

Examiners' Report

June 2023

GCSE Combined Science 1SC0 2PF

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Introduction

This examination is an external assessment of physical concepts and their application. The candidates sitting this examination had generally covered the course without disruption.

However, candidates were not required to recall any equation as an equation booklet was given out with the examination paper, and for this paper question, which required the use of an equation, it had the equation given within the question.

Questions were set on the following topics: –

- Topic 1 – Key concepts in physics
- Topic 8 – Energy-forces and doing work
- Topic 10 – Electricity and circuits
- Topic 12 – Magnetism and the motor effect
- Topic 13 – Electromagnetic induction
- Topic 14 – Particle model

Practical work on energy transfer, magnetism and setting up electrical circuits was used to test candidates' familiarity with methods used to make measurements and to find relationships between quantities.

Candidates' ability to apply physics knowledge to different situations was tested in the question on energy transfers. The ability to compare the properties of thermal insulators and assess the most suitable test with the table of information given was tested in the extended response.

Mathematical skills were tested throughout the paper. Candidates needed to be able to use standard form, evaluate ratios and understand relationships shown graphically as well as rearrange equations to change the subject.

Question 1 (a)

Almost half of the candidates were able to score the full four marks on this question. They could recall the symbols used to represent electrical devices in a circuit and drew a complete circuit.

Candidates lost marks either for not knowing the correct symbols for the lamp switch and resistor, or the circuit was drawn with gaps.

Correct circuit.

1 (a) Figure 1 shows the parts in an electrical circuit.

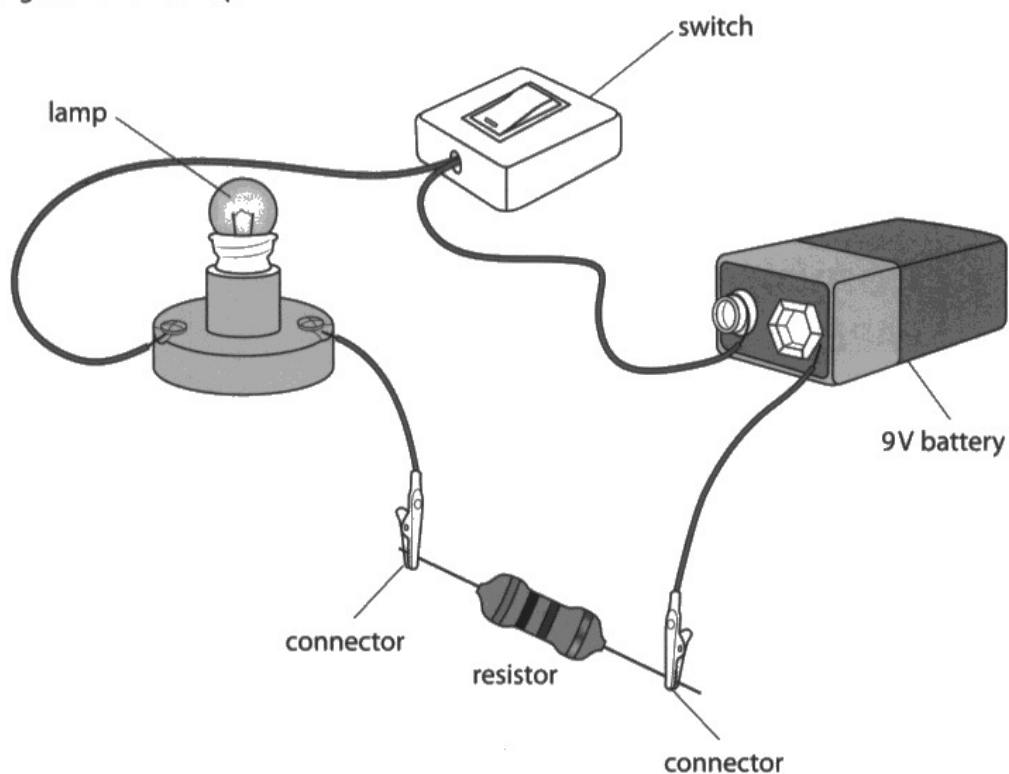


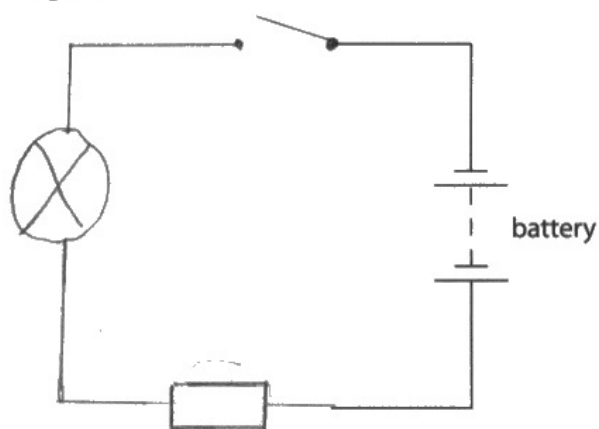
Figure 1

Draw the circuit diagram of this electrical circuit in the space provided.

The battery symbol and some of the connecting wires have been drawn for you.

(4)

circuit diagram





This response scores four marks.

The circuit shows correct symbols for a lamp, resistor and switch and the circuit is completed without gaps.



