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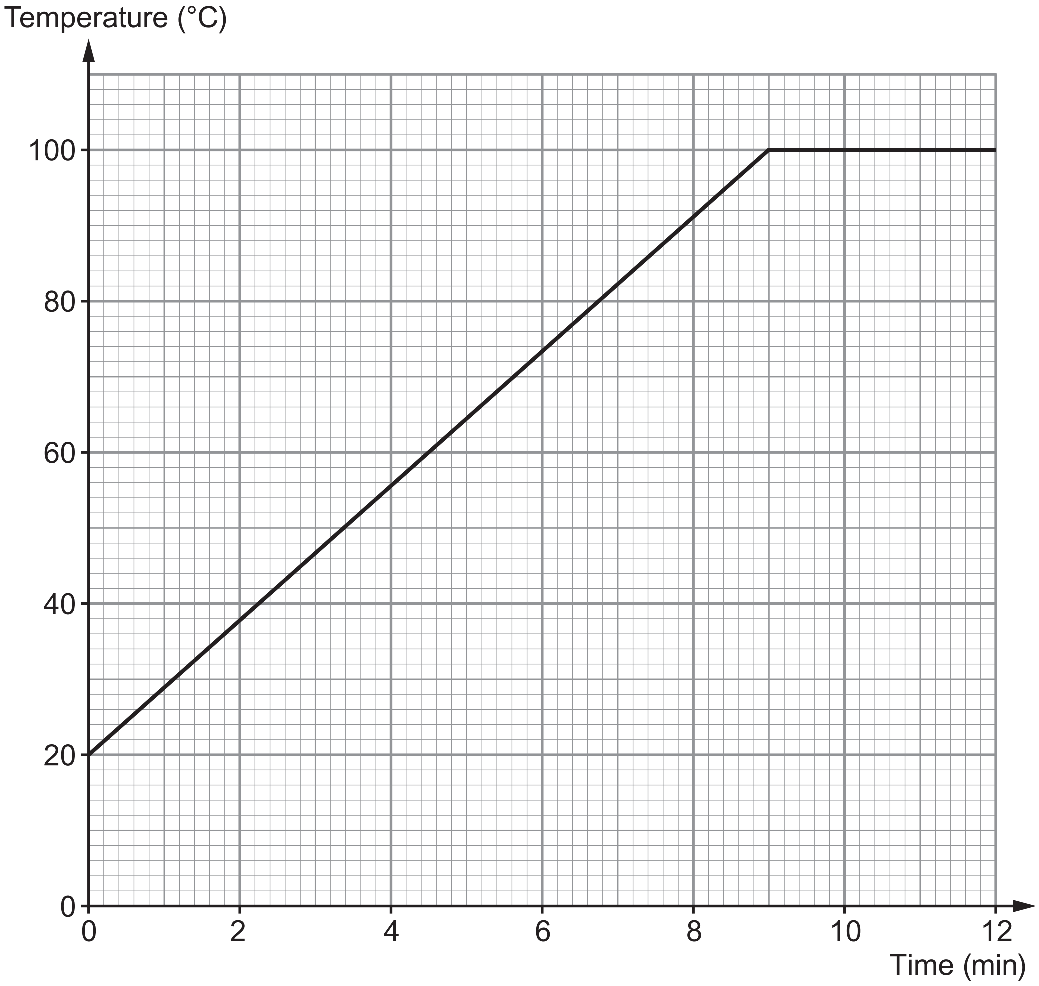
5. The graph below shows how the temperature of 0.2 kg of water changes as it is heated from 20 °C.



(a) Describe the relationship between temperature and time in the first 9 minutes. [2]

....

....

(b) (i) Write down the temperature of the water at 9 minutes. [1]

Temperature = ... °C

(ii) Calculate the change in temperature in the first 9 minutes. [1]

Change in temperature = ... °C

Examiner only

(iii) The specific heat capacity of water is 4 200 J/kg °C.
Use the equation:

$$\text{thermal energy} = \text{mass} \times \text{specific heat capacity} \times \text{change in temperature}$$

to calculate how much thermal energy is supplied to the 0.2 kg water in the first 9 minutes. [2]

Thermal energy supplied = ... J

(c) Between 9 and 12 minutes the water is boiling and its temperature stays constant even though heat energy is still being supplied. State what is happening to the water during this time. [1]

....

