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Examiners' Report
June 2022

GCSE Combined Science 1SC0 2PH

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June 2022

Publications Code 1SC0_2PH_2206_ER

Introduction

Candidates taking this examination had their education disrupted over the past two years by the Covid crisis. The learning experiences of these candidates therefore varied widely. Due to this, an Advance Information Document was issued to all centres which allowed teachers the option of concentrating on certain parts of the specification when teaching time had been reduced. An extra formulae sheet was also given out with the examination paper. The formulae sheet gave all the equations used in the specification reducing the need to be able to recall some equations.

Question were set using the following topics:

- Topic 1 – Key concepts in physics.
- Topic 8 – Energy-forces doing work.
- Topic 10 – Electricity and circuits.
- Topic 12 – Magnetism and the motor effect.
- Topic 14 – Particle model.

The examination tested knowledge, understanding, analysis and evaluation. The core practicals that were assessed were electrical circuits from Topic 10, density of solids and liquids from Topic 14 and determining the specific heat capacity of water also from Topic 14. Candidates were more able to deal with electrical circuits and were less familiar with the investigation to determine the specific heat capacity of water. The majority of candidates were able to use their mathematical skills to evaluate a quantity using an equation, however finding the gradient of a curve at a point proved to be more challenging. Diagrams that were given on the examination paper were often not used to the best effect especially when the information from the diagram was needed to answer the question. Adding to diagrams was not done carefully enough and circuit diagrams were poorly drawn. Examples of the skills that need to be practised will be given in the report.

Question 1 (a)(i)

This was a calculation to find the resistance of a lamp. Potential difference, current and equation with R was the subject given.

This was a substitution into a given equation.

(i) Calculate the resistance of the lamp.

Use the equation

$$R = \frac{V}{I} \qquad \frac{4.5}{0.30} = 15$$

(1)

resistance = 15 Ω

ResultsPlus
Examiner Comments

Substitution shown and evaluation correct.

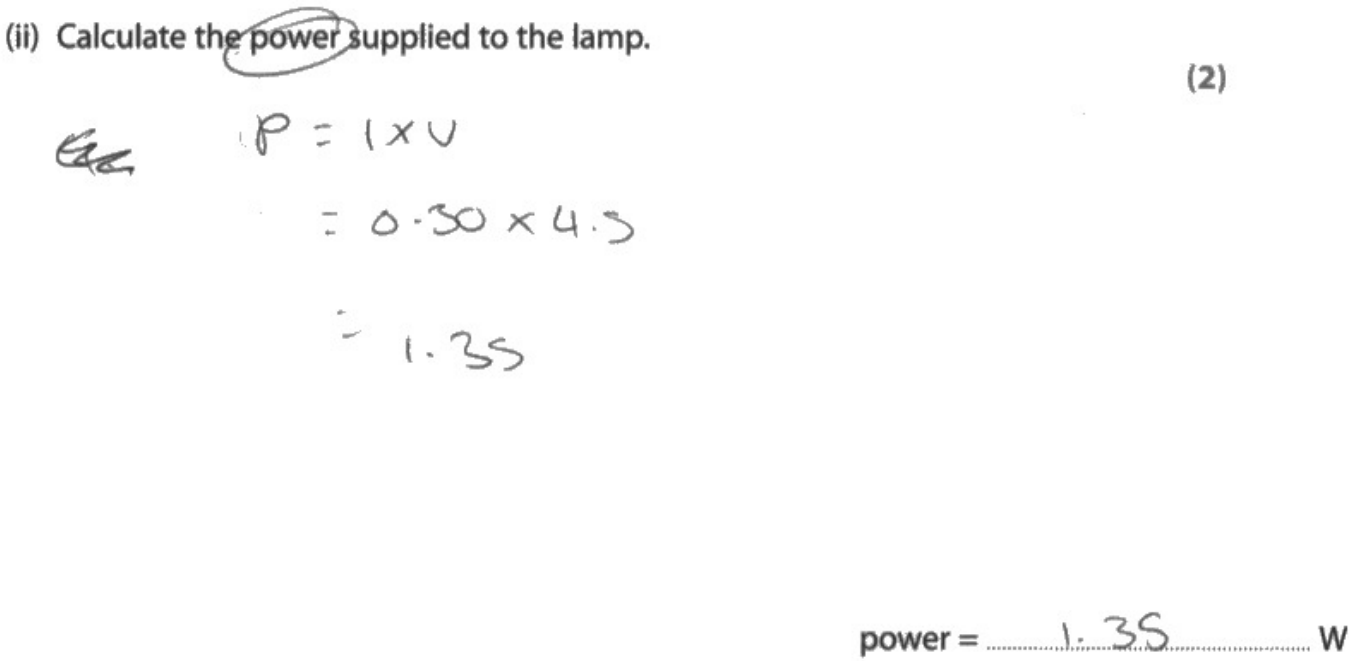
ResultsPlus
Examiner Tip

Show the substitution before giving the answer on the answer line.

Question 1 (a)(ii)

This was a calculation to determine the power of a lamp, the values in the stem of the question can be used with the equation P=V x I.

This equation P=V x I was given on the additional formulae sheet.



ResultsPlus
Examiner Comments

P=V x I is the best equation to use as the values of V and I are given in the question.

Using the other equations for power to get the correct answer relies on the value of resistance to have been correctly calculated.

ResultsPlus
Examiner Tip

Use values from the stem of the question and not calculated values which may be incorrect.

Question 1 (b)

The question tests knowledge of potential difference, current and resistance in circuits.

Look carefully at the two circuits Figure 1 and Figure 2. Note the lamps are identical and the power supply provides the same potential difference.

In this example the candidate states which circuit has the brighter lamp and then explains this is because the voltage is shared in the second circuit.

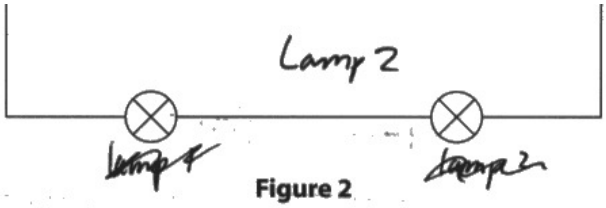


Figure 2

The power supply provides the same potential difference as it provided in the circuit in Figure 1.

State and explain the difference between the brightness of the lamp in Figure 1 and the brightness of a lamp in Figure 2.

(3)

lamp 1 will be brighter ~~ben~~ than lamp 2 because it is using all the voltage for itself but the lamps in figure will be dimmer because they are sharing potential difference.

ResultsPlus
Examiner Comments

There are three marks for this question. Giving that circuit 1 has the brighter lamp scores 1 mark. The voltage is shared scores 1 mark.

To get a third mark something needs to be added about the current in the circuit or the resistance of two lamps compared to one.

ResultsPlus
Examiner Tip

Look at the marks awarded to a question and remember one mark will be awarded for each point that is made.

Question 1 (c)

Candidates had to draw a circuit to measure the resistance of 50cm of resistance wire being given a low voltage power supply, 1m of resistance wire and other pieces of equipment.