Learn circuit symbols.

Question 1 (c)(i)

The majority of candidates were able to substitute the correct values in the equation and evaluate the answers as 13.8C.

Correct calculation.

(c) (i) There is a current of 0.46 A in a lamp.

Calculate the total charge that flows through the lamp in 30 seconds.

Use the equation

$$\text{charge} = \text{current} \times \text{time in seconds}$$

(2)

$$\text{Charge} = 0.46 \times 30$$

$$\text{charge} = \underline{\quad 13.8 \quad} \text{ C}$$



ResultsPlus
Examiner Comments

This response scores both marks as the evaluation is correct.

The candidate has shown the correct substitution. This assures one mark even if the evaluation is incorrect.



ResultsPlus
Examiner Tip

Always show the substitution in your working.

Question 1 (c)(ii)

About three quarters of candidates were able to evaluate correctly.

Substituting correctly was a little more difficult as the time of one minute had to be converted to 60 seconds and three values had to be substituted.

However, an allowance was made for those that did not convert to seconds or used 30s from the previous question giving a maximum of one mark.

Correct evaluation.

(ii) The voltage across the lamp is 6.0V.

The current in the lamp is 0.46 A.

Calculate the energy transferred to the lamp in one minute. $(60s)$
 $\times 60$

Use the equation

energy transferred = current $\times$ voltage $\times$ time in seconds

(2)

$$0.46 \times 6.0 \times 60$$

energy transferred = 165.6 J



ResultsPlus
Examiner Comments

The response scores 2 marks. The substitution shows the conversion to 60 s and the evaluation is correct.



ResultsPlus
Examiner Tip

Remember to convert time in minutes to time in seconds for use in equations.

Question 2 (a)(i)

The question shows paper clips suspended from a magnet and the candidates have to add N and S poles to the paper clips.

About half of the candidates could add the N and S poles to the paper clips correctly.

Incorrect

- 2 This question is about magnets and magnetism.

(a) Figure 3 shows a magnet that has picked up three paper clips.

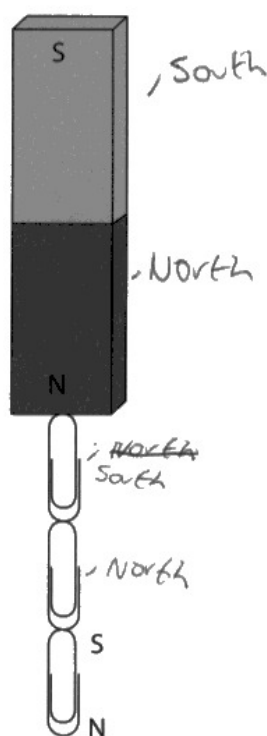


Figure 3

- (i) The poles of the lowest paper clip are labelled.

Label the poles of the other two paper clips in Figure 3.



ResultsPlus
Examiner Comments

No marks awarded. It is not clear where the poles are supposed to be on the paper clips.



ResultsPlus
Examiner Tip

Take care with labelling diagrams.

Correct answer.

2 This question is about magnets and magnetism.

(a) Figure 3 shows a magnet that has picked up three paper clips.

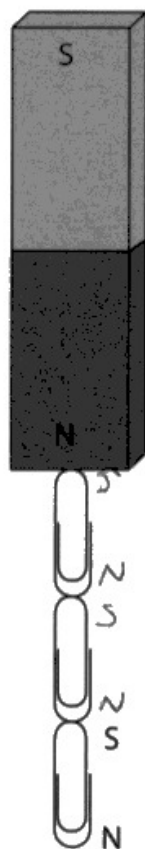


Figure 3

(i) The poles of the lowest paper clip are labelled.

Label the poles of the other two paper clips in Figure 3.



ResultsPlus
Examiner Comments

This response scores both marks. The N and S poles are correct as marked at the ends of the paper clips.



ResultsPlus
Examiner Tip

Take care that the poles are shown at the ends of the paper clips.

Question 2 (a)(ii)

Just over half of candidates opted for the paper clips being induced magnets when given a choice. Alternate was the next favourite option.

Question 2 (a)(iii)

The most common answer for 'What could the paper clips be made of' was metal. This was much too vague and did not score. The most commonly named incorrect metal was aluminium.

The paper clips in the question stuck to a magnet and therefore must be ferromagnetic and made from iron, steel, nickel or cobalt.

Less than half the candidates were able to score a mark on this question.

Correct answer.

(iii) Suggest a material that these paper clips in Figure 3 could be made from.

(1)

iron



ResultsPlus
Examiner Comments

This scores 1 mark, as would steel, cobalt or nickel.



ResultsPlus
Examiner Tip

Remember only everyday objects made of iron and steel are attracted to magnets.

Question 2 (a)(iv)

About half the candidates were able to gain at least one mark for their answer.

Very few candidates mentioned using a plotting compass or iron filings. Most of the marks were obtained from 'bring the paper clips together to see if they stick'.

The most common incorrect response was to hold a magnet to the paper clips and see if there is attraction.

A number of candidates scored marks by suggesting that if the paper clips had magnetism they would stick to a fridge or radiator.

Typical correct answer.

- (iv) When the paper clips were pulled off the magnet they fell separately to the table.

Describe how you could test whether any of the paper clips had kept any magnetism.

