Examiners' Report
June 2025

GCSE Physics 1PH0 2H

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June 2025

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Introduction

This was the eighth year of examining this specification, paper 2 of Physics, higher tier.

Questions were set to test candidates' knowledge, application and understanding from nine topics in the specification:

- Topic 1 – Key concepts of physics.
- Topic 8 – Energy – Forces doing work.
- Topic 9 – Forces and their effects.
- Topic 10 – Electricity and circuits.
- Topic 11 – Static electricity.
- Topic 12 – Magnetism and the motor effect.
- Topic 13 – Electromagnetic induction.
- Topic 14 – Particle model.
- Topic 15 – Forces and matter.

It was intended that the examination paper would allow every candidate to show what they knew, understood and were able to do. Within the question paper, a variety of question types were included, such as objective questions, short answer questions worth one or two marks each and longer questions worth three or four marks each. Several questions assessed candidates' knowledge of practical procedures, notably Q10 on electrical circuits. The standard of answers on practical questions was variable with some candidates showing good knowledge of the use of meters and components in series and parallel circuits. Candidates continued to do well with most calculation questions, including Q07(c) where the equation given was probably unfamiliar. Some did not cope well with the units involved in calculations. There was one question, Q09(a), that required several calculation steps. This was targeted at the higher grades. Q09(b) assessed candidates' ability to analyse a drawing of a device that could lift heavy loads and to apply their knowledge and understanding of the underlying physics principles. Most candidates engaged well with this question and some very good responses were seen.

Successful candidates were:

- Well-acquainted with the content of the specification.
- Skilled as a result of having been engaged with practical work during their course.
- Competent in quantitative work, especially in using equations.
- Well-focused in their comprehension of the question-at-hand.
- Willing to apply physics principles to the novel situations presented to them.

Less successful candidates:

- Had gaps in their conceptual knowledge of the topics of this paper.
- Had gaps in their procedural knowledge relating to their practical work.

- Were uncertain about SI units and when to convert them to sub or multiple units.
- Did not focus sufficiently on what the question was asking.
- Found difficulty in applying their knowledge to new situations.

This report will provide exemplification of candidates' work, together with tips and/or comments, for a selection of questions. The exemplification will come from responses which highlight successes and pitfalls, with the aim of aiding future teaching of these topics.

Question 1(a)(i)

Most candidates used the correct equation and rearranged it to find h.

(a) (i) The pressure on the ground due to the water in the pool is 3500 Pa.

The density of water is 10^3 kg / m^3.

The gravitational field strength, *g*, = 10 N / kg.

Calculate the depth of the water in the pool.

(2)

$$\text{Pressure} = h \times \rho \times g$$
$$3500 = h \times (10^3) \times 10$$
$$h = 3500 \div 10{,}000$$

depth = 0·35 m

ResultsPlus
Examiner Comments

A well laid out and fully correct answer. It scores the full two marks.

The most common error was to use 10 for the density of water rather than 10^3.

(a) (i) The pressure on the ground due to the water in the pool is 3500 Pa.

The density of water is 10^3 kg / m^3.

The gravitational field strength, *g*, = 10 N / kg.

Calculate the depth of the water in the pool.

(2)

$$P = h \times \rho \times g$$
$$\frac{P}{\rho \times g} = h \qquad \frac{3500}{10 \times 10} = 35$$

depth = 35 m

ResultsPlus
Examiner Comments

Examiners would allow one mark for an answer of 35 m even though this is the height of a large building. It scored one out of two marks.

ResultsPlus
Examiner Tip

Hint: Look at the result of a calculation to see if the value makes sense.

Question 1(a)(ii)

Candidates almost always drew an acceptable arrow pointing downwards either from or to the point X.

(ii) Figure 2 shows part of the side and base of the pool.

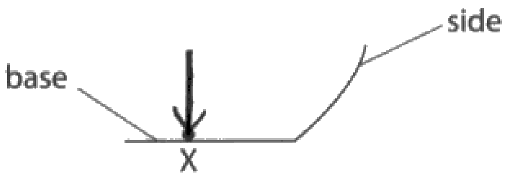


Figure 2

The water in the pool causes a force on the base of the pool.

Draw an arrow on Figure 2 to show the direction of this force at point X.

(1)

ResultsPlus
Examiner Comments

A clear and well drawn arrow in the correct position and pointing down. It scored the one mark for this question.

The most common error was to draw the arrow too far away from the point.

(ii) Figure 2 shows part of the side and base of the pool.

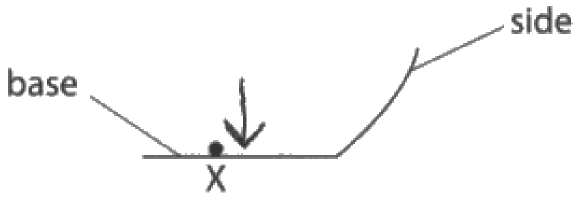


Figure 2

The water in the pool causes a force on the base of the pool.

Draw an arrow on Figure 2 to show the direction of this force at point X.

ResultsPlus
Examiner Comments

An arrow like this does not show the force at X but somewhere in the middle of the pool. It scored zero marks.

Question 1(c)

Candidates had to substitute the given values into the given equation and rearrange it in order to evaluate the force.

(c) A small hole is made in the base of the large pool shown in Figure 1.

$= 1.5 \times 10^{-6}\ m^2$

The area of the hole is 1.5 mm². The pressure at the base of the pool due to the water is 3500 Pa.

Calculate the force on the ground directly below the hole due to the water in the pool.

Use the equation

$$P = \frac{F}{A}$$

$$3500 = \frac{F}{1.5\times10^{-6}}$$

$$F = 3500 \times 1.5\times10^{-6} = 5.25\times10^{-3}$$

(2)

force = 0.00525 N

ResultsPlus
Examiner Comments

A correct substitution, rearrangement and evaluation for two marks.

Some candidates seemed to be uncomfortable in handling powers of ten and converted the units by adding a suitable number of decimal places. This method runs the risk of losing count of the zeros.

the pool.

Use the equation

$1{\cdot}5 \div 1000^2 = 0{\cdot}0000015$

$$P = \frac{F}{A}$$

(2)

$3500 = \frac{F}{\cancel{1.5}}$

$3500 \times 0{\cdot}0000015 = 0{\cdot}00525$

force = 0·00525 N

ResultsPlus
Examiner Comments

This answer scored the full two marks, however a better technique is to use powers of ten.

(c) A small hole is made in the base of the large pool shown in Figure 1.

The area of the hole is 1.5 mm^2. The pressure at the base of the pool due to the water is 3500 Pa.

Calculate the force on the ground directly below the hole due to the water in the pool.

Use the equation

$$P = \frac{F}{A}$$

(2)

$3500 = \frac{F}{1.5}$

$3500 \times 1.5 = F$

so F = 5250

force = 5250 N

ResultsPlus
Examiner Comments

A very common mistake was to forget to convert the units of area from mm^2 to m^2.

This would produce an answer that was a million times too large.

It scored one out of the possible two marks.

ResultsPlus
Examiner Tip

Hint: Look carefully at the units given in the question.

Question 1(d)

Most candidates correctly stated that the force below a bigger hole would be greater.

Question 2(a)(iii)

Many candidates failed to read this question fully. It asked for a way to reduce the difference between actual and expected velocities, however many candidates answered in general terms of reducing friction rather than **how** this could be achieved.

Several suggestions were accepted.

Some candidates recalled an air track being used to demonstrate the motion of a trolley with very little friction. Although these are normally used horizontally or without a significant slope, examiners would credit this suggestion.

The more common responses are shown below.

(iii) The light gate, shown in Figure 3, is used to determine the actual velocity of the trolley at the end of the runway.

The actual velocity at the end of the runway is less than the expected velocity as calculated in (ii).

Suggest **one** way to reduce the difference between the actual velocity and the expected velocity.

(1)

Lubricate the wheels of the trolley

ResultsPlus
Examiner Comments

Lubricating the wheels would reduce friction and therefore reduce the amount of energy transferred to thermal energy. This scored the mark.

Increase the slope of the runway

ResultsPlus
Examiner Comments

Increasing the slope of the runway is a plausible way of reducing the fraction of GPE transferred to friction. It scored the mark.

(1)

Make a trolley with a more streamlined or aerodynamic shape to reduce frictional drag from air resistance -

ResultsPlus
Examiner Comments

Examiners would accept a suggestion that reduced air resistance by changing the trolley for a more aerodynamic one. It scored the mark.

Reduce the friction on the runway

ResultsPlus
Examiner Comments

This response does not suggest a method, only a reason. It did not score the mark.

(1)

re calculate average and calculate a mean.

ResultsPlus
Examiner Comments

This incorrect response was often seen.

Question 2(a)(i-ii)

In Q02(a)(i), candidates were asked to use the rearranged equation for change in gravitational potential energy to use the given values to show that the mass is about 1.6 kg.

In this type of question, the candidate's working is scored rather than their final evaluation.

Q02(a)(ii) required substitution of the given values into the equation to find v^2. The value of v is then the square root of this value. Very many candidates tackled this problem with confidence to arrive at an expected velocity that rounded to 2.3 m/s.

The change in height, Δh, is given as 26 cm and this must be converted into 0.26 m before being substituted into the equation.

2 (a) A student places a trolley at the top of a runway, as shown in Figure 3.

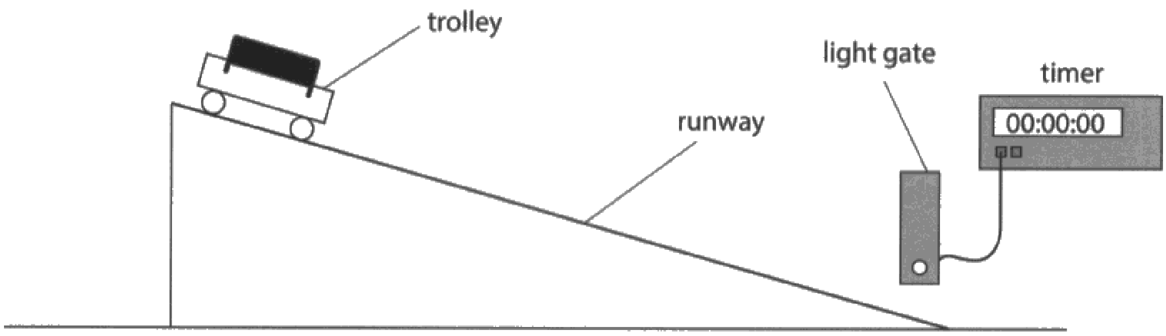


Figure 3

The student had to lift the trolley through a height of 26 cm to put it at the top of the runway.

The gravitational potential energy, Δ*GPE*, of the trolley increases by 4.1 J when lifted to the top of the runway.

The gravitational field strength, *g*, = 10 N/kg.

(i) Show that the mass of the trolley is about 1.6 kg.

Use the equation

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

26 ÷ 100 = 0.26

26cm → 0.26m **(2)**

$\cancel{\frac{4.1}{10 \times 0.26}} =$

$\frac{4.1}{10 \times 0.26} = 1.57$

$= 1.6$ kg

ResultsPlus
Examiner Comments

Here the candidate has clearly converted the 26cm into 0.26m before substituting into the equation. This scores the full two marks.

2 (a) A student places a [redacted] at the [redacted] of a runway, as shown in Figure 3.

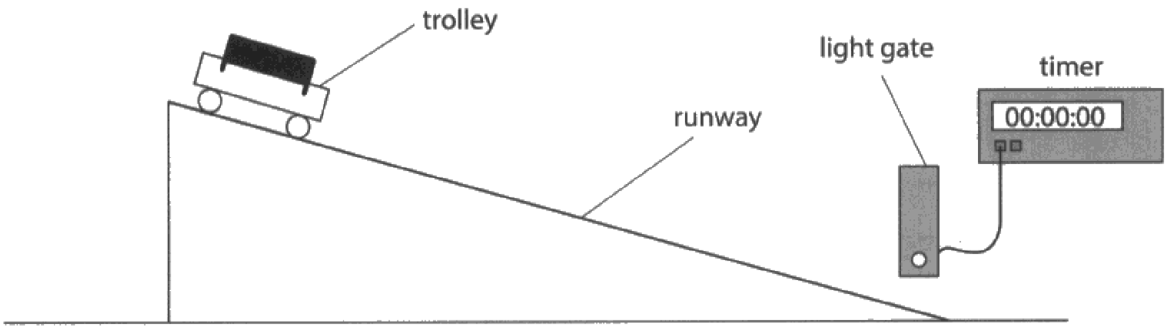


Figure 3

The student had to [redacted] the trolley through a [redacted] of [redacted] to put it at the top of the [redacted]

The g[redacted], Δ[redacted] of the trolley [redacted] by [redacted] when [redacted] the top of the runway.

