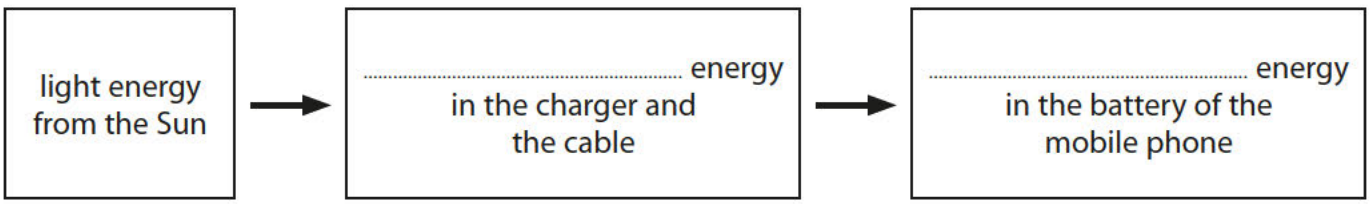
1 The photograph shows a solar-powered battery charger connected to a mobile phone.



When the battery charger is used, it transfers light energy from the Sun to the battery of the mobile phone.

(a) Complete the energy transfer diagram.

(2)



(b) It takes 3.5 hours to recharge the battery fully.

The average current supplied by the charger is 400 mA.

(i) State the equation linking charge, current and time.

(1)

(ii) Calculate the amount of charge needed to recharge the battery fully, and give the unit.

(3)

charge = ... unit .....

(c) If the charger is moved into the shade, the output power decreases.

The voltage across the charger stays the same.

Explain how moving the charger into the shade affects the time needed to recharge the battery fully.

(2)

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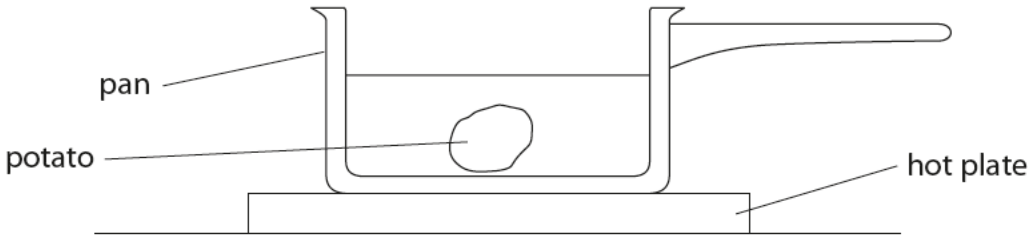
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(Total for Question 1 = 8 marks)

2 This question is about three different methods used to cook potatoes.

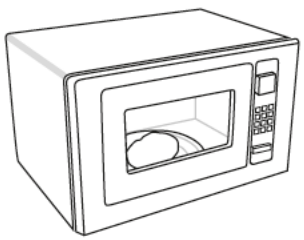
(a) On a traditional cooker, a potato is placed in water in a pan on top of a hot plate.



Describe how energy is transferred from the hot plate to heat up all of the potato.

(4)

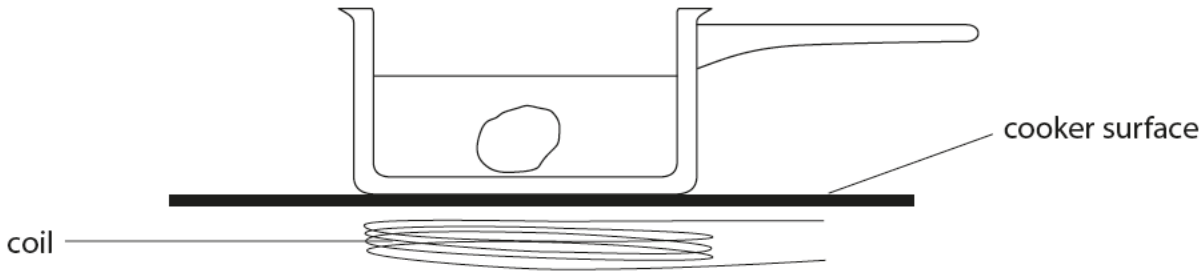
(b) A microwave cooker is often said to *'cook the food from the inside'*.