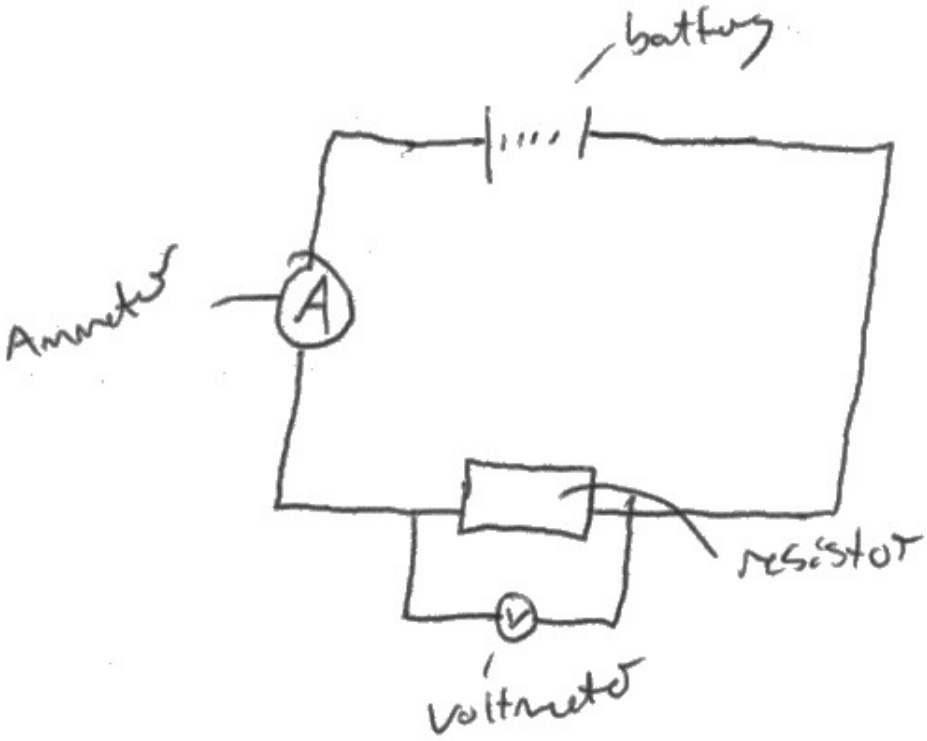
The other additional piece of equipment that could be used is an ohmmeter in place of the ammeter and voltmeter. This can be used to measure the resistance of the 50cm of wire by putting it across the ends of the wire. If an ohmmeter is used, the low voltage power supply must be removed from the circuit

This candidate has chosen the other pieces of equipment needed to make the measurement of resistance and has added to the circuit an ammeter and voltmeter.

Draw a diagram of the circuit that the student should use.

Your circuit diagram should identify the pieces of equipment that the student uses.

(3)



ResultsPlus
Examiner Comments

The ammeter and the voltmeter are placed correctly in the circuit to measure the resistance of a resistor but the 50cm of wire has not been put in the circuit.

ResultsPlus
Examiner Tip

Read the question carefully and include what is asked for in the diagram, not just what you used when you set up your circuit.

This candidate has set up the correct circuit with the ammeter and voltmeter and also shows that the voltmeter is across the 50cm of wire.

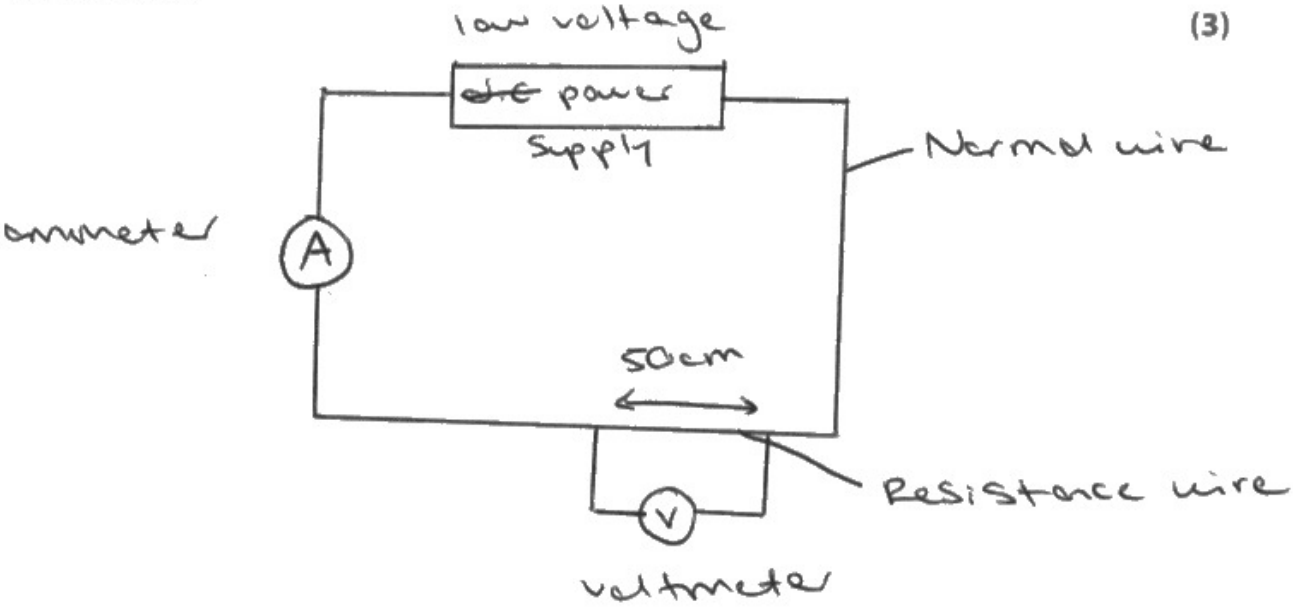
(c) A student is given a low voltage power supply and 1 m of resistance wire.

The student uses these and other pieces of equipment to measure the resistance of just 50 cm of the resistance wire.

Draw a diagram of the circuit that the student should use.

Your circuit diagram should identify the pieces of equipment that the student uses.

(3)



ResultsPlus
Examiner Comments

The circuit diagram uses symbols and labelling to show everything in the circuit that is required.

ResultsPlus
Examiner Tip

Circuit diagrams are always clearer and look better if they are drawn using a ruler.

Question 2 (b)

This question tested knowledge of an experimental technique, determining volume by displacement of water. The volume determined using the diagram was then used to find the mass of the object being given the density.

The equation density = mass/volume was given but needed to be rearranged to find the mass. The answer then had to be given to two significant figures.

This response is completely correct and gains 4 marks.

Give your answer to 2 significant figures.

(4)

$m = d \times V$

$7.9\,g/cm^3 \times 40$ $530 - 490 = 40$

316 → 2 S.F =

320

mass = 320 g

ResultsPlus Examiner Comments

The candidate uses the diagram and notes the volume of water is 490 cm^3. The question states that when the piece of iron is lowered into the measuring cylinder the water level rises to 530cm^3 – giving 40cm^3 for the volume of the piece of iron.

Rearranging the equation the mass of iron is found to be 316 gm.

The answer expressed as 2 significant figures is 320 gm.

ResultsPlus Examiner Tip

Look carefully at the diagram to get the information needed to complete the calculation.

This response shows a common error.

The candidate did not use the information from the diagram to determine the volume of the piece of iron.

Give your answer to 2 significant figures.

(4)

mass = density x volume

7.9 x 530 = 4187

mass = 4200 g

ResultsPlus
Examiner Comments

The information in the question states that the water level in the measuring cylinder rises to 530 cm^3. This candidate, like many others took 530 cm^3 to be the volume of the iron and completed the calculation with the incorrect volume.

In this example the incorrect volume 4178 cm^3 was written as 4200 cm^3 and the independent mark for giving the answer to 2 significant figures was awarded.