The g[redacted] g, = [redacted]

(i) Show that the [redacted] the trolley is about [redacted]

Use the equation

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

(2)

$$\frac{4.1}{26 \times 10} = 0.016$$

$$0.016 \xrightarrow{\times 100} 1.6\text{kg}$$

ResultsPlus
Examiner Comments

The candidate has simply substituted the value of 26 into the equation. This can score one mark. This was then evaluated to be 0.016 and then multiplied by 100 for no apparent reason other than to bring it to a value of 1.6. There is no evidence that 26 cm has been converted to 0.26 m. It can only score one mark out of a possible two.

(ii) The student releases the trolley and the trolley moves down the runway.

The student assumes that all the extra gravitational potential energy, ΔGPE, stored at the top of the runway is transferred to kinetic energy at the end of the runway.

Calculate the expected value of the velocity of the trolley at the end of the runway.

Use the equation

$$v^2 = \frac{2 \times \Delta GPE}{m}$$

$$\frac{2 \times 4.1}{1.6} = 5.125 \text{ m/s}$$

$$= 5.13 \text{ m/s}$$

$$\sqrt{5.13} = 2.263 \text{ m/s}$$

(3)

expected velocity = ~~82.13~~ 2.26 m/s

ResultsPlus
Examiner Comments

A nicely laid out answer that scored full marks.

$$v^2 = \frac{2 \times \Delta GPE}{m}$$

$$v^2 = \frac{2 \times 4.1}{1.6} = 5.125 = v^2$$

(3)

expected velocity = 5.125 m/s

ResultsPlus
Examiner Comments

The candidate has correctly evaluated v^2 but it did not go on to find the square root. It scored two out of three marks.

Question 2(b)

Although the equation for power was given, correct substitution required candidates to first determine the weight of the student from the student's mass. The final value had to be given to 2 significant figures.

Significant figures were often confused with decimal places.

(b) A different student finds out how much power can be generated by running up some stairs in a measured amount of time.

The following quantities are measured:

mass of student = 48 kg

total height of stairs = 2.9 m

time to run up stairs = 3.4 s

Calculate the power the student generated.

Give the answer to 2 significant figures (2 s.f.).

Use the equation

$$\text{power} = \frac{\text{weight of student} \times \text{height of stairs}}{\text{time to run up stairs}}$$

(3)

weight = mass × gravitation field strength

$48 \times 10 = 480$

$$\text{power} = \frac{480 \times 2.9}{3.4} = 409.4117\ldots$$

$= 409.41$ W (2d.p)

power = 409.41 W

ResultsPlus
Examiner Comments

A nicely laid out answer with correct evaluation. However, this value has been expressed to two decimal places rather than to two significant figures. It scored two out of three possible marks.

$$\text{power} = \frac{\text{weight of student} \times \text{height of stairs}}{\text{time to run up stairs}}$$

(3)

weight of student: $\omega = mg$

~~power =~~

$\omega = 48 \times 10 = 480N$

$$\text{power} = \frac{480 \times 2.9}{3.4} = 409.4117647$$

$= 410 \,(2sf)\, \omega$

power = 410 W

ResultsPlus
Examiner Comments

A fully correct answer that is expressed to two significant figures. It scored full marks.

$$409.411 \quad \frac{48 \times 10 \times 2.9}{3.4}$$

409

power = 409 W

ResultsPlus
Examiner Comments

Here the value of 409.411 has been expressed as 409 by simply removing the numbers after the decimal point. This has 3 significant figures. It scored two out of a possible three marks.

$$\text{Power} = \frac{(48 \times 10) \times 2.9}{3.4}$$

Power = 409.4117647

= 400 (2sf)

power = 400 W

ResultsPlus
Examiner Comments

An attempt to express the answer to two significant figures, however the value of 409.41 is closer to 410 than to 400. It scored two out of a possible three marks.

ResultsPlus
Examiner Tip

Make sure you know how to round a value to a specified number of significant figures.

A very common error was to use the given value of mass (48 kg) rather than weight.

$$\text{power} = \frac{48 \times 2.9}{3.4}$$

= 40.94...

= 41

power = 41 W

ResultsPlus
Examiner Comments

The wrong value for weight has been used and so does not score any marks for the evaluation. However, this result has been rounded to two significant figures and so scores one mark.

Although the value of g was given as 10 N/kg in part (a) of the question a surprising number of candidates used 9.8 or 9.81. Examiners did not penalise this however.

(b) A different student finds out how much power can be generated by running up some stairs in a measured amount of time.

The following quantities are measured:

mass of student = 48 kg

total height of stairs = 2.9 m

time to run up stairs = 3.4 s

Calculate the power the student generated.

Give the answer to 2 significant figures (2 s.f.).

Use the equation

$$\text{power} = \frac{\text{weight of student} \times \text{height of stairs}}{\text{time to run up stairs}}$$

(3)

weight = mass × gravitational field
= 48 × 9.81
= 470.88 N

$$\text{power} = \frac{\text{weight} \times \text{height}}{\text{time}}$$

$$\frac{470.88 \times 2.9}{3.4}$$

= 401.6329412
= 400 (2sf)

power = ~~402~~ 400 W

ResultsPlus
Examiner Comments

The calculated value of 401.63 has been correctly rounded to 2 significant figures. It scored full marks.

Question 3(b)

This question required the use of the equation given to calculate power.

Many candidates found this straightforward with the most common error being simply incorrect use of the calculator.

(b) The mains supply to the television is 230V.

The current supplied to the television is 0.53 A.

Calculate the power input to the television.

Use the equation

$$P = I \times V$$

(2)

$P = 0.53 \times 230 = 121.9$

$= 122W$

power = 122 W

ResultsPlus
Examiner Comments

A fully acceptable response. An ideal answer would round the value of 122 to 120. This would be to the same number of significant figures in the given values of voltage and current. Even so, this response scored the full two marks.

$230 \times 0.53 = 132.5$

power = 132.5 W

ResultsPlus
Examiner Comments

Correct substitution of values into the equation for one mark.

However, the evaluation was incorrect and did not score the second mark. Possibly the candidate calculated 250 ÷ 0.53.

Question 3(c)(ii)

The question asked for an explanation of what happens if the current in a plug exceeds the fuse rating. It is noteworthy that responses to similar questions have improved over the years and candidates are very often able to link the melting of the wire in the fuse with the breaking of the circuit which prevents further current to the appliance.

(ii) A 3 A fuse is used in the plug.

Explain what happens if a fault causes the current to rise to more than 3 A.

(2)

the fuse will overheat and melt
breaking the circuit and stopping
the current

ResultsPlus
Examiner Comments

An excellent response that scored full marks.

The fuse blows if current exceeds 3A
to reduce any potential damage

ResultsPlus
Examiner Comments

Examiners would accept "blows" for melts. This scored one out of a possible two marks because it did not go on to fully explain what happens.

Examiners were tolerant of descriptions of the circuit being broken and would accept, for example, “switches off the TV”.

The fuse is a safety device in the plug. If the current rises above 3A, the fuse would detect this and stop current from flowing into the appliance.

ResultsPlus
Examiner Comments

This is a partly acceptable answer. It did not mention how the fuse behaves; ie melts or "blows". It scored one out of a possible two marks.

Question 3(c)(iii)

Candidates were asked to identify a safety device (other than a fuse) that can be used in domestic wiring and many responses correctly mentioned a circuit breaker.

In addition examiners gave credit for features of domestic wiring that were not exactly a device but nevertheless did improve safety. The most common example suggested was the earth wire (or pin).

Other acceptable suggestions included a cable clamp in a plug (which prevents wires from being accidentally pulled out) and protective covers that can be placed over sockets. Examiners would also accept a description of insulation around wires.

(iii) A fuse is a safety device.

State **one** other safety device that can be used in domestic electrical wiring.

(1)

Circuit Breaker

ResultsPlus
Examiner Comments

Another acceptable common response.

Earth wire

ResultsPlus
Examiner Comments

A common and acceptable answer.

insulation around the wires so the current can't be conducted to people.

ResultsPlus
Examiner Comments

An acceptable answer.

Question 3(d)

Candidates were required to extract information from the figure showing two different cables and explain why one cable was the most suitable for supplying electric current to the house. A creditworthy response would compare the cross sectional areas of the copper wires and then reason that the larger wires would have less resistance and so could safely carry a higher current.

(d) Figure 4 shows two pieces of electrical cable side by side.

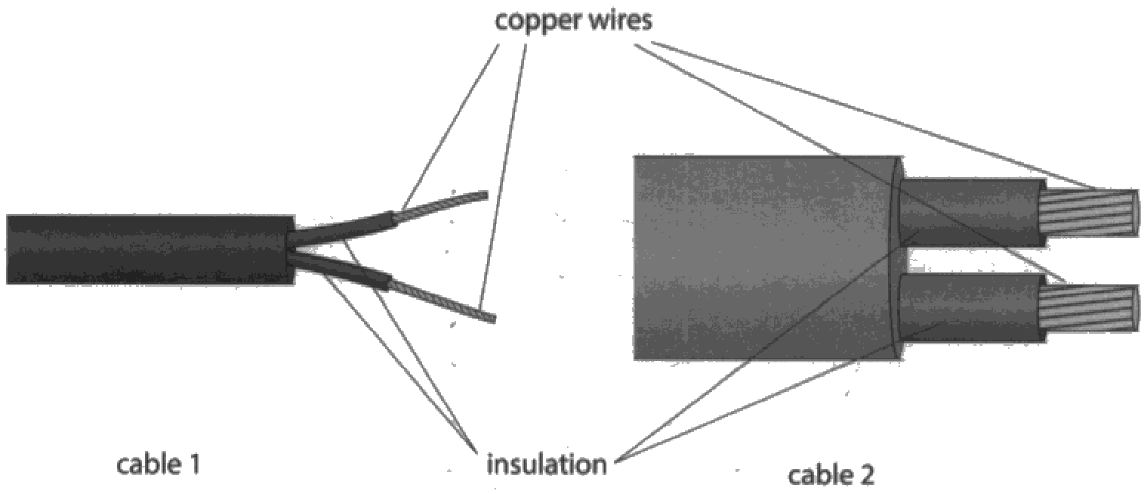


Figure 4

Cable 1 is used to supply electric current to the television.

Cable 2 is used to supply electric current to the house.

Explain why cable 2 is more suitable than cable 1 for supplying electric current to the house.

(2)

the house needs a higher ~~electric~~ supply of electric current so cable 2 is bigger and can provide a ~~t~~ larger current while cable 1 is too small and will have more resistance

(Total for Question 3 = 9 marks)

ResultsPlus
Examiner Comments

There were no marks for stating that the cable was bigger. Examiners were looking for a reference to the copper wires in the cable. However, this answer went on to correctly reason that cable 2 could carry a larger current (one mark) because it had a lower resistance (one mark).

(d) Figure 4 shows two pieces of electrical cable side by side.

