Candidate Name	Centre Number					Candidate Number				
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GCSE

PHYSICS

UNIT 1: ELECTRICITY, ENERGY and WAVES

FOUNDATION TIER

SAMPLE ASSESSMENT MATERIALS

(1 hour 45 minutes)

For Examiner's use only		
Question	**Maximum Mark**	**Mark Awarded**
1.	**14**	
2.	**7**	
3.	**17**	
4.	**6**	
5.	**9**	
6.	**7**	
7.	**14**	
8.	**6**	
Total	**80**	

ADDITIONAL MATERIALS
In addition to this paper you will require a calculator.

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.

INFORMATION FOR CANDIDATES
The number of marks is given in brackets at the end of each question or part-question.
Question **5(a)** is a quality of extended response (QER) question where your writing skills will be assessed.

Equations

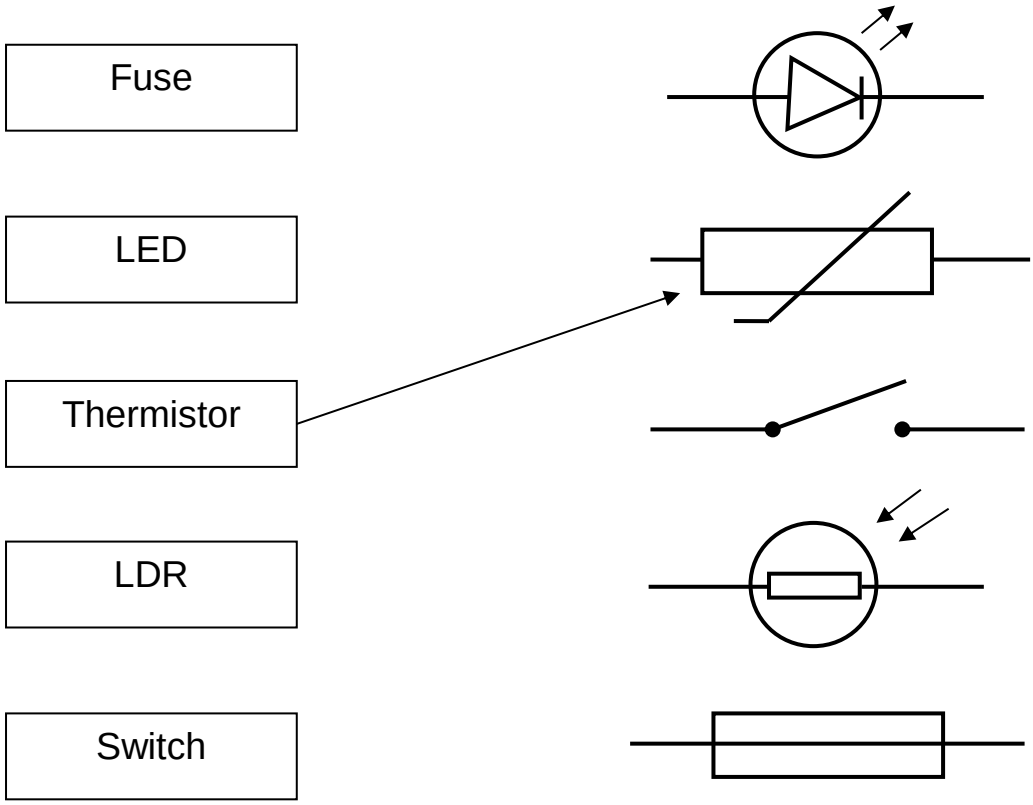
current = $\frac{\text{voltage}}{\text{resistance}}$	$I = \frac{V}{R}$
total resistance in a series circuit	$R = R_1 + R_2$
energy transferred = power × time	$E = Pt$
power = voltage × current	$P = VI$
% efficiency = $\frac{\text{energy [or power] usefully transferred}}{\text{total energy [or power] supplied}} \times 100$	
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 = $\frac{\text{distance}}{\text{time}}$	
pressure = $\frac{\text{force}}{\text{area}}$	$p = \frac{F}{A}$
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	$\frac{V_1}{V_2} = \frac{N_1}{N_2}$

