Materials
For this paper you must have:
• Ruler
• Pencil, Rubber, Protractor and Compass
• Scientific calculator, which you are expected to use when appropriate

Instructions
• Answer all questions
• Answer questions in the space provided
• All working must be shown
• Do all rough work in this book. Cross out any rough work you don’t want to be marked

Information
• The marks for the questions are shown in brackets
Figure 1 shows the circuit symbol for three different components.

Figure 1

(a) Which component is a variable resistor?

Tick one box.

A  B  C

(1)

(b) Which component is a thermistor?

Tick one box.

A  B  C

(1)

(c) In which component will the resistance decrease when the temperature increases?

Tick one box.

A  B  C

(1)

(d) In which component will the resistance decrease when the light intensity increases?

Tick one box.

A  B  C

(1)
Figure 2 shows four different arrangements of resistors.

Figure 2

(e) Two of the arrangements are in series and two are in parallel. Describe the difference between a series and a parallel arrangement.

___________________________________________________________________
___________________________________________________________________
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(f) Which arrangement has a resistance of 10 Ω? Tick one box.

P □ Q □ R □ S □

(g) Which arrangement has the highest resistance? Tick one box.

P □ Q □ R □ S □
(h) A student connects a resistor to a cell for 60 seconds.

The current through the resistor is 0.97 \text{ A}

Calculate the charge flow.

Use the equation:

\[
\text{charge flow} = \text{current} \times \text{time}
\]

Give your answer to 2 significant figures.

\[
\text{Charge flow} = \underline{\underline{}}} \text{ C}
\]

(Total 11 marks)

\[\text{Figure 1}\] shows a mobile phone being recharged by a portable power source.

\[\text{Figure 1}\]
(a) Why does the battery in the phone need recharging?

Tick **one** box.

- The store of chemical energy in the battery has reduced.
- The store of thermal energy in the battery has reduced.
- The store of kinetic energy in the battery has reduced.
- The store of gravitational energy in the battery has reduced.

(1)

(b) The power source provides a current of 1.86 A at a potential difference of 3.90 V

Calculate the power of the power source.

Use the equation:

\[ \text{power} = \text{potential difference} \times \text{current} \]

Choose the correct unit from the box.

C \hspace{1cm} J \hspace{1cm} W

___________________________________________________________________
___________________________________________________________________
___________________________________________________________________

\[ \text{Power} = \underline{\hspace{2cm}} \]

Unit \underline{\hspace{2cm}}

(3)
(c) A student needs a new power source.

**Figure 2** shows three different sized power sources.

The table below gives data about the different power sources.

<table>
<thead>
<tr>
<th>Power source</th>
<th>Number of charges</th>
<th>Mass in grams</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compact</td>
<td>1</td>
<td>100</td>
</tr>
<tr>
<td>Large</td>
<td>5</td>
<td>200</td>
</tr>
<tr>
<td>High capacity</td>
<td>10</td>
<td>600</td>
</tr>
</tbody>
</table>

The student chose the large power source.

Suggest why the student chose the large power source.

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(4) (Total 8 marks)
Some ceiling lights in the home are connected to the mains by a two-core cable. Figure 1 shows a ceiling light.

(a) Suggest why some ceiling lights do not have an earth wire.
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________

(b) Write down the equation that links charge flow, current and time.
___________________________________________________________________

(c) There is a current of 2.95 A in one of the copper wires for 60 seconds.
Calculate the charge flow through the wire.
Use your equation from part (b)
___________________________________________________________________
___________________________________________________________________

Charge flow = _________________ C
(d) **Figure 2** shows a current potential difference graph for a piece of copper wire.

![Figure 2](image)

Draw another line on **Figure 2** for a wire with a different resistance.

Some fuses have a thin piece of copper that melts if the current is too large.

(e) Draw the circuit symbol for a fuse.
(f) Describe how the movement of the copper particles in the wire changes when copper melts.

___________________________________________________________________
___________________________________________________________________
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(g) Old copper wires are melted when they are recycled.

Calculate the energy needed to melt 500 kg of copper at its melting point.

Specific latent heat of fusion of copper = 200 kJ/kg

Use the Physics Equations Sheet.

