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Examiners' Report
June 2023

Int GCSE Physics Science Double Award 4SD0 1P

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Introduction

The examination was written to assess the full range of grades from 1 to 9. Consequently, some questions were written to be challenging whilst others were designed to be more straightforward and accessible. A range of different question types were included in the examination such as objective and multiple choice, calculations, and both short and long written responses. Approximately 20% of the marks available in the examination were for candidates' demonstrations of experimental skills and understanding. Candidates were provided with a full list of the formulae to be used in this examination. Successful candidates were well-acquainted with the content of the specification and could recall facts whilst applying their understanding to new and complex situations. They were competent in performing quantitative work and could rearrange and substitute data into given formulae to obtain the correct answer. Successful candidates also showed evidence of undertaking all the required practicals themselves and could produce detailed, coherent methods whilst recalling the relevant results of these experiments. Less successful candidates showed gaps in their knowledge of topics and either had limited experience or could not recall information from the required practical tasks. These candidates often did not address the demands of the question and overlooked the importance of the command words being used.

Question 1 (c)(i)

Most candidates knew which equipment to use to answer this question. However, some candidates wrote the correct equipment the wrong way round, which scored zero marks.

Question 1 (c)(ii)

Almost all candidates could select the correct data point as the anomalous result in the graph. Some candidates did not answer the question, whilst others selected the data points at 25s and 30s.

Question 1 (c)(iii)

Most candidates answered this question correctly. The most common mistake was halving the original count rate and quoting that as the final answer. Some candidates also chose an initial count rate other than that at t=0s and then halved it to find the time. However, they often forgot to take away the time of their initial count rate. Responses like this scored 1 mark only.

Question 1 (c)(iv)

Candidates found this question challenging and less than half were able to score the mark. Most incorrect answers focused on examples of human error or simply not accounting for background radiation.

(iv) Give a reason why the teacher should not expect the data points to lie exactly on the curve of best fit.

(1)

because ~~this~~ background radiation is also present which can vary the results.

ResultsPlus
Examiner Comments

This response scored zero marks. The idea of background radiation being present is insufficient to account for the random error in the results. If the candidate had said that the background radiation varied (or is random) then that would have been sufficient.

(iv) Give a reason why the teacher should not expect the data points to lie exactly on the curve of best fit.

(1)

Decay happens randomly is no peticular pattern or flowing a exact timing

ResultsPlus
Examiner Comments

This response shows the most common example of an answer that was awarded the mark. The idea that the decay is random sufficiently accounts for the data points deviating from the curve on the graph.

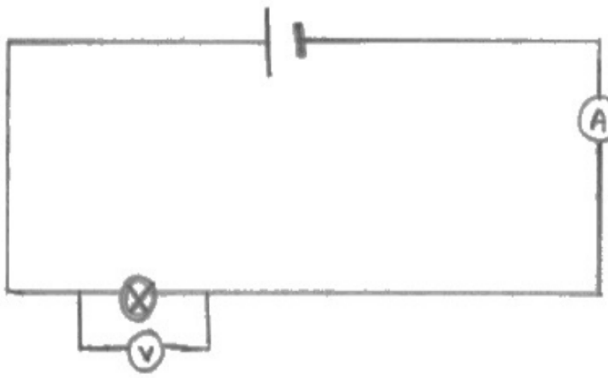
Question 2 (a)

Most candidates were able to score at least 3 marks in this question for drawing a circuit diagram with a suitable power source, lamp, ammeter and voltmeter all connected appropriately. Only a third of all candidates scored full marks for the inclusion of an appropriate component to vary the current in the lamp. Weaker candidates lost marks for connecting ammeters or voltmeters incorrectly, whilst others lost marks for using incorrect circuit symbols.

2 A student investigates how the current in a filament lamp changes when the voltage across the lamp is varied.

(a) Draw a circuit diagram the student could use in their investigation.

(4)



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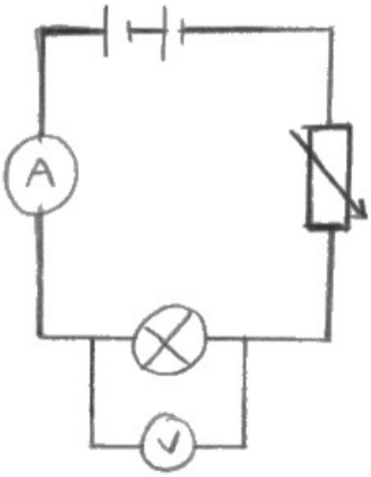
Examiner Comments

This response shows the typical response that scored 3 marks. The circuit diagram allows a reading of voltage and current to be made for the lamp but offers no way of varying the current to obtain the set of results shown in the question.