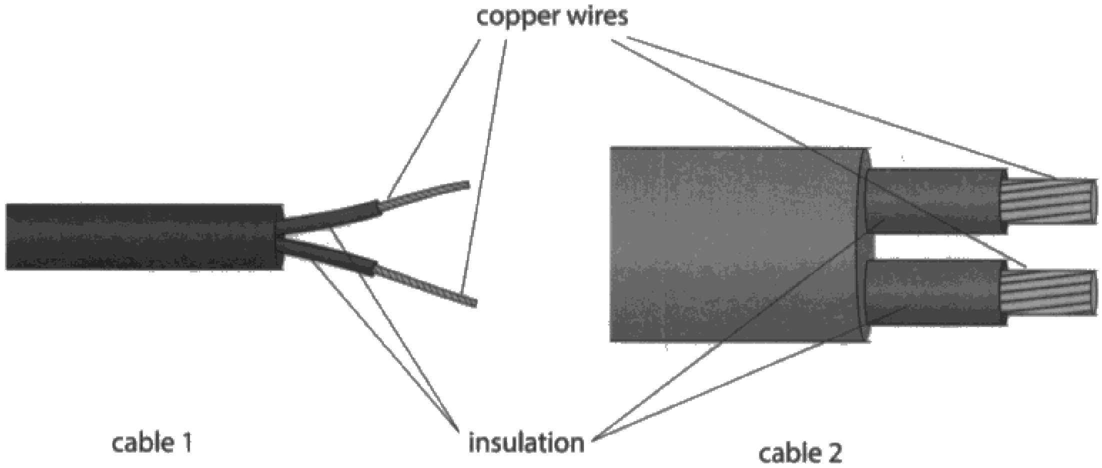


Figure 4

Cable 1 is used to supply electric current to the television.

Cable 2 is used to supply electric current to the house.

Explain why cable 2 is more suitable than cable 1 for supplying electric current to the house.

(2)

Cable 2 has thicker wires so that means a higher current can be transferred without a lot of energy being lost to the surroundings.

ResultsPlus Examiner Comments

This scored a mark for reference to thicker wires. It scored a second mark for stating that it could carry a higher current. The examiner ignored the last statement about energy being lost to the surroundings because full marks had already been scored.

Examiners saw many references to the thickness of the insulation and candidates often seemed to think, incorrectly, that this provided thermal insulation "to prevent the wires from losing energy".

cable two has more / thicker insulation which will decrease wasted energy, such as heat to the surroundings, to increase efficiency of the current and therefore more electricity can be supplied.

ResultsPlus
Examiner Comments

This was a common, incorrect, answer. The amount of energy "wasted as heat" can only be lowered by reducing the resistance of the wires. It cannot be lowered by thermal insulation which, at best, would only reduce transfer of this "wasted" energy to the air.

Additionally, many candidates seemed to think that a thicker insulation provided better protection against electric shock; often implying, incorrectly, that the voltage of the mains supply to the house was more than the 230V being supplied to the T.V.

cable 2 has thicker wires so can carry 230V easily and has thicker insulation because the voltage is higher and more dangerous

ResultsPlus
Examiner Comments

Although there is one mark for correctly identifying the thicker wires in cable 2, it is incorect to imply that the TV set is supplied with a lower voltage than the mains supply to the house.

The insulation around cable 1 already provides sufficient electrical insulation.

Question 4(a)

Candidates were asked to show the shape and direction of an electric field between two charged metal plates.

Examiners were looking for straight lines with arrows going from the positive to the negative plate.

4 (a) Figure 5 shows **two** metal plates.

The plates are charged by a very high voltage (potential difference).

Draw, on Figure 5, the shape and direction of the electric field between the two plates.

(2)

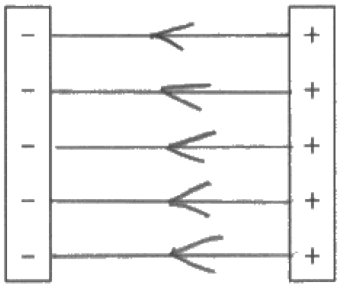


Figure 5

(b) Figure 6 shows a device that removes small particles of soot from sooty air.

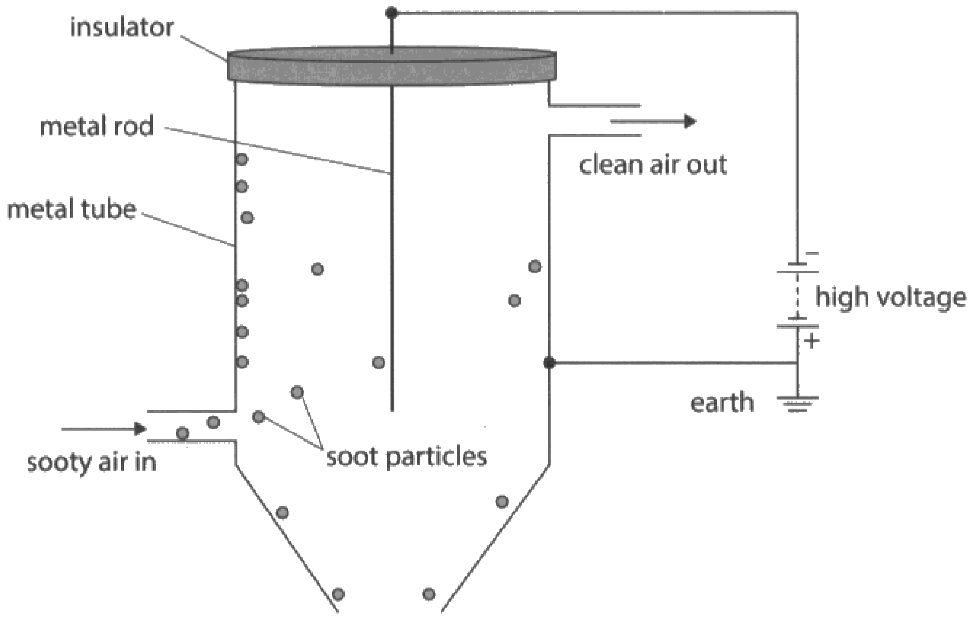
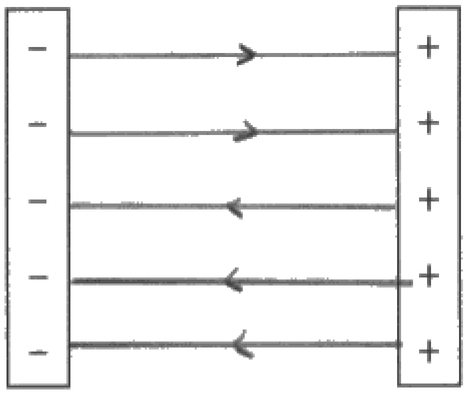


Figure 6

ResultsPlus
Examiner Comments

A well drawn and fully correct answer for two marks.



ResultsPlus
Examiner Comments

The lines are correctly drawn for one mark. However, some of the arrows go the wrong way and so does not score the second mark.

Question 4(b)(ii)

The charged soot particles are in an electric field and are attracted towards the metal tube.

Alternatively a positive charge would be induced on the surface of the metal tube resulting in a force of attraction of the soot particles towards the metal tube. Examiners would accept an answer that linked attraction towards the metal tube and unlike charges or repulsion from the central metal rod because of like charges.

(ii) Explain why, in Figure 6, the charged soot particles move towards the metal tube.

(2)

- negative soot particles attract to positive charged metal tubes.
- interacting electric field

ResultsPlus
Examiner Comments

This response scores a mark for attraction and another mark for reference to the positive metal tube.

There is no credit for reference to the negative charge on the soot particles because this had already been given in the previous part of the question.

It also correctly refers to an electric field. However, two out of two marks had been already been scored.

the positive charges in the metal tube are brought to the surface of the tube, attracting the negatively charged soot particles, as opposite charges attract.

ResultsPlus
Examiner Comments

A good description of positive charges on the surface of the metal rod attracting the oppositely charged soot particles. It scored two out of two marks.

The metal rod is negatively charged by the high voltage circuit. As the soot particles are also negatively charged, like charges repel and causes the soot to stick to the tube.

ResultsPlus
Examiner Comments

A clear answer that correctly described repulsion between the negative rod and soot particles. Two out of two scored.

they get repelled by the metal rod ~~been~~ causing them to go to the tube.

ResultsPlus
Examiner Comments

This scores a mark for the idea of the central metal rod repelling the particles for one mark. To score two marks it should have stated that the rod had the same charge as the particles (ie negative).

Question 4(b)(iii-iv)

In Q04(b)(iii), candidates were asked what happens to the charge on the soot particles when they reach the metal tube.

Examiners were looking for the idea of charge being lost from the soot particles as they settle on to the metal tube. This could be expressed as becoming neutral or being discharged. Most candidates were able to provide an acceptable response.

In Q04(b)(iv), the metal tube is a conductor that is connected to earth. Therefore, any electric charge transferred to it by the soot particles will travel through the metal and it’s connected wire to earth.

Very many candidates gave a good explanation along these lines.

A mark was sometimes lost by failing to state that the metal tube is a conductor.

Other candidates lost a mark by failing to recognise that charge would only move through the metal tube if it had somewhere to go, ie earth.

Question 4(c)

This question required candidates to select the correct equation from the equation booklet to calculate the amount of charge and also to recall the unit of charge. The current was given as 2.5mA and therefore had to be converted to amperes to give an answer in coulombs.

Examiners were pleased to see many fully correct answers.

(c) There is a current of 2.5 mA in a circuit.

Calculate the amount of charge that moves past a point in the circuit in 80 seconds.

State the unit of charge.

(3)

$2.5 \div 1000 = 2.5 \times 10^{-3}$

$2.5 \times 10^{-3} \times 80 = 0.2$

charge = 0.2 unit coulombs

(Total for Question 4 = 11 marks)

ResultsPlus
Examiner Comments

The values have been substituted into the equation Q = I x T for one mark.

The current has been converted from mA to A which is correctly evaluated for one mark.

The unit has been correctly recalled for one mark.

charge = current × time $2.5 mA = 2.5 \times 10^{-3}$

charge = $2.5 \times 10^{-3} \times 80$

charge = 0.2

charge = 0.2 unit As

ResultsPlus
Examiner Comments

The evaluation of 0.2 is correct for two marks.

Although the SI unit for charge is the coulomb, As (ampere seconds) is an acceptable unit and scores the third mark.

e unit of charge.   mA x S   (3)

charge = current x time
= 2.5 x 80
= 200

charge = 200 unit mA S

ResultsPlus
Examiner Comments

Some candidates kept the current in mA and then correctly gave the unit as mC. This is perfectly acceptable.

Here the candidate gave the unit as mAs. This was also accepted. The response scored the full three marks.

Very many candidates did not correctly convert mA into A.

(3)

$Q = I \times t$

$Q = 2.5 \times 80$

$Q = 200$

charge = 200 unit Coulombs

ResultsPlus
Examiner Comments

There is a mark for substitution into Q = I x T but there is no attempt at conversion from mA to A so it does not score the mark for evaluation.

There is a mark, however, for recall of the unit of charge.

This response scored two out of three.

e the unit of charge.

$2.5 \times 100 = 250$

$Q = I \times t$

$= 250 \times 80$

$= 20000$

charge = 20000 unit C

ResultsPlus
Examiner Comments

The candidate incorrectly converted from mA to A. This scored one mark for the substitution.

There is also a mark for the unit and so this scored two out of three marks.

Some candidates gave an acceptable alternative unit for charge even though their evaluation was incorrect.

$$\frac{80}{2 \cdot 5} = 32$$

charge = 32 unit C

ResultsPlus
Examiner Comments

This scored one mark for the unit.

Question 5(b)

Candidates were often able to describe the change in motion of wax particles as the wax changed from liquid to solid in terms of the particles slowing down and no longer moving past each other. Examiners would also credit responses that implied the difference; for example "now only vibrate in fixed positions".

This type of response was seen very often.

(b) Describe the change in the motion of the wax particles as the wax changes from liquid to solid.

(2)

When in a liquid the particles are randomly arranged and move freely but in a solid the particles are close together and vibrate in fixed positions.

ResultsPlus
Examiner Comments

There is a mark for describing vibrating particles.

There is another mark for describing them as being in fixed positions.

It scored the full two marks.

the particles stop flowing quickly past eachother, slowing down, entering a lattice structure, remaining touching and vibrating on the spot.

ResultsPlus
Examiner Comments

There is a mark for stating that the particles no longer move past each other.

There is a mark for describing the particles slowing down.

There would also be a mark for "vibrating" but full marks have already been scored in this response.

The particles loose energy causing them to slow down.
They become closer together.

ResultsPlus
Examiner Comments

A mark was scored for writing "slow down". The same mark would also have been given for "lose energy".

"become closer together" is not enough for another mark. The response scores one out of two.