7

3420U101
13

Examiner only

6. Electricity in the UK is generated in a variety of ways. Most of our electricity is produced by burning fossil fuels, mainly gas and coal. When deciding which type of power station to build, it is important to consider the environmental problems they cause.

(a) Tick (✓) the **two** correct statements below. [2]

Burning fossil fuels adds to climate change ☐

Nuclear power stations emit lots of carbon dioxide when used ☐

Tidal barrages damage marine habitats ☐

Waste from gas power stations is radioactive ☐

Wind power causes acid rain ☐

(b) The table below shows the gases released when the same mass of different fossil fuels are burned.

Fossil fuel	Emissions of polluting gas (units)		
	Carbon dioxide	Carbon monoxide	Sulfur dioxide
coal	208 000	208	2 591
oil	164 000	33	208
gas	11 700	40	1

Explain why coal has the greatest effect on global warming. [2]

....

....

....

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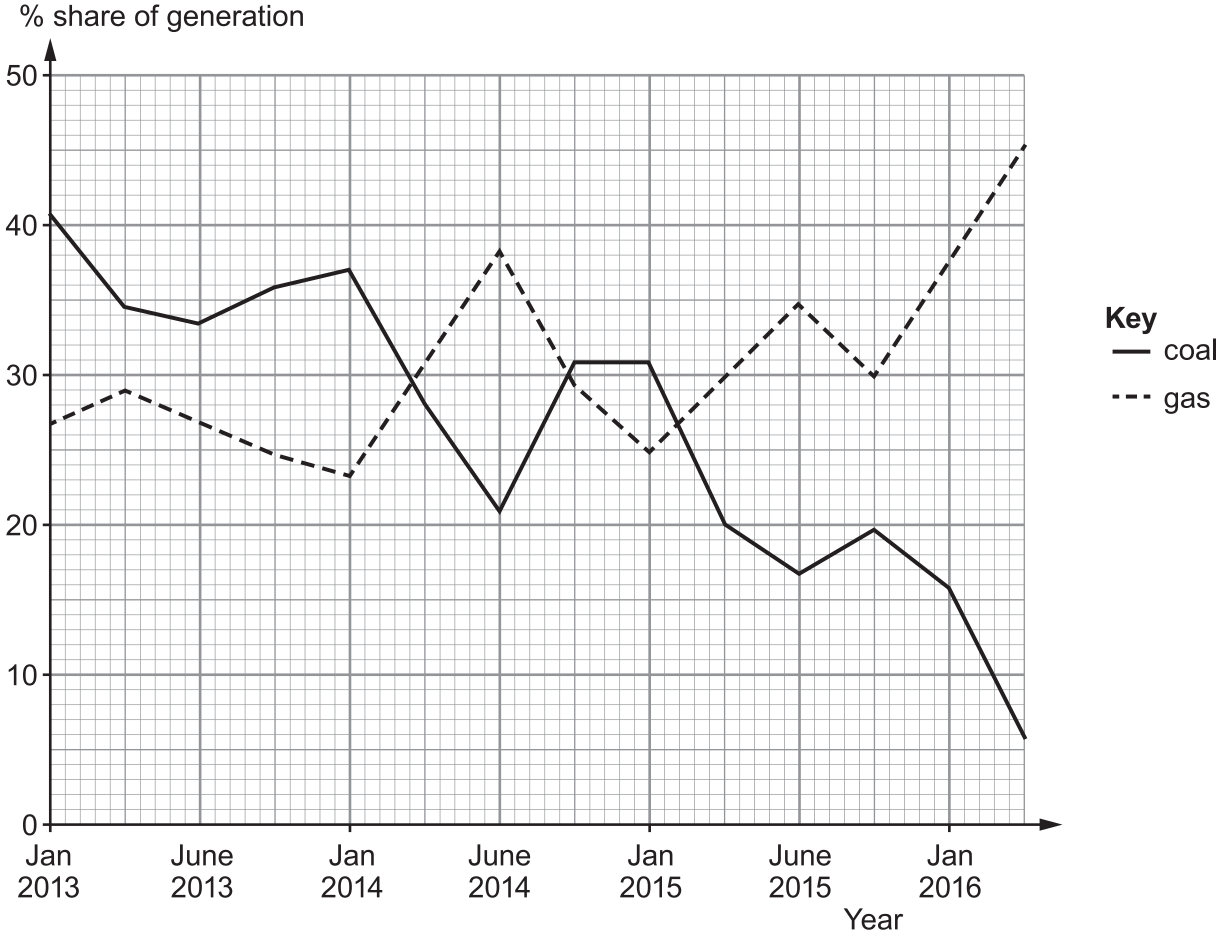
(c) Coal and gas are both used in power stations to generate electricity. The diagram below shows how the percentage share of electricity generation from coal and gas has changed since 2013.