Explain whether this statement is true by describing how energy is transferred to heat up all of the potato.

(3)

(c) n an induction cooker, there is a coil under the surface of the cooker.



A potato is placed in water in a metal pan.

An alternating current is switched on in the coil under the pan.

The coil does not heat the surface of the cooker.

Describe how energy is transferred to heat up all of the potato.

(5)

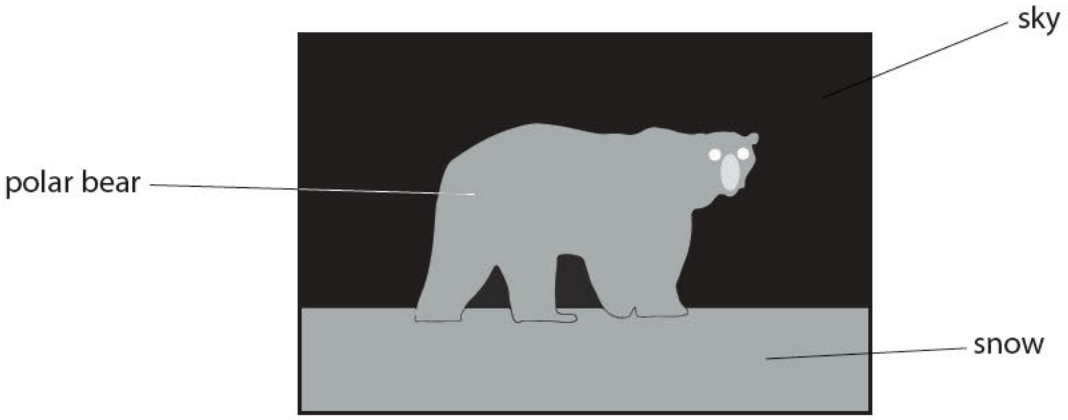
(Total for Question 2 = 12 marks)

3 Polar bears have thick fur to keep them warm.

(a) This photograph of a polar bear was taken using visible light.



The diagram shows a thermal image of the same scene.



Darker colours in this image indicate lower temperatures.

Discuss what information the image gives about the temperatures of the objects shown.

(2)

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(b) The polar bear's fur includes short hairs and longer hairs.

These longer hairs are hollow and contain air.

(i) Explain how its fur reduces the amount of thermal energy lost by the polar bear.

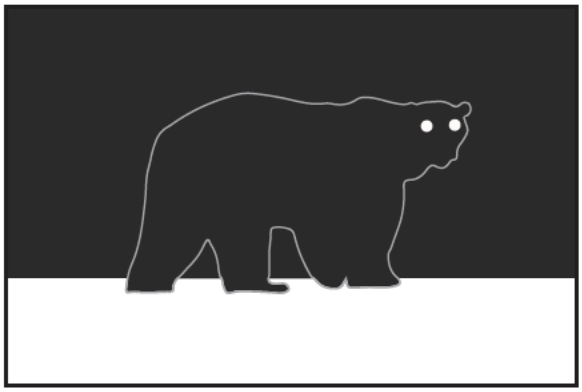
(2)

(ii) Underneath its white fur, a polar bear has black skin.

Discuss how these colours affect the overall amount of thermal energy lost by the polar bear's body.

(3)

(c) The diagram shows another image of the same scene.



The image was made during the day using ultraviolet rays from the Sun.

Brighter colours in this image indicate larger amounts of ultraviolet radiation.

The grey line is added to show the position of the polar bear.

(i) Compare the absorption and reflection of ultraviolet rays by the objects shown in the image.

(2)

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(ii) Suggest why the sky appears dark, even though the Sun emits ultraviolet rays.

(1)

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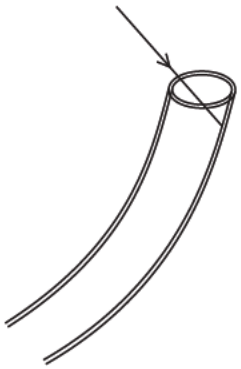
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(iii) The hollow hairs in polar bear fur are transparent tubes filled with air.