SI multipliers

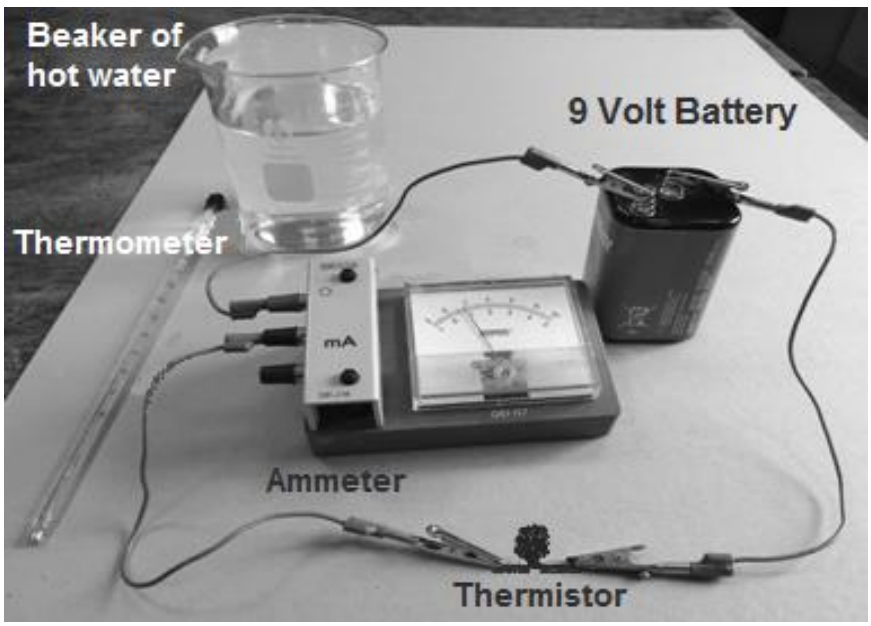
Prefix	Multiplier
m	1×10^{-3}
k	1×10^{3}
M	1×10^{6}

Answer **all** *questions*

1. (a) The boxes on the left show the names of some electrical components. The circuit symbols are shown on the right. They are not in order.
Draw a line from each box on the left to the correct circuit symbol.
One has been completed. [3]

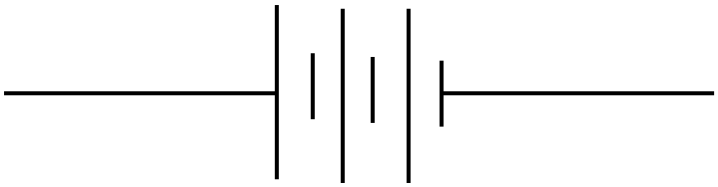


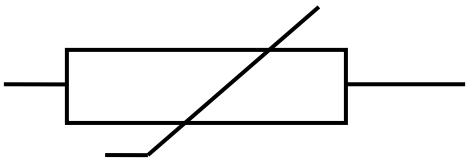
(b) Rhys correctly uses the circuit shown below to investigate the behaviour of a thermistor. He takes a photo of the circuit on his phone. He places the thermistor into a beaker of hot water to start the experiment.



(i) Complete the circuit diagram of the circuit used. [2]