Question 5(c)(i)

Most candidates were able to substitute the given values into the given equation. Rearrangement proved difficult for some but examiners saw very many correct answers.

(c) Figure 8 shows the values of some properties of the wax.

property	value
density when solid	930 kg / m^3
density when liquid	830 kg / m^3
specific latent heat	190 kJ / kg
specific heat capacity of solid wax	2.1 kJ / kg °C

Figure 8

(i) The wax has a mass of 3.9 kg.

Using information from Figure 8, calculate the volume of the wax when it is all liquid.

Use the equation

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

(2)

$830 = \frac{3 \cdot 9}{V}$

$3 \cdot 9 \div 830 = 0 \cdot 0047$

volume = 0·0047 m^3

ResultsPlus
Examiner Comments

A fully correct answer. There is one mark for the substitution and one mark for the correct evaluation.

equation

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

$m - 3.9\text{kg}$

$d \times V$?

~~830~~ 830

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

$\frac{3.9}{830} = 4.698\ldots \times 10^{-3}$ m^3

(2)

volume = 4.7×10^{-3} m^3

ResultsPlus
Examiner Comments

Examiners were pleased to see many responses such as this. The candidate has correctly expressed the answer in scientific notation: 4.7×10^{-3}.

uation

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

3.9 830 = $\frac{kg}{m^3}$

$m^3 \times 830 = kg$
$\div 830$ $\div 830$

(2)

$3.9 \div 830 = 0.00469$

0.005

volume = 0.005 m^3

ResultsPlus
Examiner Comments

It was noteworthy that many candidates rounded their answers from 0.0047 m^3 to 0.005 m^3. This is unnecessary and actually poor practice. Evaluations should be rounded to the same number of significant figures that were supplied in the given values; in this case 2 significant figures.

Nevertheless, this response scored the full two marks.

(c) Figure 8 shows the values of some properties of the wax.

property	value
density when solid	930 kg / m^3
density when liquid	830 kg / m^3
specific latent heat	190 kJ / kg
specific heat capacity of solid wax	2.1 kJ / kg °C

Figure 8

(i) The wax has a mass of 3.9 kg.

Using information from Figure 8, calculate the volume of the wax when it is all liquid.

Use the equation

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

(2)

$$830 = \frac{3.9}{V}$$

$$830 \times 3.9 = 3237$$

volume = 3237 m^3

ResultsPlus
Examiner Comments

There is one mark for substituting the values into the equation. However, the candidate did not rearrange correctly and could not score the second mark.

Question 5(c)(ii)

Candidates often used the data in the table to reason that the volume of the solid wax was less than the same mass of liquid wax.

(ii) State, using information from Figure 8, how the volume of the wax changes when it becomes a solid.

(1)

Volume decreases as the density increases from 830 kg/m^3 to 930 kg/m^3.

ResultsPlus
Examiner Comments

A simple and fully correct response that scored the mark.

Question 5(c)(iii)

The question asked candidates to explain the cooling curve in terms of the data in the table. Very many realised that the specific latent heat of the wax was very much more than the specific heat capacity of the liquid wax. Marks could be gained by using values from the table to support the explanation. Examiners were also looking for a comparison of thermal energy being transferred from the material to the surroundings; however, a surprisingly large number wrote responses that referred to the wax being heated from a solid into a liquid. This required thermal energy being transferred **to** the material and therefore did not score this mark. Another possible mark could be awarded for the idea that, when cooling, the rate of energy transfer remained (approximately) the same. This mark was rarely scored.

(iii) Explain why, using Figure 8, the time from R to S is much shorter than the time from Q to R on the graph in Figure 7.

(3)

The wax's specific latent heat (190kJ/Kg) is much greater than the wax's specific heat capacity of (2.1 kJ/kg°C) which means ~~m~~ a higher energy needs to be tansferred to change 1kg of the wax's ~~the~~ state ~~of the wax~~ than the energy required to change 1 kg of the wax by 1°C which would require more time if energy is being transfered at the same rate.

(Total for Question 5 = 9 marks)

ResultsPlus
Examiner Comments

There is one mark for stating that the specific latent heat is much greater than the specific heat capacity. There is another one mark for using values from the table to support that statement.

The statement about energy being transferred is ambiguous; it is not clear in which direction this transfer is taking place.

However, there is another one mark for stating that the energy transfer is occurring at the same rate.

the specific latent heat is much larger than the specific heat capacity 190kJ/kg > 2.1 kJ/kg°C. This means it takes longer to release energy when changing state (Q to R) compared to changing the internal energy of the wax R to S

ResultsPlus
Examiner Comments

Once again there are two marks for comparing the specific latent heat and specific heat capacity with supporting values.

It is also clear that it is requiring energy to be transferred from the wax to the surroundings and so scores one additional mark. Total three out of three possible marks.

Many candidates seemed to imply that the wax was melting rather than freezing.

The time from Q to R is much longer because the wax is undergoing a state change - there is a lot of energy being used to break the bonds in the wax for it to turn into a liquid. The specific latent heat is much higher than the specific heat capacity.

ResultsPlus
Examiner Comments

There is one mark for comparing specific latent heat and specific heat capacity. However, energy is not being used to turn the wax into a liquid. It scores only one out of three marks.

Question 6(a)(i)

The question showed a diagram of part of an electric toothbrush charger system. This is essentially a transformer.

In spite of the, probably, unfamiliar scenario of the question, candidates seemed to be familiar with an explanation of how an alternating current in the primary coil induces an alternating pd across the secondary coil via a change in the magnetic field of the iron core.

There is an alternating current in the primary coil.
This produces an alternating /varying magnetic field (in the iron core).
The field lines of this magnetic field cut through the secondary coil. This induces an alternating potential difference, which induces an alternating current (as current can flow in the circuit).

ResultsPlus
Examiner Comments

A very clear answer that links:

- alternating current in the primary coil (one mark)
- changing magnetic field in the iron core (one mark)
- induces an alternating pd in the secondary coil (one mark).

Marks were usually lost by not stating the magnetic field in the core was changing.

an alternating current is provided to the primary coil creating a magnetic fields which cuts through the secondary coil and induces an alternating potential difference and so an alternating current in the secondary coil

ResultsPlus
Examiner Comments

The answer given links:

- alternating current in the primary coil (one mark)
- induces alternating pd in the secondary coil (one mark).

However, the change in magnetic field was not described.

Two out of three marks scored.

There still seems to be a confusion between a p.d. being **induced** and a p.d. being **produced**.

(3)

The alternating current in the primary coil cuts through the magnetic field which induces an alternating magnetic field and produces an alternating current in the secondary coil.

ResultsPlus
Examiner Comments

The answer links:

- alternating current in the primary coil (one mark)
- changing magnetic field in the iron core (one mark).

However, examiners would not accept "produces" an alternating current. The correct word is "induces".

Two marks out of three scored.

ResultsPlus
Examiner Tip

Make sure you know when to use the term "induces".

Question 6(a)(ii)

Examiners saw many examples of confident substitution into and rearrangement of the appropriate transformer equation. Only a small minority of responses attempted to use the equation linking pd and current.

(ii) The potential difference across the primary coil is 230V.

The potential difference across the secondary coil is 1.5V.

The primary coil has 1840 turns of wire.

Calculate the number of turns of wire in the secondary coil.

(2)

$$\frac{V_p}{V_s} = \frac{N_p}{N_s}$$

$$\frac{230V}{1.5V} = \frac{1840}{x}$$

$$\frac{1840}{\left(\frac{230}{1.5}\right)} = x$$

$$x = 12$$

number of turns = 12

ResultsPlus
Examiner Comments

A clearly laid out and fully correct answer that scored the full two marks.

Question 6(b)

Although the uses of a diode to rectify an alternating current into a direct current was known by many, very few went on to link this to the need for a direct current to recharge the battery.

(b) In Figure 9, a diode is connected in series with the rechargeable battery. NS

Explain why a diode is needed in the toothbrush in this part of the circuit.

(2)

- Batteries use direct current
- The diode ensures current only flows in one direction, converting alternating current to direct current to charge the battery in the series circuit.

2/105

ResultsPlus Examiner Comments

There is one mark for recognising that batteries are d.c. devices.

There is one mark for writing that diodes allow current in one direction only.

Two out of two marks scored.

A diode only allows current to flow in one direction, this is needed so that the current all goes to the rechargeable battery so that the toothbrush can work.

ResultsPlus
Examiner Comments

There is one mark for the diode only allowing current in one direction.

There is no mark for describing the current going to the battery; this was already described in the question.

One mark out of two scored.

Many candidates thought that the diode limited the size of the current.

Makes the current travel in one direction so current isn't too high to charge the brush.

ResultsPlus
Examiner Comments

There is only one mark here for current travelling in one direction.

A significant number of candidates seemed to think the diode was a LED used as an indicator.

(b) In Figure 9, a diode is connected in series with the rechargeable battery.

Explain why a diode is needed in the toothbrush in this part of the circuit.

(2)

The diode is needed in order to indicate the remaining charge within the ~~reg~~ rechargeable battery.

ResultsPlus
Examiner Comments

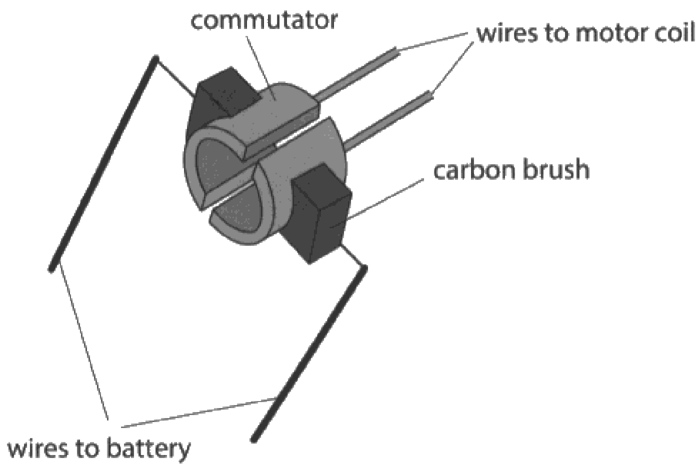
An electric toothbrush may include one or more LEDs, but these are not the same as the diode between the transformer and the battery.

No marks were scored here.

Question 6(c)

The purpose of a commutator in a d.c electric motor was poorly explained. Although the idea of switching the connections every half revolution was often shown, candidates did not go on to describe that this would ensure the motor continuously rotated. The simple fact that the commutator carried current from the battery to the coil (via the carbon brushes) was usually omitted or described in terms of preventing the wires from getting tangled up.

(c) Figure 10 shows a simplified diagram of the split ring commutator in a d.c. electric motor.



(Source: gsu.edu)

Figure 10

Explain the function of the commutator in a d.c. electric motor.

(3)

The commutator reverses the directions of current every half turn so that the coil in the motor can spin continuously.

ResultsPlus
Examiner Comments

A clear answer that links:

- reversing the direction of the current every half turn (one mark)
- enabling the motor to spin continuously (one mark).

Two marks out of three scored.

To flip the current going into the motor, because if this did not happen the motor would not be able to turn ~~more than~~ 360°, and would be pushed the other direction. What the commutator does is flip the current in the motor every half turn, keeping the force acting in one direction

ResultsPlus
Examiner Comments

This response links:

- reverse the current every half turn (one mark)
- to keep the force acting (on the coil) in one direction (one mark).

In spite of it being clearly labelled an electric motor, a surprisingly large number of candidates attempted to describe a dynamo or a d.c. generator.

(3)

The split ring commutator reverses the flow of current to the motor every half turn, which produces a direct current. The function of the commutator is to produce a direct current rather than an alternating current.

ResultsPlus
Examiner Comments

There is one mark for describing the current reversing every half turn.

However, the motor does not produce a current.

One mark out of three scored.

ResultsPlus
Examiner Tip

Make sure you understand the difference between using electric current to create movement (eg in a motor or loudspeaker) and using movement to generate an electric current (eg in a dynamo or a microphone).

Question 7(b)(ii-iii)

Instead of a possibly more familiar graph, candidates were required to complete and interpret a bar chart.

The completion was usually correct and a simple interpretation such as “the more plastic strips, the fewer the nails” was given. Better candidates went on to recognise that the relationship was not linear.