2 A student investigates how the current in a filament lamp changes when the voltage across the lamp is varied.

(a) Draw a circuit diagram the student could use in their investigation.

(4)



ResultsPlus
Examiner Comments

The inclusion of the variable resistor in this circuit allows the current in the lamp to be varied and this response was awarded full marks.

Question 2 (b)(i)

Most candidates scored at least 1 mark in this question for a simple pattern statement linking current and voltage eg "as the voltage increases the current increases". More able candidates scored the second mark for a further detail about the relationship; usually a simple statement that it is non-linear. Some candidates wrote confusing statements such as "the current decreases at higher voltages", which were given no credit.

(i) Describe the relationship between current and voltage shown on the graph. (2)

As the voltage increases, the current increases however the rate of current increase decreases as the voltage increase causing the line to curve.

ResultsPlus Examiner Comments

An excellent response that was awarded full marks. The idea of the non-constant increase in current is well expressed.

(i) Describe the relationship between current and voltage shown on the graph. (2)

If the Voltage increases, the current will also increase.

ResultsPlus Examiner Comments

This response was awarded 1 mark for a simple, correct statement linking current and voltage.

Question 2 (b)(ii)-(iii)

The inclusion of the full formulae booklet in the examinations this series meant that almost all candidates wrote the correct formula in Q02(b)(ii). Most candidates also completed the straightforward calculation in Q02(b)(iii) successfully. However, weaker candidates lost marks by incorrectly reading data from the graph or incorrectly rearranging the formula.

Question 3 (a)

Most candidates scored at least 2 marks in this calculation. Most candidates opted to use P=E/t, but some made mistakes when dealing with the units of time. Some candidates did not convert the units at all, whilst others attempted to convert to seconds, but did so incorrectly.

3 A family has a television set.

(a) The television set has a low power mode called standby.

When on standby, the power rating of the television set is 0.27 W.

Calculate the energy transferred to the television set on standby in 12 hours.

(3)

energy trans = I × V × t

→ 12 × ~~[illegible]~~ 520
= 6240 s

0.27 × 12 × 60
= 194.4

energy transferred = ... J

ResultsPlus
Examiner Comments

This candidate has attempted to convert hours to seconds but has missed an additional factor of 60 in their conversion. The final answer of 194.4 was seen frequently and was awarded 2 marks.

3 A family has a television set.

(a) The television set has a low power mode called standby.

When on standby, the power rating of the television set is 0.27 W.

Calculate the energy transferred to the television set on standby in 12 hours.

(3)

energy transferred = Power × time

(Power = current × voltage)

= 0.27 W × (12 × 60 × 60)

= 0.27 × 43200

= 11664 J

energy transferred = 11664 J

ResultsPlus Examiner Comments

A fully correct answer gaining 3 marks.

Question 3 (b)(i)

This standard question was answered well by most candidates. Most understood that the fuse melts to break circuit if large currents pass through to gain full marks. Some candidates were not clear enough in their responses to be awarded Mark Point 1. For example, some stated that a fuse breaks the circuit when the current increases, rather than when the current is too high or above the rating of the fuse.

(b) In normal use, the current in the television set is 0.31 A.

(i) Explain how a fuse works to protect the television set if there is a fault.

(3)

If there is a fault and there is a surge of current, the fuse separating the live wire and the live pin in the television set plug melts. This means that the circuit is broken and the current that is too high doesn't reach the television set, protecting it.

ResultsPlus
Examiner Comments

A clearly laid out response that gained full marks. The idea of a surge of current was deemed sufficient to imply that the current is too high.

Question 3 (b)(ii)

Candidates found this question more challenging than Q03(b)(i), although most were able to score at least one mark. Mark Point 1 and Mark Point 3 were awarded most frequently.

Question 4 (a)

The greatest challenge in this calculation was the unit conversion from MHz to Hz. Some candidates did not attempt to convert the units at all, which usually resulted in 2 marks being awarded in Q04(a)(ii) if the rearrangement of the formula was correct. Some candidates knew to convert the units of frequency but made mistakes due to the less commonly seen prefix of mega, M, being used.

4 Ground-penetrating radar (GPR) uses radio waves to detect changes in material underground.

(a) (i) State the formula linking the speed, frequency and wavelength of a wave.

(1)

wave speed = frequency × wave length

(ii) GPR radio waves have a frequency of 170 MHz.

The speed of radio waves is 3.0×10^8 m/s.