Use the graph to compare how the percentages of electricity generated from coal and gas changed during the time shown. [2]

....

....

....

Examiner only

(d) The UK is trying to increase the percentage of electricity generated by renewable sources such as wind.

Between April 2015 and April 2016 many new wind farms and other renewable power stations were built.
The table below shows the percentage of electricity generated by renewable sources in April 2015 and in April 2016.

Date	% of electricity produced by renewable sources	% of electricity produced by non-renewable sources
April 2015	25.4	74.6
April 2016	24.9	75.1

(i) Use the data in the table to compare the percentage of electricity produced by renewable sources in April 2015 and April 2016. [1]

....

(ii) Is your answer to *(d)*(i) what you expected? Give a reason for your answer. [1]

....

....

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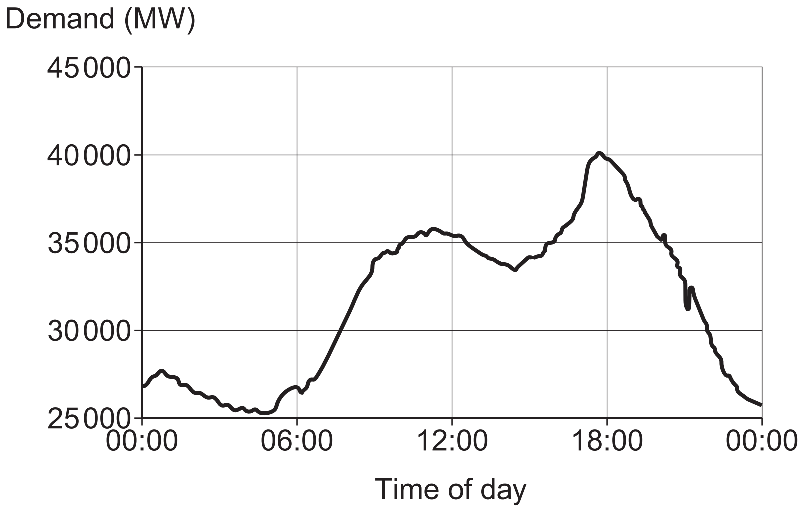
(e) As well as generating electricity the UK also imports electricity from France. The diagram shows how demand for electricity varies throughout one day for the UK.



(i) Give a reason why electricity is imported into the UK. [1]

....

(ii) At what time of day is electricity most likely to be imported into the UK from France? [1]

....

10

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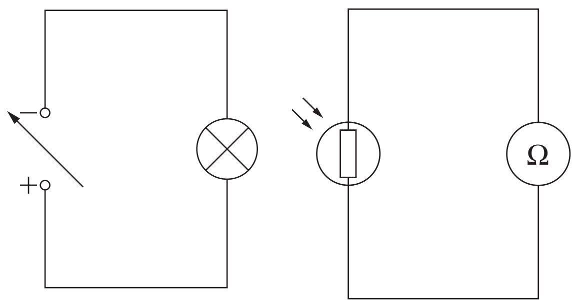
7. The following circuits are set up to investigate a light dependent resistor (LDR). The voltage of the power supply is changed to vary the power of the lamp to alter its brightness. The resistance of the LDR is measured with an ohmmeter (Ω) for each power of the lamp.



(a) (i) State **two** variables, **other than using the same components**, that should be controlled in this experiment. [2]

1. ....

2. ....

(ii) Explain how the design of the experiment could be improved to make the results more valid. [2]

....

....

....

(b) The results are shown in the table below.

