GCSE SCIENCE WORKBOOK

electricity

Contents

Electricity

Equations

Whole topic summary https://youtu.be/jSA4WaLSVEA in only 10 minutes!!

Equation	Symbols	Units
Q = It	Q = Charge I = Current t = Time	Q = C (coulombs) I = A (amps) t = s (seconds)
V = IR	V = Potential difference I = Current R = Resistance	V = V (volts) I = A (amps) R = Ω (ohms)
P = VI	P = Power V = Potential difference I = Current	P = W (watts) V = V (volts) I = A (amps)
$P = I^2R$	P = Power I = Current R = Resistance	P = W (watts) I = A (amps) R = Ω (ohms)
E = Pt	E = Energy P = Power t = Time	E = J (joules) P = W (watts) t = s (seconds)
E = QV	E = Energy Q = Charge V = Potential difference	E = J (joules) Q = C (coulombs) V = V (volts)

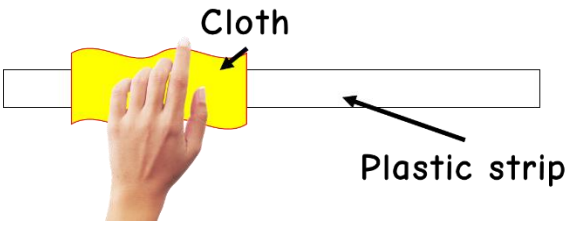
Static electricity

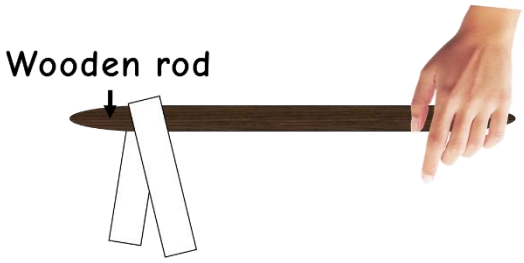
Knowledge Checklist

Specification statement These are the bits the exam board wants you to know, make sure you can do all of these…	**Self-assessment**		
	First review 4-7 months before exam	**Second review** 1-2 months before exam	**Final review** 1 week before exam
I can describe the circumstances in which an object might become charged **-Physics only**	☺ 😐 ☹	☺ 😐 ☹	☺ 😐 ☹

Practice Questions

1. A student uses some everyday items to investigate static electricity.





a. Complete the sentences below.

Rubbing the plastic strip with a cloth causes the strip to become negatively charged. This happens because _____ move from the cloth onto the plastic strip.

The cloth is then left with a _____ charge.

(2 marks)

b. When the plastic strip is hung over the wooden rod, the two halves of the strip move equally away from each other.

What conclusions can the student make about the forces acting on the two halves of the plastic strip?

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(2 marks)

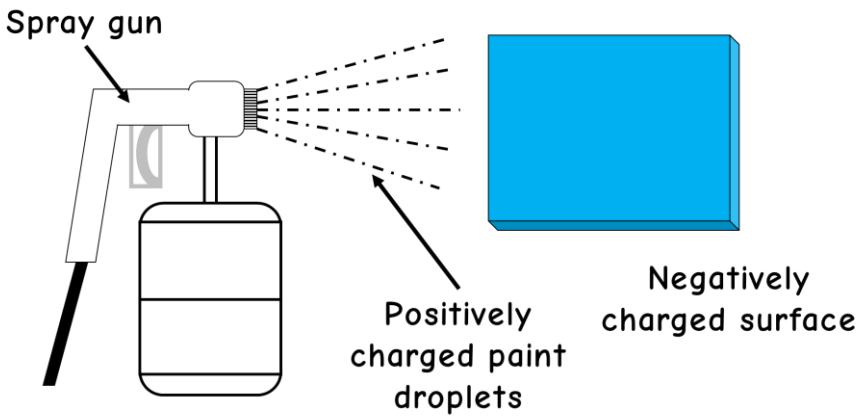
c. Electrical charges move more easily through some materials than through other materials. Through which one of the following materials would an electrical charge move most easily?

Draw a ring around your answer.

Aluminium Glass Rubber

(1 mark)

2. The diagram shows how static electricity is used to paint a metal car panel.



a. Use the words from the box to complete the following sentences.

Attract	Opposite	Repel	Same

All of the paint droplets have the _____ type of charge. This makes the paint droplets _____ each other and spread out.

The car panel and the paint droplets have the _____ type of charge. This causes the car panel to _____ the paint droplets.

The car panel is covered by an even layer of paint.

(4 marks)

b. In which one of the situations below is static electricity considered to be dangerous. Draw a ring around your answer and give a reason.

Using a photocopier Refuelling an aircraft

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(3 marks)

3. A student takes off his nylon fleece and feels a small electrical shock. He then realises that this happens because his fleece becomes charged.

a. Explain how his fleece becomes charged.

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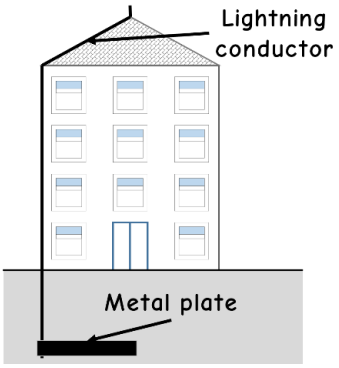
(2 marks)

b. The diagram shows a lightning conductor attached to the side of a building.



If the building is struck by lightning, the charge flows to the earth through the lightning conductor.

Which one of the materials below should be used to make the lightning conductor?

Copper Glass Plastic

Give a reason for your answer

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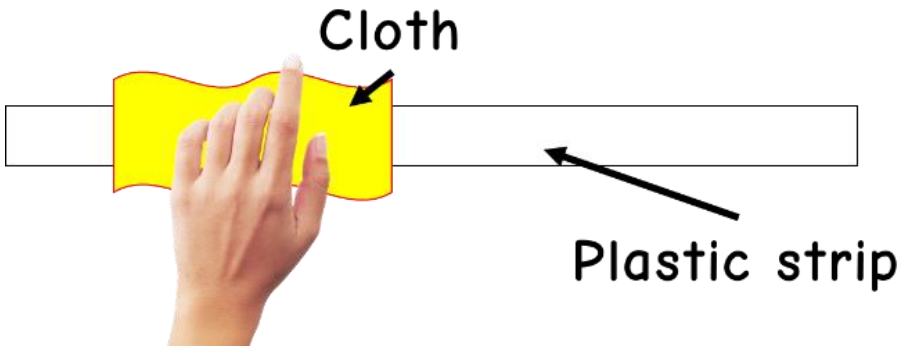
(3 marks)

4. The diagram shows a polythene rod being rubbed with a woollen cloth.



a. Explain how the polythene rod becomes negatively charged.