___________________________________________________________________
___________________________________________________________________

Energy = _________________ J

(Total 13 marks)

Figure 1 shows the information label from a hairdryer.

Figure 1

| 50 Hz | 230 V | 2100 W |

(a) What is the power of the hairdryer?

Tick one box.

50 Hz

230 V

2100 W
(b) What is the equation which links current, potential difference and power?

Tick one box.

\[
\text{power} = \text{potential difference} \times \text{current}
\]

\[
\text{power} = \frac{\text{potential difference}}{\text{current}}
\]

\[
\text{power} = \frac{\text{current}}{\text{potential difference}}
\]

(1)

(c) The mains electricity supply in the UK is an alternating current (ac).

What is the frequency of the UK ac supply?

___________________________________________________________________

(1)

(d) Some electrical appliances use batteries.

What type of current does a battery supply?

Tick one box.

Alternating current (ac) only

Direct current (dc) only

Both ac and dc

Not ac or dc

(1)
The hairdryer is connected to the mains electricity supply by a plug.

**Figure 2** shows the inside of a plug.

**Figure 2**

The insulation around the Earth wire has two colours. What are the two colours?

____________________ and ____________________

(1)

(e) Draw **one** line from each wire to the colour of insulation around the wire.

<table>
<thead>
<tr>
<th>Wire</th>
<th>Colour of insulation around wire</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blue</td>
<td>Blue</td>
</tr>
<tr>
<td>Live</td>
<td>Brown</td>
</tr>
<tr>
<td>Neutral</td>
<td>Green</td>
</tr>
<tr>
<td>White</td>
<td>Yellow</td>
</tr>
</tbody>
</table>

(2)

(f) The insulation around the Earth wire has two colours.

What are the **two** colours?

____________________ and ____________________
(g) Brass is an alloy of copper and zinc.

Give two properties of brass that make it suitable to use in the plug.

1. _________________________________________________________________
2. _________________________________________________________________

(h) **Figure 3** shows how the National Grid links power stations to consumers.

**Figure 3**

![Diagram of the National Grid](image)

Describe how electrical power is transferred from power stations to consumers by the National Grid.

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(4) (Total 13 marks)

Some electrical appliances use electricity from the mains supply and some use electricity from a battery.
(a) Explain the differences between the current supplied by the mains supply and the current supplied by a battery.

___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________

(2)

(b) Which set of units correctly links current, potential difference and power?

Tick one box.

\[
\begin{align*}
\text{one watt} &= \text{one volt} \times \text{one amp} \\
\text{one watt} &= \frac{\text{one amp}}{\text{one volt}} \\
\text{one watt} &= \frac{\text{one volt}}{\text{one amp}}
\end{align*}
\]

(1)

Electrical appliances can be connected to the mains supply using three-core cables.

The cables contain the mains wires.

(c) What are the colours of the insulation around the wires?

Tick one box.

<table>
<thead>
<tr>
<th>Earth</th>
<th>Live</th>
<th>Neutral</th>
<th>Tick one box</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blue</td>
<td>Brown</td>
<td>Green and yellow</td>
<td></td>
</tr>
<tr>
<td>Blue</td>
<td>Green and yellow</td>
<td>Brown</td>
<td></td>
</tr>
<tr>
<td>Brown</td>
<td>Blue</td>
<td>Green and yellow</td>
<td></td>
</tr>
<tr>
<td>Brown</td>
<td>Green and yellow</td>
<td>Blue</td>
<td></td>
</tr>
<tr>
<td>Green and yellow</td>
<td>Blue</td>
<td>Brown</td>
<td></td>
</tr>
<tr>
<td>Green and yellow</td>
<td>Brown</td>
<td>Blue</td>
<td></td>
</tr>
</tbody>
</table>
(d) Touching the live wire of an appliance is dangerous when the appliance is connected to the mains electricity supply.

Explain why.

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___________________________________________________________________
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(4)
(Total 8 marks)

An energy input of $1.3 \times 10^{18}$ J is supplied each year by power stations to the National Grid.

Not all of this energy is supplied to consumers. Some of the energy is wasted in the distribution process.