Power of lamp (W)	Resistance of LDR (kΩ)
2	19.5
4	10.3
8	3.0
12	2.2
16	1.5
20	1.3
24	1.1

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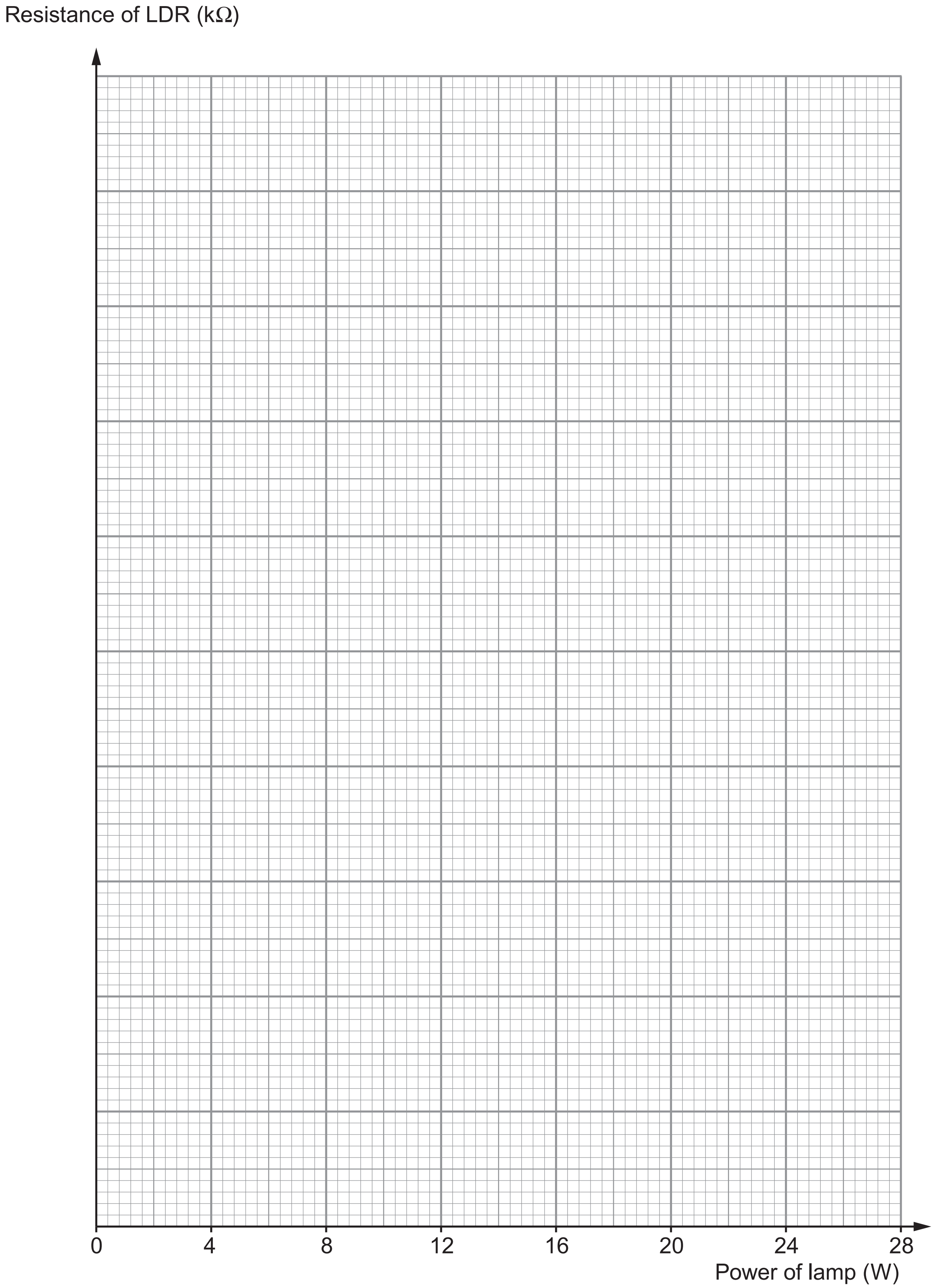
(i) Use the data to plot a graph on the grid below and draw a suitable line. [4]



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(ii) Use the graph to find the resistance of the LDR for a lamp power of 10 W. [1]

Resistance = ... Ω

(iii) It is suggested that when the lamp power doubles, the LDR resistance halves. Explain, using values from the table, to what extent this suggestion is true. [3]

....

....

....