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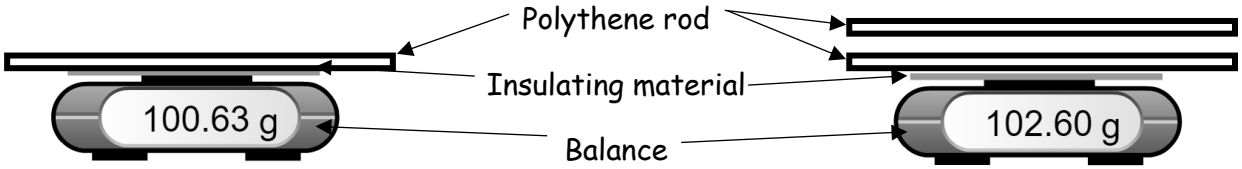
(2 marks)

b. A student put the charged polythene rod on to a balance. The rod was separated from the metal pan of the balance by a thin block of insulating material. The student then held a second charged polythene rod above (but not touching) the first rod. The reading on the balance increased.



Explain why the reading on the balance increases.

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(2 marks)

Electric fields

Knowledge Checklist

Specification statement These are the bits the exam board wants you to know, make sure you can do all of these…	**Self-assessment**		
	First review 4-7 months before exam	**Second review** 1-2 months before exam	**Final review** 1 week before exam
I can describe what happens what two charged objects are bought close together **-Physics only**	☺ 😐 ☹	☺ 😐 ☹	☺ 😐 ☹
I can state that a charged object creates an electric field around itself **-Physics only**	☺ 😐 ☹	☺ 😐 ☹	☺ 😐 ☹
I can draw the electric field pattern for an object **-Physics only**	☺ 😐 ☹	☺ 😐 ☹	☺ 😐 ☹

1. A van de Graaff generator that is used to investigate static electricity. Before it is switched on, the metal dome has no overall charge. After it is switched on, the metal dome becomes negatively charged.

   a. Explain how an uncharged object may become positively charged.

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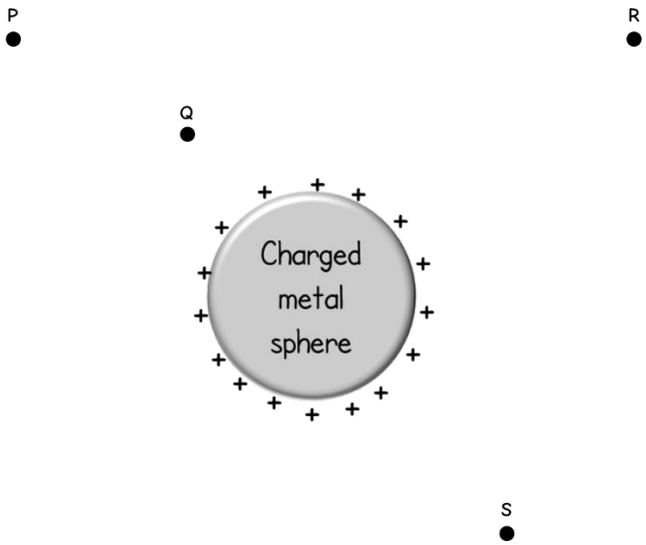
(5 marks)

b. The image below shows a plan view of the positively charged metal dome of a van de Graaff generator.

Draw the electric field pattern around the metal dome when it is not interacting with anything from its surroundings.

(2 marks)

c. Another positively charged object is placed in the electric field.



In which position would the object experience the greatest force?

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Explain your choice

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……..

(3 marks)

Circuit Symbols and Current

Knowledge Checklist

Specification statement These are the bits the exam board wants you to know, make sure you can do all of these…	**Self-assessment**			**Bits to help if you don't understand**
	First review 4-7 months before exam	**Second review** 1-2 months before exam	**Final review** Week before exam	
I can draw and use the common circuit symbols	☺ 😐 ☹	☺ 😐 ☹	☺ 😐 ☹	https://youtu.be/HiVcnpDQOcI
I can draw series and parallel circuits	☺ 😐 ☹	☺ 😐 ☹	☺ 😐 ☹	https://youtu.be/2QBTaq63mYk https://youtu.be/rbLqufYEVN8 https://youtu.be/xZXKaQW2jBc https://youtu.be/oBuewt6m_KM
I can define the terms charge and current	☺ 😐 ☹	☺ 😐 ☹	☺ 😐 ☹	https://youtu.be/k3vCg3lGpys
I can recall the units needed for Q = It	☺ 😐 ☹	☺ 😐 ☹	☺ 😐 ☹	
I can rearrange Q = It	☺ 😐 ☹	☺ 😐 ☹	☺ 😐 ☹	
I can use Q = It	☺ 😐 ☹	☺ 😐 ☹	☺ 😐 ☹	

1. Name a circuit component that is used to provide a current in a circuit.

……..

(1 mark)

2. Current, charge and time are linked together by the equation:

Charge = Current x time

Write down the units that we measure each quantity in from the equation.

Charge: ……..
Current: ……..
Time: ……..

(3 marks)

3. A circuit has a current of 3 amps.

a. Calculate the charge that flows in the circuit in 20 seconds.

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……..
……..

(2 marks)

b. Calculate the charge that flows in the circuit in 10 minutes.

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(3 marks)

4. Draw the circuit symbols for the following components:

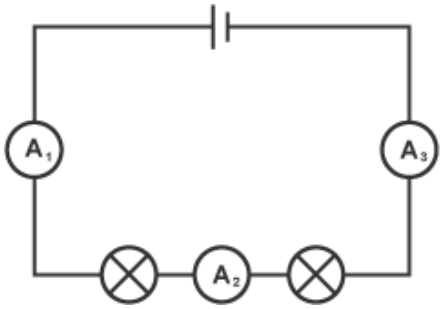
Ammeter	Resistor	LDR	Bulb	Voltmeter

(5 marks)

5. A circuit is needed to measure the current through a light emitting diode. A battery is provided. Draw the circuit diagram below.

(3 marks)

6. Use the diagram below to help you answer this question.



a. The current flowing through A_1 is 5A. What would the current be that is flowing through A_3?

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Justify your answer

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(2 marks)

b. Calculate the current that flows through each lightbulb in 1 hour. Give a unit for your answer.

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Charge: ……..

Unit: ……..