9 V battery

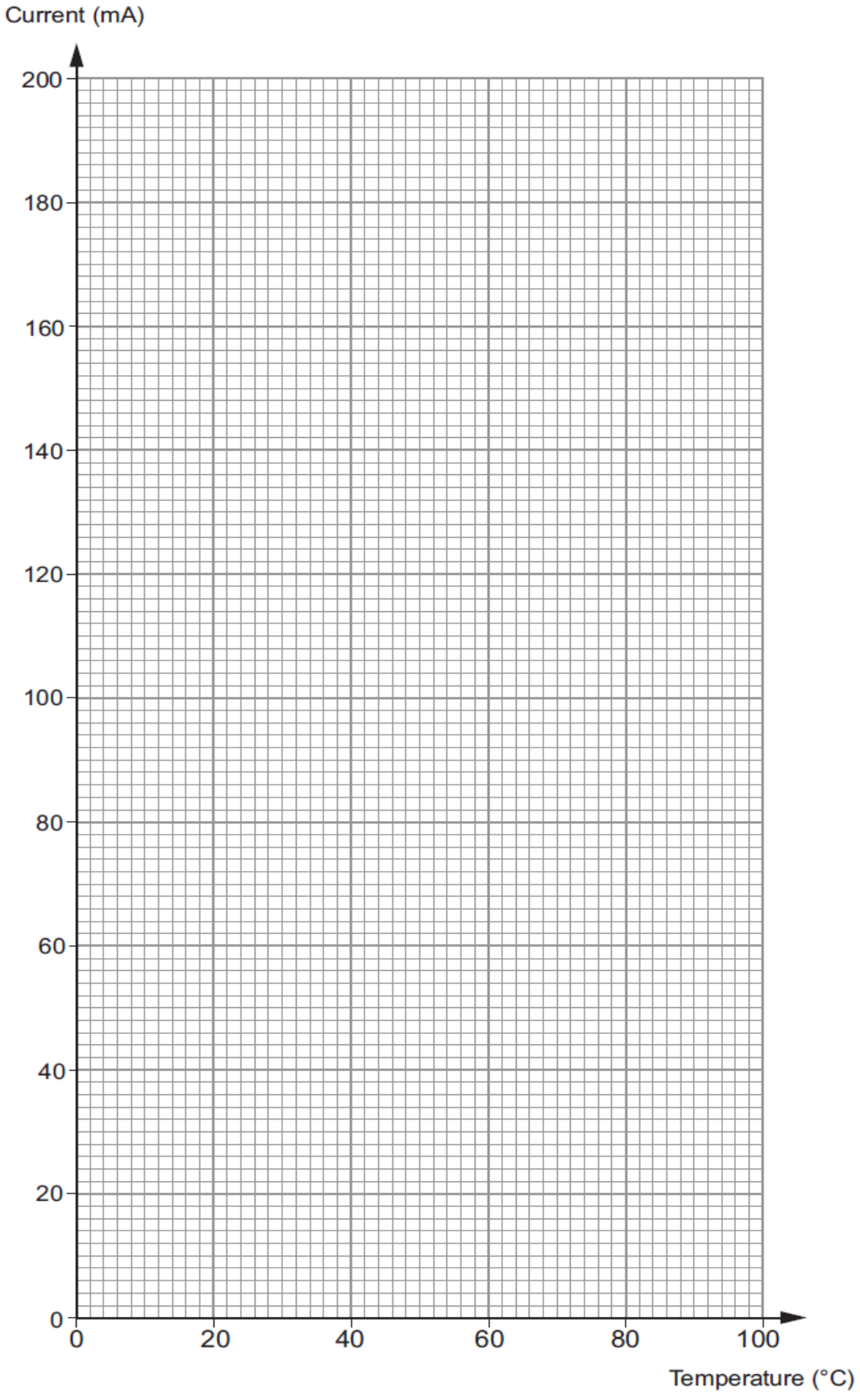




As the hot water cools the reading on the ammeter is recorded in the table below.

Temperature (^{o}C)	**Current (mA)**
100	200
80	140
60	100
40	70
20	50

(ii) Plot a graph of the data on the grid below. [3]



(iii) Describe the relationship between the temperature of the thermistor and the current. [2]

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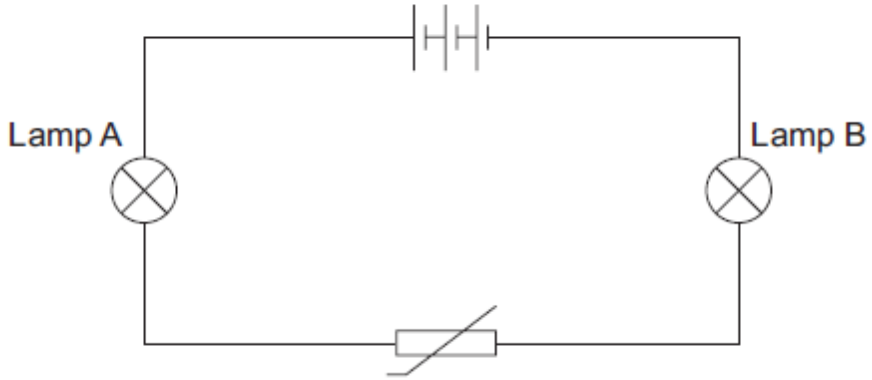
(c) Rhys sets up the following circuit.



(i) Explain how this circuit can be used to indicate changes in temperature. [2]

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(ii) Lamp B breaks. Explain what happens to lamp A. [2]

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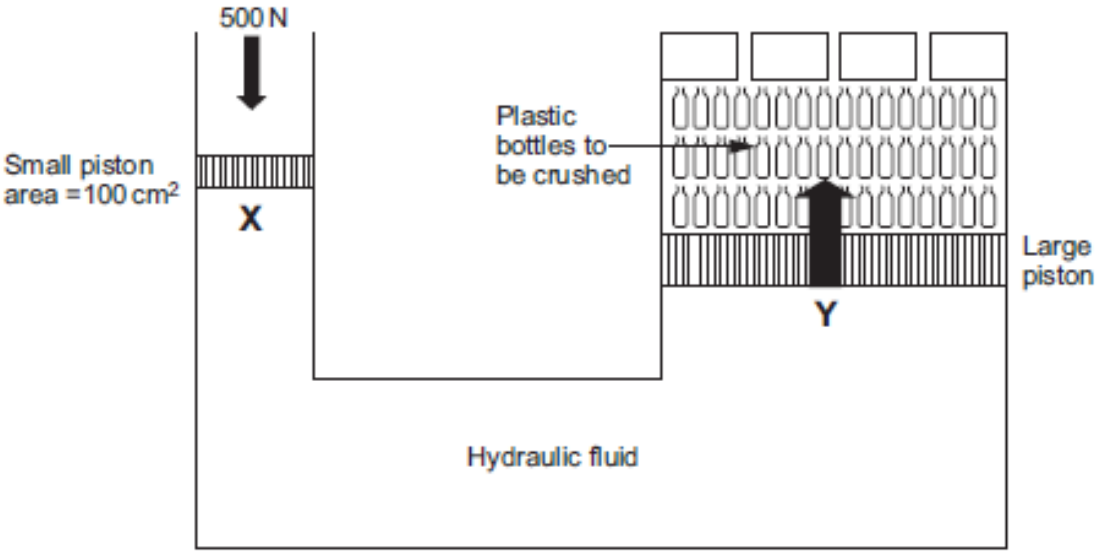
14