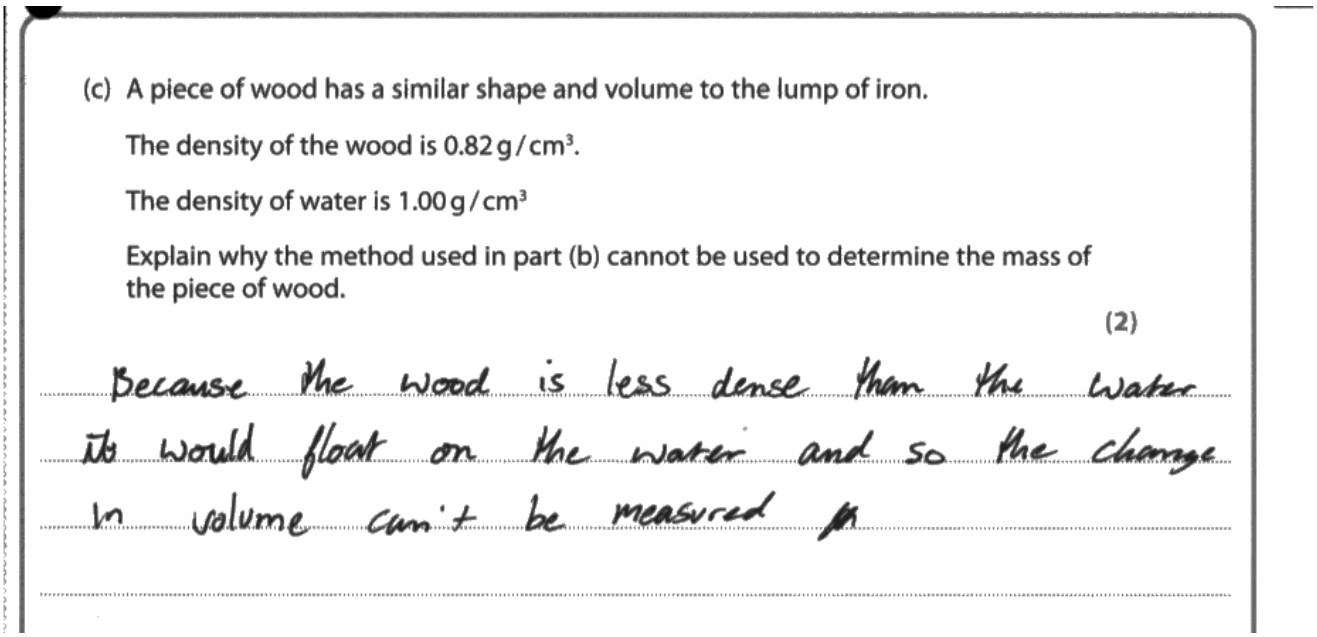
ResultsPlus
Examiner Tip

Think about the values you are using, look at the diagram, if there are about 500cm^3 of water then the piece of iron, which is obviously much smaller, cannot be 530cm^3.

Question 2 (c)

The understanding of experimental practice is continued by replacing the piece of iron with a piece of wood of similar shape.

This response shows that the information in the question has been used to draw a conclusion as to why the method used for the piece of iron would not be suitable for determining the mass of a piece of wood.



(c) A piece of wood has a similar shape and volume to the lump of iron.

The density of the wood is 0.82 g / cm^3.

The density of water is 1.00 g / cm^3

Explain why the method used in part (b) cannot be used to determine the mass of the piece of wood.

(2)

Because the wood is less dense than the water its would float on the water and so the change in volume can't be measured

ResultsPlus
Examiner Comments

The values of density of wood and water are compared and the candidate realises that the wood will float and therefore this method cannot be used to determine the volume of the wood.

ResultsPlus
Examiner Tip

Use the information in the question as a basis for an explanation.

There are other possible reasons apart from the difference in density for the method of displacement of water not being used to determine the volume of wood.

(c) A piece of wood has a similar shape and volume to the lump of iron.

The density of the wood is 0.82 g / cm³.

The density of water is 1.00 g / cm³

Explain why the method used in part (b) cannot be used to determine the mass of the piece of wood.

(2)

Wood absorbs water therefore an accurate volume cannot be obtained

ResultsPlus
Examiner Comments

This candidate gives the reason that water would be absorbed by the wood. This is a credible answer and was accepted.

ResultsPlus
Examiner Tip

Better to use the information in the question rather than thinking up some other reason.

Question 2 (d)

This question tested the meaning of sublimation.

The response is an accurate description of sublimation.

(d) Describe what happens when a substance experiences sublimation.

(2)

It is when the substances goes straight from a solid no gas.

ResultsPlus
Examiner Comments

Knowing sublimation was a change of state would gain one mark.

ResultsPlus
Examiner Tip

If you are unsure of the correct answer, always write down anything relevant that you do know.

Question 3 (a)(i-ii)

This question tested knowledge of magnetic fields and how they are represented diagrammatically.

The diagram given was the representation of a magnetic field around a bar magnet.

Candidates had to add to the diagram to show the direction of the magnetic field and at which point the magnetic field is strongest.

3 (a) Figure 4 shows the shape of the magnetic field near a bar magnet.

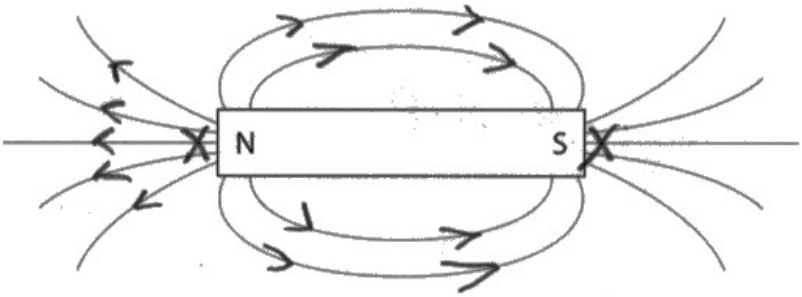


Figure 4

(i) Draw arrows on the field lines in Figure 4 to show the direction of the magnetic field.

(1)

(ii) Place a letter X on Figure 4 at a place where the magnetic field is strongest.

(1)

ResultsPlus
Examiner Comments

The diagram shows the north and south poles of the bar magnet.

This candidate has used this information to draw arrows which show the direction of the magnetic field is from north pole to south pole.

The strength of a magnetic field is indicated by the concentration of the magnetic field lines.

The closer together, the stronger the magnetic field.

The candidate has put an X in both places where the lines are closest together.

ResultsPlus
Examiner Tip

Learn how the direction and strength of magnetic fields are shown in diagrams.

Question 3 (a)(iii)

This question tested knowledge of the differences between the magnetic field of a bar magnet, which was shown in the diagram Figure 4, and a uniform magnetic field.

This response gives two differences between the magnetic field shown in Figure 4.

The candidate has already completed the diagram to show the direction and strength of the magnetic field of the bar magnet.

Even if this is incorrect it is a good place to start in giving differences between fields.

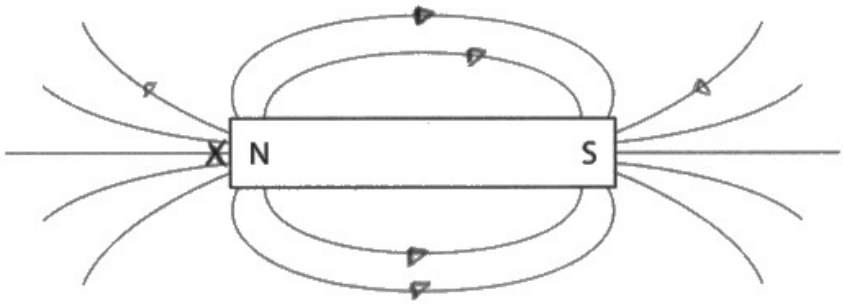


Figure 4

(i) Draw arrows on the field lines in Figure 4 to show the direction of the magnetic field.