Examiners saw many references to “Inversely proportional”, and candidates appear to regard this is being the same as a negative correlation. This is not true. Candidates should be discouraged from using the term “Inversely proportional” unless it is a relationship where one variable is clearly proportional to the reciprocal of the other variable.

Question 7(b)(iv)

The question asked for suggestions as to how it could be established that the nails were not permanently magnetised. Examiners would give one mark for suitable test that could include testing the nails against each other, or another magnetic material or against a permanent magnet or compass needle.

A second mark was for a clear statement about the expected results of the test. Although many scored the first mark, the second mark was often lost for the incomplete description of the result.

(iv) A student thinks that none of the nails used in the investigation become permanently magnetised.

Suggest how the student could test this hypothesis.

(2)

after the nails have been Picked up by the magnet take ~~one~~ 1 nail and try picking up a Iron paper clip or another nail.

ResultsPlus
Examiner Comments

This response scores one mark for a suitable test; in this case trying to pick up a paper clip or another nail. It does not go on to describe how the result would show whether the student's hypothesis was correct.

One mark out of two scored.

(iv) A student thinks that none of the nails used in the investigation become permanently magnetised.

Suggest how the student could test this hypothesis.

(2)

the Student should hold one of the nails used in a clamp ~~30~~ 30 cm ~~heigh~~ high. Hold another nail touching the bottom of the first and notice if the second nail remains hanging after the student has let go. If not, flip the second nail upside down and repeat. If the nail falls again, the nails have not been permanently magnetised.

ResultsPlus
Examiner Comments

This very clear response gives a detailed description of the test for one mark.

It also gives a clear indication of what the results would show for one mark.

The candidate has been careful to check that the two nails were not actually repelling each other (and therefore one nail falling off the other) by reversing one nail to make sure that no attraction took place in any direction.

It scored two out two marks.

Question 7(c)

The question required candidates to use a given equation that was probably unfamiliar to them.

To their credit, a large number of candidates, particularly the better candidates, confidently used the equation and given values to arrive at the correct answer of 160 μT.

(c) The magnetic flux density, *B*, is a measure of the strength of the magnetic field of a magnet.

B varies with the distance, *d*, from a magnetic pole of a magnet as given by the equation

$$B \times d^2 = K$$

where *K* is a constant for the magnet.

At a distance of 3 mm from the pole of a magnet, $B = 650\,\mu T$.

Calculate the value of *B* at a distance of 6 mm from the pole of the magnet.

(3)

$650 \times 3^2 = 5850$

$x \times 6^2 = 5850$

$B = \dfrac{5850}{6^2}$

$B = 162.5$

B at 6 mm = 162.5 μT

ResultsPlus
Examiner Comments

A clearly laid out and fully correct answer.

Three out three marks scored.

$3^2 \times 650 = K = 5850$

$6 \times B = 5850$

$\div 6$

$B = 975$

B at 6 mm = 975 μT

ResultsPlus
Examiner Comments

Clear working allowed the examiner to award one mark for finding the value of *K*. However, no further progress was made.

One mark out of three scored.

A very small number of candidates recognised that the equation showed an inverse square relationship between B and d.

~~[illegible]~~

if distance doubles B reduces by 4x because distance is being squared

$\therefore$ 650 ÷ 4 = 162.5

B at 6 mm = 162.5 µT

ResultsPlus
Examiner Comments

This response shows a very clear understanding of equations and was able to arrive at the correct answer in one single step.

Three out of three marks scored.

Question 8(b)(i)

A large number of candidates were able to use the graph to find the increase in potential energy of the spring as it was stretched. The most common error was to forget to convert the extension from cm to m. This resulted in a value that was 100 times too large. Nevertheless, examiners would give partial credit for this answer.

(i) The increase in potential energy stored in the spring is equal to the area under the graph in Figure 17.

Calculate the increase in potential energy stored in the spring when the spring is extended from 0 cm to 8 cm.

Give your answer in joules (J).

(3)

8cm = 0.08m

$$\frac{3.6 \times 0.08}{2}$$

= 0.144

energy = 0.144 J

ResultsPlus
Examiner Comments

Distance has been correctly converted from cm to m for one mark.

The correct points have been read from the graph (one mark).

The increase in potential energy has been calculated from the area under the graph (one mark).

It scores the full three out of three marks.

(3)

8cm → 0.08m.

$$\frac{0.08 \times 3.6}{2}$$

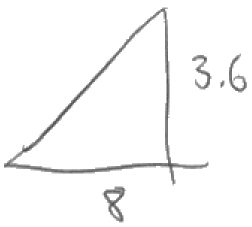
energy = 0.144 J

= 0.144

ResultsPlus
Examiner Comments

The candidate has drawn a triangle and labelled it with the values from the graph. This was not strictly necessary but it did probably help the candidate to structure the correct response.

It scores three out of three marks.



area of Δ = $\frac{b \times h}{2}$

increase in P.E = $\frac{8 \times 3.6}{2}$

= 14.4

energy = ~~144~~ 14.4 J

ResultsPlus
Examiner Comments

The extension has not been converted from cm to m and so cannot score full marks. However, clear working shows the correct method and allows the examiner to award two out of three marks.

Question 8(b)(ii)

Calculation of the value of the spring constant was often correctly done, but the unit was less well known. A very common error was to use the extension in cm and to give the value as N/m.

(ii) Calculate the spring constant of the spring using data from the graph in Figure 17.

State the unit.

(2)

$F = k \times x$

$\cancel{6 =}$

$\cancel{3.6 \times}$

$3.6 = k \times 0.08$

$k = \frac{3.6}{0.08}$

$= 45$

spring constant = 45 unit N/m

ResultsPlus
Examiner Comments

A well laid out answer that scored two out of two marks.

e the unit.

(2)

$k = \frac{F}{x} = \frac{N}{m}$

$F = k \times x$

$k = \frac{F}{x} = \frac{6}{13.2} = 0.4\dot{5} = 0.4545\ldots$

spring constant = 0.45 unit N/m

ResultsPlus
Examiner Comments

Examiners saw many responses like this. Although the correct equation has been selected and rearranged, the extension has not been converted from cm to m. This means that the final answer is 100 times too small. It scores one mark out of two.

An alternative approach is to substitute the previous value calculated for increase in potential energy when the extension is 8 cm into the equation E = ½ × k × x^2.

Figure 17.

State the unit.

$0 \cdot 144 = \frac{1}{2} \times k \times 8^2$

(2)

$\frac{3 \cdot 6}{0 \cdot 08} = 45$ or $\frac{2 \times 0 \cdot 144}{0 \cdot 08^2} = 45$

spring constant = 45 unit N/m

$\frac{2k}{x^2}$

0·0045

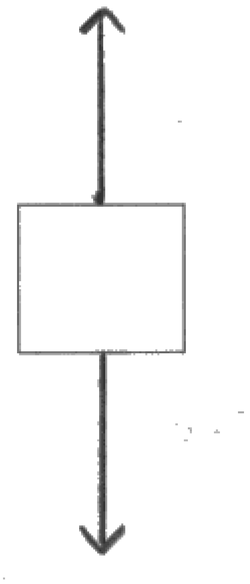
0·45

ResultsPlus
Examiner Comments

Here the candidate has used both methods and arrived at the same, correct answer in each case. It scored the full two out of two marks.

Question 8(b)(iii)

Candidates were required to draw a free body force diagram. Examiners were looking for correctly labelled vectors that would both pass through the centre of the block.

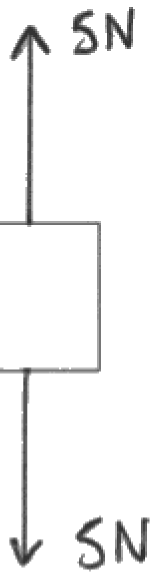


ResultsPlus
Examiner Comments

The two vectors are in the correct direction but there is no indication of the size.

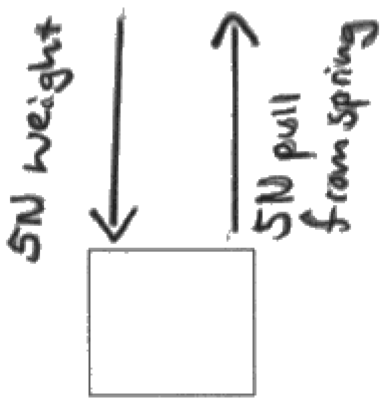
ResultsPlus
Examiner Tip

Force vectors must have a size as well as a direction. This scored one out of two marks.



ResultsPlus
Examiner Comments

A fully acceptable free body diagram that scored two out of two marks.



ResultsPlus
Examiner Comments

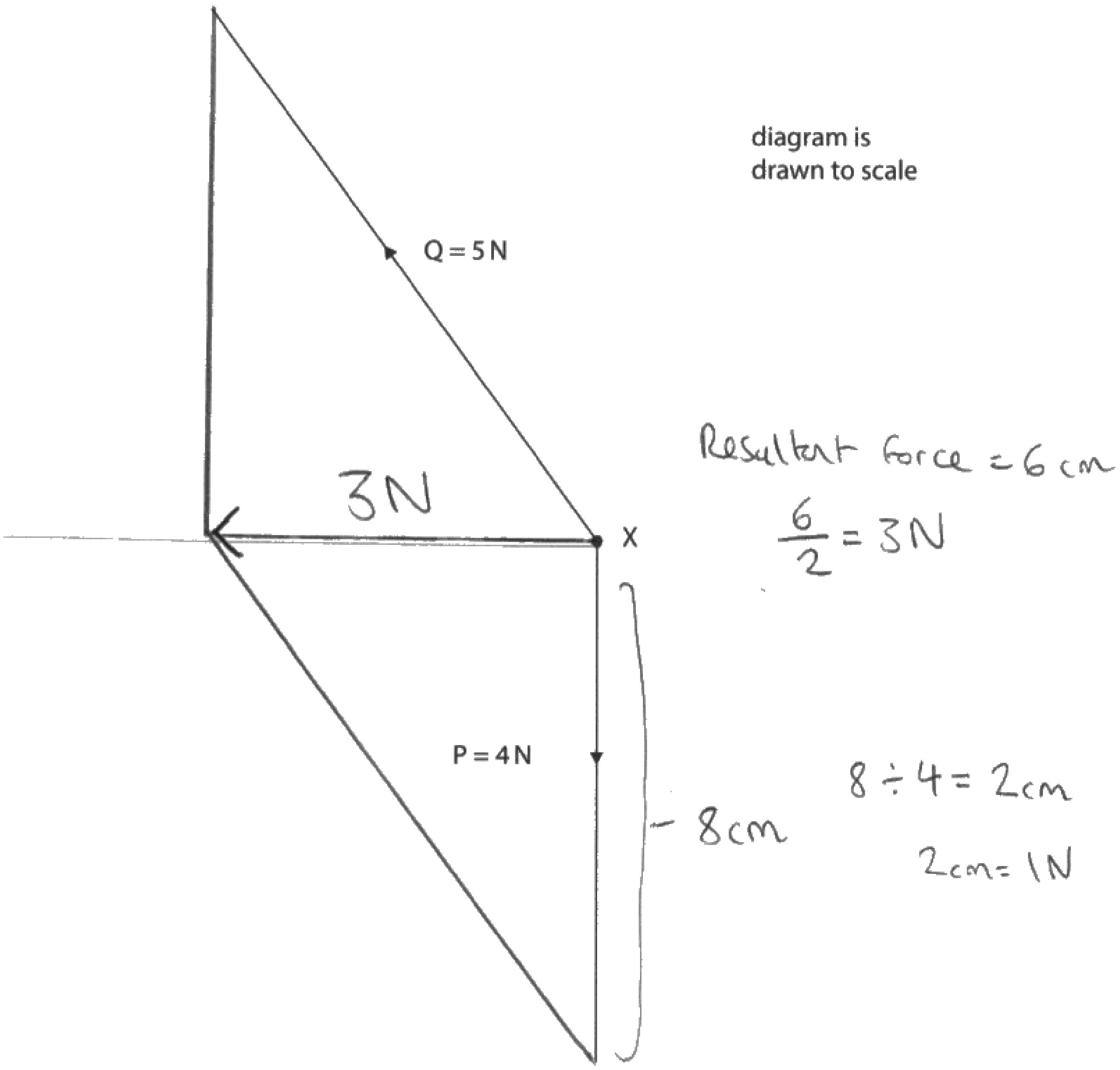
Although the two vectors have the correct size and point in opposite directions, they both act near the edge of the box. The weight would not be in equilibrium; instead it would spin around.