2. In Wales about 725 000 plastic bottles are used each day. Plastic bottles that are collected by local councils need to be transported to recycling plants that are based all around Wales. 250 plastic bottles are crushed into a single small bale. This makes it much easier to transfer them to the recycling factory.

A hydraulic press, as shown in the diagram, can be used. It is designed to exert a large force on the plastic bottles to crush them into a compact single bale. Only a relatively small force needs to be applied at **X** to crush the plastic bottles at **Y**. The pressure applied on the big piston at **Y** will be the same as the pressure exerted at **X**, however the area of the piston at **Y** is 15 times larger than the area of the piston at **X**.



(a) If all of the plastic bottles used each day in Wales are crushed, how many small bales would be produced in **one week**? [2]

number of small bales = ……

(b) Tick (✓) the box that shows the correct calculation of the pressure exerted by the small piston on the hydraulic fluid at **X**. [1]

$\text{pressure} = \dfrac{\text{force}}{\text{area}} = 500 \times 100 = 50\,000\ \text{N/cm}^2$ ☐

$\text{pressure} = \dfrac{\text{force}}{\text{area}} = \dfrac{500}{100} = 5\ \text{N/cm}^2$ ☐

$\text{pressure} = \dfrac{\text{force}}{\text{area}} = \dfrac{500}{100} = 5\ \text{N/m}^2$ ☐

$\text{pressure} = \dfrac{\text{force}}{\text{area}} = \dfrac{100}{500} = 5\ \text{N/cm}^2$ ☐

(c) Use information from the text and the equation:

force = pressure × area

to calculate the force applied to crush the plastic bottles at **Y**. [2]

force = …… N

(d) The hydraulic press develops a leak. Hydraulic fluid is expensive. A worker at the recycling factory suggests that replacing the hydraulic fluid with air would save money. Explain why the hydraulic press will no longer work if air is used. [2]

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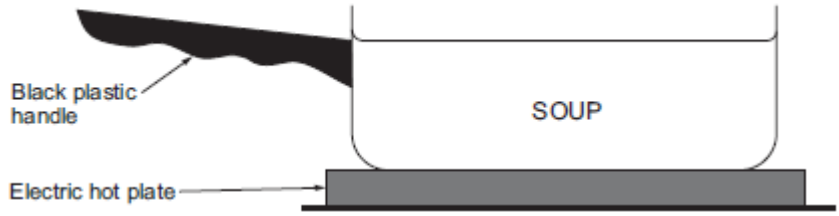
7

3. The diagram shows a metal pan, containing soup, being heated by an electric hot plate on a cooker.



(a) Complete the following sentences using only the words provided in the box. **Each word can be used once, more than once or not at all.** [4]

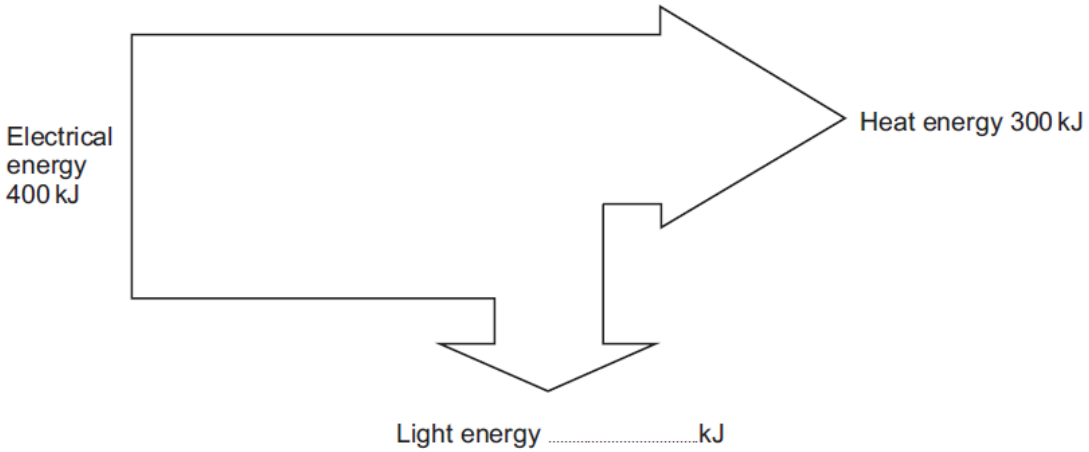
convection **radiation** **conductor** **insulator** **conduction**

(i) The heat is transferred through the base of the metal pan by .....