12

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8. The ***epicentre*** is the point on the Earth's surface directly above an earthquake. Seismic stations detect earthquakes by the tracings made on seismographs.

(a) Surface, P and S waves are three types of earthquake waves.
Tick (✓) the boxes next to the **three** correct statements about earthquake waves. [3]

Surface waves travel the fastest	☐
S waves travel on the surface of the Earth	☐
S waves are transverse waves	☐
P waves travel through solids and liquids	☐
P waves are longitudinal waves	☐
S waves cause the most damage	☐

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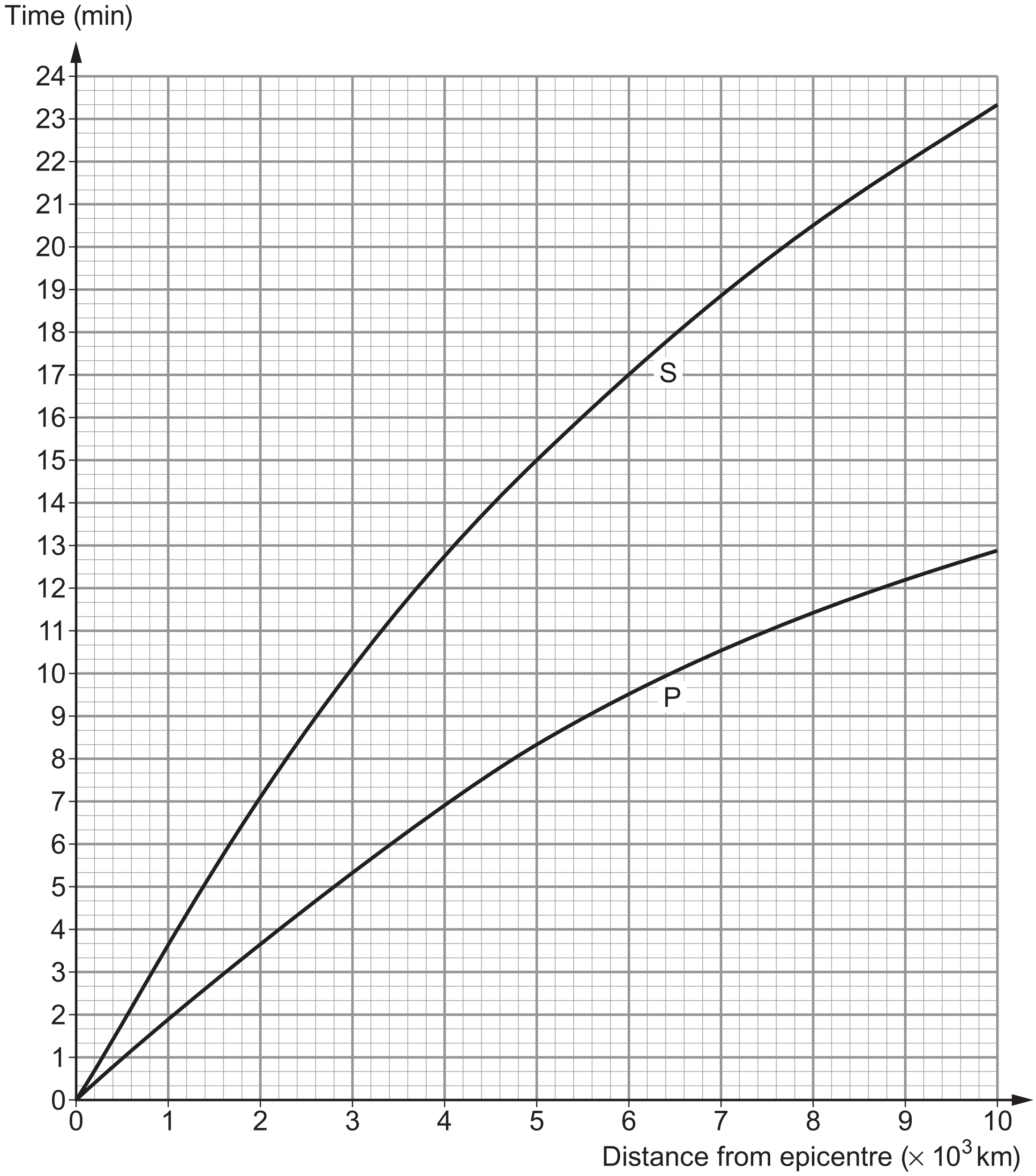
(b) The graph shows the time taken by P and S waves to travel different distances from the epicentre.