It was thought that these hairs could act like optical fibres and guide ultraviolet rays down to the polar bear's skin.

It is now known that this idea is **incorrect**. The ultraviolet rays do **not** reach the polar bear's skin.

The diagram shows an ultraviolet ray entering the air inside a hollow hair.



Suggest why this radiation does not pass down to the polar bear's skin.

(2)

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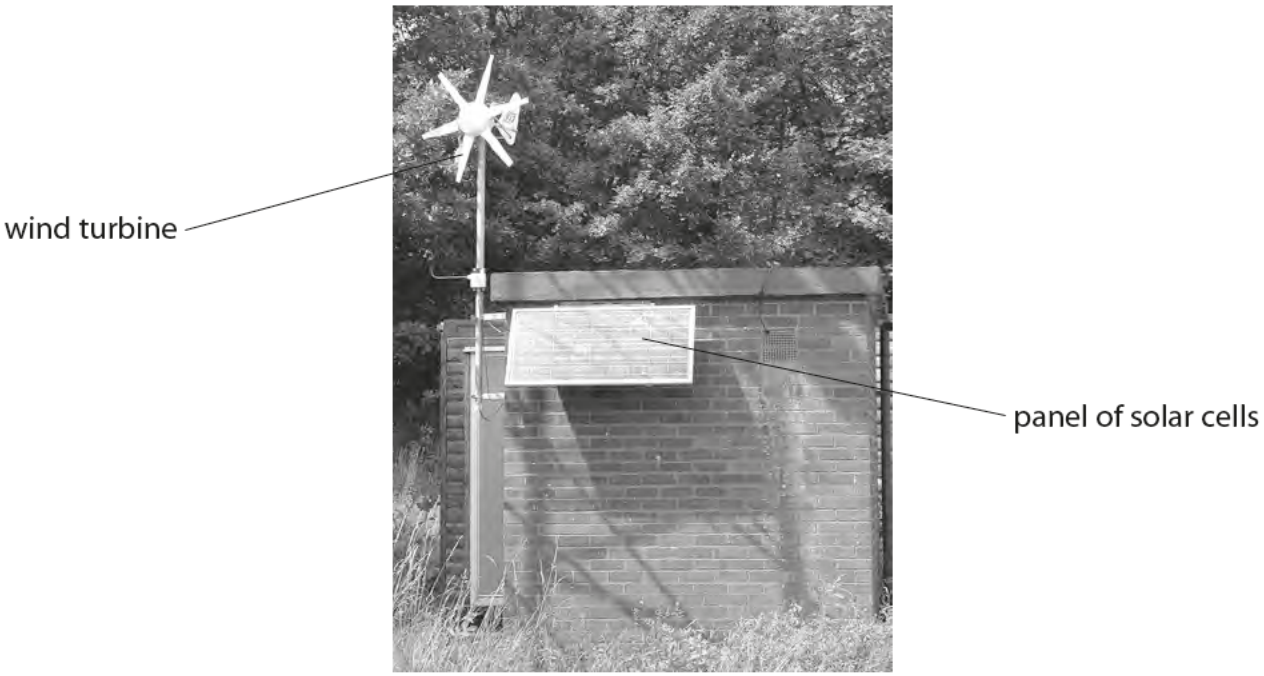
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(Total for Question 3 = 12 marks)

4 The photograph shows equipment used for generating electricity from renewable sources.



(a) Complete the sentences using words from the box.

chemical	**t**	**kinetic**	**light**	**sound**

(i) The panel of solar cells transforms ..... energy into electrical energy.

(1)

(ii) The wind turbine transforms ..... energy into electrical energy.

(1)

(b) On a windy day, the wind turbine transfers 78 W of power.

(i) State the equation linking power, energy transferred and time.