(2)

You could try putting them together and see if they would stick to one another



ResultsPlus
Examiner Comments

This response scores two marks. The paper clips are brought together and stick.



ResultsPlus
Examiner Tip

Just think of a test you would use to find out if something was magnetic.

Question 2 (b)(i)

The idea that the strength of the magnetic field was represented by the closeness of the magnetic lines of force was not readily accepted in this context although it would be accepted for the field around a bar magnet.

Very few candidates noted that the circles were closer together at P and therefore the field was stronger.

The most common incorrect answer was that P was closer to the wire carrying the current rather than Q.

Question 2 (b)(ii)

More than half of the candidates could score one mark by describing that 'as the current increases the magnetic field strength increases', as this could describe a curve or a straight line.

To get the second mark candidates need to add something else such as it is linear proportional or increases on even steps.

Stating that the line showed 'direct proportionality' because it was straight and passed through the origin would gain both marks.

Correct answer.

- (ii) The magnetic field strength is measured at P for different values of current in the wire.

The results of this investigation are shown in Figure 5.

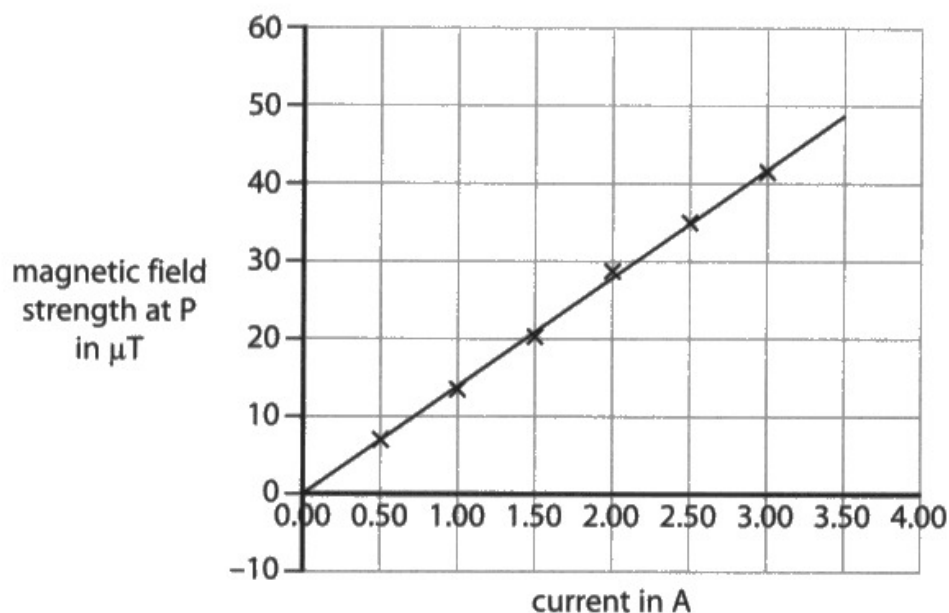


Figure 5

Describe the relationship between magnetic field strength and current.

(2)

as the current increases so does the magnetic field strength at a constant rate.



This response scores two marks. Both the current and the magnetic field strength increase, and they increase at a constant rate.



Remember to give the relationship and describe the line to get two marks.

Question 3 (b)

Very few candidates were able to explain why the National Grid used high voltages and low currents to transfer electricity.

The most common correct answer to gain one mark was that it was more efficient.

Candidates sometimes referred to energy loss or heat loss being reduced. This would gain a mark.

However, it is not 'electricity' that is lost or wasted, and this does not score a mark.

Correct answer.

(b) Explain why the National Grid uses high voltages with small currents to transfer electricity from power stations.

(2)

The more higher the voltage the less power loss through heat



ResultsPlus
Examiner Comments

This scores 2 marks. Less power loss through heat gets both marks.



ResultsPlus
Examiner Tip

It is power or energy loss which is reduced due to a reduction in the heating effect when the current is small.

Incorrect answer.

- (b) Explain why the National Grid uses high voltages with small currents to transfer electricity from power stations.

so that less electricity is (2)
wasted



ResultsPlus
Examiner Comments

No mark is scored because 'electricity' cannot be wasted. It is only energy or power that is wasted.



ResultsPlus
Examiner Tip

Electricity is a way of transferring energy not storing it.

Question 3 (c)(i)

This is the first of three calculations using the information given in the diagram of the transformer.

More than half of the candidates were able to score both marks for the calculation of power.

Question 3 (c)(ii)

This calculation required candidates to select the correct values from the diagram and use the values in the equation given to evaluate as a division.

More than half of the candidates were able to score both marks.

This is incorrect.

(ii) Calculate the following for the transformer in Figure 7.

$$\frac{\text{number of turns in secondary coil}}{\text{number of turns in primary coil}}$$

$$1600 \div 80,000 = 50$$

(2)

50



ResultsPlus
Examiner Comments

One mark is scored for correct values selected and the division is incorrect and should be 0.02.



ResultsPlus
Examiner Tip

Take care to get the correct values from the diagram and to divide values correctly.

Question 3 (c)(iii)

Again, information was required from the diagram, but the equation was given as a ratio.

This was found to be more difficult, with less than half the candidates scoring both marks.

Even if the correct values were used getting the ratio to its simplest form it presented problems for some candidates. Most candidates did this by a series of cancellings rather than using their calculator to divide 12000 by 240.