(1)

(ii) Place a letter X on Figure 4 at a place where the magnetic field is strongest.

(1)

(iii) Describe **two** differences between the magnetic field shown in Figure 4 and a uniform magnetic field.

(2)

A uniform magnetic field ~~is~~ has the same strength at every point and the lines are drawn the same distance appart. However in fig 4 the strongest part is neares the poles, the more you go outwards the weaker it gets.

ResultsPlus
Examiner Comments

This response gives two differences and clearly states that the points that are being made are for a uniform magnetic field.

1. The uniform magnetic field has the same strength at every point.
2. The (magnetic field) lines are drawn the same distance apart.

ResultsPlus
Examiner Tip

Take care not to give just one difference eg the lines for a uniform magnetic field are straight and in Figure 4 (bar magnet) the lines are curved.

Make sure you state which magnetic field you are referring to.

Question 3 (b)

Very few candidates were able to give the name of a piece of apparatus that could be used to produce a uniform magnetic field electrically in the laboratory, this being a solenoid.

However, more responses suggested using opposite poles of magnets facing each other.

This response gives a solenoid as the apparatus which produces a uniform magnetic field and explains what it is.

(b) State how a uniform magnetic field may be obtained in a school laboratory.

(1)

By creating a solenoid (a coil of wire with a current flowing through it)

ResultsPlus
Examiner Comments

The solenoid is an electrical method of producing a magnetic field and should be known as it is in the specification.

ResultsPlus
Examiner Tip

Learn that a current creates a magnetic field inside a coil of wire (solenoid).

A uniform magnetic field can be produced using opposite poles of magnets facing each other.

(b) State how a uniform magnetic field may be obtained in a school laboratory.

(1)

use two magnets, one in the south pole and one in the north pole (facing each other)

ResultsPlus
Examiner Comments

This response gets the mark as facing each other is added.

ResultsPlus
Examiner Tip

Be clear about the arrangement of magnets as magnets next to each other would not produce a uniform magnetic field.

Question 3 (c)(i)

This question tested knowledge of the Earth's magnetic field by adding magnetic lines of force to a diagram.

The magnetic lines of force showing the earth's magnetic field have been added to the diagram with arrows correctly assigned.

(c) Figure 5 shows the directions of some plotting compass needles placed at different points near the Earth's surface.

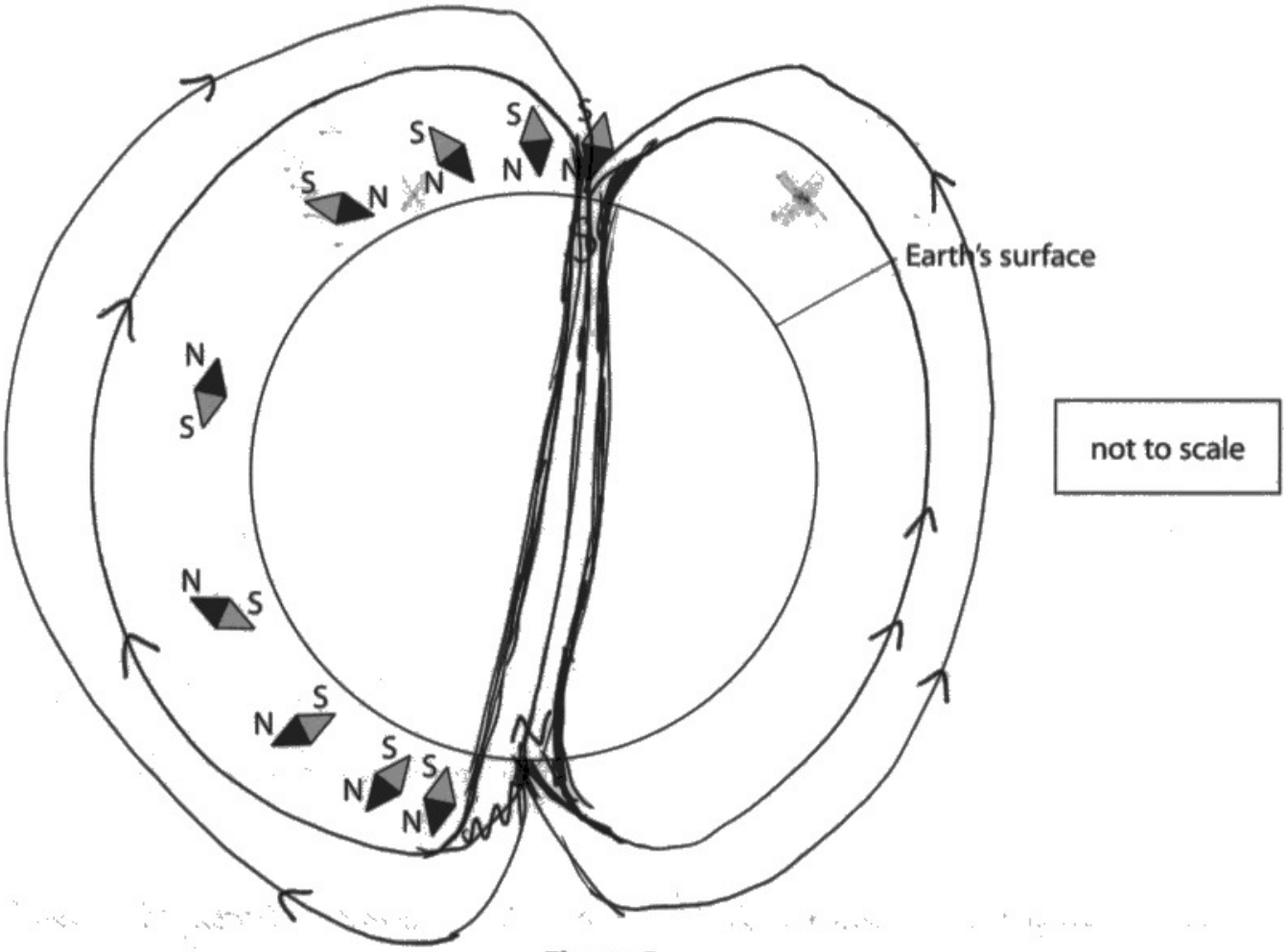


Figure 5

(i) Sketch, on Figure 5, the Earth's magnetic field outside and inside the Earth.

(2)

ResultsPlus
Examiner Comments

The candidate has added magnetic field lines to show the Earth's magnetic field.

The lines outside the Earth are correct and the arrows indicate the correct direction.

The incorrect lines inside the Earth can be ignored.

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Examiner Tip

Learn that the magnetic field lines of the Earth have the same direction as a compass needles points and that is towards the geographical North Pole.

This response also gets two marks.

(c) Figure 5 shows the directions of some plotting compass needles placed at different points near the Earth's surface.