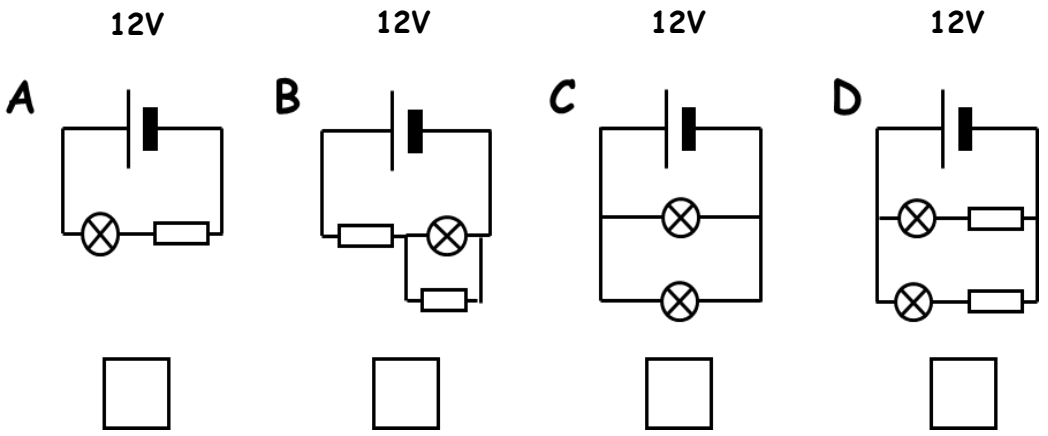
(4 marks)

Series and parallel

Knowledge Checklist

Specification statement These are the bits the exam board wants you to know, make sure you can do all of these…	**Self-assessment**			**Bits to help if you don't understand**
	First review 4-7 months before exam	**Second review** 1-2 months before exam	**Final review** 1 week before exam	
I can describe the way current behaves in a series circuit	☺ 😐 ☹	☺ 😐 ☹	☺ 😐 ☹	https://youtu.be/g2kUj3xfM90 https://youtu.be/E70eNm2lITI https://youtu.be/OdmmKxa0Nhs https://youtu.be/g2kUj3xfM90
I can describe the way potential difference behaves in a series circuit	☺ 😐 ☹	☺ 😐 ☹	☺ 😐 ☹	
I can describe the way resistance behaves in a series circuit	☺ 😐 ☹	☺ 😐 ☹	☺ 😐 ☹	
I can describe the way current behaves in a parallel circuit	☺ 😐 ☹	☺ 😐 ☹	☺ 😐 ☹	
I can describe the way potential difference behaves in a parallel circuit	☺ 😐 ☹	☺ 😐 ☹	☺ 😐 ☹	
I can describe the way resistance behaves in a parallel circuit	☺ 😐 ☹	☺ 😐 ☹	☺ 😐 ☹	

1. Look at the circuits below.



a. Put a tick in the box that shows the circuit with all of the components in series.
(1 mark)

b. In circuit A, the potential difference across the resistor is 8V. What is the potential difference across the lightbulb?

Potential difference: V

(1 mark)

c. Explain your answer to part b.

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(1 mark)

d. In circuit C, the two bulbs are identical. What is the potential difference across each of the bulbs?

Potential difference: V

(1 mark)

e. In circuit A, the current through the resistor is 1.5A. What is the value of the current that is flowing through the bulb?

Current: …….

(1 mark)

f. Explain your answer to part e.

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(1 mark)

2. A 13A current flows from a 230V mains electricity supply to a kettle. The kettle is on for 180s. Calculate:

a. The charge that flowed from the plug socket to the kettle:

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(2 marks)

b. The energy that is transferred from the kettle to heat the water:

……..

……..

(2 marks)

c. If all of the energy in b. was transferred to heat the water; use the following information to find the mass of water that was in the kettle.

- The starting temperature of the water was 22°C, and the kettle turned off when the water was boiling.
- The specific heat capacity of water is 4200J/kg.°C
- The equation for specific heat capacity is E = m x c x ΔT

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Mass: ……. kg

(5 marks)

Current, Voltage and Resistance.

Knowledge Checklist

Specification statement These are the bits the exam board wants you to know, make sure you can do all of these…	**Self-assessment**			**Bits to help if you don't understand**
	First review 4-7 months before exam	**Second review** 1-2 months before exam	**Final review** Week before exam	
I can define the terms potential difference and resistance	☺ 😐 ☹	☺ 😐 ☹	☺ 😐 ☹	https://youtu.be/k3vCg3lGpys
I can recall the units needed for V = IR	☺ 😐 ☹	☺ 😐 ☹	☺ 😐 ☹	
I can rearrange V = IR	☺ 😐 ☹	☺ 😐 ☹	☺ 😐 ☹	
I can use V = IR	☺ 😐 ☹	☺ 😐 ☹	☺ 😐 ☹	

Practice Questions

1. Complete the sentences below by using the words given.

Coulombs Current Voltage Increases Decreases

a. The potential difference is sometime called the _____.
(1 mark)

b. If the potential difference in a circuit increases, the current _____.
(1 mark)

c. If the resistance is increased for the same potential difference, the current _____.
(1 mark)

2. A circuit has a resistance of 20Ω.

Calculate the potential difference needed to give a current of 4A in the circuit.

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Potential difference: …….V

(3 marks)

3. A cell in a circuit provides a potential difference on 12V. The current in the circuit is 3A.

Calculate the resistance of the circuit. Give units with your answer.

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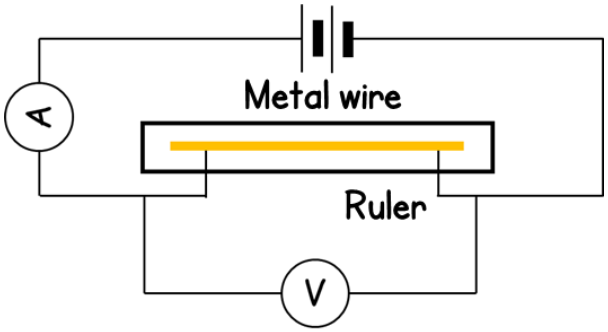
Resistance: …….

Unit: …….

(3 marks)

4. A student investigated how the resistance of a piece of wire depends on its length. The circuit used for this investigation and the results that were collected are shown below.



Length (m)	Resistance (Ω)
0.1	0.6
0.2	1.3
0.3	1.7
0.4	2.4
0.5	3.0

a. Describe how the student could have used the equipment above to collect the results in the table.

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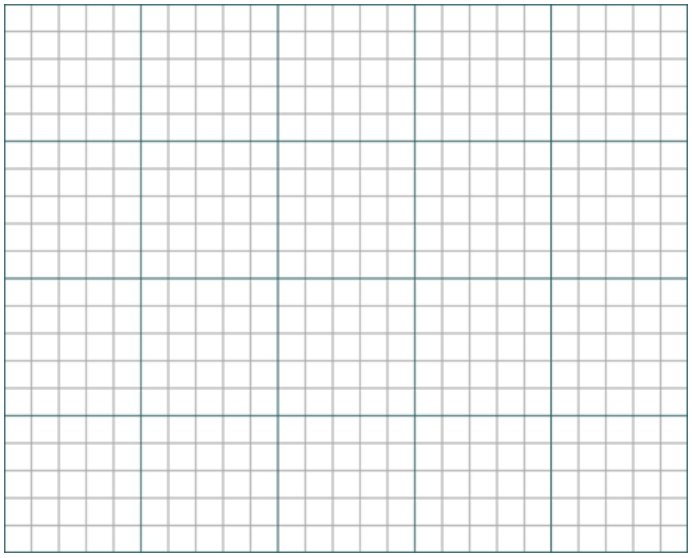
(3 marks)

b. Plot a graph of the data from the table in 4.1 onto the grid. Label the axes correctly and add a line of best fit.