(ii) All of the soup becomes heated by a …… current that is set up in the liquid.

(iii) The handle is made from plastic as it is a poor …… It is black as it is the best colour at emitting infra-red by ……. when hot.

(b) The Sankey diagram shows the energy transfers taking place when the metal pan is being heated.



(i) **Fill in** the missing value on the diagram. [1]

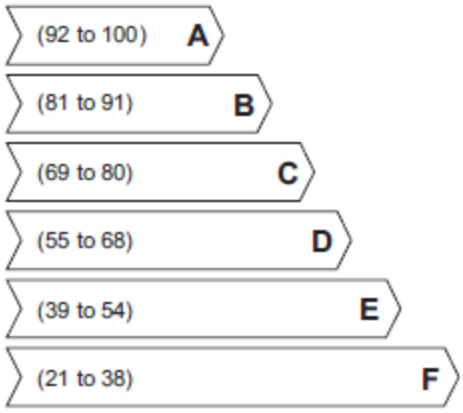
(ii) Use the equation:

$$\% \text{ efficiency} = \frac{\text{energy usefully transferred}}{\text{total energy supplied}} \times 100$$

to calculate the % efficiency of the electric hot plate. [2]

% efficiency = ……

(iii) Manufacturers of electrical appliances use an energy banding code to inform their customers of percentage energy efficiency ratings. A version is shown.



State the energy band for the hotplate of the cooker. [1]

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(iv) Discuss the importance of buying an appliance which has a high energy efficiency rating, for example a band A appliance. [3]

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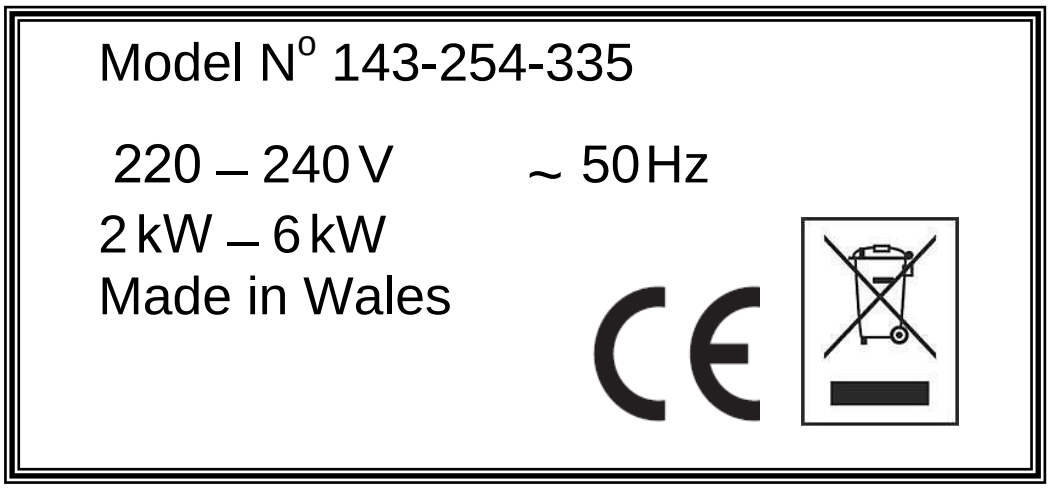
(c) The electric cooker has an information label as shown.



The cooker is being used at maximum power for 3 hours.