Correct answer.

(iii) For the transformer in Figure 7, evaluate, in its simplest form, the ratio

secondary voltage : primary voltage

(2)

A handwritten answer '1 : 50' is shown on a dotted line. Above the line, there is a faint, curved pencil mark.



ResultsPlus
Examiner Comments

This scores 2 marks but there is no working shown so if the answer is wrong no other mark can be awarded.



ResultsPlus
Examiner Tip

Always show your working.

Question 4 (a)

The majority of candidates were able to find the mean speed although there was some confusion with median.

Correct answer, with the correct use of recurring.

4 This question is about energy transfers.

Figure 8 shows the apparatus used for investigating the transfer between gravitational potential energy and kinetic energy.

A metal ball is attached to a thread.

The ball is released from a starting position and swings on the thread.

The ball cuts a light beam at the bottom of its swing.

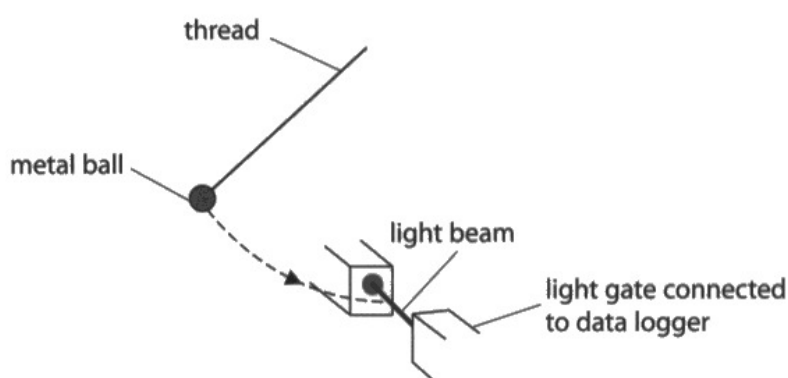


Figure 8

When the ball cuts the light beam, the speed of the ball is recorded by the data logger.

The ball was released 3 times from the same height and the speed measured each time.

The measurements of speed are given in Figure 9.

speed in m/s	1.31	1.27	1.16
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Figure 9

(a) Calculate the mean speed.

(2)

$$\frac{1.31 + 1.27 + 1.16}{3} = 1.24\dot{6}$$

mean speed = 1.246 m/s



This response scores both marks and the working is clearly shown to allow the first mark to be awarded even if the evaluation is incorrect.



Always show your working.

Question 4 (b)

Very few candidates were able to score a mark on this question. The most common incorrect answer was 'to make it more accurate'.

The purpose of repetition is to check precision (how close the results are to each other), reliability or to remove uncertainties such as, always starting from the same point, not pushing the ball.

Correct answer.

(b) Suggest **one** reason why the measurements of speed were repeated.

(1)

so they could have more
reliable results.



ResultsPlus
Examiner Comments

This scores 1 mark.



ResultsPlus
Examiner Tip

Learn the difference between accuracy, precision and reliability.

Question 4 (c)

Most candidates were able to score two marks on this question.

The equation was given, and the substitution was straight forward but rarely did candidates convert 5.0cm to metres for use in the equation.

The most common incorrect answer.

(c) The mass of the ball is 0.052 kg.

The ball falls through a vertical height (Δh) of 5.0cm as it swings.

The gravitational field strength, g , is 10 N/kg.

Calculate the change in the gravitational potential energy of the ball.

Use the equation

$$\Delta \text{GPE} = m \times g \times \Delta h$$

(3)

$$0.052 \times 10 \times 5.0 = 2.6$$

change in gravitational potential energy =2.6..... J



ResultsPlus
Examiner Comments

This scores 2 marks out of 3. The 5.0 cm is not converted to metres.



ResultsPlus
Examiner Tip

Remember that metres are the unit of distance to be used in equations.

Question 4 (d)(i)

More than half of the candidates were able to put the ruler in the correct position.

To measure the change in the height of the ball the ruler had to cover the distance between the bottom of the ball and the top of the light beam.

A straight vertical line was sufficient to indicate the position of the ruler, although many drawings showed much more detail.

Correct answer.

(d) Figure 10 shows an end-on view of the ball's swing from its starting position.

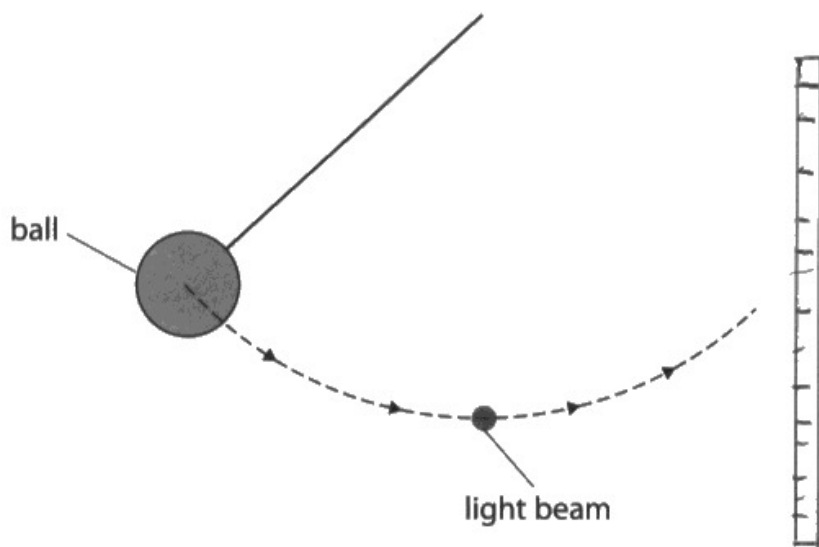


Figure 10

- (i) To measure the change in vertical height, Δh , through which the ball moves, a ruler could be used.