(4 marks)

c. State one conclusion that the student can make about the relationship between the resistance of a wire and the length of it.

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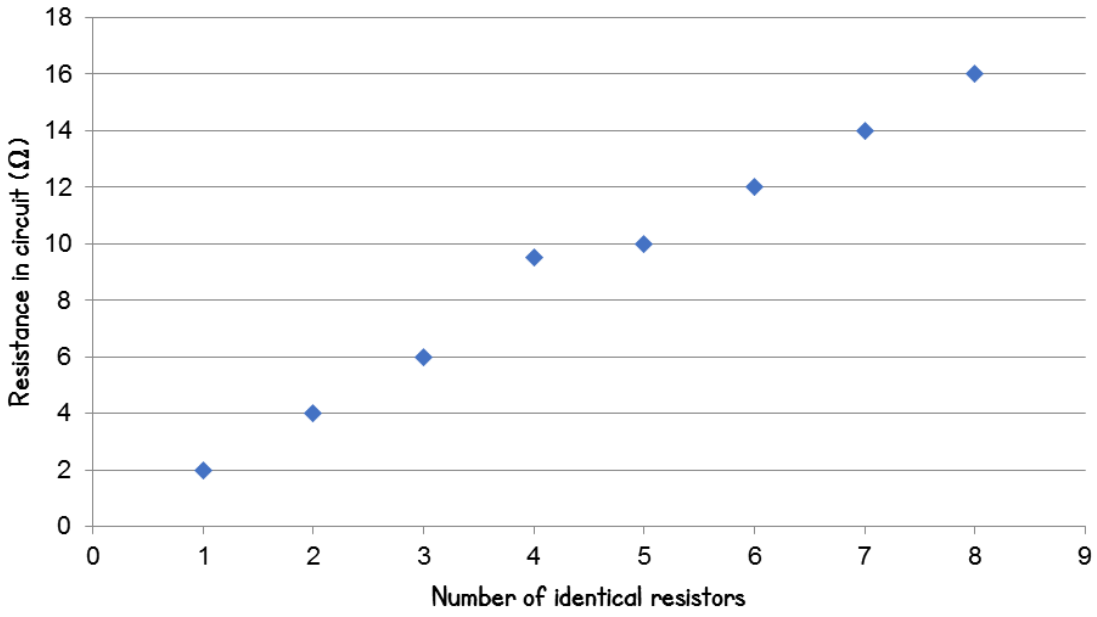
(1 mark)

5. Another student completed another practical where they investigated how adding identical fixed resistors in series affected the resistance of a circuit. Each resistor had a resistance of 2 Ohms. The results produced the following graph.



a. The student made a mistake when plotting their results. Circle the anomalous result.

(1 mark)

b. Add a line of best fit to the student's graph.

(1 mark)

c. Using the line of best fit, predict the value of the correct resistance of the circuit for the incorrectly plotted result.

Resistance: …….Ω

(1 mark)

d. This student now repeats the experiment using 1Ω and 5Ω resistors. Draw lines of best fit onto the graph above for the results you expect the student to obtain from the new investigations.

(2 marks)

6. A student wants to investigate how adding resistors in parallel affects the overall resistance of a circuit. Describe an experiment you could do to investigate this. You must include:

- A list of the equipment you would use
- A diagram of the circuit you would use
- A method of how you would intend to collect your results.

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(6 marks)

Ohmic conductors and semiconductors

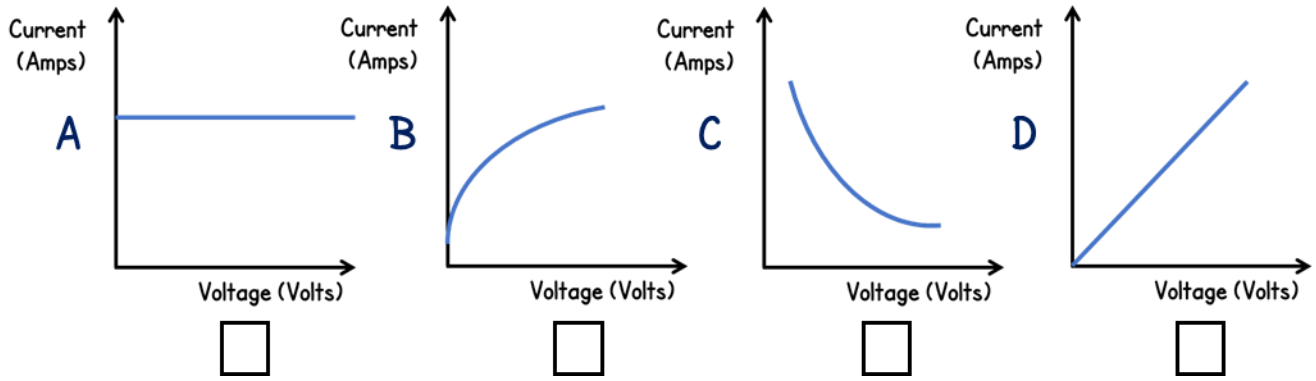
Knowledge Checklist

Specification statement These are the bits the exam board wants you to know, make sure you can do all of these…	**Self-assessment**			**Bits to help if you don't understand**
	First review 4-7 months before exam	**Second review** 1-2 months before exam	**Final review** 1 week before exam	
I can draw and explain current-potential difference graphs for ohmic conductors, filament lamps and diodes	☺ 😐 ☹	☺ 😐 ☹	☺ 😐 ☹	https://youtu.be/fxDNqQ3hH2A https://youtu.be/ylHsTMAGV1I

Practice Questions

1. The following four graphs plot current against potential difference.

   a. Select the graph below that shows the correct results for a resistor that is at a constant temperature. Tick one box.



(1 mark)

b. Name the type of relationship that is shown in d.

……..

(1 mark)

c. Use the words below to complete the sentences

Linear Non-Linear Non-Ohmic Ohmic

A resistor at a constant temperature is an example of a(n) _____ conductor. This produces a _____ graph.

(2 marks)

2.

a. Draw the circuit symbol for a diode in the box provided below.

(1 mark)

b. A student measured the resistance of an LDR using an electric circuit. He found the resistance to be 0.02Ω. The next day he measured the resistance again and found it to be 1000kΩ. Suggest why the results were so different. Assume that the circuit was working perfectly on both occasions.