Calculate the wavelength of the waves.

(3)

300000000 = 170 × wave length

$\frac{300000000}{170}$ = wave length

wavelength = 1764705.882 m

ResultsPlus
Examiner Comments

This response was awarded 2 marks in Q04(a)(ii) due to the conversion from MHz to Hz not being attempted.

ResultsPlus
Examiner Tip

Candidates should know to convert to standard units and should be familiar with the prefix mega, M.

Question 4 (b)(i)

Many candidates scored no marks in this question due to not drawing a reflected ray, despite the question stating that the ray had been reflected. Those candidates who did draw a reflected ray often lost marks for not drawing their wavefronts carefully. Non-perpendicular wavefronts were seen in many responses, whilst other candidates did not take enough care to ensure the spacing of their wavefronts matched the incident ray.

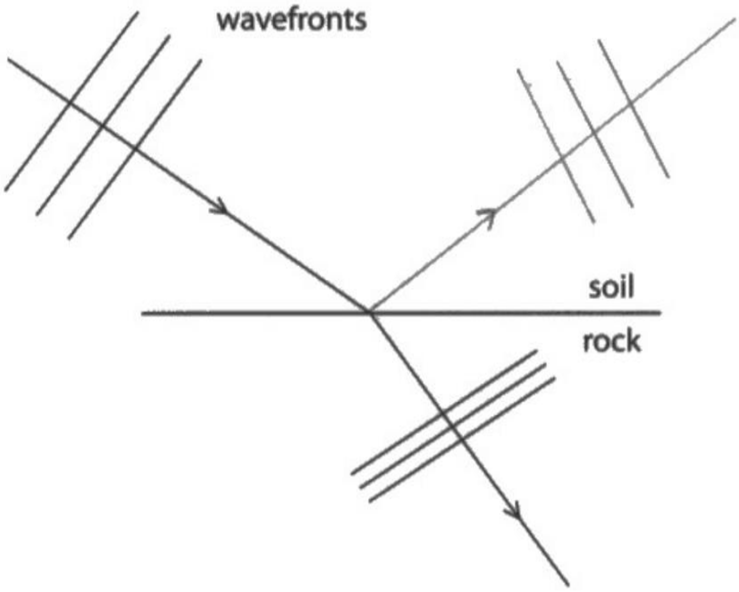
(b) (i) A radio wave passes through the ground and refracts at the boundary between soil and rock.

The diagram shows three wavefronts of the wave before and after refraction.

The wave is also reflected at the boundary between the soil and the rock.

Complete the diagram to show three wavefronts after the wave has been reflected at the boundary.

(3)



ResultsPlus Examiner Comments

This response scored 2 marks. Although a ruler has been used, the wavefronts are clearly not perpendicular to the reflected ray.

ResultsPlus Examiner Tip

Candidates should take care when drawing diagrams, especially when that is the focus of the question.

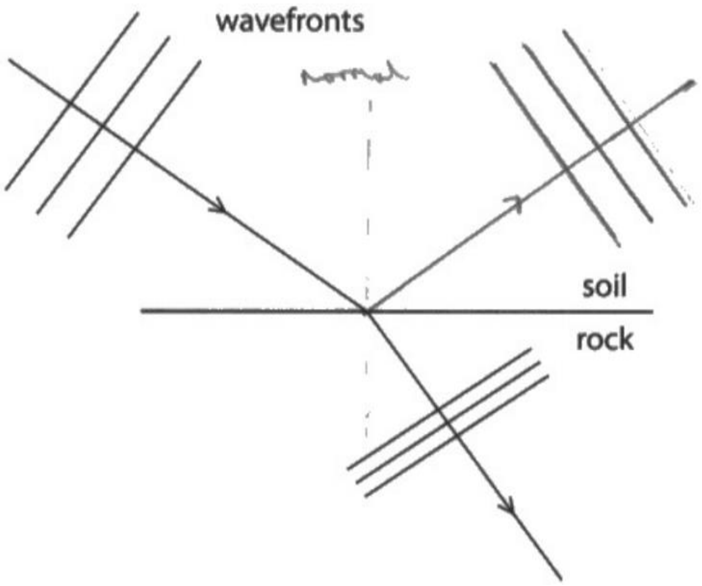
(b) (i) A radio wave passes through the ground and refracts at the boundary between soil and rock.

The diagram shows three wavefronts of the wave before and after refraction.

The wave is also reflected at the boundary between the soil and the rock.

Complete the diagram to show three wavefronts after the wave has been reflected at the boundary.