One mark for correct size out of two possible marks.

Question 8(c)

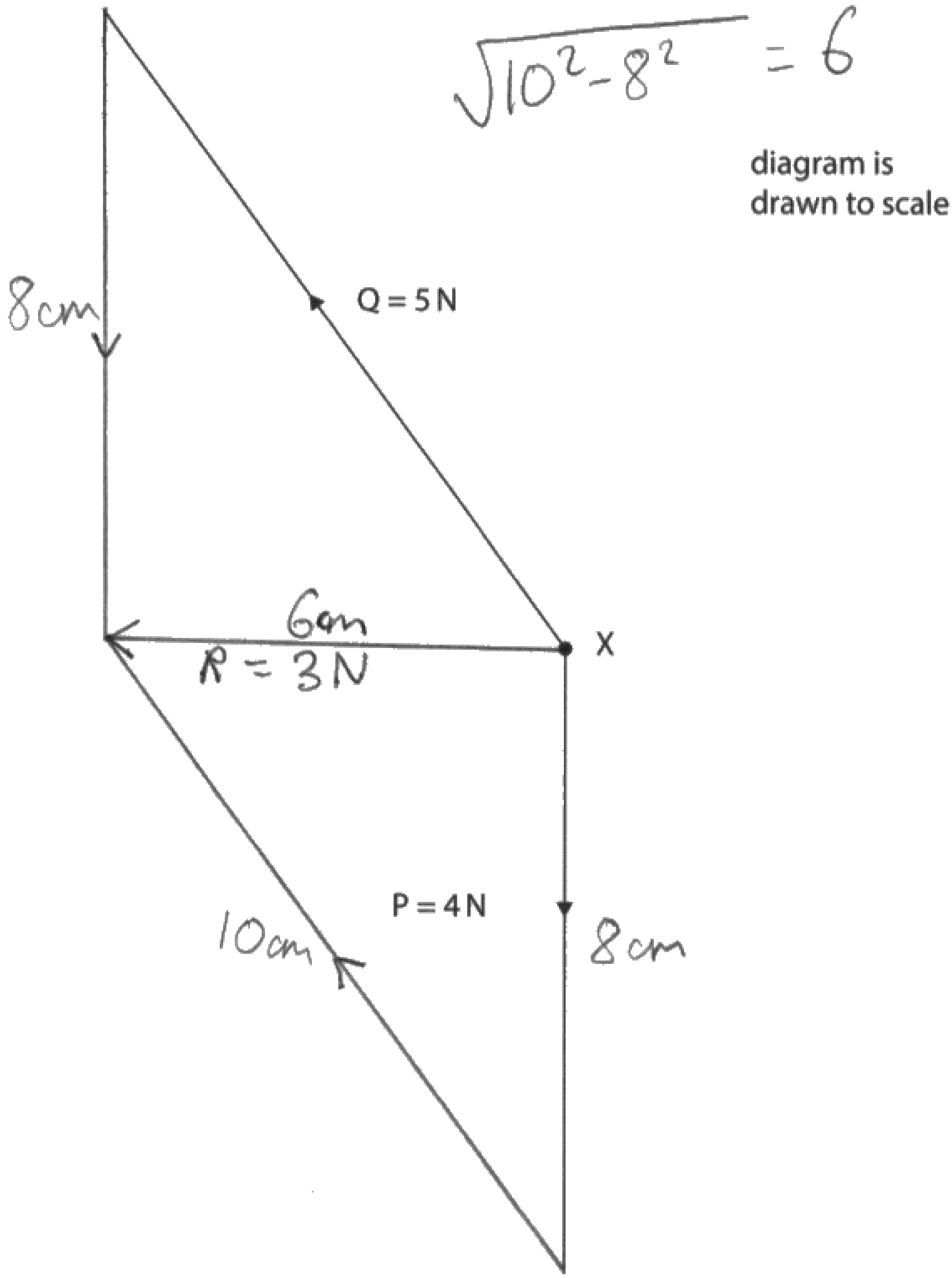
This question required candidates to find the resultant of two forces. It was targeted at the higher grades.

Examiners saw several confident responses that constructed a parallelogram to find the direction of the resultant force.



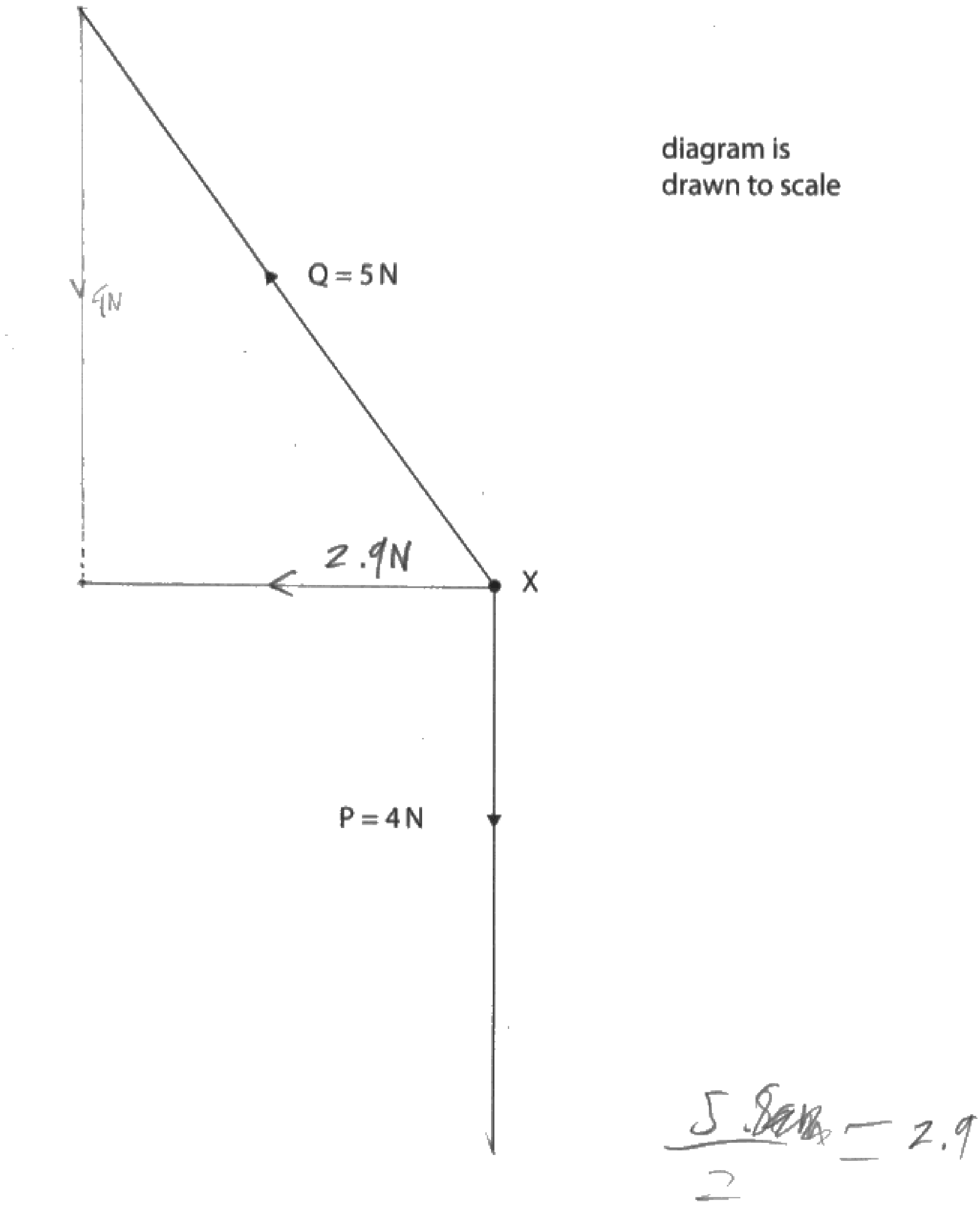
ResultsPlus
Examiner Comments

Here the size of the force was found by first measuring the length of one of the given forces (here 4N) to determine the scale of the drawing (2cm = 1N). The length of the resultant force vector was then measured to be 6 cm which, using the scale already determined, meant that the size of the resultant force was 3N. It scored two out of two marks.



ResultsPlus
Examiner Comments

Other candidates recognised that the three forces were the sides of a right angled triangle. This meant that Pythagoras' Theorem could be used to find the size of the resultant force and so score full marks.



ResultsPlus
Examiner Comments

Some candidates simply drew another 4N force at the same angle but starting from the top of the 5N force. The resultant force was then drawn between the bottom ends of the two given force. This was an equally valid method and scored the full two marks.

Question 9(a)(i)

Most candidates seemed familiar with the idea of the apparent loss in weight of an object immersed in a liquid and often described this in terms of upthrust on the block but rarely linked this to the idea that the block displaced liquid.

9 (a) Figure 20 shows a metal block being weighed by a newton meter (force meter).

In Figure 20a the block is hanging in a liquid.
In Figure 20b the **same** block is hanging in air.

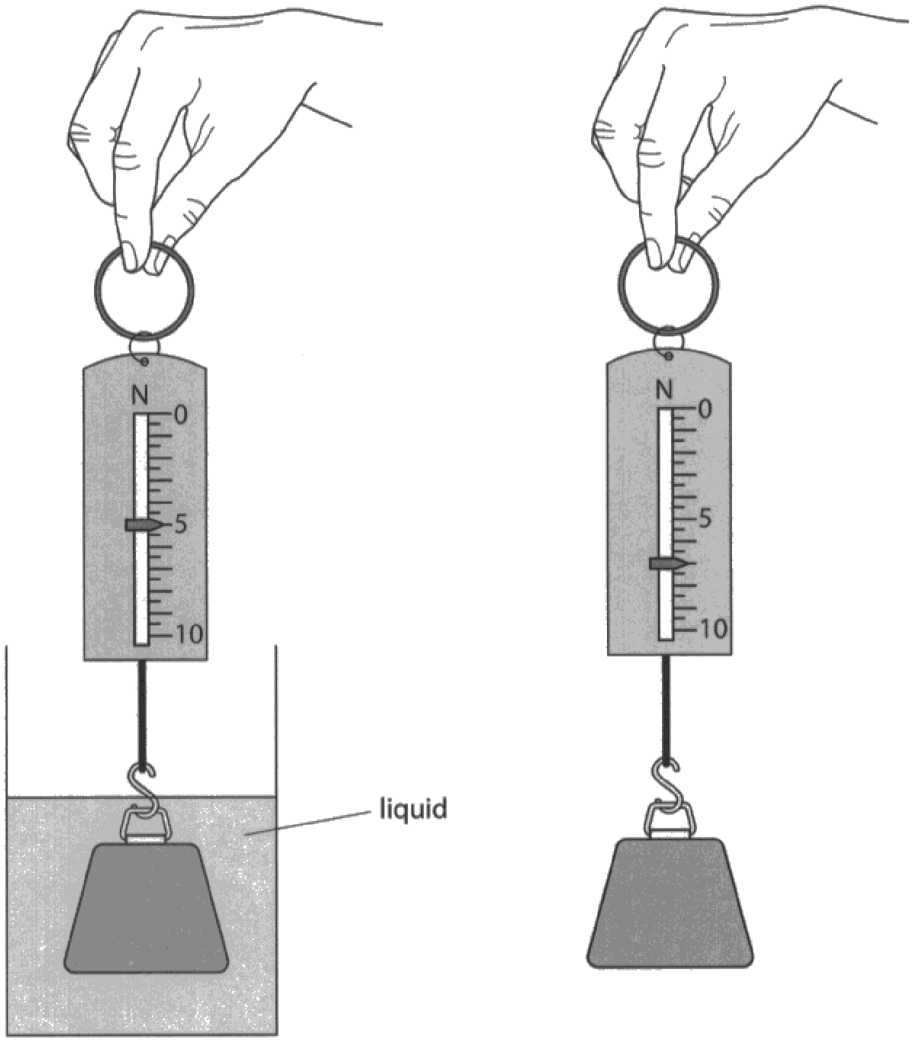


Figure 20a **Figure 20b**

(i) Explain why the reading on the newton meter is different in Figures 20a and 20b.

