P2
ELECTRICITY
TEST 3

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
Many electrical appliances are connected to the mains supply using a three-core cable and a three-pin plug.

(a) Use the correct answer from the box to complete the sentence.

<table>
<thead>
<tr>
<th>charge</th>
<th>energy</th>
<th>power</th>
</tr>
</thead>
</table>

Electric current is the rate of flow of _______________________________ .

(b) The diagram shows a three-pin plug connected to a three-core cable.

(i) The three wires of the three-core cable have different coloured coverings.

State the colour of the covering of the neutral wire.

______________________________________________________________

(ii) Which two parts of the plug shown above protect the wiring of a circuit?

Tick (✓) two boxes.

Tick (✓)

<table>
<thead>
<tr>
<th>Earth wire</th>
<th>Fuse</th>
<th>Live wire</th>
<th>Neutral wire</th>
</tr>
</thead>
</table>

(2)
(c) Some electrical appliances are connected to the mains supply using a two-core cable and a three-pin plug. Appliances that are double insulated do not require all three wires.

(i) What does ‘double insulated’ mean?

........................................................................................................................................
........................................................................................................................................

(1)

(ii) State which of the three wires is not required.

........................................................................................................................................

(1)

(d) (i) An electrical appliance is connected to a 20 V supply.

The current in the appliance is 3 A.

Calculate the power of the appliance.

........................................................................................................................................
........................................................................................................................................

Power = _________________________ W

(2)

(ii) Another electrical appliance is connected to a 20 V supply.

The appliance transfers 300 J of energy.

Calculate the charge.

Give the unit.

........................................................................................................................................
........................................................................................................................................

Charge = _________________________

Unit ______________

(3)

(Total 11 marks)
(a) A resistor is a component that is used in an electric circuit.

(i) Describe how a student would use the circuit to take the readings necessary to determine the resistance of resistor R.
(ii) Explain why the student should open the switch after each reading.

________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________

(2)

(iii) In an experiment using this circuit, an ammeter reading was 0.75 A. The calculated value of the resistance of resistor $R$ was 16 $\Omega$.

What is the voltmeter reading?

________________________________________________________________________
________________________________________________________________________

Voltmeter reading = ________________ $V$

(2)

(iv) The student told his teacher that the resistance of resistor $R$ was 16 $\Omega$.

The teacher explained that the resistors used could only have one of the following values of resistance.

$$10 \ \Omega \quad 12 \ \Omega \quad 15 \ \Omega \quad 18 \ \Omega \quad 22 \ \Omega$$

Suggest which of these resistors the student had used in his experiment.

Give a reason for your answer.

________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________

(2)
(b) The diagram shows a fuse.

![Fuse Diagram]

Describe the action of the fuse in a circuit.

___________________________________________________________________
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(3)
(Total 15 marks)

Most electrical appliances are connected to the mains electricity using three-core cables.

(a) What is the approximate value of the potential difference of the UK mains electricity supply?

Tick one box.

- 23 V
- 230 V
- 300 V
- 350 V

(1)
(b) Figure 1 shows a three-core cable.

![Figure 1](image)

Use answers from the box to label the wires and complete Figure 1.

<table>
<thead>
<tr>
<th>Earth</th>
<th>Negative</th>
<th>Neutral</th>
</tr>
</thead>
</table>

(c) In the UK the three wires in a three-core cable are always the same colours.

Why are the wires always the same colours?

Tick one box.

- Each wire is made by a different company.
- It is easy to identify each wire.
- They are cheaper to manufacture.

(d) Touching the live wire is dangerous.

Use answers from the box to complete the sentences.

<table>
<thead>
<tr>
<th>current</th>
<th>resistance</th>
<th>shock</th>
<th>force</th>
<th>voltage</th>
</tr>
</thead>
</table>

Touching the live wire causes a large potential difference to exist across the body.

This causes a _____________________________ through the body, which results in an electric _____________________________
(e) What is the approximate frequency of the UK mains electricity supply?

Tick one answer.

- 50 Hz
- 75 Hz
- 100 Hz
- 150 Hz

(f) Figure 2 shows how power stations transfer electrical power to consumers using the National Grid.