(3)



ResultsPlus
Examiner Comments

This response scored full marks. The candidate has drawn their diagram carefully using a ruler.

Question 4 (b)(ii)

The majority of candidates were awarded Mark Point 2 for stating that the rock is denser than the soil. However, most were unable to link this to valid wave properties to score further marks. Only candidates working beyond Grade 7 linked ideas about wave speed and frequency to explain why the wavelength decreased.

(ii) Explain why the radio waves passing through the rock have a smaller wavelength than the radio waves passing through the soil.

(3)

Rock is more dense than Soil and the Smaller the wavelength the more penetrating the wave is.

ResultsPlus
Examiner Comments

This response was often seen for 1 mark. No wave properties have been linked to the rock being denser than the soil to explain why the wavelength decreases.

(ii) Explain why the radio waves passing through the rock have a smaller wavelength than the radio waves passing through the soil.

(3)

Rock is more dense than soil. When the radio waves go from the less dense soil into the more dense rock the radio waves bends towards the normal and slows down. ~~Becau~~ Due to the radio waves slowing down they have a smaller wave length causing their wavefronts to appear closer together.

ResultsPlus
Examiner Comments

An excellent response that was awarded 3 marks. Mark Point 1, Mark Point 2 and Mark Point 3 are all seen.

Question 5 (a)

Most candidates had the correct general idea of how the pressure could be determined in this question based on the formula linking pressure, force and area. However, the details needed to measure the force and area enabled this question to be used to differentiate between outcomes at the major grade boundaries. Most candidates knew to measure the area and more able candidates gave a further detail of how this could be done using squared paper or an equivalent. Although most candidates knew to measure weight, the apparatus used to do this was seen less often.

5 The drawing shows a camel and a person in a desert.

(Source: © Hennadii H/Shutterstock)

(a) Describe a method you could use to find the pressure a person exerts on the ground when standing on two feet.

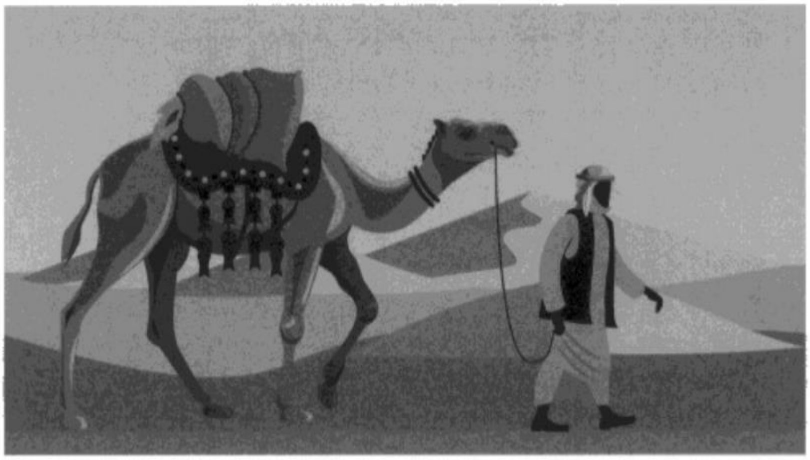
(4)

- Pressure $= \frac{\text{force}}{\text{area}}$
- measure area of the soles of a persons 2 feet in cm^2
- measure the force of the person in ~~kg~~ Newtons
- put into equation
- repeat experiment 3 times to ensure results are cocordinate & accurate

ResultsPlus
Examiner Comments

This response was awarded 2 marks for Mark Point 1 and Mark Point 5. The appropriate details of how to measure the area are missing and there is no indication that the relevant force is the weight of the person.

5 The drawing shows a camel and a person in a desert.



(Source: © Hennadii H/Shutterstock)

(a) Describe a method you could use to find the pressure a person exerts on the ground when standing on two feet.

(4)

to complete this experiment you would need graph paper and a newton weight scale. You would get the person to stand on both feet on the graph paper and draw around the feet, then you would measure his weight in Newtons on the scale. Find the area of the feet by counting the squares of the feet on the graph paper then using pressure = force (in Newtons, the weight) / (area of feet) ← area

ResultsPlus
Examiner Comments

This is a much more detailed, higher level response that meets the criteria for all five marking points in the mark scheme.

Question 5 (b)

Most candidates completed this calculation successfully due to the inclusion of the formula in the formulae booklet and the lack of any rearrangement. The most common error was using the mass of the person in the calculation, rather than first calculating their weight.

Question 6 (a)(i)

Two thirds of all candidates scored the mark in this question, usually for a reference to all EM waves having the same (or a quoted) speed. Erroneous responses focused on all EM waves being harmful or other incorrect ideas.