Draw a ruler on Figure 10, placed in a position to measure the change in vertical height Δh .



ResultsPlus
Examiner Comments

The addition of the ruler to the diagram scores the mark, as the length of the ruler covers the distance which has to be measured.



ResultsPlus
Examiner Tip

Make diagrams clear and if necessary, add labels.

Question 4 (d)(ii)

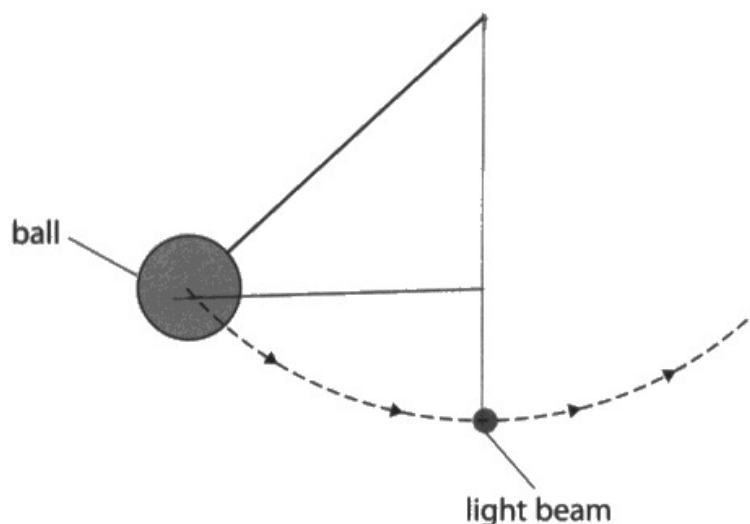
Although the diagram of a set square was given, the majority of candidates did not add this to their diagram to ensure the ruler was vertical.

Very few candidates were able to score two marks for this question. Even if the ruler had been added to Figure 10 for the previous question there were very few attempts to show the addition of the set square.

Some candidates were able to achieve one mark by stating that using the set square would make the measurement more accurate. There is improvement in accuracy in measuring the change in the vertical height because the set square can be used to ensure the ruler is vertical, however this was rarely described.

Correct answer.

(d) Figure 10 shows an end-on view of the ball's swing from its starting position.



(ii) Figure 11 shows a set square.

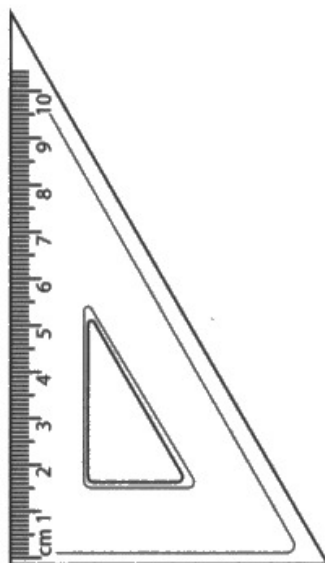


Figure 11

Describe how the measurement of the change in vertical height, Δh , could be improved using the set square.

You may add to Figure 10 or Figure 11 to help your description.

(2)

as the ruler is at a perfect right angle, making the vertical height easier to measure.



ResultsPlus
Examiner Comments

This response scores both marks. The ruler is added to the diagram as the vertical line through the light beam and the set square is added as the horizontal line at right angle to ensure the ruler is vertical.

The understanding of the importance of the right angle is given in the text.



ResultsPlus
Examiner Tip

Label diagrams to make them clearer.

Question 5 (a)

The majority of candidates were able to gain both marks by substituting and evaluating using the equation given. The most common error was a power of 10 or using 0.42C instead of 0.042C.

Question 5 (b)

About half of the candidates could gain one mark for this question by putting the ammeter in series in the circuit.

However, very few candidates were able to achieve both marks as it was found to be challenging to correctly position the voltmeter in parallel with the iron wire.

The majority of responses showed the ammeter and the voltmeter both placed in series in the circuit.

A typical one-mark answer.

- (b) Figure 12 shows some of the apparatus that students use to determine the resistance of a piece of iron wire.