![Figure 2](https://www.examqa.com)

The power station generates electricity at a voltage of 25 kV.

Transformer A increases the voltage by a factor of 16.

What is the voltage output of transformer A?

___________________________________________________________________
___________________________________________________________________
___________________________________________________________________

Output voltage = _____________________ kV

(2)
(g) Why is the voltage increased by transformer A?

Tick one box.

- To reduce the energy lost due to heating
- To increase the power
- To increase the current

(1)

(h) Why is it important that the voltage is decreased by transformer B?

Tick one box.

- Less energy is used by consumers
- It is safer for consumers
- It reduces consumers’ electricity bills

(1)

(Total 11 marks)
The graph shows how the current through a filament bulb changes after the bulb is switched on.

(a) What happens to the current through the bulb in the first 0.02 seconds after the bulb is switched on?

(b) Between 0.02 seconds and 0.08 seconds the current through the bulb decreases.

   (i) What, if anything, happens to the resistance of the bulb between 0.02 seconds and 0.08 seconds?

   Draw a ring around the correct answer.

   decreases  does not change  increases

   (1)

   (ii) What, if anything, happens to the temperature of the bulb between 0.02 seconds and 0.08 seconds?

   Draw a ring around the correct answer.

   decreases  does not change  increases

   (1)
(c) The bulb is connected to a 12 V power supply.

Calculate the power of the bulb when the current through the bulb is 1.5 A.

Choose the unit from the list below.

<table>
<thead>
<tr>
<th>coulomb</th>
<th>joule</th>
<th>watt</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Power = ____________________ unit ________________

(Total 6 marks)

(a) A washing machine is connected to the mains electricity supply using a cable and three-pin plug.

**Figure 1** shows a three-pin plug.

![Figure 1](image)

Name the materials used in the structure of a plug. Give the reason why each material is used.

Pin ________________________________________________________________

___________________________________________________________________

Outer case _________________________________________________________

___________________________________________________________________

(1)

(b) The three-pin plug contains a fuse. The fuse is connected to one of the wires inside the cable.

(i) Which one of the wires inside the cable is the fuse connected to?

___________________________________________________________________

(1)
(ii) The fuse is a thin wire inside a closed glass tube. The wire acts as a resistor.

What effect does a current through a wire have on the wire?

______________________________________________________________

(1)

(iii) The power of the washing machine varies between 0.7 kW and 2 kW depending on which part of the wash cycle is operating.

Calculate the maximum current drawn from the mains electricity supply by the washing machine.

The mains electricity supply is at a potential difference of 230 V.

______________________________________________________________

______________________________________________________________

______________________________________________________________

Current = __________________________ A

(2)
(c) **Figure 2** shows how the mains electricity cable is connected to the washing machine.

The earth wire is connected to the metal case of the washing machine.

![Diagram of mains electricity cable connected to washing machine](image)

If a fault makes the metal case live, the earth wire and fuse inside the plug prevent the mains cable from overheating and causing a fire.

Explain how.

___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________

(2)

(d) New research has shown that many people underestimate the hazards of using mains electricity.

It is important that people do understand the hazards of using mains electricity.

Suggest why.

___________________________________________________________________
___________________________________________________________________
___________________________________________________________________

(1)

(Total 9 marks)
The current in a circuit depends on the potential difference provided by the cells and the total resistance of the circuit.

(a) **Figure 1** shows the graph of current against potential difference for a component.

![Figure 1](image)

What is the name of the component?

Draw a ring around the correct answer.

- diode
- filament bulb
- thermistor

(b) **Figure 2** shows a circuit containing a 6 V battery.

Two resistors, X and Y, are connected in parallel.

The current in some parts of the circuit is shown.

![Figure 2](image)

(i) What is the potential difference across X?

Potential difference across X = _______________ V
(ii) Calculate the resistance of \( X \).

\[
\text{Resistance of } X = \underline{\text{_____________}} \ \Omega
\]

(2)

(iii) What is the current in \( Y \)?