Question 6 (a)(ii)

This question was answered to a high standard. Most candidates gained the mark for giving a correct comment about x-rays damaging cells or causing cancer. Those candidates who did not score the mark were usually too vague in their responses eg "x-rays harm cells".

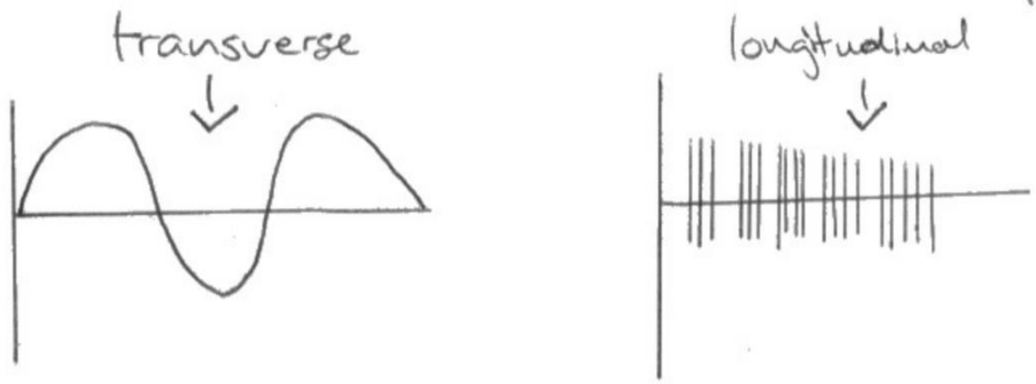
Question 6 (a)(iii)

Candidates found this standard question challenging and either gained full marks or none at all. Those candidates scoring only one mark usually made some valid reference to vibrations or oscillations. Many candidates knew that vibrations are perpendicular in transverse waves and parallel in longitudinal waves, but struggled to correctly describe what they were perpendicular/parallel to. For example, references to vibrations being perpendicular to "movement" were seen frequently. Some candidates knew the correct definitions of both types of waves but got them the wrong way round.

(iii) Describe the difference between transverse waves and longitudinal waves.

You may draw a diagram to help your answer.

(3)



- A transverse wave means vibrations are parallel to the direction of wave travel

- Whereas a longitudinal wave vibrations are perpendicular to the direction of wave travel

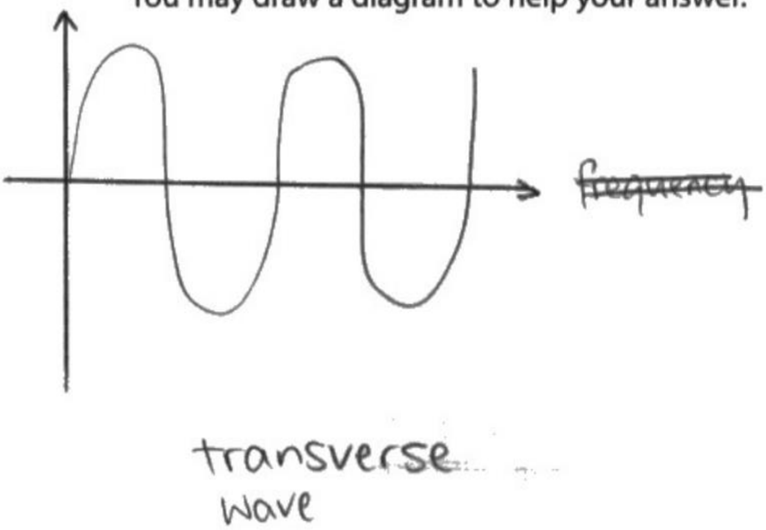
ResultsPlus
Examiner Comments

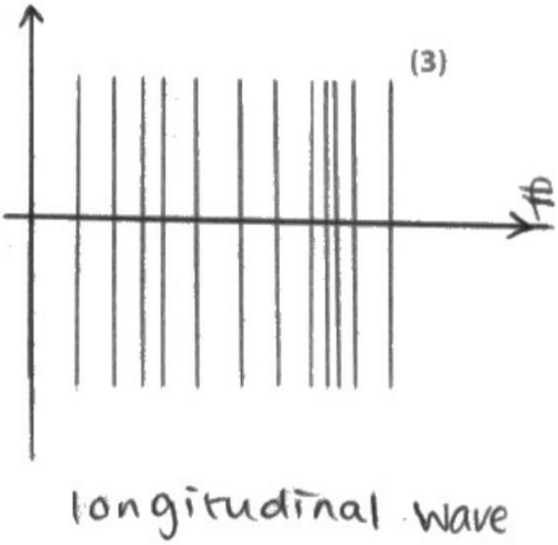
This candidate has given correct descriptions for both types of wave but got them the wrong way round. Only 1 mark was awarded.