(i) Use the equation:

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

to calculate the number of units used by the cooker. [1]

number of units used = ……. kWh

(ii) Use the equation:

cost = units used × cost per unit

to calculate the cost, in pence, of using the cooker. One unit (kWh) of electricity costs 15 p. [2]

cost = ……p

(d) The cooker is connected to a fuse. When the cooker is operating at full power the current is 25 A.
Explain the function of the fuse and select a fuse for the cooker so that it operates safely. You may select from 10 A, 20 A, 25 A or 30 A fuses. [3]

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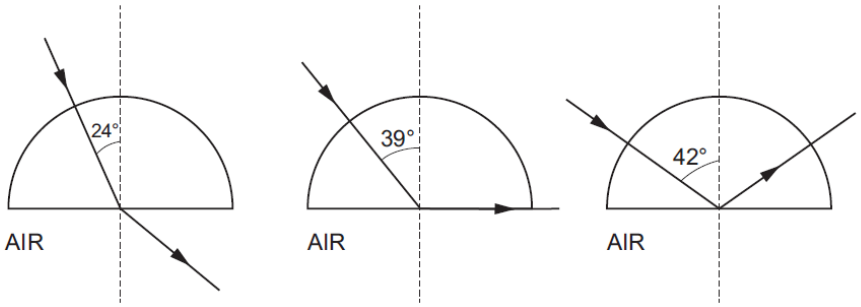
17

4. The table shows the critical angle for 4 materials as a light beam travels from the material into air.

Material	**Critical angle (degrees)**
diamond	24
glass A	35
glass B	39
perspex	42

A student uses a semi-circular block made from one of the four materials.
Her results are shown below.



(i) Using information from the table and the results explain which material the block is made from. [2]

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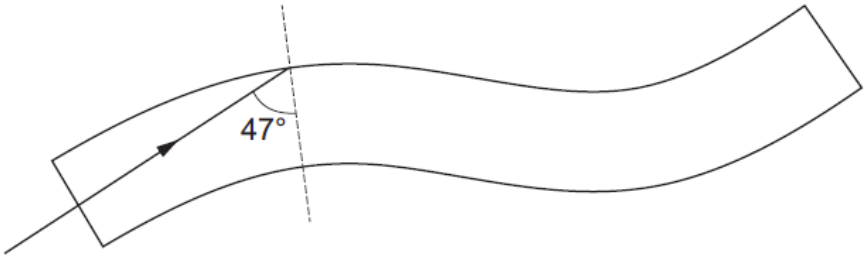
(ii) **Complete the diagram** to show how the light ray travels through an optical fibre of an endoscope. [2]



(iii) Medical information about a patient could be obtained with a CT scan. Explain an advantage of using an endoscopic medical examination over a CT scan.[2]

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6

5. The chart shows the regions of the electromagnetic spectrum (em spectrum).

Radio waves	Micro-waves	Infra-red waves	Visible light	Ultraviolet waves	X-rays	Gamma waves

(a) Describe in terms of their properties why they are all members of this spectrum and explain why they are arranged in the order shown. [6 QER]

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(b) A high exposure to either ultraviolet or infra-red waves can be harmful. State and explain the effects of overexposure to these waves on the human body. [3]

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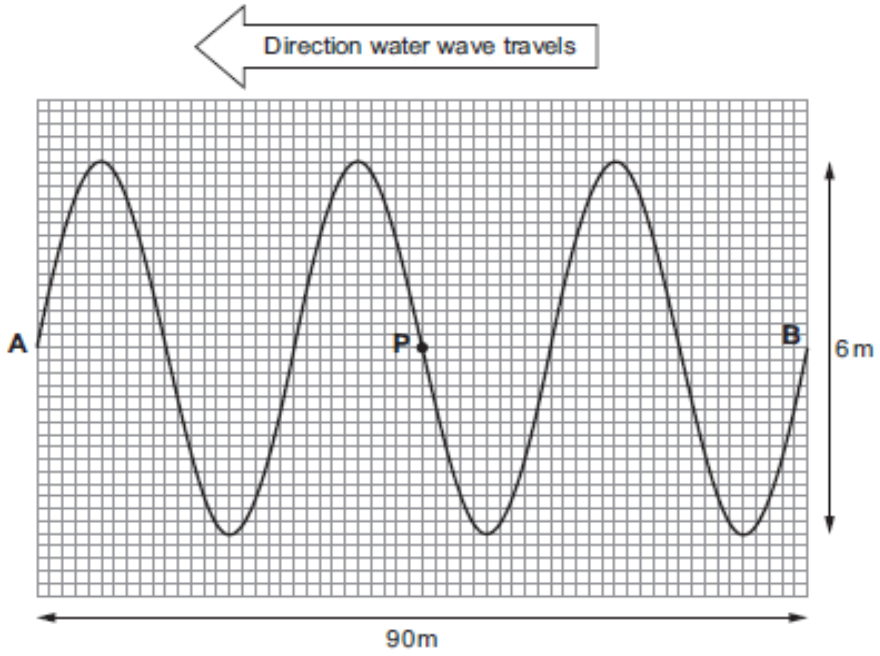
6. The diagram shows some water waves that have been produced following a small earthquake.