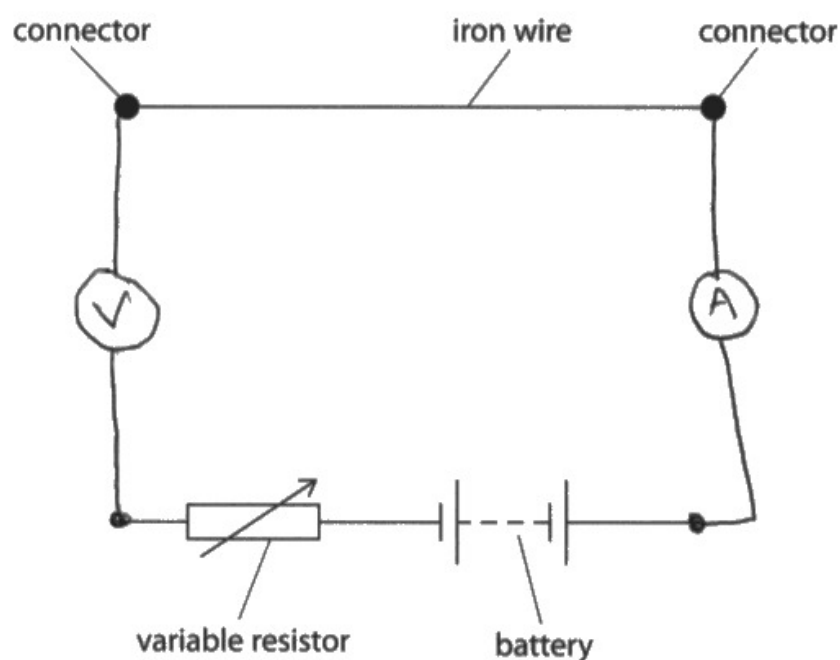


Figure 12

Add connecting wires, a voltmeter and an ammeter to complete the circuit in Figure 12 so that the students can determine the resistance of the piece of iron wire.



ResultsPlus
Examiner Comments

This scores one mark for the correct positioning of the ammeter in series in the circuit.



ResultsPlus
Examiner Tip

Learn how to show a voltmeter in parallel with a component in a circuit.

Correct answer.

- (b) Figure 12 shows some of the apparatus that students use to determine the resistance of a piece of iron wire.

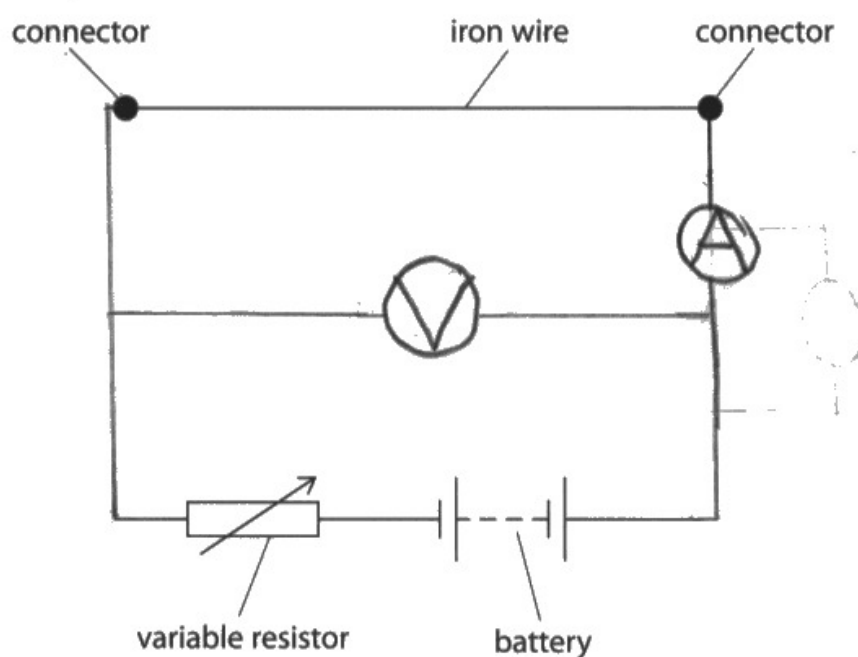


Figure 12

Add connecting wires, a voltmeter and an ammeter to complete the circuit in Figure 12 so that the students can determine the resistance of the piece of iron wire.



ResultsPlus
Examiner Comments

This response scores two marks. The ammeter is in series and the voltmeter is in parallel with the iron wire.



ResultsPlus
Examiner Tip

Practise drawing circuits with an ammeter and voltmeters in correct positions.

Question 5 (c)(i)

The question states that the investigation is to determine how the resistance of the iron wire changes with length, however only about a quarter of the candidates were able to give a ruler as the additional piece of apparatus needed.

Question 5 (c)(ii-iii)

The majority of candidates could add the straight line of best fit to the diagram and extended the line to find the resistance at a length of 100 cm.

The value of the resistance found could be between 2.7cm and 3.3cm.

Correct response.

(ii) Figure 13 shows a graph of the results.