(iii) Describe the difference between transverse waves and longitudinal waves.

You may draw a diagram to help your answer.

(3)





Particles in transverse waves vibrate in perpendicular direction.

Particles in longitudinal waves vibrate in parallel direction.

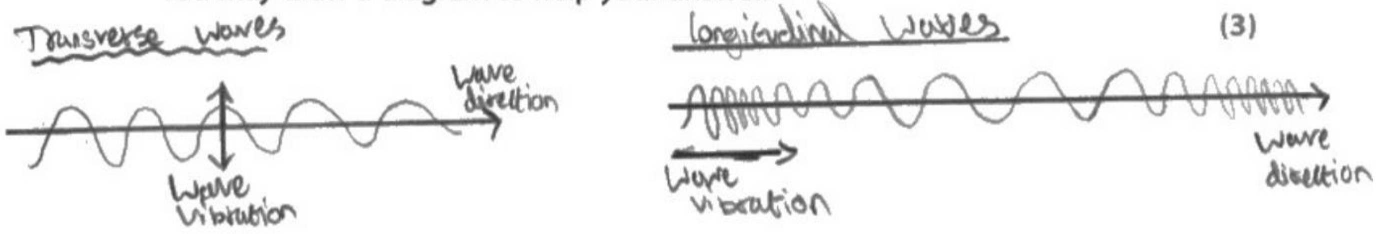
ResultsPlus
Examiner Comments

This response also got 1 mark. The candidate has not given a valid comparison when describing what the vibrations are perpendicular/parallel to.

(iii) Describe the difference between transverse waves and longitudinal waves.

You may draw a diagram to help your answer.

(3)



Transverse waves have their wave vibration perpendicular to their wave direction.* Longitudinal waves have their wave vibration parallel to their wave direction, an example of this is a sound wave.

* an example of this is a light wave

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Examiner Comments

A fully correct response that scores 3 marks. Note that the diagram on its own is good enough for full marks.

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Examiner Tip

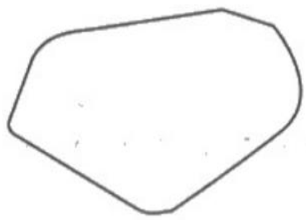
Diagrams can be very helpful in communicating understanding, especially in questions where the correct use of terminology is expected.

Question 6 (b)

This question assessed experimental details for one of the required practicals. Some candidates did not carefully read the question and gave well-revised descriptions of a standard method for determining density. The marks here focused specifically on how the mass and volume of the irregular object could be determined. The displacement method was usually chosen, but some candidates did not give enough detail for this method or missed out essential pieces of measuring equipment.

(b) The diagram shows a part of the knee called the patella. The patella has been removed from a person's knee.

$$\text{density} = \frac{\text{mass}}{\text{volume}}$$



The patella is a small, irregularly shaped bone that is denser than water.

Describe how to find the mass and the volume of the patella bone.

(4)

To find to volume, fill a beaker part way up with water and record the volume. Place the patella in the beaker and record the new volume. The difference in volume in [illegible] milli litres is equal to the volume of the patella in centimetres squared. For the mass of the patella, use a mass balance. Place the patella on gently and record the mass.

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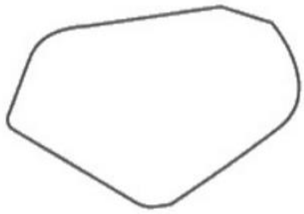
Examiner Comments

This response scored 2 marks (Mark Point 2 and Mark Point 3). The lack of using a measuring cylinder and a valid accuracy detail prevented further marks from being awarded.

(b) The diagram shows a part of the knee called the patella. The patella has been removed from a person's knee.



The patella is a small, irregularly shaped bone that is denser than water.

Describe how to find the mass and the volume of the patella bone.

(4)

To find the mass, use an electric balance - ensuring it's set to 0. Measure in Kg. To calculate volume, use a displacement method. Fill up displacement cylinder with water up until it reaches the funnel. Completely submerge the patella bone, by holding it down with a skewer. Use a measuring cylinder to catch water coming out the funnel. The volume collected is equal to the volume of the patella bone. Ensure you measure volume from the bottom of the meniscus.

ResultsPlus Examiner Comments

An excellent response with a high level of attention to detail.