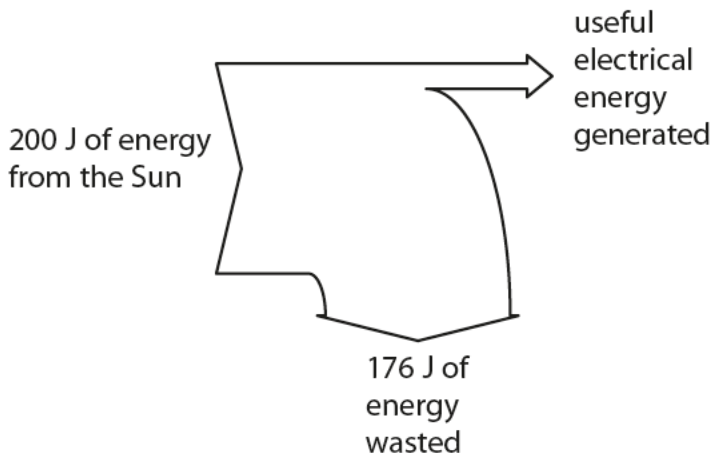
(1)

(ii) Calculate the amount of energy the turbine transfers in 10 s.

(3)

Energy transferred = ... J

(c) The Sankey diagram shows the energy transferred by the panel of solar cells.

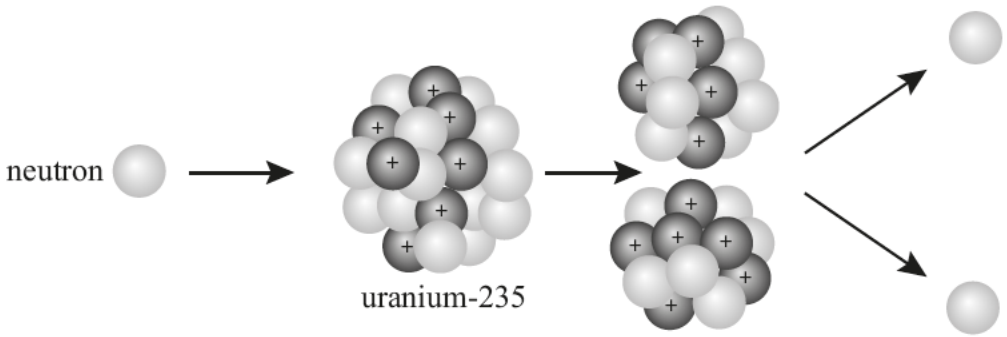


Show that the efficiency of the panel of solar cells is 12%.

(2)

(Total for Question 4 = 8 marks)

5 The diagram shows a neutron colliding with a nucleus of uranium-235, producing a number of products.



(a) Name the process shown in the diagram.

(1)

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(b) Explain how the process shown in the diagram can lead to a chain reaction.

(3)

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(c) This process releases energy.

Explain the form that this energy takes.

(2)

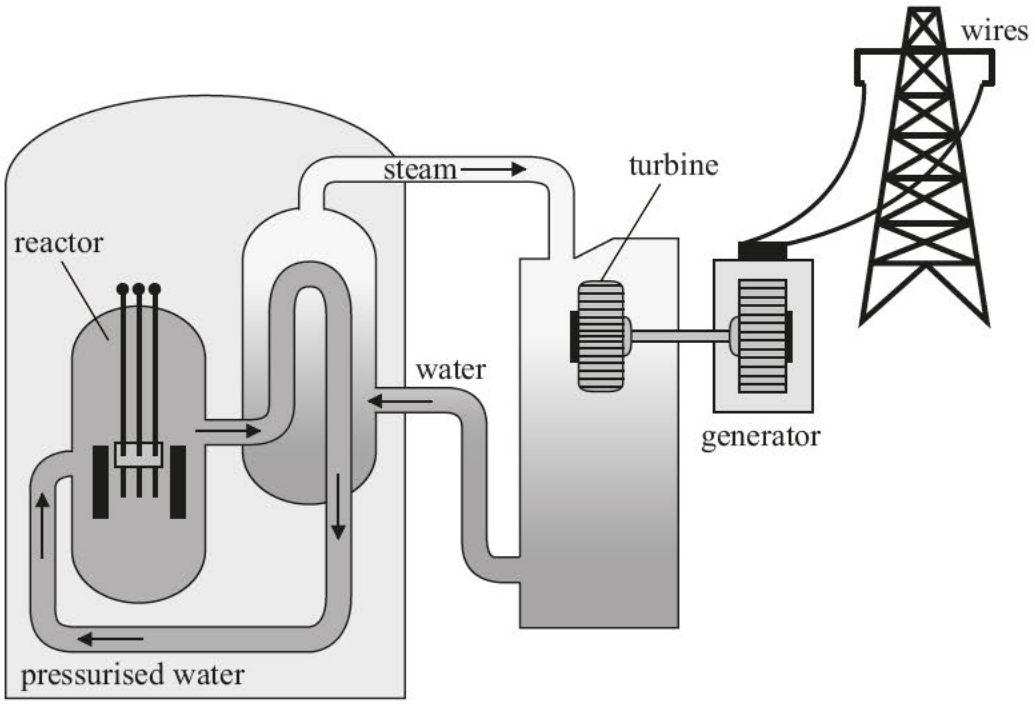
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(d) The energy released in this process can be used in a nuclear power station.