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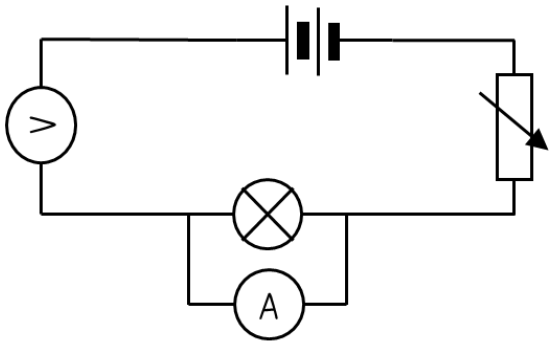
(2 marks)

3. A student set up the circuit below to find the I-V characteristic of a filament lamp.



a. Explain what is wrong with this circuit.

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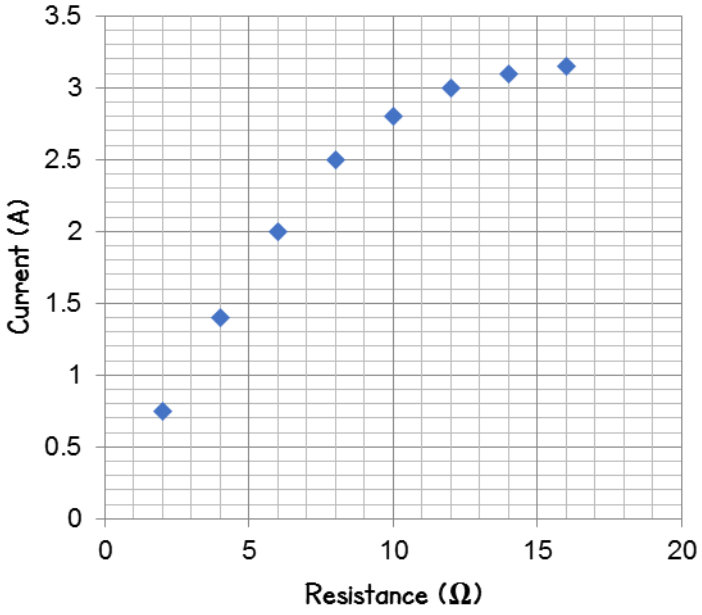
(2 marks)

After correcting the circuit, the student obtained the following graph of results.



b. Use this graph to find the PD of the lamp at 3A.

PD: V

(1 mark)

c. Add a line of best fit to the graph of the student's results.

(1 mark)

d. Using the graph, predict what the PD of the bulb would be when 1A of current is flowing through it.

PD: …….V

(1 mark)

e. What does the graph tell you about the lamp's resistance as the current increases? Explain why the resistance behaves in this way.

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(2 marks)

f. The student states that lamp behaves like an Ohmic conductor up until a certain potential difference.

Explain what is meant by an Ohmic conductor.

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……..

(2 marks)

g. Give an example of an Ohmic conductor.

……..

(1 mark)

h. Up to what potential difference does this filament lamp act like an Ohmic conductor?

Potential difference = _____V

(1 mark)

i. Explain your answer to part h.

……..

……..

(1 mark)

Sensor circuits

Knowledge Checklist

Specification statement These are the bits the exam board wants you to know, make sure you can do all of these…	**Self-assessment**			**Bits to help if you don't understand**
	First review 4-7 months before exam	**Second review** 1-2 months before exam	**Final review** Week before exam	
I can explain the change in resistance of a thermistor as the temperature changes	☺ 😐 ☹	☺ 😐 ☹	☺ 😐 ☹	https://youtu.be/2PdHk4wa5Bg https://youtu.be/Ra7sqF8oZxg
I can explain the change in resistance of an LDR as the light intensity changes	☺ 😐 ☹	☺ 😐 ☹	☺ 😐 ☹	https://youtu.be/Ra7sqF8oZxg https://youtu.be/iUnMBMmkxnY

Practice Questions

1. A pair of students investigate how the resistance of a thermistor changes when its temperature changes. They use a cell, an ammeter, a voltmeter, a thermistor and some connecting wires.

   a. Draw the circuit they should use in the space below.

(4 marks)

b. Explain why the students need to measure both the voltage and current across the thermistor.

……..

……..

(1 mark)

2. Complete the sentences below using the words given. You may use a word more than once, or not at all.

Brightness Decreases Increases Temperature

a. When the potential difference across a filament lamp _____, its resistance _____.

(2 marks)

b. When the _____ of the thermistor increases, its resistance _____ .

(2 marks)

c. When the _____ decreases, the resistance of an LDR _____.

(2 marks)

3. A simple fire alarm sounds a buzzer if the temperature gets too high. These sentences explain how it works.

Number the sentences to put them in order.

☐ If there is a fire, the temperature rises and so the resistance of the thermistor goes down.

☐ When the thermistor is cold, the resistance is high.

☐ The circuit includes a cell, a thermistor, and a buzzer.

☐ This allows a bigger current to flow in the circuit, so the buzzer sounds.

☐ Only a very small current can flow in the circuit, so the buzzer does not sound.

(5 marks)

4. A fridge has a thermostat that turns the cooling system on if the temperature of the fridge gets too high.

A thermistor can be used in this circuit to make sure that the fridge stays at a constant temperature.

Explain how this circuit works.

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(3 marks)

5. Most street lamps have a sensor that switches the lights on when it gets too dark. Before LDR's were used, street lamps would have been switched on manually.

a. Suggest why street lights have been fitted with LDR's.

……..

……..

(1 mark)

b. The circuit that controls the street lamp is made from a fixed resistor, and LDR, a lamp, and some connecting wires.

In the space below, sketch the circuit that is used in street lamps to turn them on when it gets too dark.

(4 marks)

c. Explain, in words, how this circuit works.

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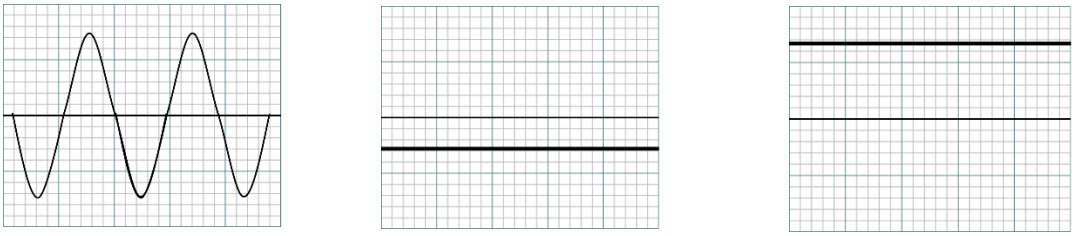
(5 marks)

AC and DC

Knowledge Checklist

Specification statement These are the bits the exam board wants you to know, make sure you can do all of these…	**Self-assessment**		
	First review 4-7 months before exam	**Second review** 1-2 months before exam	**Final review** Week before exam
I can recall the voltage and frequency of mains electricity in the UK	☺ 😐 ☹	☺ 😐 ☹	☺ 😐 ☹
I can explain the difference between direct current and alternating current	☺ 😐 ☹	☺ 😐 ☹	☺ 😐 ☹

1. The diagram shows the traces produced on an oscilloscope when it is connected across different electricity supplies.



a. Which of the traces could have been produced by a mains electricity supply?