Question 6 (c)

The inclusion of the formulae booklet made this question very accessible and most candidates scored at least 3 marks. However, some did not read the question carefully and did not give their final answer to two significant figures as requested.

(c) A scientist finds the volume and mass of a patella.

The mass of the patella is 17 g.

The volume of the patella is 13 cm³.

Calculate the density of the patella.

Give your answer to 2 significant figures.

(4)

density = $\frac{\text{mass}}{\text{volume}}$

density = $\frac{17\text{g}}{13\text{cm}}$

density = 1.307

density = 1.307 g/cm³

ResultsPlus
Examiner Comments

This response gained 3 marks. The final answer has not been rounded correctly.

ResultsPlus
Examiner Tip

Read each question carefully to ensure all its demands are met in the response.

Question 7 (a)

Most candidates interpreted the lack of movement as there being no energy in the kinetic store of the motor.

Question 7 (b)

Most candidates opted for a straightforward calculation using E=VIt, but some chose a more complicated (but valid) method of using P=VI followed by P=E/t. Other, more unusual, methods involved using Q=It followed by V=E/Q. All these methods gained full credits as long as the final evaluation was expressed to more than two significant figures.

Question 7 (c)-(d)

The majority of candidates scored marks in Q07(c) for determining 10J for the kinetic store and choosing "thermal" or "heat" for the wasted arrow. However, fewer candidates correctly identified "electrically" as the method of transfer from the battery to the motor. It was encouraging to see most candidates correctly extract information from the Sankey diagram to complete the efficiency calculation in Q07(d) successfully.

Question 8 (a)

A great variety in terms of the quality of responses was seen in this question. However, the majority of candidates were able to identify absorption or reflection, scoring Mark Point 1. Poor absorbers was seen in less than half of the full 2 mark responses. The idea of snow being a good reflector was seen more often.

8 In some countries, snow can fall and collect on the ground.

Diagram 1 shows that after the snow has fallen, the sky can be clear, leaving the snow directly exposed to the Sun.

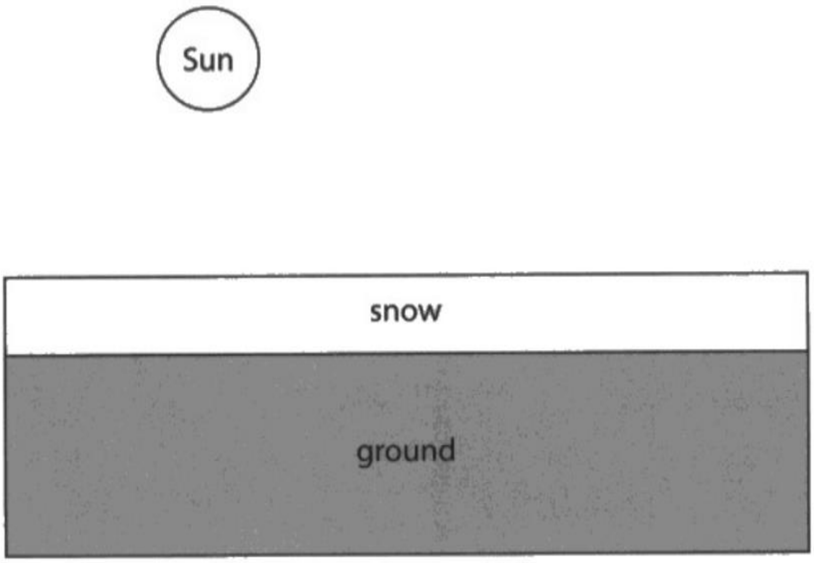


Diagram 1

(a) Explain why the white snow will take a long time to melt, even though directly exposed to the Sun.

(2)

white reflects the sun's ray and is a poor absorber of heat, meaning it will take longer to heat up and melt

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Examiner Comments

A high level response that was awarded 2 marks for the reference to snow being a poor absorber.

Question 8 (b)

Not many candidates referred to Mark Point 1 in their responses (the idea that ground / drain cover is warmer than snow). Mark Point 2 was seen in most responses, which enabled most candidates to score at least one mark. Mark Point 3 was seen in the higher level responses.

(b) Diagram 2 shows a different piece of ground that has a metal drain cover.

If the snow lands on metal, the snow takes a shorter time to melt.