(a) (i) How many wavelengths are there between points **A** and **B**? [1]

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(ii) Calculate the wavelength of the wave. [1]

wavelength = …….…. m

(b) A boat at **P** moves up and down 5 times in 10 seconds.

(i) State the frequency of the water waves. [1]

frequency = …… Hz

(ii) Select and use an equation from page 2 to calculate the speed of the water waves. [3]

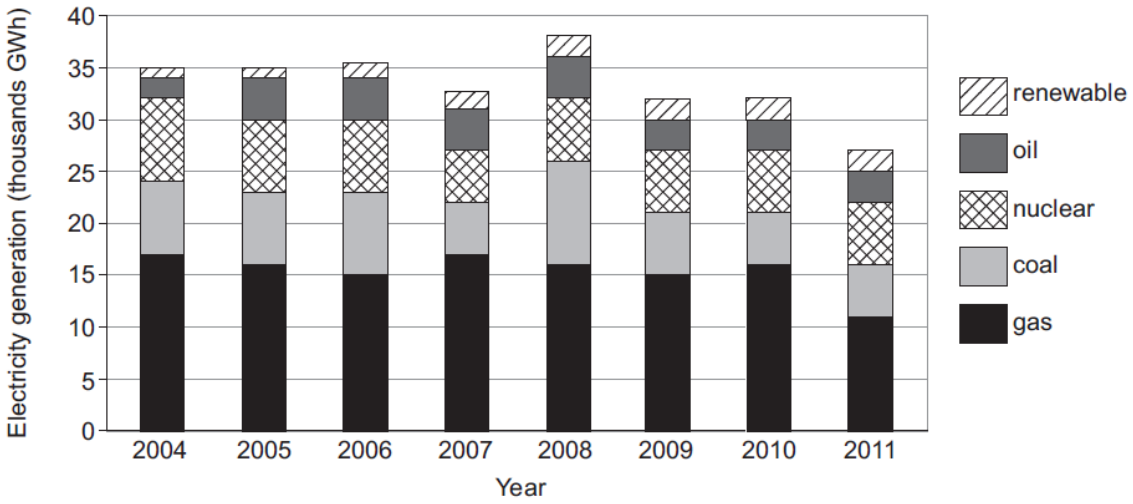
speed = ……m/s

(iii) **Draw an arrow** at P to show the direction that the boat moves. [1]

7

7. Renewable energy is a general term used to describe any source of energy that occurs naturally and is not exhaustible. Developing renewable energy sources for electricity generation is necessary to meet EU and UK Government targets on greenhouse gas emissions and to ensure fuel security. In its 2010 Energy Policy Statement, "*A low carbon revolution",* the Welsh Government set out aspirations totalling 22.5 gigawatts (22.5 GW) of installed capacity from different renewable energy technologies in Wales by 2020/25.

Figure 1: Generation of electricity by energy sources in Wales 2004 -2011



Source: Department of Energy and Climate Change, Welsh Government.

Between 2004 and 2010 the total amount of electricity generated in Wales fluctuated between 32 000 GWh and 38 000 GWh with no consistent trend. In 2011 the total amount of electricity generated in Wales fell to 28 000 GWh.

There are proposals for new power stations to be built in Wales. The most significant is a new nuclear power station at Wylfa B. It has the potential to generate 23 000 GWh each year.

(a) (i) In the article published by the Welsh Government, the 2010 Energy Policy Statement refers to "*A low carbon revolution".* Discuss what this term means for the future of electricity generation in Wales. [2]

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(ii) Use **Figure 1** to identify the trends in the generation of electricity using different energy sources between 2009 and 2011. [2]

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(iii) In 2011 consumers in Wales used 45 000 GWh of electrical energy. Describe how the shortfall between supply and demand was met. [2]