……..

(1 mark)

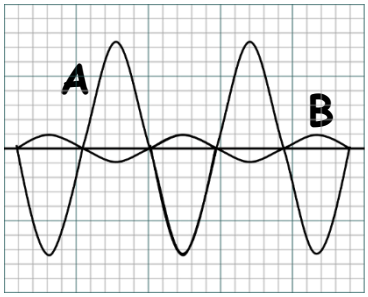
b. Give a reason for your answer.

……..

……..

(1 mark)

2. Two oscilloscope traces are shown in the diagram.



a. Each division represents 0.005s.

What is the time period of this electricity supply?

……..

……..

Time period: _____s

(3 marks)

b. What is the frequency of this electricity supply?

……..

……..

Frequency: _____Hz

(2 marks)

c. Trace A shows how the potential difference between the live and neutral terminals of an electricity supply changes with time.

Describe how the potential difference of the live terminal varies with respect to the neutral terminal of the electricity supply

……..

……..

……..

……..

(3 marks)

3. A student wants to investigate the how the current through a diode varies with the resistance in a circuit.

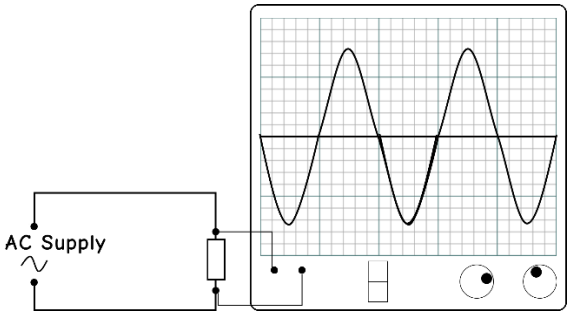
a. In the boxes below, draw the symbol for a diode and a variable resistor.

Diode	Variable resistor

(2 marks)

b. The diagram shows the trace produced by an AC supply on an oscilloscope.

Each horizontal division on the oscilloscope screen represents a time of 0.1s. What is the frequency of this supply?



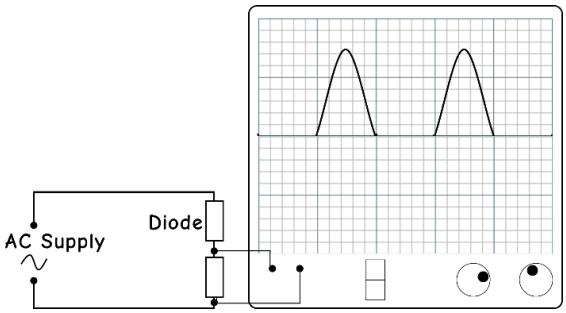
……..

……..

Frequency:_____Hz

(3 marks)

c. A diode is now connected in series with the AC power supply.



Why does the diode cause the trace on the oscilloscope screen to change?

.....

.....

.....

.....

(3 marks)

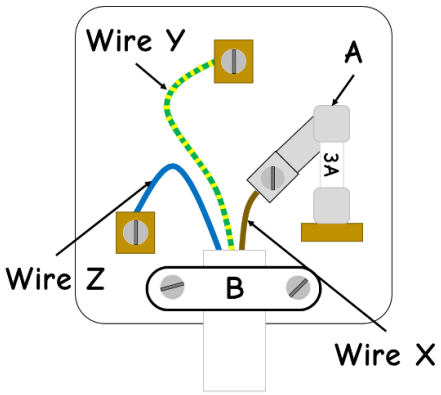
Plugs and the earth wire

Knowledge Checklist

Specification statement These are the bits the exam board wants you to know, make sure you can do all of these…	**Self-assessment**			**Bits to help if you don't understand Primrose Kitten**
	First review 4-7 months before exam	**Second review** 1-2 months before exam	**Final review** Week before exam	
I can describe the inside of a plug	☺ 😐 ☹	☺ 😐 ☹	☺ 😐 ☹	https://youtu.be/Ke4yyUZH-hY
I can describe the safety features of a plug	☺ 😐 ☹	☺ 😐 ☹	☺ 😐 ☹	

Practice Questions

1.



a. Name the parts of the plug labelled A and B.

A _____

B _____

(2 marks)

b. Name the colour of each of the wires X, Y, and Z.

X _____

Y _____

Z _____

(3 marks)

c. Suggest a material that the case of the plug can be made from.

……..

……..

(1 mark)

d. Define what electric current is, and state the equation that links together current, charge, and time.

……..

……..

(2 marks)

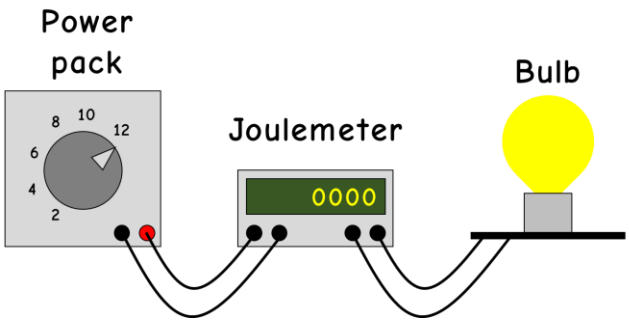
Power, energy and charge

Knowledge Checklist

Specification statement These are the bits the exam board wants you to know, make sure you can do all of these…	**Self-assessment**		
	First review 4-7 months before exam	**Second review** 1-2 months before exam	**Final review** Week before exam
I can describe how power in a circuit is related to the potential difference	☺ 😐 ☹	☺ 😐 ☹	☺ 😐 ☹
I can recall the units needed for P = VI	☺ 😐 ☹	☺ 😐 ☹	☺ 😐 ☹
I can rearrange P = VI	☺ 😐 ☹	☺ 😐 ☹	☺ 😐 ☹
I can use P = VI	☺ 😐 ☹	☺ 😐 ☹	☺ 😐 ☹
I can recall the units needed for $P = I^2R$	☺ 😐 ☹	☺ 😐 ☹	☺ 😐 ☹
I can rearrange $P = I^2R$	☺ 😐 ☹	☺ 😐 ☹	☺ 😐 ☹
I can use $P = I^2R$	☺ 😐 ☹	☺ 😐 ☹	☺ 😐 ☹
I can describe how domestic appliances transfer energy	☺ 😐 ☹	☺ 😐 ☹	☺ 😐 ☹

I can recall the units needed for E = Pt	☺ 😐 ☹	☺ 😐 ☹	☺ 😐 ☹
I can rearrange E = Pt	☺ 😐 ☹	☺ 😐 ☹	☺ 😐 ☹
I can use E = Pt	☺ 😐 ☹	☺ 😐 ☹	☺ 😐 ☹
I can recall the units needed for E = QV	☺ 😐 ☹	☺ 😐 ☹	☺ 😐 ☹
I can rearrange E = QV	☺ 😐 ☹	☺ 😐 ☹	☺ 😐 ☹
I can use E = QV	☺ 😐 ☹	☺ 😐 ☹	☺ 😐 ☹

1. A student used a joule meter to measure the energy transformed by a lamp.



The student set the joule meter to 0, and then switched on the power supply. After 120 seconds, the reading on the joule meter had increased to 2880.

a. In the space below, draw the circuit symbol that is used to represent a lamp.