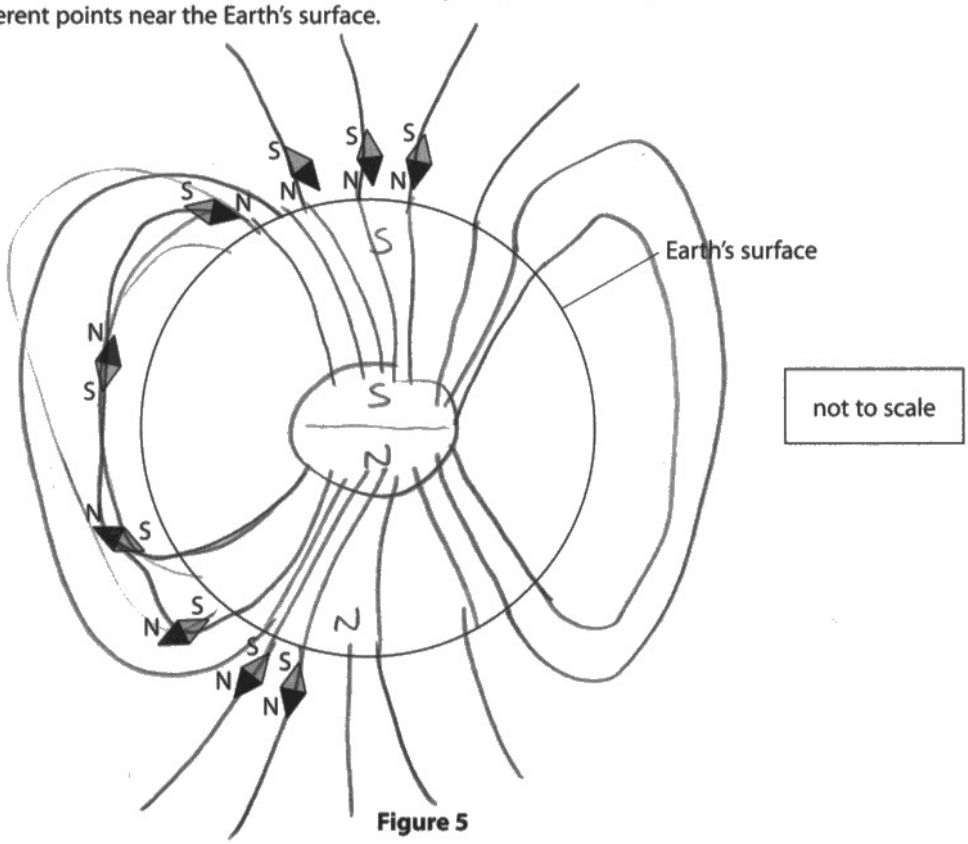


Figure 5

(i) Sketch, on Figure 5, the Earth's magnetic field outside and inside the Earth.

(2)

ResultsPlus
Examiner Comments

The field outside the Earth is the correct shape but has no arrows to show direction.

The second mark is given because at least two of the field lines continue inside the Earth towards imaginary pole.

ResultsPlus
Examiner Tip

Learn that field lines inside the Earth are not continuous.

Question 3 (c)(ii)

The majority of candidates knew that it is the core of the Earth that generates its magnetic field.

The core was a sufficient answer.

(ii) State which part of the Earth generates its magnetic field.

(1)

The Earth's core.

ResultsPlus
Examiner Comments

No further explanation is required.

ResultsPlus
Examiner Tip

Take care when adding to a straightforward answer that you do not make mistakes.

Question 3 (d)

This question tested that the candidates were able to identify the symbols used for magnetic quantities as well as mathematical ability in the use of equations and the use of submultiples.

A common error of not converting mA (milli amps) to A (amps) for use in the equation.

(d) A wire is placed at right angles to the Earth's magnetic field.

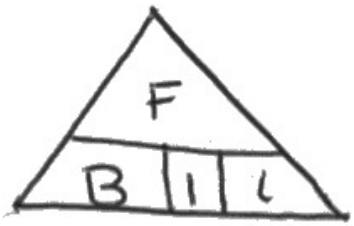
The wire is 0.600 m long and carries a current of 93.1 mA.

The force on the wire is 1.11×10^{-5} N.

Calculate the magnetic flux density of the Earth's magnetic field.

Use the equation

$F = B \times I \times l$



(2)

$\frac{1.11 \times 10^{-5}}{0.600 \times 93.1}$

$= 55.86$

magnetic flux density = 1.99×10^{-7} T

ResultsPlus Examiner Comments

The equation was rearranged correctly to find the magnetic flux density but gave a power of ten error as the current was not converted to amps.

ResultsPlus Examiner Tip

Look carefully at the units given in the question.

This was correctly calculated.

(d) A wire is placed at right angles to the Earth's magnetic field.

The wire is 0.600 m long and carries a current of 93.1 mA.

The force on the wire is 1.11×10^{-5} N.

Calculate the magnetic flux density of the Earth's magnetic field.

Use the equation

93·1 mA = 0·0931 A

$F = B \times I \times l$

(2)

$B = \frac{F}{I \times L}$

$= \frac{1.11 \times 10^{-5}}{0.093 \times 0.6}$

$= 0.00019892...$

$= 1.99 \times 10^{-4}$

magnetic flux density = 1.99×10^{-4} T

ResultsPlus
Examiner Comments

The 93.1mA has been converted to 0.093 A for use in the equation.

ResultsPlus
Examiner Tip

Learn the submultiples of units so they can be converted correctly for use in equations.

The candidate does not know the meaning of the symbols in the equation.

(d) A wire is placed at right angles to the Earth's magnetic field.

The wire is 0.600 m long and carries a current of 93.1 mA.

The force on the wire is 1.11×10^{-5} N.

Calculate the magnetic flux density of the Earth's magnetic field.

Use the equation

$$F = B \times I \times l$$

$1.11 \times 10^{-5} \times 93.1 \times 0.6 = 6.20046 \times 10^{-4}$ (2)

magnetic flux density = 6.20046×10^{-4} T

ResultsPlus Examiner Comments

F the force on the wire has been confused with B the magnetic flux density and the milliamps have not been converted to amps.

ResultsPlus Examiner Tip

Learn that B is the symbol for magnetic flux density.

Question 4 (a)(i)

This question could not be answered successfully without the use of information which was given on the diagram.

To calculate the change in gravitational potential energy, the original height of the rover above Mars has to be used and this is only given in the diagram.

In this response the candidate has used the diagram incorrectly trying to use both vertical and horizontal distances in some way.

(i) Calculate the change in gravitational potential energy of the rover as it descends from position P to position Q.

Mass of rover = 1100 kg

Gravitational field strength on Mars = 3.7 N / kg

Give your answer to 2 significant figures.

(3)

mass x Gravitional Strength x change in vertical height

$\frac{1.80}{1.60} = 1.125$

$1.125 \times 1100 \times 3.7 = 46$

change in gravitational potential energy = 46 J

ResultsPlus
Examiner Comments

The height used is incorrect and the answer should be 4579 J from this.

Although the calculation gets no marks, the answer has been given as two significant figures and gains a mark.

ResultsPlus
Examiner Tip

Practice giving answers to the correct number of significant figures.

This response shows the correct equation has been selected and the change in height of the Mars rover has been taken from the diagram as 1.8 km.

(i) Calculate the change in gravitational potential energy of the rover as it descends from position P to position Q.

Mass of rover = 1100 kg

Gravitational field strength on Mars = 3.7 N/kg

Give your answer to 2 significant figures.

(3)

$gpe = 1100 \times 3.7 \times 1.8$

$\hookrightarrow 7326\ J$

change in gravitational potential energy = 7326 J

ResultsPlus
Examiner Comments

The equation used to determine the change in gravitational energy requires the change in height to be given in metres.

The answer therefore has a power of ten error. There is an independent mark for giving the answer to two significant figures, this has also been missed.