(2)

The force acting on the block in water is less due the upthrust of the water, meaning less gravity is acting on it, decreasing the force

ResultsPlus
Examiner Comments

The apparent loss in weight shown on the force meter is correctly linked to upthrust due to the liquid.

Examiners would accept the liquid being described as water.

It scored one mark out of two.

Some candidates went on to explain that this was because the liquid had a greater density than air.

(2)

The liquid is denser than air, so there is more of an upthrust on the metal block in 20a, meaning the resultant force is less than 20b

ResultsPlus
Examiner Comments

An acceptable explanation that scored two out of two marks.

Only a very few candidates correctly linked the loss in weight with the weight of liquid displaced.

(2)

~~a~~ In 20a, the block is in a liquid which would applied an upthrust ~~force~~ force equal to the weight of liquid displaced. This ~~uph~~ upthrust is ~~a~~ the opposite direction of the block's weight so it decreases its weight

ResultsPlus
Examiner Comments

A correct explanation that scored two out of two marks.

Good responses could be quite short.

- less force when block is in water
- upthrust = weight of water displaced.
- air is less dense than ~~the~~ liquid.

ResultsPlus
Examiner Comments

A very clear response that linked:

- upthrust (one mark)
- weight of liquid displaced (one mark)
- liquid is more dense than air (one mark).

This scored the maximum of two out of two marks.

Question 9(a)(ii)

This was a multi-stage calculation that built on the previous question. It was targeted at the higher grades. Successful candidates adopted the following approach.

Calculate the loss in weight to find the weight of liquid displaced. (2N) for one mark.

Use this calculated weight of liquid and the given value of density of liquid to determine the volume of liquid displaced and hence the volume of the block. (1.43×10^{-4} m^3) for one mark.

Use the calculated volume of the block and the weight of the block as shown on the newton meter in the equation to calculate the density of the block for one mark.

Correctly evaluate to arrive at a value of 4.9×10^3 kg/m^3 for one mark.

Partial credit could be obtained by successfully completing each stage as indicated.

7-5

(ii) The density of the liquid is 1.4×10^3 kg/m^3.

Calculate the density of the block.
Gravitational field strength, g, = 10 N/kg

upthrust = 2N ∴ weight of displaced water = 2N

∴ mass = 0.2 kgs → (2 ÷ 10)

$$\left(\frac{0.2}{1.4 \times 10^3}\right) = Vol = \frac{1}{7000}$$

V of water displaced = V of object

mass of object = 0.7 kgs → (7 ÷ 10)

density = 4900 kg/m³

(4)

$$\therefore \text{density} = \frac{0.7}{\left(\frac{1}{7000}\right)} = 4900$$

ResultsPlus
Examiner Comments

A fully correct answer with clear working. It scored all four marks. Well done!

$d = \frac{M}{V}$

5N

0.5kg = 5N

7N = 0.7kg

$1.4 \times 10^3 = \frac{0.5}{V}$

0.000357142 05

$V = \frac{1}{2800}$

$d = \frac{0.7}{\frac{1}{2800}} = 1960$

density = 1960 kg / m^3

ResultsPlus

Examiner Comments

This response started with the wrong value for upthrust (5N rather than 2N). However, it did go on to use the correct equations to determine the volume of liquid displaced and the density of the metal. The examiner could award three out of four marks.

(4)

7-5 = 2 N

Upthrust = 2 N

Block = 2N

= 0.2kg

density = $\frac{M}{V}$

$d = \frac{0.2}{V}$

density = ... kg / m^3

ResultsPlus
Examiner Comments

The upthrust has been calculated as 2N. This can score one mark.

Question 9(b)

The question presented candidates with a picture and a drawing of a hand winch that can be used to lift heavy loads. Candidates were asked to apply their understanding of physics principles (in particular equations used in calculations), to explain how the sizes of each component helps to determine the effort required to lift a given load.

Candidates engaged well with this question and examiners saw many different approaches. In each case, where several sizes were discussed, examiners gave credit for the best application of physics demonstrated.

The most popular approach was to consider the distance between the effort force on the end of the handle and the pivot point; in this case the centre of gear Y. A good discussion would include the equation moment = force x perpendicular distance. Provided that the distance was clearly related to the length of the handle, it can be shown that, for an increased distance, the same moment can be obtained from a smaller effort force. A common error in this approach was to confuse work done with moment of a force. This would limit the score to level 2 only.

It is possible to use work done = force x distance to argue that, for a longer handle, the effort moves through a greater distance during one rotation and so, to do the same amount of work, a smaller effort is required. Examiners rarely saw this clearly expressed.

It is also possible to consider the gears. Consideration of their relative radii can be used in moment calculations. A smaller gear Y would result, (for the same effort force) in a smaller moment where gear X and gear Y meet. Provided gear X remained the same size, this would reduce the force needed to move gear Y. Examiners saw some examples of this being used successfully but many responses implied that the force of Y on X would be increased.

Finally it is possible to consider the number of teeth on the gears. The gear ratio determines how many times gear Y needs to turn to make gear X revolve. This can be used in a work done calculation involving the total distance moved by the effort to move the load upwards by a given distance.

Alternatively, consideration of gear ratio can be used in a discussion about the speeds of the effort and load. A load moving more slowly takes longer to move up through a given amount. Therefore, using power = work done / time taken, a smaller power input is required for the same amount of work done.

Figure 22 shows the important parts of the device. The curved arrows show the directions of rotation of the handle, the gears and the drum.

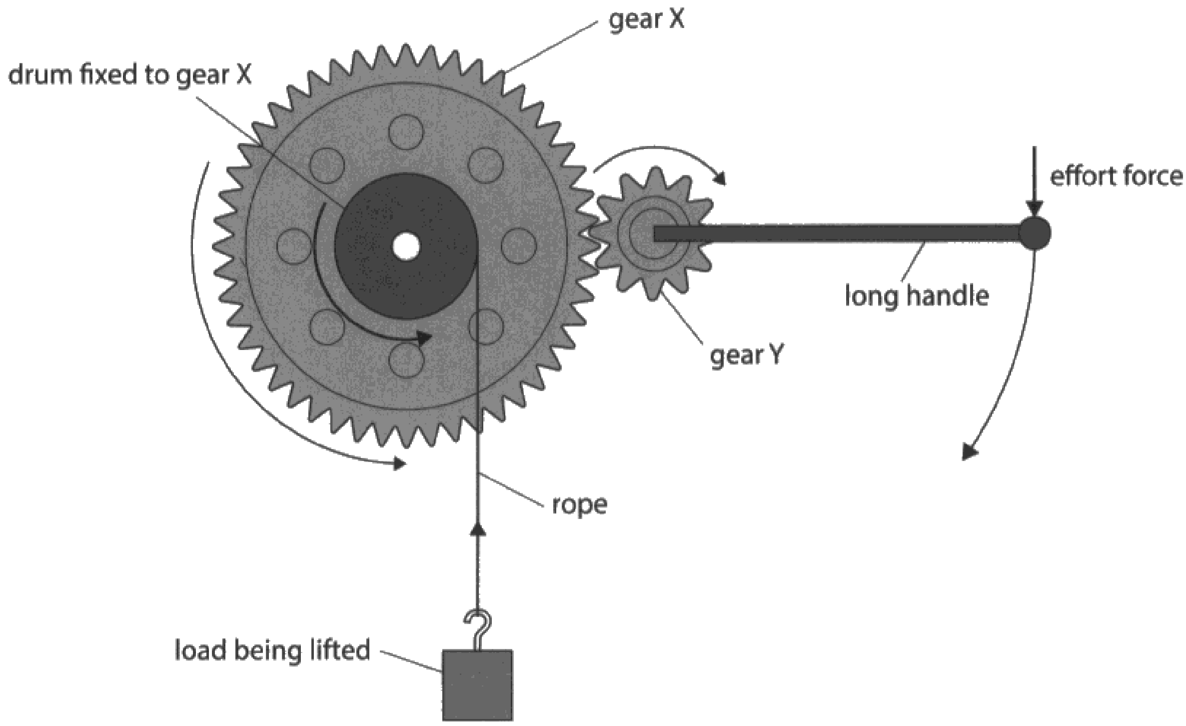


Figure 22

The size of the effort force needed to lift the load is determined by the sizes of the parts of the device.

Explain why this is the case.

Your answer should refer to

- the sizes of the different parts of the device
- how these sizes are used in relevant calculations

(6)

The size of the long handle determines the force needed to turn gear Y. This is because moment of a force = force × distance. This means that to exert the same ~~amount of~~ moment, with a longer distance, you need less force. This means that in order to make it easier to turn gear Y, the handle should be long, as then less force would be required to turn the gear.

The ratio between the sizes of gear Y and gear X is also very important. This is because with a larger gear, it completes less full rotations than the smaller gear. Gear Y and Gear X ~~move~~ rotate in opposite directions. By turning the handle, you turn gear Y, which turns gear X. It is easier to turn gear Y and then Gear ~~X~~ X than manually move the load.

The drum is fixed to gear X, which means it moves as gear X moves, which moves as gear Y moves, which therefore lifts the load. The drum has a smaller turning radius, meaning it rotates multiple times with each rotation of gear X.

(Total for Question 9 = 12 marks)

ResultsPlus
Examiner Comments

The first paragraph discusses the length of the handle and the moment of the effort around the centre of gear Y. A suitable equation has been used and it is clear what is meant by "force" and "distance" in this application of the equation. It concludes that the longer the handle, the less the effort needed for the same moment. This is a level 3 response.

The second paragraph discusses the sizes of the gears. However, it does not consider the effect of changing one or both of the sizes. This is a level 1 response.

Overall, the candidate has given at least one Level 3 answer. It scored six marks.

parts of the device.

Explain why this is the case.

Your answer should refer to

- the sizes of the different parts of the device
- how these sizes are used in relevant calculations

(6)

The first gear supplies the power to second gear (gear Y) which moves ~~anticlock~~ clockwise - ~~wise~~ (opposite to gear x which ~~rot~~ turns anticlockwise)
As the second gear is smaller than the first gear, less effort is needed to lift the load. Furthermore there is a long handle which increase the distance between the force applied and the gears, which also decreases the effort needed (less work done), as work done = force x distance moved / distance moved = work done ÷ force.
If the gear Y was larger than gear x, lots of effort is needed for gear Y just to complete a revolution.
~~And if~~ Additionally, if the ~~force~~ handle is short then more effort is needed.

ResultsPlus
Examiner Comments

After mentioning the gears, this answer considers the length of the handle and reasons that a long handle decreases the effort needed. The candidate has attempted to support this with an equation; work done = force x distance. This would be relevant if it had been clearly stated as the distance moved by the (end of) the handle over the revolutions of the handle. This was not the case. This is a level 2 answer that linked a size to an equation, but because the equation was incorrectly used it was placed at the lower end of level 2 for three marks.

Question 10(a)(i)

Candidates generally found calculation of resistance straightforward. As may be expected, most errors resulted from incorrect conversion of 6mA to 6 x 10^{-3} A.

10 (a) A student connects a resistor across the terminals of a 9V battery.

There is a current of 6 mA in the resistor.

(i) Calculate the resistance of the resistor.

(2)

$V = I \times R$ $\quad$ $6\,mA \downarrow$

$R = \frac{V}{I}$ $\quad$ 6×10^{-3} A

$\frac{9}{6 \times 10^{-3}} = 1500$

resistance = 1500 Ω

ResultsPlus
Examiner Comments

A well laid out and fully correct answer. It scored two out of two marks.

(2)

$V = I \times R$

$9 = 6 \times R$

$\frac{9}{6} = R \rightarrow R = 1.5$

resistance = 1.5 Ω

ResultsPlus
Examiner Comments

The candidate did not convert mA into A. It scored one out of two possible marks.