(a) Write the equation which links efficiency, total input energy transfer and useful output energy transfer.

___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________

(1)

(b) The energy supplied each year to consumers is $1.2 \times 10^{18}$ J

Calculate the efficiency of the distribution process.

___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________

Efficiency = _______________________

(2)
(c) How is electrical power transmitted across the National Grid to make the process as efficient as possible?

Tick one box.

- At a high potential difference and a high current
- At a high potential difference and a low current
- At a low potential difference and a high current
- At a low potential difference and a low current

(d) Write the equation which links energy transferred, power and time.

___________________________________________________________________
___________________________________________________________________

(1)

(e) A wind turbine supplies a power output of 8000 kW for 1200 seconds.

Calculate the energy transferred by the wind turbine in kJ

___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________

Energy transferred = ___________________________ kJ

(3)
Describe the environmental advantages and disadvantages of using wind turbines to generate electricity in the UK.

Figure 1 shows a water distiller which is used to purify water.

The distiller boils water and then condenses most of the water vapour back to water.

The distiller boils water and then condenses most of the water vapour back to water.
(a) The water distiller is filled with 5.0 kg of water at 20 °C

The specific heat capacity of water = 4200 J/kg °C

Calculate the energy needed to raise the temperature of the water to 100 °C

Use the Physics Equations sheet.

___________________________________________________________________

___________________________________________________________________

___________________________________________________________________

___________________________________________________________________

___________________________________________________________________

___________________________________________________________________

Energy = ____________________ J

(3)

Figure 2 shows how the temperature of the water in the distiller changes with time.

Figure 2

(b) Energy is transferred to the water at a constant rate.

Explain why the graph is a different shape in parts A and B.

___________________________________________________________________

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___________________________________________________________________

(3)
(c) When the water drops to a low level, the heater automatically switches off.

Explain what problem would be caused if the heater did not automatically switch off.

___________________________________________________________________
___________________________________________________________________
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___________________________________________________________________

(3)

(d) The distiller is connected to the mains by a three-core cable.

The wires are covered by different coloured insulation.

What colour is the insulation covering each of the wires?

Live wire ____________________
Neutral wire ____________________
Earth wire ____________________

(2)

(e) Which statement gives the purpose of the earth wire?

Tick one box.

It carries an alternating potential difference. □

It melts if the current in the circuit is too high. □

It provides a connection to complete the circuit. □

It stops the casing of the appliance becoming live. □

(1)
The heating element has a power of 2.5 kW

The resistance of the heating element is 17 Ω

Calculate the current in the heating element.

Give your answer to 2 significant figures.

Write any equations that you use.

Current = ____________________ A

A light dependent resistor (LDR) is connected in a circuit.

(a) Draw the circuit symbol for an LDR.
(b) A student investigated the relationship between current and potential difference for an LDR.

How should the student have connected the ammeter and voltmeter in the circuit?

Tick one box.

<table>
<thead>
<tr>
<th>Ammeter</th>
<th>Voltmeter</th>
</tr>
</thead>
<tbody>
<tr>
<td>in parallel with LDR</td>
<td>in parallel with LDR</td>
</tr>
<tr>
<td>in parallel with LDR</td>
<td>in series with LDR</td>
</tr>
<tr>
<td>in series with LDR</td>
<td>in parallel with LDR</td>
</tr>
<tr>
<td>in series with LDR</td>
<td>in series with LDR</td>
</tr>
</tbody>
</table>

(1)

The diagram below shows a sketch graph of the student’s results.

The LDR was in a constant bright light.
(c) The student concluded that the current in the LDR is inversely proportional to the potential difference across the LDR.

Explain why the student’s conclusion is incorrect.
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________

(d) The student repeated the investigation with the LDR in constant dark conditions.

Sketch on the diagram above the graph for the LDR in constant dark conditions.

The LDR was placed near a light source.

The following results were recorded:

potential difference = 5.50 V

current = 12.5 mA

(e) Write down the equation that links current, potential difference and resistance.
___________________________________________________________________

(f) Calculate the resistance of the LDR.

___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________

Resistance = _____________ Ω

(Total 11 marks)