Each small square on the time axis represents 20 s.

(i) Use the graph to answer the following questions.

I. State the time it takes for a P wave to travel 5×10^3 km from the epicentre. [1]

time = ... min .... s

II. State the **extra** time it takes S waves to travel 5×10^3 km from the epicentre. [1]

time = ... min .... s

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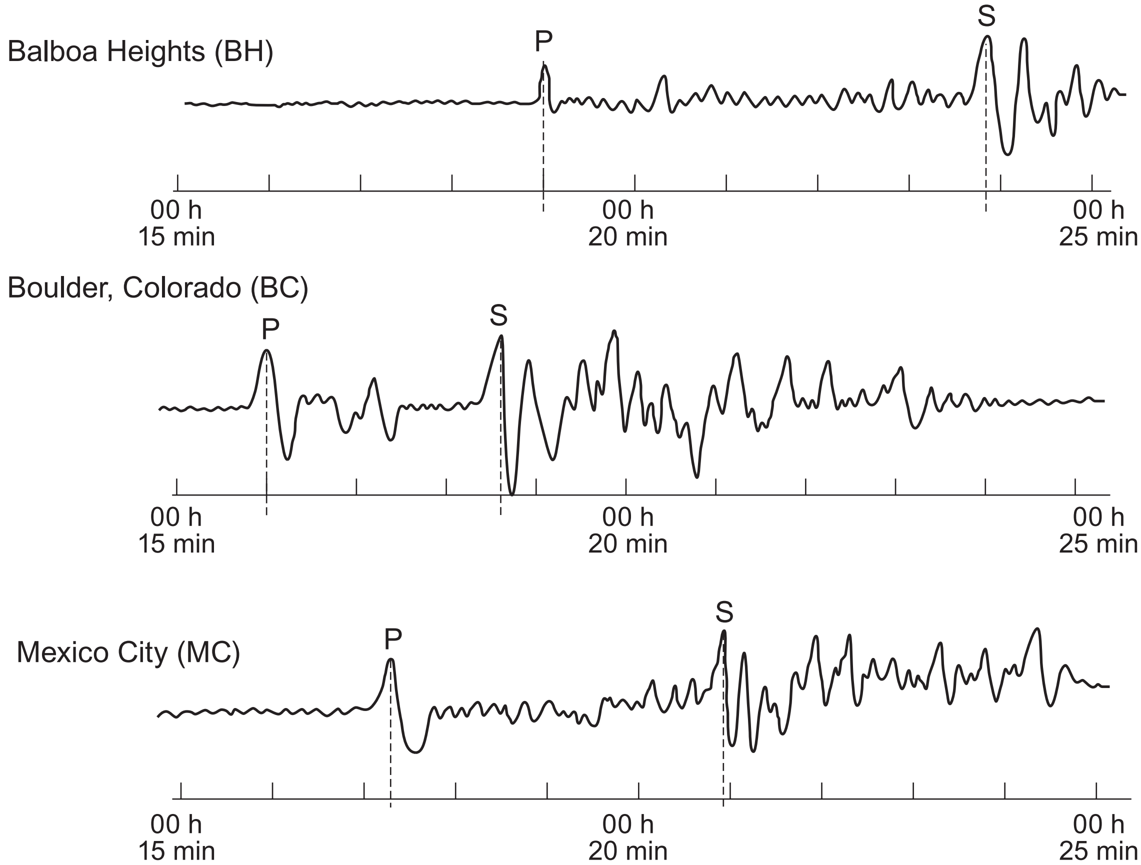
(ii) Study the three seismograph tracings below. Tracings made at three separate seismic stations are needed to locate an earthquake epicentre. P shows the arrival of P waves and S shows the arrival of S waves.