(i) The pressurised water acts as a coolant. It also acts as a moderator.

What is the purpose of a **moderator**?

(1)

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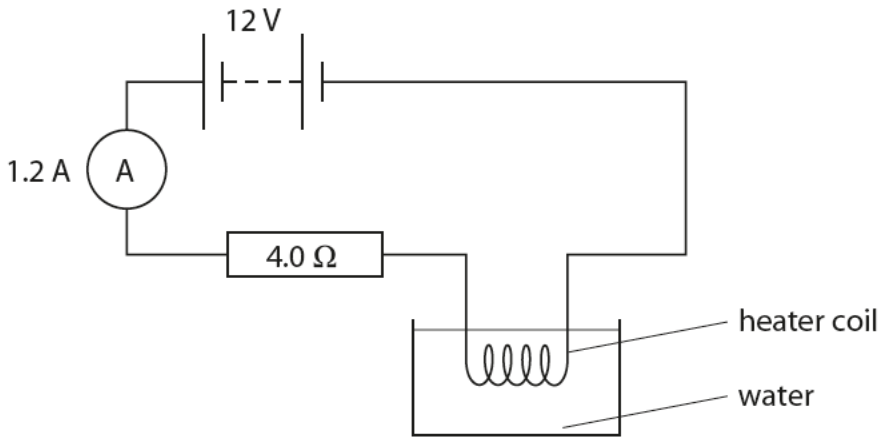
(ii) Complete the chart below to show the main useful energy transfers in a nuclear power station.

(4)

Heat energy released by reactor	..... energy in water/steam	..... energy in turbine	..... energy in generator	..... energy in wires

(Total for Question 5 11 marks)

6 The diagram shows a heater coil and a resistor connected to a 12 V battery and an ammeter. The ammeter reading is 1.2 A.



(a) (i) State the equation linking voltage, current and resistance.

(1)

(ii) Calculate the voltage across the 4.0 Ω resistor.

(2)

Voltage = ... V

(iii) Show that the voltage across the heater coil is about 7 V.

(2)

(iv) Calculate the energy transferred to the heater coil in 5.0 minutes.

(3)

Energy transferred = ... J

(v) At first, the temperature of the water increases.

After a while, the temperature reaches a steady value below the boiling point of water.

Explain why the temperature reaches a steady value.

(2)

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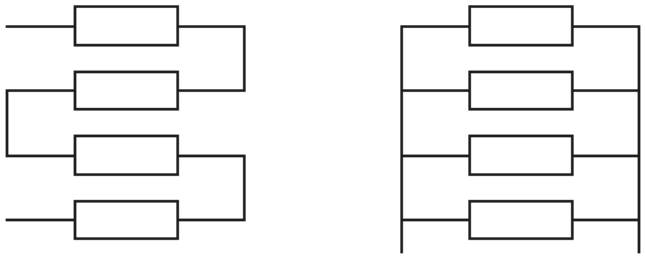
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(b) Resistors can be used as heating elements in the rear windows of cars.

The diagram shows two possible designs.



X **Y**

(i) Complete the table by placing a tick (✓) in the correct boxes.

(1)

Design	Series	Parallel
X		
Y		

(ii) Describe the advantages and disadvantages of design **X** when used as a heater in a car window.

(3)

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(Total for Question 6 = 14 marks)