Current in \( Y = \underline{\text{_____________}} \ \text{A}

(1)

(iv) Calculate the resistance of \( Y \).

\[
\text{Resistance of } Y = \underline{\text{_____________}} \ \Omega
\]

(1)

(v) When the temperature of resistor \( X \) increases, its resistance increases.

What would happen to the:
- potential difference across \( X \)
- current in \( X \)
- total current in the circuit?

Tick (✓) three boxes.

<table>
<thead>
<tr>
<th>Potential difference across ( X )</th>
<th>Decrease</th>
<th>Stay the same</th>
<th>Increase</th>
</tr>
</thead>
<tbody>
<tr>
<td>Current in ( X )</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total current in the circuit</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(3)

(Total 9 marks)

Electrical circuits have resistance.

(a) Draw a ring around the correct answer to complete the sentence.

When the resistance of a circuit increases, the current in the circuit

decreases.
increases.
stays the same.

(1)
(b) Use the correct answer from the box to complete each sentence.

<table>
<thead>
<tr>
<th>a filament bulb</th>
<th>an LED</th>
<th>an LDR</th>
</tr>
</thead>
</table>

An electrical component which has a resistance that increases as the temperature increases is _________________________ .

An electrical component which emits light only when a current flows through it in the forward direction is _________________________ .

(2)

(c) When some metals are heated the resistance of the metal changes.

The equipment for investigating how the resistance of a metal changes when it is heated is shown in the diagram.
In this question you will be assessed on using good English, organising information clearly and using specialist terms where appropriate.

Describe an investigation a student could do to find how the resistance of a metal sample varies with temperature. The student uses the equipment shown.

Include in your answer:

• how the student should use the equipment

• the measurements the student should make

• how the student should use these measurements to determine the resistance

• how to make sure the results are valid.
The table shows some data for samples of four metals P, Q, R and S.

The metal samples all had the same cross-sectional area and were the same length.

<table>
<thead>
<tr>
<th>Metal sample</th>
<th>Resistance at 0°C in ohms</th>
<th>Resistance at 100°C in ohms</th>
</tr>
</thead>
<tbody>
<tr>
<td>P</td>
<td>4.05</td>
<td>5.67</td>
</tr>
<tr>
<td>Q</td>
<td>2.65</td>
<td>3.48</td>
</tr>
<tr>
<td>R</td>
<td>6.0</td>
<td>9.17</td>
</tr>
<tr>
<td>S</td>
<td>1.70</td>
<td>2.23</td>
</tr>
</tbody>
</table>

A graph of the results for one of the metal samples is shown.

(i) Which metal sample, P, Q, R or S, has the data shown in the graph? (1)

(ii) One of the results is anomalous. Circle this result on the graph. (1)
(iii) Suggest a reason for the anomalous result.
________________________________________________________________________
________________________________________________________________________

(iv) The same equipment used in the investigation could be used as a thermometer known as a ‘resistance thermometer.’

Suggest two disadvantages of using this equipment as a thermometer compared to a liquid-in-glass thermometer.

1. ____________________________________________________________
________________________________________________________________________

2. ____________________________________________________________
________________________________________________________________________

(Total 14 marks)
A student built a circuit using filament lamps.

(a) Sketch a current potential difference graph for a filament lamp on Figure 1

Figure 1

<table>
<thead>
<tr>
<th>Current</th>
<th>Potential difference</th>
</tr>
</thead>
</table>

(b) Compare the currents $I_1$, $I_2$ and $I_3$

___________________________________________________________________
___________________________________________________________________
___________________________________________________________________

Figure 2 shows the circuit with two identical filament lamps.

Figure 2

(b) Compare the currents $I_1$, $I_2$ and $I_3$

___________________________________________________________________
___________________________________________________________________
___________________________________________________________________

(2)
(c) Calculate the charge that flows through the cell in 1 minute.

Each filament lamp has a power of 3 W and a resistance of 12 Ω

Write any equations that you use.

Give the unit.

___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________

Charge = _________________

Unit = _________________

(6)

(d) The student builds a different circuit.

Figure 3 shows the circuit.
Explain how the readings on both meters change when the environmental conditions change.

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(6)  
(Total 16 marks)