Use the information in the graph and tracings to **complete the table**. [3]

City	Arrival time of P waves (h:min:s)	Arrival time of S waves (h:min:s)	Time difference for P and S waves (h:min:s)	Distance to epicentre ($\times 10^3$ km)
Balboa Heights (BH)	00:19:00	00:23:50	00:04:50	3.2
Boulder, Colorado (BC)	.... : .... :	00:18:40	.... : .... :	....
Mexico City (MC)	00:17:15	00:20:55	00:03:40	2.2

TURN OVER FOR THE REST OF THE QUESTION

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(iii) The P waves arriving at Balboa Heights (BH) took 6 **minutes** to travel from the epicentre. Use an equation from page 2 to calculate the speed of the P waves arriving at Balboa Heights in **km/s**. [Note that 3.2×10^3 km = 3 200 km] [2]

Speed = ... km/s

(iv) The data is used to locate the epicentre of the earthquake. **Indicate with crosses (X) on the diagram opposite two** possible positions for the location of the earthquake. [1]

(v) Use the data for Boulder Colorado (BC) to show clearly **on the diagram opposite** the actual location of the epicentre. Justify how you have arrived at your answer. [2]

....

....

....

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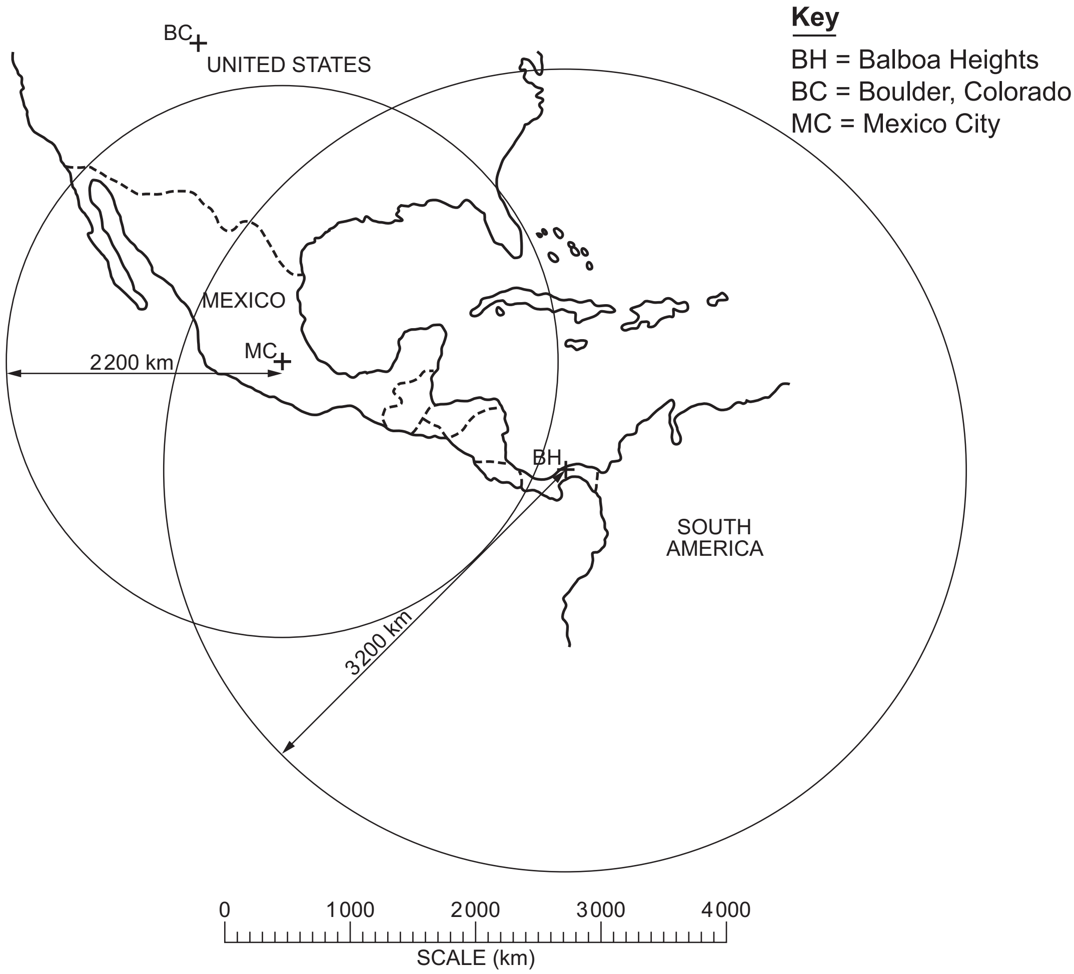

13

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