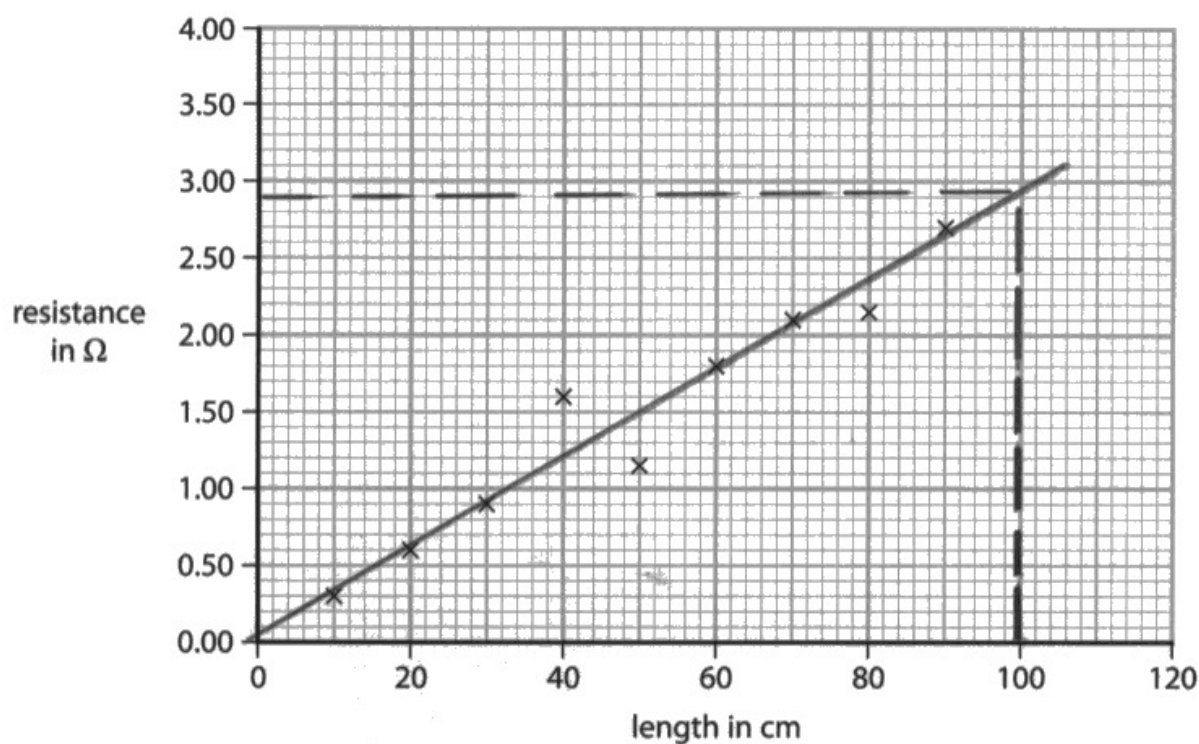


Figure 13

Draw a straight line of best fit on Figure 13.

(1)

(iii) Use Figure 13 to estimate the resistance of a 100 cm length of the iron wire.

(1)

resistance = 2.90 Ω



This response scores both marks. The line is between the two outliers and is extended to cut the 100cm line.

The candidate then draws a vertical broken line up from 100cm to the solid line of the graph and draws a horizontal broken line to find the resistance of the wire.



Ensure your graph reading is correct by drawing broken lines to the axes.

Question 5 (c)(iv)

Very few candidates were able to score one mark and even fewer two marks on this question.

The responses indicated that candidates did not know that increasing the resistance in a circuit will decrease the current and that it is the current that increases the temperature of the wire.

Correct response.

- (iv) The variable resistor shown in Figure 12 is used to prevent the iron wire from becoming too hot.

Explain how the variable resistor is used to prevent the iron wire from becoming too hot.

(2)

if the current increases the variable resistor
will increase resistance stopping the current from
getting too high which would heat the iron
wire.



ResultsPlus
Examiner Comments

This response scores 2 marks and is a complete answer. The resistance of the variable resistance is increased to reduce the current and added that it is the current which heats the iron wire.



ResultsPlus
Examiner Tip

Learn how changing the resistance in a circuit changes the current.

- (iv) The variable resistor shown in Figure 12 is used to prevent the iron wire from becoming too hot.

Explain how the variable resistor is used to prevent the iron wire from becoming too hot.

(2)

Stops too much current flowing.



ResultsPlus
Examiner Comments

This response scores 1 mark, there is no mention of increasing the resistance but the purpose of the variable resistor is to 'stop too much current flowing'.



ResultsPlus
Examiner Tip

Learn how resistance affects current in a circuit.

Question 5 (d)

The question required a rearrangement of the equation given and only about half of the candidates could do this successfully.

(d) The potential difference (voltage) across another piece of wire is 1.56 V.

The current in the wire is 0.45 A.

Calculate the resistance of this piece of wire.

Use the equation

$$V = I \times R$$

(2)

$$1.56 = 0.45 \times R$$

resistance = Ω



ResultsPlus
Examiner Comments

This response gains 1 mark. The candidate has substituted the values correctly into the equation although has made no further progress with the rearrangement.



ResultsPlus
Examiner Tip

Always substitute into the equation given. To get the substitution mark practice rearranging equations.

Question 6 (b)

The calculation of density using values of mass and volume given in standard form produced a large number of power of ten errors. About half of the candidates were able to get a value.

The majority of candidates were not able to give the unit of density.

- (b) An object has a mass of $7.22 \times 10^{-2} \text{ kg}$ and a volume of $2.69 \times 10^{-5} \text{ m}^3$.

Calculate the density, ρ , of the object.

Use the equation

$$\rho = \frac{m}{V}$$

State the unit.

$$7.22 \times 10^{-2} = 0.0722$$

$$2.69 \times 10^{-5} = 0.0000269$$

$$\frac{0.0722}{0.0000269} =$$

(3)

$$2684.01487$$

$$\text{density} = 2684.01487 \text{ unit } \rho$$



ResultsPlus
Examiner Comments

This example scores 2 marks. The answer for density is correct but shows the candidate is unable to use standard form on their calculator.



ResultsPlus
Examiner Tip

Learn to use standard form on your calculator.