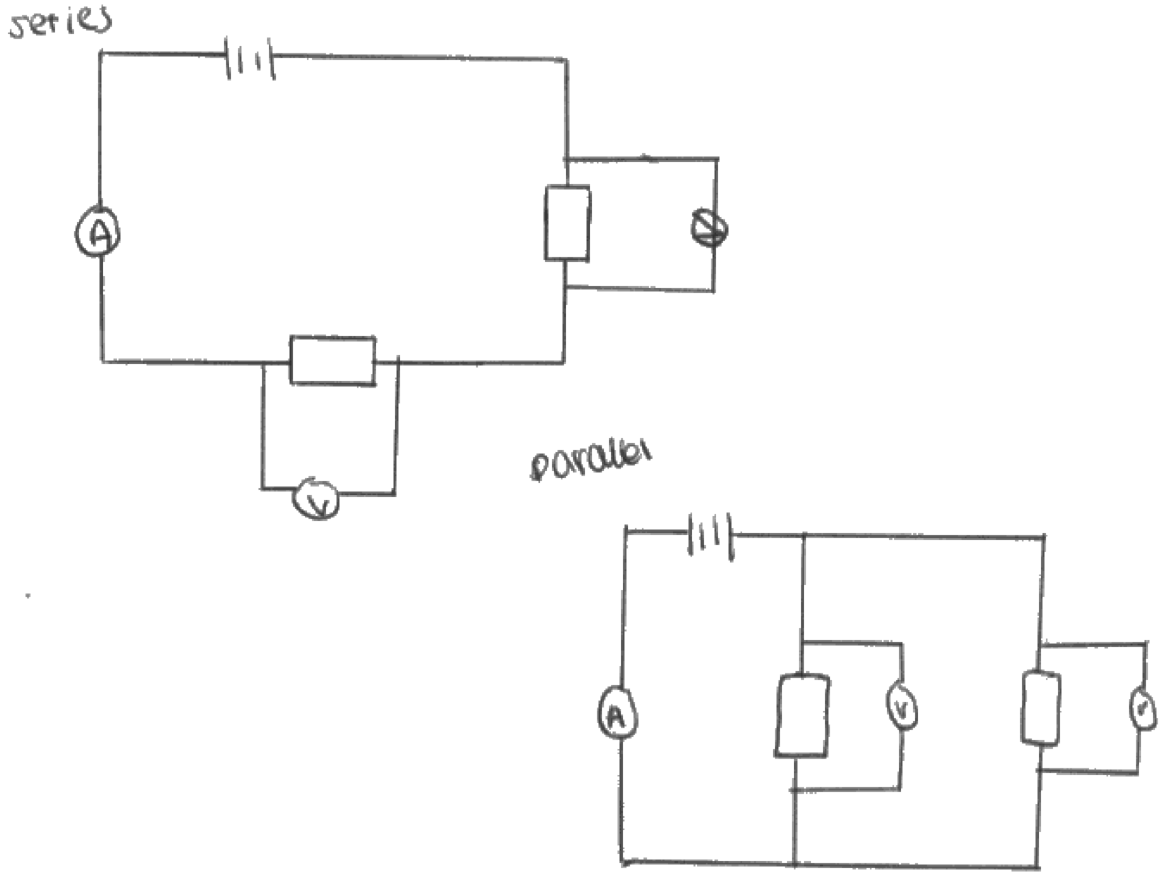
Question 10(c)

This question required candidates to recall a core practical that investigated resistors in series and in parallel.

Very many candidates had clearly carried out this investigation and could produce excellent responses that included well drawn circuit diagrams and detailed discussion about the currents in each circuit and the pd across the resistors.

Weaker candidates often struggled to either draw a suitable circuit diagram or failed to describe how voltmeters and ammeters are connected. This limited the answer to level 1 or the lower end of level 2.

Space for circuit diagrams



in ~~the~~ series circuit current ~~is spread around~~ goes around the circuit in one direction from the power supply and any resistance is applied to every bit of current, the voltmeter in both series a parallel must be placed parallel to the componant being measured, voltage / potential difference is also shared.

in parallel the current is shared / split across each junction meaning the resistance ~~on~~ any affects the current in that junction, therefore current is different around the circuit

for potential difference it should be the same throughout the circuit and each resistor.

ResultsPlus
Examiner Comments

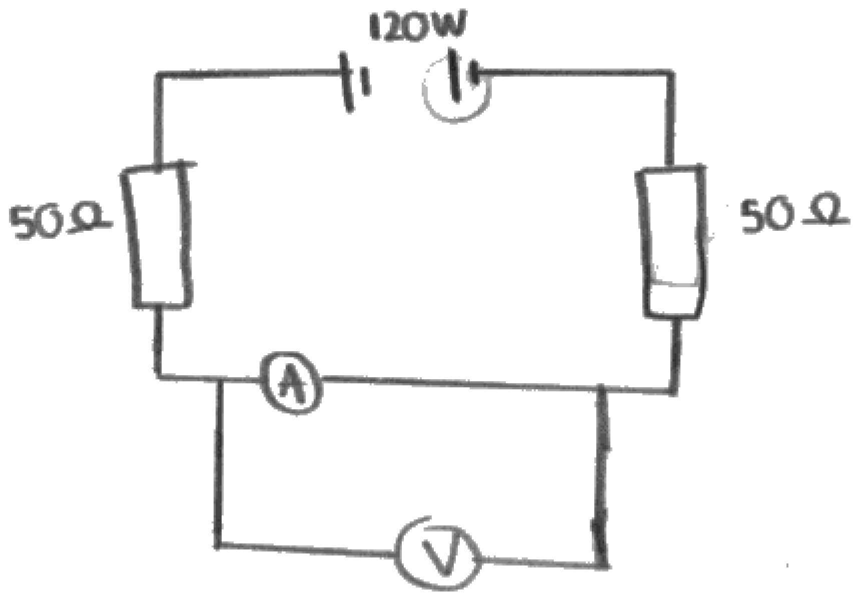
Well drawn and clear circuit diagrams showed resistors in series and in parallel. Ammeters and voltmeters were correctly placed.

The first paragraph in the written answer mentions a series circuit and confirms correct use of the voltmeter. Examiners would credit such a description if the circuit diagram had been unclear. However, no results have been given.

The second paragraph correctly gives the expected results that would be obtained from the parallel circuit.

A correct description of how to obtain measurements with expected results for one circuit is a level 2 response for four marks.

Space for circuit diagrams



~~Put an ammeter anywhere is a series circuit along with 2 resi~~

Set up circuits like from the figure and add ~~the~~ an ammeter to a series circuit and a voltmeter to a parallel circuit opposite to what you are testing and write down the readings on eachone. to measure currents and voltages. You should see both increase with eachother. ~~Potent~~ voltage in each resistor when resistors are in a series will be different than voltage across one in parallel as ~~they~~ charge has different pathways and will often try to go for the quicker one. However the total resistance will be smaller than voltage in the smallest resistor

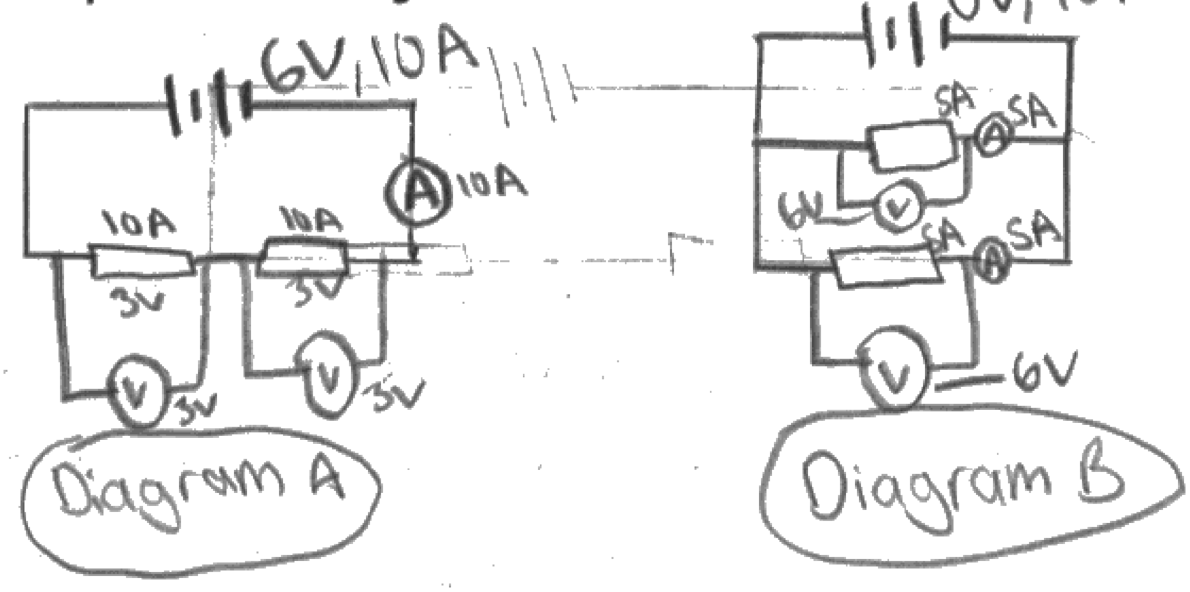
ResultsPlus
Examiner Comments

The circuit diagram shows two resistors in series and a correctly placed ammeter. No parallel circuit has been shown and the voltmeter is incorrectly placed.

The description mentions how to place a voltmeter but it is unclear. It goes on to mention voltages in series and parallel circuits but only states that they will be different without specifying which one is larger. There is an attempt to describe the differences in "pathways" in a series and parallel circuit but this is unclear. The last sentence confuses resistance and voltage.

This is a level 1 answer that demonstrates elements of understanding but scientific techniques lack detail. This response scored two marks.

Space for circuit diagrams



When the resistors are in series, the current from the battery is ~~shared between the~~ the same for all the resistors. You can measure current using an ammeter in series. ~~The current of each~~ Whereas, the current in the resistors in parallel will be different as the current splits between the branches. You can see the current ~~in~~ for each resistor by putting an ammeter in each branch.
The potential difference is shared between resistors in a series circuit. The ~~resis~~ voltage of each resistor will sum to the total voltage, which is the voltage of the battery. You calculate potential difference using a voltmeter in parallel to each resistor. In contrast to this, potential difference is the same for each resistor when they are connected in parallel. The voltmeters will show that the potential difference is the same throughout the circuit for the battery and resistors.

ResultsPlus
Examiner Comments

Two well drawn circuit diagrams clearly show series and parallel circuits with correct placement of ammeters and voltmeters. In addition, the inclusion of expected values next to each meter demonstrates how the currents and voltages would be expected to be distributed even though the total current in the two circuits would not both be 10A.

The description clearly describes how the battery voltage is distributed in both circuits. It also describes the current being shared between branches of the parallel circuit but being the same through the whole of the series circuit.

This is a level 3 answer that scores six out of six marks.

Paper Summary

Overall this exam gave ample opportunity for candidates to display their knowledge and understanding at grades 4-9; particularly in the topic areas of electricity, electromagnetism and forces. Less confidence was shown in the application of Archimedes' principle and also the difference between the **moment** of a force and the **work done** by a force; both of which can be calculated from force x distance.

Candidates have continued to do well with most calculation questions, although some did not cope well with significant figures and some of the units involved.

Based on their performance on this paper, candidates should:

- Make the most of opportunities afforded in school laboratories where they become acquainted with practical work from the specification. This concerns both core practicals and the suggested practicals.
- Always question 'What is the purpose of this experiment?', making sure that they are clear in their minds about it.

Candidates also need to have the mathematical skill of being able to round off results of calculations to an appropriate number of significant figures.

Candidates seem to need more practice on handling powers of ten in their calculations. They should be able to use their calculators with numbers in standard form when needed. It often helps to put answers in standard form rather than risk writing too many or too few 000s in an answer.

In constructing explanations, candidates need to take note of the marks allocated to a particular question and respond with a corresponding number of points in their answer.

Candidates should look carefully at diagrams and make sure their answer is in the correct context. For example, very many candidates attempted to describe the action of the d.c. motor commutator in the context of a dynamo or d.c. generator.

Grade boundaries

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