ResultsPlus
Examiner Tip

Look carefully at units used and learn how to convert multiples of units correctly.

Correct response gains 3 marks.

(i) Calculate the change in gravitational potential energy of the rover as it descends from position P to position Q.

Mass of rover = 1100 kg

Gravitational field strength on Mars = 3.7 N / kg

Give your answer to 2 significant figures.

(3)

1.8 km = 1800

ΔGPE = m × GFS × Δh
= 1100 × 3.7 × 1800
= 7326000
= 7300000

change in gravitational potential energy = 7300000 J

ResultsPlus
Examiner Comments

Correct equation selected, height converted to metres and answer given to 2 significant figures.

ResultsPlus
Examiner Tip

Remember multiples and significant figures when completing calculations.

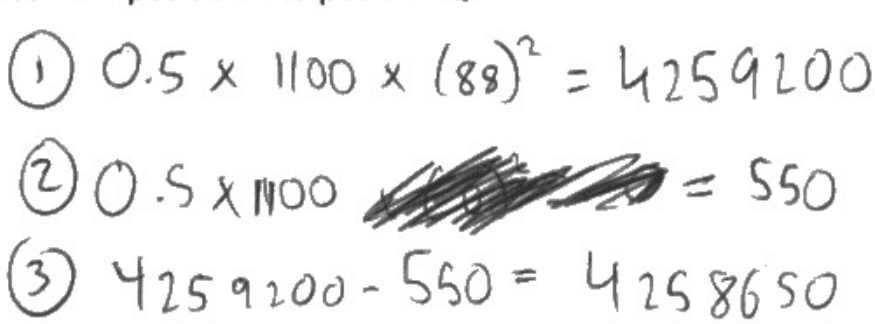
Question 4 (a)(ii)

This question tests the selection of the correct equation to calculate kinetic energy and the use of the diagram to find the initial speed at P and the final speed at Q.

This example shows a common error.

(ii) Use data from Figure 6 to calculate the change in kinetic energy of the rover as it descends from position P to position Q.

(2)



change in kinetic energy = 4258650 J

ResultsPlus Examiner Comments

The KE at P has been calculated correctly. The KE at Q is zero because the velocity is zero. Therefore there is nothing to subtract, the change in KE is just the value at P.

ResultsPlus Examiner Tip

Remember that anything multiplied by zero is zero.

Question 4 (a)(iii)

The question states that the Mars rover is slowed down so it can land safely and that the methods used to slow it down are a parachute and thruster jets.

The question tests understanding of energy changes and work done by the various forces as the rover descends.

This response gives work done and energy changes and is clear and logical.

(iii) The rover is slowed down safely using thrusters and a parachute (not shown in Figure 6).

The thrusters use jets of gas to control movements and the parachute is designed to be used in the atmosphere of Mars.

Describe the energy changes involved in terms of the work done by various forces as the rover descends.

(3)

The chemical energy from the gas is turned into kinetic energy ~~done~~ doing work against friction in movements. Work done is also done against gravity to lift the rover. Work done is also occuring when the weight of the rover falling down is reduced in speed by the parachute.

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Examiner Comments

The candidate considers the chemical energy from jets of gas in the thrusters being converted to kinetic energy as the gas leaves the thrusters, this does work against friction in controlling movement.

Work is also done against gravity as the rover descends.

Work is also done by the parachute as the rover descends.

ResultsPlus
Examiner Tip

The questions has 3 marks and therefore three separate points about the work done and energy changes as the rover descends are required.

Most candidates found this description challenging and restricted answers to just one idea of where work done was involved.

(iii) The rover is slowed down safely using thrusters and a parachute (not shown in Figure 6).

The thrusters use jets of gas to control movements and the parachute is designed to be used in the atmosphere of Mars.

Describe the energy changes involved in terms of the work done by various forces as the rover descends.

(3)

Parachute used against air resistance (non-contact force), thrusters control movements because gravitational force may pull the rover with too much intensity. There is gravitational work

ResultsPlus
Examiner Comments

Consider the air resistance produced by the parachute is sufficient for the third marking point.

ResultsPlus
Examiner Tip

Look for one point to comment on such as gravitational potential energy is reduced (as the rover gets closer to the surface of Mars).

Question 4 (b)(i)

This tests that candidates understand the line between energy power and time.

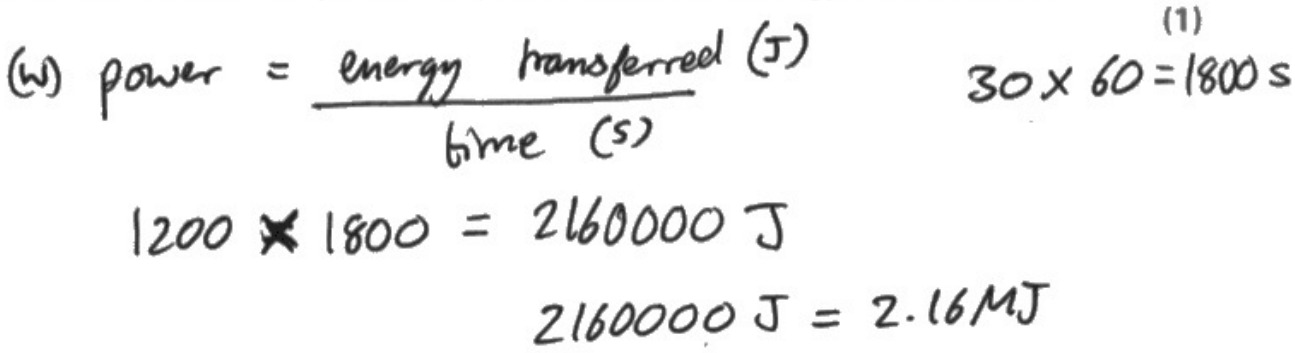
The candidate gives the equation for power which could be selected.

(b) The rover uses solar panels for its power needs.

The solar panels can provide 1200 W of power.

(i) Show that the solar panels can provide 2.16 MJ of energy in 30 minutes.

(1)



ResultsPlus
Examiner Comments

The candidates recognised that power x time gave energy. 30 minutes was converted to 1800 seconds, as seconds must be used in the equation.

1200 x 1800 gives the energy in 30 minutes and this is shown to be 216000J, which is 2.16MJ.

ResultsPlus
Examiner Tip

Learn the number of seconds in a minute and the multiples of units ie 1000J=1.0 MJ.

Question 4 (b)(ii)

This question tested the use of the equation for efficiency, which could be selected from the formulae sheet.

The equation needed to be selected, given a correct substitution and rearranged to calculate the solar energy received when the output of the panel is 2.26MJ and the efficiency of the panel is 27%.

(ii) The solar panels convert 27% of the energy they receive from the Sun into electricity.

Calculate the solar energy received by the panels that provides the 2.16 MJ of energy.

(2)

efficiency = useful / total

0·27 = 2160

2160 / 0·27 = 8000

energy received = 8000 J

ResultsPlus Examiner Comments

This candidate used the efficiency as 0.27 and rearranged the equation correctly.

However 2160 is neither the value of energy in MJ or in J, therefore the answer is incorrect.

ResultsPlus Examiner Tip

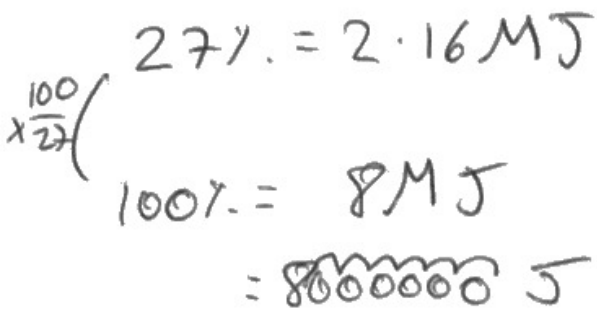
Learn how to convert multiples of units correctly.