Question 6 (c)(i)

The use of the negative -273°C confused most candidates and very few added 273 to 660 to get the correct answer of 933 $660 - (-273) = 933$.

This was the most common error.

(c) Aluminium has a melting point of 660°C .

The absolute zero of temperature is -273°C .

(i) Calculate the melting point of aluminium in kelvin.

$$660 - 273 = \text{ALUMINUM} 387 \quad (1)$$

melting point of aluminium = 387°C K



ResultsPlus
Examiner Comments

This response does not score a mark. 273 is subtracted from 660 and should be added.



ResultsPlus
Examiner Tip

Check the use of negative values.

Question 6 (c)(ii)

Candidates were asked to describe the motion of particles in a liquid but because the liquid was liquid aluminium and was at a high temperature many candidates found this challenging.

About half of the candidates were able to achieve one or two marks. The most common correct answers were that the particles moved about or moved freely, collided or moved fast.

(ii) Describe the motion of particles in liquid aluminium (above 660 °C).

(2)

particles will be fast moving as they are able to move freely throughout the structure.



ResultsPlus
Examiner Comments

This example scored 2 marks. The particles move 'fast' and 'move freely'.



ResultsPlus
Examiner Tip

Relate the question to what you know about particles in a liquid.

Question 6 (d)

The extended response question produced some very good answers with almost half the candidates being able to achieve level 3.

A table was used to give some properties of two materials.

The properties were what the materials were made of R-value of thermal insulation and fire resistance.

The materials to compare were fibreglass and polystyrene.

Candidates then had to compare the materials and conclude which would be the most suitable to use for thermal insulation in a building.

*(d) The table shows some properties of two materials used as thermal insulation.

The higher the R-value, the better the thermal insulating properties of the material.

material	R-value	fire resistance
fibreglass, made from sand	R-3.3	non-flammable
polystyrene, made from petroleum oil	R-4.0	melts at 270 °C and spreads fire very quickly

Assess which of these materials may be the more suitable to use as thermal insulation in a building.

Your answer should compare the properties of fibreglass and polystyrene given in the table.

(6)

Fibreglass would make a better material because it's made from sand, less dangerous, and is more safer than using petroleum oil.



ResultsPlus
Examiner Comments

Level 1-2 marks. The candidate has decided which is the better material to use but has not backed this up with any comparison to polystyrene.

Sand and petroleum oil are compared in terms of safety and danger but the petroleum oil needs to be linked to polystyrene to gain credit.



ResultsPlus
Examiner Tip

In a comparison of two materials, mention both materials.

*(d) The table shows some properties of two materials used as thermal insulation.

The higher the R-value, the better the thermal insulating properties of the material.

material	R-value	fire resistance
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Assess which of these materials may be the more suitable to use as thermal insulation in a building.

Your answer should compare the properties of fibreglass and polystyrene given in the table.

(6)

~~Both materials~~ Fibre-glass is made from sand and polystyrene is made from petroleum oil meaning that fibreglass is non-flammable and polystyrene melts at 270°C and spreads fire very quickly the R value in fibreglass is lower than the polystyrene because the fire resistance is very dangerous for polystyrene as it is a petroleum oil which is very flammable.



ResultsPlus
Examiner Comments

Level 2-4 marks. The candidate has compared fire resistance and R-value but has not come to a conclusion as to which would be the most suitable material to use.



Use all the information to make comparisons and remember to come to a conclusion.

*(d) The table shows some properties of two materials used as thermal insulation.

The higher the R-value, the better the thermal insulating properties of the material.

material	R-value	fire resistance
fibreglass, made from sand	R-3.3	non-flammable
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Your answer should compare the properties of fibreglass and polystyrene given in the table.

(6)

Fiberglass would be more suitable for insulating a building, in this is because fiber glass is a sustainable and easy to replace material, the R-value being 3.3 ~~does mean~~ means that the polystyrene has a 0.7 better properties for insulation but the fiberglass is non-flammable which fits into health and safety, if there were a fire in the building the fiberglass insulation will not increase the spread of the fire.

Contrastly, to the polystyrene it is not sustainable for the environment, even though the R-value is better than the fiberglass, its resistance to fire is a hazard as it makes the spread of fire more rapid, the polystyrene melting at 270° can be a positive because temperatures inside buildings do not reach that high but if there were a fire it would melt the polystyrene. Therefore, fibre glass is a more suitable thermal insulator.



Level 3-6 marks. The candidate has compared R value and fire resistance and considered sustainability. The argument put forward is logical and comes to a conclusion.



If asked to assess which is most suitable you must come to a conclusion.

Paper Summary

Based on their performance on this paper, candidates should:

- Learn circuit symbols
- Learn how changing the resistance in a circuit changes the current
- Practise putting voltmeters in parallel with components when setting up circuits and in circuit diagrams
- Always show substitution in an equation before evaluating
- Practise rearranging equations to change the subject
- Learn to calculate with standard form on your calculator
- When adding to diagrams, label what you have added
- When describing the relationship on a graph remember to make a comment on the straight line or curve.
- Read diagrams and tables carefully when taking information from them.

Grade boundaries

Grade boundaries for this, and all other papers, can be found on the website on this link:

<https://qualifications.pearson.com/en/support/support-topics/results-certification/grade-boundaries.html>