(1 mark)

b. Use the equation below to calculate the power of the lamp

$$\text{Power} = \frac{\text{energy transformed}}{\text{time}}$$

Show clearly how you calculate your answer.

Include a unit in your answer.

.....

.....

Power = _____

Unit = _____

(2 marks)

c. Complete the following sentence by using one of the phrases from below.

Larger than The same as Smaller than

If the lamp was switched on for 10 minutes, the amount of energy transformed would be _____ the amount of energy transformed in 2 minutes.

(1 mark)

2. a. Write down the equation that shows the relationship between the electric current, the power and the voltage.

……..

……..

(1 mark)

b. Calculate the energy transferred by a device that has a potential difference of 400,000V, that has transferred 2000C of charge. Show clearly how you work out your answer.

Give a unit to your answer

……..

……..

Energy: _____

Unit:_____

(3 marks)

3.

a. State the potential difference of the UK mains electricity supply.

……..

……..

(1 mark)

b. A cooker is connected to the UK mains supply. This electricity supply causes a current of 11 amps to flow to the cooker.

Calculate the amount of charge that flows through the cable when the cooker is switched on for 2 hours.

……..

……..

Charge:_____C

(3 marks)

c. Calculate the energy transferred by the cooker in 2 hours.

……..

……..

Energy transferred:_____J

(1 mark)

d. A device like a cooker will have an earth wire attached to the casing. This will prevent the user from receiving an electric shock if the live wire was to touch the casing.

Explain how the earth wire works to prevent the user from being electrocuted.

……..

……..

……..

……..

……..

……..

(3 marks)

Answers

Static electricity answers

1.

a. Electron (1 mark); Positive (1 mark)
b. 1. The forces are the same size – the strips move the same distance apart (1 mark); 2. The charges are opposite – the strips are repelling (1 mark).
c. Aluminium (1 mark)

2.

a. Same (1 mark); Repel (1 mark); Opposite (1 mark); Attract (1 mark).
b. Refuelling an aircraft (1 mark)
Static electricity can create a spark (1 mark);
This could cause the fuel to catch fire (1 mark)

3.

a. Electrons are transferred (1 mark); From the student to the fleece (1 mark).
b. Copper (1 mark); Copper is a conductor (1 mark); allowing electrical energy to flow to the ground (1 mark).

4.

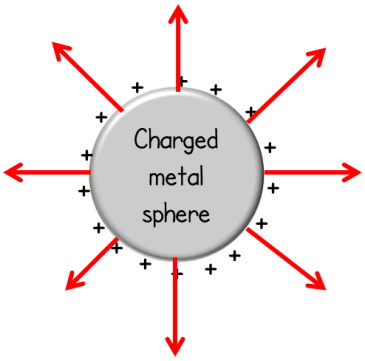
a. Electrons are transferred (1 mark) from the cloth to the rod (1 mark).
b. The charges on the rods repel (1 mark); increasing the downward force on the balance (1 mark).

Electric fields answers

1.

a. Electrons are transferred (1 mark); From one object to another (1 mark); This creates more negative charge than positive charge on one of the objects (1 mark); Creating an overall negative charge on one of the objects (1 mark); And an overall positive charge on the other object (1 mark).

b.



c. Q (1 mark); Q is closest to the sphere (1 mark); The closer the charges, the stronger the force felt OR the force felt decreases with distance (1 mark).

Circuit symbols and current answers

1. Cell OR Battery OR Power pack (1 mark).

2. Coulombs (1 mark); Amps (1 mark); Seconds (1 mark).

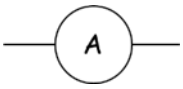
3.

a. Q = 3A x 20s (1 mark)
Q = 60C

b. 10 minutes = 600 seconds (1 mark)
Q = 3A x 600s (1 mark)
Q = 1800C (1 mark)

4.

Ammeter

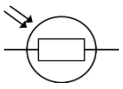


(1 mark)

Resistor


(1 mark)

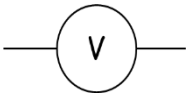
LDR


(1 mark)

Bulb

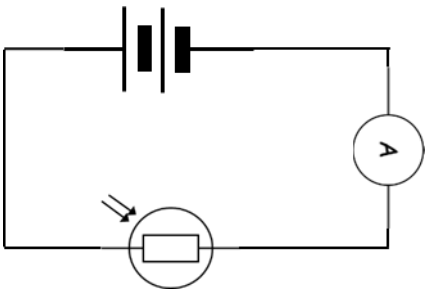

(1 mark)

Voltmeter



(1 mark)

5.



[1 mark per correct symbol]

6.

a. 5A (1 mark)
The current flowing in a series circuit is the same at all points (1 mark)
b. 1 hour = 3600s (1 mark)
Q = 5A x 3600s (1 mark)
Q = 18,000 (1 mark) C (1 mark)

Series and parallel answers

1.

a. Circuit A ticked (1 mark).
b. 4 (1 mark) V
c. The potential difference is shared across all components in a series circuits (1 mark).
d. 12 (1 mark) V
e. 1.5 (1 mark) A
f. The current flowing in a series circuit is the same at all points (1 mark).

2.

a. Q = 13A x 180s (1 mark)
Q = 2340 C (1 mark)
b. E = 230V x 2340C (1 mark)
E = 538,200J (1 mark)
c. ΔT = (100-22) = 78°C (1 mark)
538,200J = m x 4200 x 78 (1 mark)
538,200/(4200 x 78) = m (1 mark)
m = 1.64 (1 mark) kg

Current, voltage and resistance answers

1.

a. Voltage (1 mark)
b. Increases (1 mark)
c. Decreases (1 mark)

2. V = 4A x 20Ω (1 mark)

V = 80 (1 mark) V

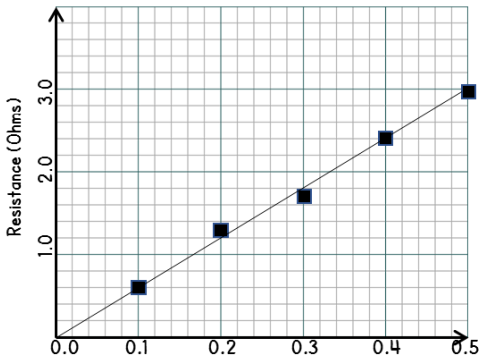
3. R = 12/3 (1 mark)

R = 4 (1 mark) Ω (1 mark)

4.

a. Recorded the current and voltage for different lengths of wire (1 mark)
Used V/I to calculate resistance (1 mark).

b.