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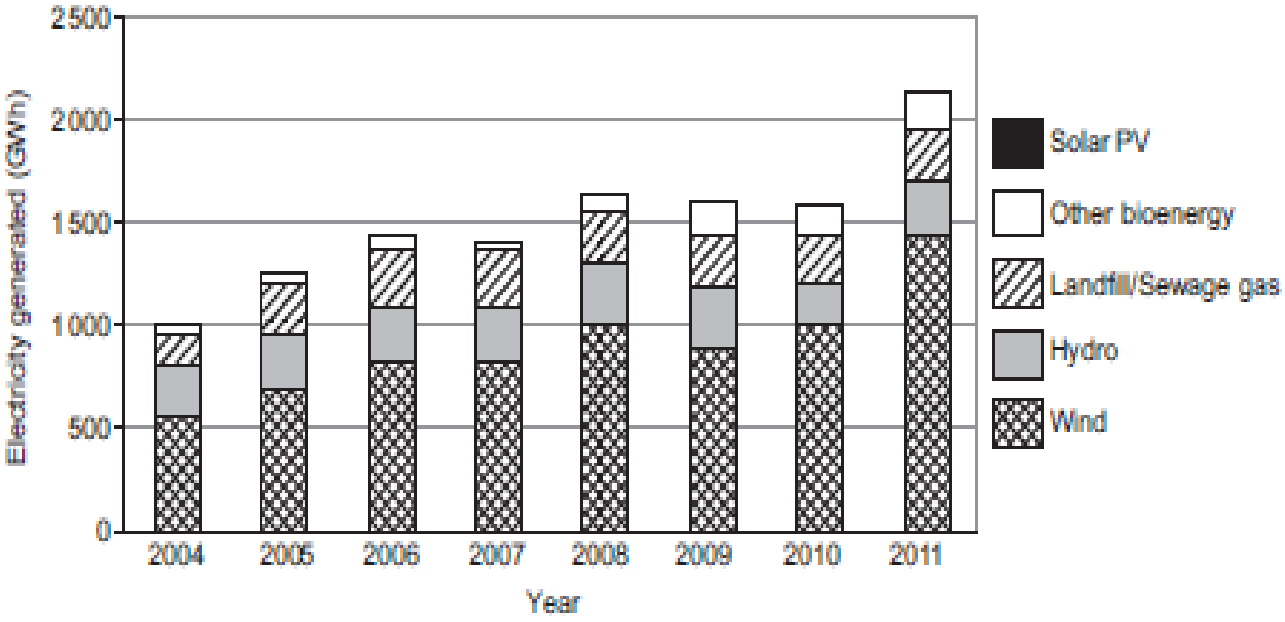
(iv) If the new nuclear power station at Wylfa B had been commisioned and used at maximum power in 2011 how much surplus electrical energy would Wales have produced? [2]

electrical energy = ……..GWh

(b) **Figure 2** shows a general upward trend in the amount of electrical energy generated from renewable sources in Wales between 2004 and 2011, reaching a maximum of 2 160 GWh in 2011.

Figure 2: Electricity generated from renewable sources in Wales, 2004 - 2011



(i) State which renewable energy source didn't make a contribution to the electrical energy generated in Wales between 2004 and 2011. [1]

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(ii) For the period considered (2004-2011) the total amount of electricity generated from renewables in Wales changes considerably. Explain which renewable energy source was mainly responsible for this change. [2]

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(c) Since 2011 considerably more Welsh homes have had PV cells installed. Describe and explain how a bar on the chart of **Figure 2** could look for 2015. [3]

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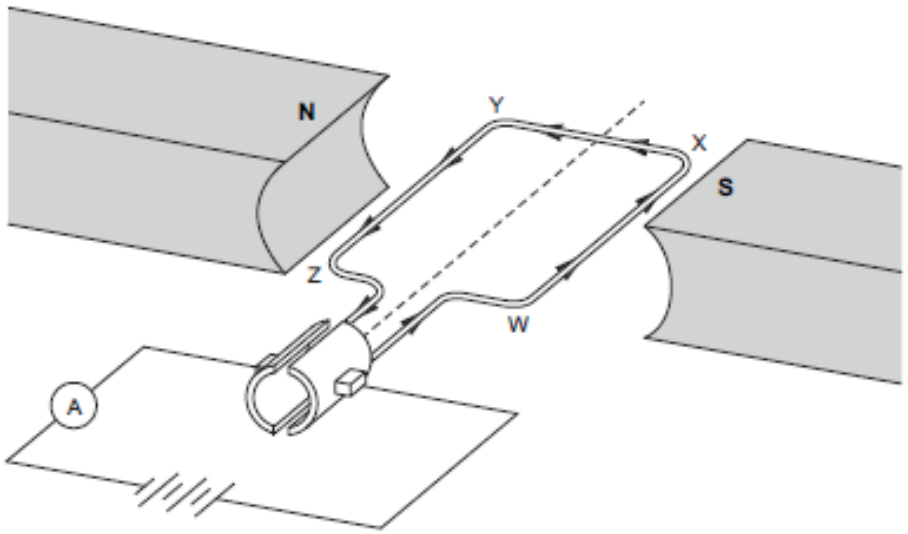
14

8. The diagram represents a simple electric motor that a pupil investigates in his lesson.



The current in the coil flows from **W** to **Z** as shown on the diagram.

(a) (i) Explain clearly how you would use Flemings left hand rule to determine the direction of the force on the side **YZ**. [3]

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(ii) State **one** change the student could make so that side **YZ** of the coil moves in the opposite direction. [1]

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(b) State **two** changes that could be made to make the coil rotate faster. [2]

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END OF PAPER

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