A correct answer on the answer line.

(ii) The solar panels convert 27% of the energy they receive from the Sun into electricity.

Calculate the solar energy received by the panels that provides the 2.16 MJ of energy.

(2)



energy received = 8,000,000 J

ResultsPlus Examiner Comments

The answer is calculated in MJ and then converted to joules.

ResultsPlus Examiner Tip

Look at the unit given on the answer line and match your answer to it.

In this example the calculation has been completed correctly in MJ.

(ii) The solar panels convert 27% of the energy they receive from the Sun into electricity.

Calculate the solar energy received by the panels that provides the 2.16 MJ of energy.

(2)

27%

2.16 ÷ 0.27 = 8

energy received = 8 J

ResultsPlus
Examiner Comments

Correct use of the efficiency equation but only one mark because the answer in not 8J.

ResultsPlus
Examiner Tip

This answer would gain both marks if the unit in the answer line had been changed to MJ by the candidate.

Question 5 (b)(i)

The question tested that candidates could describe the variation of resistance of a thermistor with temperature using information from the graph.

This example does not fully describe how the resistance of a thermistor changes with temperature.

(i) Describe how the resistance of this thermistor varies with temperature.

(2)

Resistance decreases as temperature increases e.g 5Ω and the temperature is around 16°C but it goes down to 2.2Ω and temperature is 46°C

ResultsPlus
Examiner Comments

The response gives that the 'resistance decreases as the temperature increases' and gets 1 mark.

To gain a second mark, it is necessary to give how the change occurs ie the relationship is a non-linear change, or the gradient is decreasing as the temperature increases.

ResultsPlus
Examiner Tip

Stating it is a negative correlation or quoting two sets of values from the graph is not sufficient to award the second mark.

A correct and complete description of the graph.

(i) Describe how the resistance of this thermistor varies with temperature.

(2)

As temperature increases, resistance decreases in a non-linear pattern from 6.9kΩ at 50°C to 1.7Ω at 55°C

ResultsPlus
Examiner Comments

This describes the pattern as non-linear.

ResultsPlus
Examiner Tip

If a graph is not a straight line, it is non-linear.

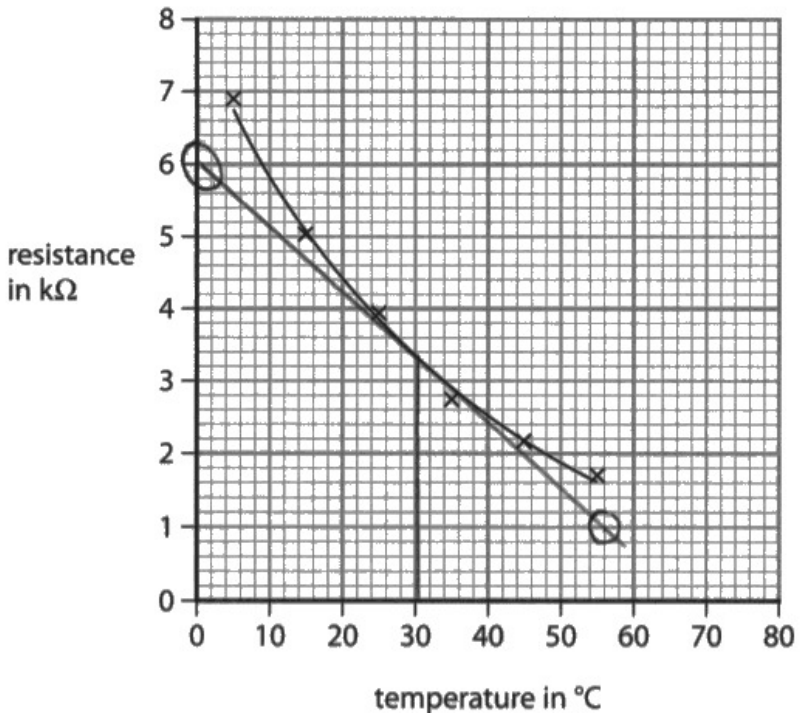
Question 5 (b)(ii)

This question tests the ability of candidates to accurately draw the tangent to a curve at a particular point on the curve and then to calculate the gradient and give the unit used.

A tangent is drawn to the graph and the triangle used is marked the two ends.

(b) A student investigates how the resistance of a thermistor varies with temperature.

Figure 7 shows a graph of the results of this investigation.



(ii) Draw the tangent to the curve at a temperature of 30 °C, to find the rate of change of resistance with temperature at 30 °C.

State the unit.

→ kΩ into Ω

$\frac{5000}{56} = 89.3$

(3)

rate of change of resistance with temperature at 30 °C = 89.3 unit Ω/°C

ResultsPlus
Examiner Comments

The candidates converts the kohms to ohms and calculates the gradient.

The gradient is within the limits given in the additional guidance and the unit is correct.

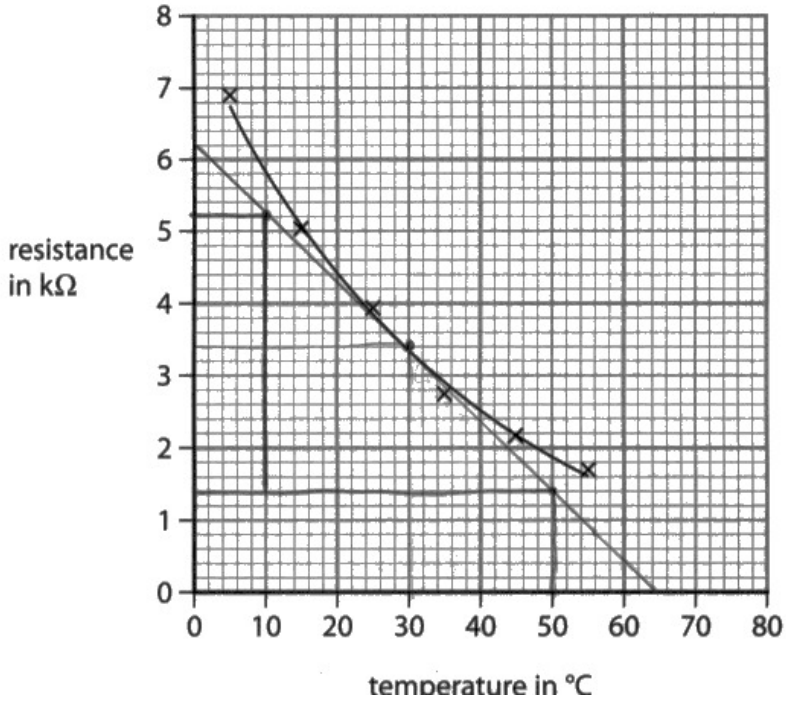
ResultsPlus
Examiner Tip

Remember to change units correctly.

A completely correct response.

(b) A student investigates how the resistance of a thermistor varies with temperature.

Figure 7 shows a graph of the results of this investigation.



(ii) Draw the tangent to the curve at a temperature of 30 °C, to find the rate of change of resistance with temperature at 30 °C.

State the unit.