Points plotted within +/- ½ a square (2 marks); Line of best fit (1 mark); good scale and axes (1 mark)

c. As the length of the wire increases, the resistance increases (1 mark).
d. Point at (4,9) circled (1 mark).
e. 8 (1 mark) Ohms
f. 5Ω resistors line of best fit with a steeper gradient (1 mark) and 1Ω line of best fit with a more shallow gradient (1 mark)

6. Equipment list [1 mark for main pieces of equipment]

- Ammeter
- Voltmeter
- Wires
- Power pack
- Resistors

[1 mark for each correct step]

1. Turn on the power pack and measure the current flowing through the resistor.
2. Measure the potential difference across the resistor.
3. Use R = V/I to calculate the resistance of the circuit.
4. Turn the power pack off.
5. Add another resistor and repeat steps 1-4.

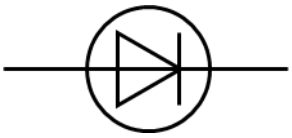
Ohmic conductors and semiconductors answers.

1.

a. Graph *D* ticked. (1 mark)
b. A proportional relationship (1 mark)
c. Ohmic (1 mark); linear (1 mark).

2.

a.



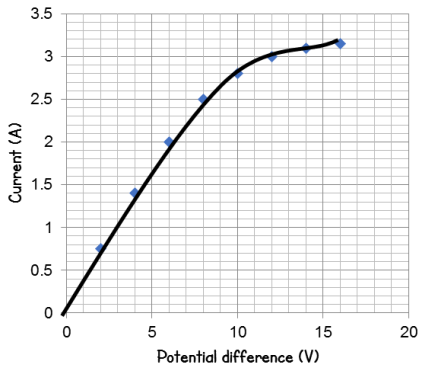
(1 mark)

b. The resistance of the LDR depends on light (1 mark); So it must have been darker in the room (1 mark).

3.

a. Ammeter should be in series (1 mark)
Voltmeter should be in parallel (1 mark)
b. 12 (1 mark) V

c.



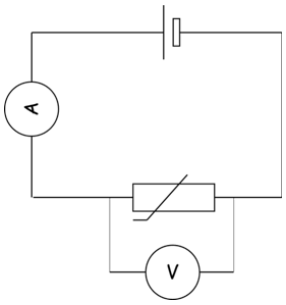
Curved line of best fit that passes through all points (1 mark).

d. 3 (1 mark) V
e. As the current increases, the resistance increases (1 mark); Resistance increases with temperature in a filament lamp (1 mark).
f. A component where the current is *proportional* to the potential difference (1 mark); at a constant temperature (1 mark).
g. Resistor OR Variable resistor (1 mark)
h. 6 (1 mark) V
i. Up to this point, the current is *proportional* to the potential difference (1 mark).

Sensor circuits answers

1.

a.



Ammeter is in series (1 mark); Voltmeter is in parallel (1 mark); correct symbols for cell and variable resistor (2 marks).

b. Both current and voltage must be measured to calculate the resistance (1 mark).

2.

a. Increases (1 mark); Increases (1 mark).
b. Temperature (1 mark); Decreases (1 mark).
c. Brightness (1 mark); Increases (1 mark).

3.

4 (1 mark); 2 (1 mark); 1 (1 mark); 5 (1 mark); 3 (1 mark)

4.

At low temperatures, the resistance of the thermistor is high (1 mark).

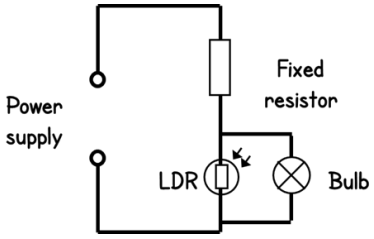
As the fridge gets warmer, the resistance decreases (1 mark).

This allows the current to flow to power the cooling system (1 mark).

5.

a. To save electricity (or another reasonable explanation) (1 mark).

b.



c. When it is light, the resistance of the LDR is low (1 mark); allowing current to flow through the LDR (1 mark); As it gets darker, the resistance of the LDR increases (1 mark); causing more current to flow through the bulb (1 mark); turning the bulb on (1 mark).

AC and DC answers

1.

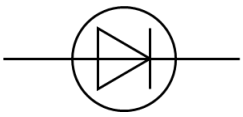
a. A (1 mark)
b. As the direction of the trace is constantly changing (1 mark).

2.

a. 10 squares across (1 mark); T = 10 x 0.005 (1 mark); T = 0.05s (1 mark).
b. f = 1/T = 1/0.05 (1 mark); f = 20 (1 mark) Hz.
c. The live terminal varies between a large positive and large negative value (1 mark); The neutral terminal is close to 0V (1 mark); When the live reading is a maximum, the neutral reading is at a minimum (1 mark).

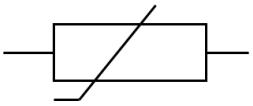
3.

a. Diode



(1 mark)

Variable resistor



(1 mark)

b. 4 squares across – T = 0.4s (1 mark)
f = 1/T = 1/0.4 = 2.5 (1 mark) Hz
c. Diode only allows a current to flow in one direction (1 mark); This means that only the current in one direction will be allowed through from the AC power supply (1 mark); anything below 0V will appear flat (1 mark),

Plugs and the earth wire

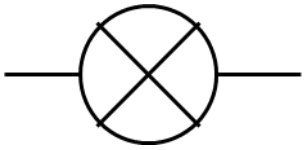
1.

a. Fuse (1 mark); Cable grip (1 mark).
b. Brown (1 mark); Green and yellow (1 mark); Blue (1 mark).
c. Plastic OR ceramic (1 mark).
d. Electric current in how much charge flows per second (1 mark);
   Q = I x t (1 mark).

Power, energy and charge answers

1.

a.



(1 mark)

b. P = 2880J/120s (1 mark)
   P = 24 (1 mark) W (1 mark)
c. Larger than (1 mark).

2.

a. V = E / Q (1 mark)
b. E = 400,000 x 2,000 (1 mark)
   E = 800,000,000 (1 mark) Joules (1 mark)

3.

a. 230 V (1 mark)
b. t = 2 x 60 x 60 = 7200 s (1 mark)
   Q = I x t = 7200 x 11 (1 mark)
   Q = 79,200 (1 mark) C
c. E = V x Q = 230 x 79,200 (1 mark)
   E = 18, 216, 000 (1 mark) J
d. Earth wire is connected to the ground (0V) (1 mark); And provides a safe route for current to flow if live wire touches casing (1 mark); The earth wire has a low resistance to make it easier for current to flow through it (1 mark).