(3)

$\frac{5.2 - 1.4 k\Omega}{50 - 10\,^{\circ}C} = 0.095\ k\Omega/^{\circ}C$

rate of change of resistance with temperature at 30 °C = 0.095 unit kΩ / °C

ResultsPlus
Examiner Comments

The candidate has drawn the tangent accurately at 30 degrees, shown the triangle used and calculated the gradient from the values given by the triangle.

The answer is with the range allowed and the units of the gradient are correct.

ResultsPlus
Examiner Tip

Practice drawing tangents to curves at a point accurately to determine the gradient of the curve at that point.

Question 5 (c)(i)

To obtain the graph shown in Q5(b)(i), the apparatus shown in Q5(c) was used.

This question shows the experimental set up and asks candidates to explain one improvement that could be made in taking measurements.

This response gives a suitable improvement.

(i) Explain **one** improvement in measurement that the student could make in the investigation.

(2)

place the thermistor close to the thermometer, so the thermistor experiences the same temperature the thermometer experiences.

ResultsPlus
Examiner Comments

In the diagram the thermistor is not right next to the thermometer so moving it closer would be an improvement as the thermometer and the thermistor would be at the same temperature.

Stirring the water would also be an improvement as a uniform temperature throughout the water would be achieved.

Using a digital thermometer might also be an improvement if the scale of the thermometer has better resolution.

ResultsPlus
Examiner Tip

Look carefully at the diagram to find improvements.

Question 5 (c)(ii)

The question shows a multimeter which can be set to read ohms, volts or amps.

The different settings can be used to measure resistance either by just using the meter as an ohmmeter or using meters as a voltmeter and an ammeter.

The meter has values on them so can be used for calculations and in comparisons.

This response shows an understanding of the use of more precise results.

(ii) Explain why method 2 gives more precise results than method 1.

(2)

You can get more precise results as it gives more decimals. ~~for~~ 1 ÷ 439.9 = 2.27..., which is similar to 2.3 but it is more accurate to calculate the resistance, when you have ~~the~~ the voltage and current data.

(Total for Question 5 = 10 marks)

ResultsPlus
Examiner Comments

The answer using the ammeter and voltmeter is calculated to more decimal places than the result using just the ohmmeter.

The results are then compared to conclude that using the ammeter and voltmeter is more precise.

ResultsPlus
Examiner Tip

Use the information given in the diagram.

Question 6 (a)

This question tested the candidates ability to differentiate between 'specific heat capacity' and 'specific latent heat'.

Most candidates that knew the difference tried to quote both definitions.

6 (a) Explain the difference between the term 'specific heat capacity' and the term 'specific latent heat' when applied to heating substances.

(2)

- Specific heat capacity is the amount of energy required to raise the temp of 1 kg of a substance by 1°C.
- specific latent heat is different. It is the energy required for a substance to change state.

ResultsPlus
Examiner Comments

This candidate was able to remember the definition of specific heat capacity and get the idea that specific latent heat was to do with change of state.

This was sufficient to gain both marks.

ResultsPlus
Examiner Tip

Just remember specific heat capacity concerns change in temperature and specific latent heat concerns change of state.

Question 6 (b)

This question tested the experimental skills of candidates in making an accurate measurement of the specific heat capacity of water.

Most candidates found this challenging and very few were able to gain three marks.

This response gives three valid points that would make the measurement of the final temperature of the water accurate.

Explain how the student should then obtain an accurate reading for the final temperature of the water, to be used in the calculation of the specific heat capacity.

(3)

The student should stir the water to ensure the energy is distributed and then wait for the thermometer to stop changing. Once the thermometer has stopped read the value off it.

ResultsPlus
Examiner Comments

The water has to be stirred to ensure the temperature is the same throughout the water. The candidate knows that they then have to wait as the temperature registered by the thermometer rises as it takes time for the thermal energy remaining from the heater to reach the thermometer. It is the maximum temperature reading on the thermometer that is then taken.

ResultsPlus
Examiner Tip

When carrying out investigations note the experimental methods that are used to ensure accurate readings.

Question 6 (c)

The extended response tested the understanding of how particles of a gas behave when heated in a container of fixed volume.

Candidates needed to understand the link between increased temperature giving increased velocity of particles and therefore increased kinetic energy.

The next stage was to link increased velocity of particle to increased frequency of collisions with the walls of the container.

The final stage was that the increase in the frequency of collisions increase the force on the container walls and that force over an area gives pressure.

A Level 1 response, 2 marks.

*(c) A container of gas is at room temperature.

The gas is then heated.

The volume of the container remains the same.

By considering changes in velocities of the gas particles, explain how the temperature increase affects

- the average kinetic energy of the particles
- the pressure the particles exert on the walls of the container.

(6)

- the particles gain kinetic energy and therefore this causes more collisions within the particles
- less denser and particles are free to move around even more
- more pressure put on container walls as the gas expands and there is even more space for particles, putting strain on the material of the container.

ResultsPlus
Examiner Comments

The candidate states that the particles gain kinetic energy this is an increase in kinetic energy and is sufficient to achieve Level 1.

The candidate also states there is more pressure on the container walls but gives the wrong reason. Noting an increase in pressure is also a Level 1 response.

Causes more collisions is not credited as it is 'within the particles' not with the walls.

ResultsPlus
Examiner Tip

Use the stem of the question. Here, it included changes in velocity but that was not mentioned in this response.

Level 2 response, 4 marks.

The average kinetic energy of the particles will increase as energy has been ~~tranf~~ transferred to them through heat. The pressure will also increase because the particles have more energy so they will be moving faster and hitting the walls of the container more often as they are trying to spread out and seperate from other particles.

ResultsPlus
Examiner Comments

The candidate understands that as the temperature increases then so does the average kinetic energy of the molecules and therefore the molecules will be moving faster. This is sufficient for Level 2.

The increase in speed of the particles leads to the idea that the particles hit the walls of the container more often but this is not extended to force or pressure increases.

ResultsPlus
Examiner Tip

Use the information in the stem of the question, this relates to kinetic energy and pressure.

Level 3 response, 6 marks.

. If the gas is heated, the gas particles gain more kinetic energy - thermal energy transfers into kinetic energy

. ~~If~~ This means they move more quickly (with a higher velocity) and exert more force when colliding with the walls of the container - this means the pressure increases.

. Since the volume is constant, increasing the temperature of the gas would mean ~~there are more gas particles within the~~ there is more quicker movement of the gas particles within the ~~so~~ same volume, so there would be more frequent collisions of the particles with the walls of the container.

. The pressure increases due to the formula $P = \frac{F}{A}$. This is because a ~~high~~ greater force is ~~not~~ exerted on the ~~par~~ walls within the same area.

ResultsPlus
Examiner Comments

This response follows through in a logical order and explains how the temperature increase affects the average kinetic energy of the particles by increasing their velocity. Then how the increase in velocity of the particles increases the force on the walls of the container.

The candidate then considers that the quicker the particles move the more frequent the collisions with the walls of the container and that this causes a greater force over the same area and therefore an increase in pressure.

ResultsPlus
Examiner Tip

This response includes reference to the force which collisions with the walls must increase and then links the force to the pressure.

Paper Summary

Based on their performance on this paper, candidates should:

- learn to use the information given in diagrams.
- learn to complete magnetic field diagrams accurately.
- practice drawing tangents to graphs at a point.
- learn to calculate a gradient of a graph using the tangent.
- learn multiples and submultiples of units.
- practice experimental skills to improve the precision of measurements taken.
- learn what the symbols used in equations represent.
- remember to note the number of marks awarded to a question to judge if you have included sufficient information in your answer.

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