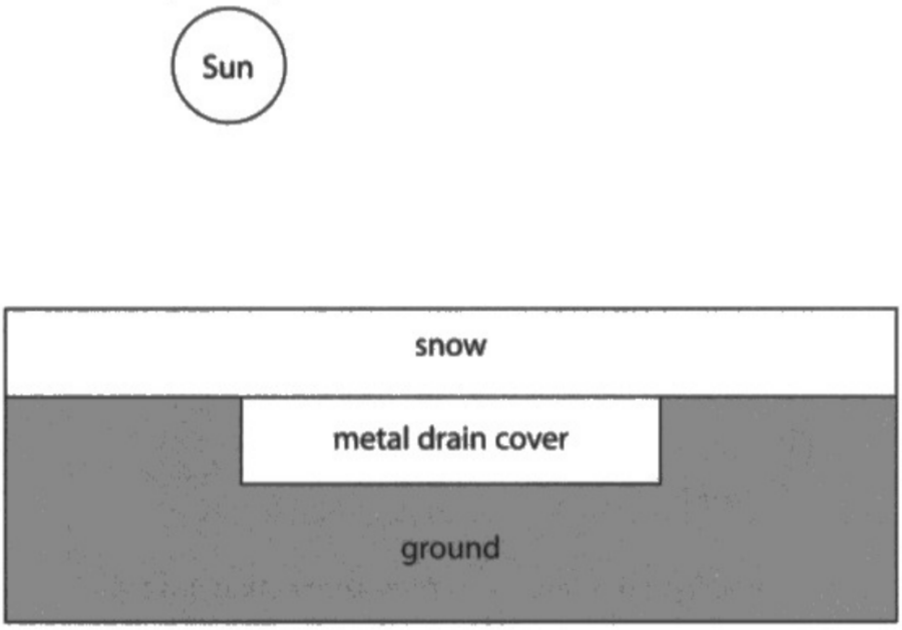

Diagram 2

Explain why the snow melts in a shorter time on the metal drain cover.

(2)

This is because metal is a good conductor so transfers heat energy to the snow by conduction. This means the snow has more heat energy so melts quicker. as heat transfers from hotter objects to cooler objects.

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A model answer that meets the demands of all three marking points.

Question 8 (c)

Most candidates recognised that a convection current would cause hot air to rise, which would leave colder air near to the snow. However, very few candidates linked this to the rate of energy transfer to score Mark Point 3. Those candidates who failed to score at all confused convection currents with electrical currents or currents in water.

(c) Explain how a convection current above the snow increases the time taken for the snow to melt.

(2)

Convection current means hot air rises that is less dense, while cool air sinks. Therefore, the snow will be closer to the cooler air, meaning it will not melt very fast, increasing time taken to melt.

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Examiner Comments

A clear response that meets the criteria for Mark Point 1 and Mark Point 2.

Question 9 (a)

Most candidates scored 2 marks in this question. Occasionally a power of ten (POT) error was made for incorrectly attempting to convert kilograms to grams, which resulted in a score of 1 mark. More significant errors involving not using g in the calculation, resulting in no marks being awarded.

Question 9 (b)(i)

Most candidates completed this question successfully, perhaps owing to it being a "show that" calculation. Some candidates multiplied 47 and 0.20 to get 9.4 and then divided by 2 at the end of their calculation to achieve the desired outcome. Benefit of the doubt was given in this case that the candidate was attempting to find the area of a triangle.

Question 9 (b)(ii)

It was encouraging to see so many candidates relate acceleration to the gradient of the graph and successfully calculate the acceleration. Some candidates used $v^2 = u^2 + 2as$ and the value of the distance found in Q09(b)(i), which was awarded full marks.

Question 9 (c)

This question worked well for discriminating at the major grade boundaries and there was an even distribution of marks awarded in the range 0-3. Candidates working at Grade 4 could usually communicate that the speed of the particles would increase (or an equivalent idea). However, only candidates working above Grade 7 gave further explanatory idea to gain further marks. Evidence of the rate of collisions with the wall increasing in a response usually indicated a candidate working at Grade 9.

(c) **Explain how the gas pressure changes if the temperature of the gas increases.**

You should use ideas about particles in your answer.

(3)

The gas pressure increases because as the temperature increases so does the kinetic energy of the particles. There is more kinetic energy so the particles move more quickly so the pressure increases because the particles move more and collide together more as well.

ResultsPlus
Examiner Comments

This response is typical of a candidate working below Grade 7. Only Mark Point 1 was given.

(c) Explain how the gas pressure changes if the temperature of the gas increases.

You should use ideas about particles in your answer.

(3)

As the temperature increases, the particles have more kinetic energy. This leads to more frequent collisions with the walls of the container applying a greater force ~~which increases the pressure as~~ over the same area which increases the pressure as pressure is force divided by area.

ResultsPlus
Examiner Comments

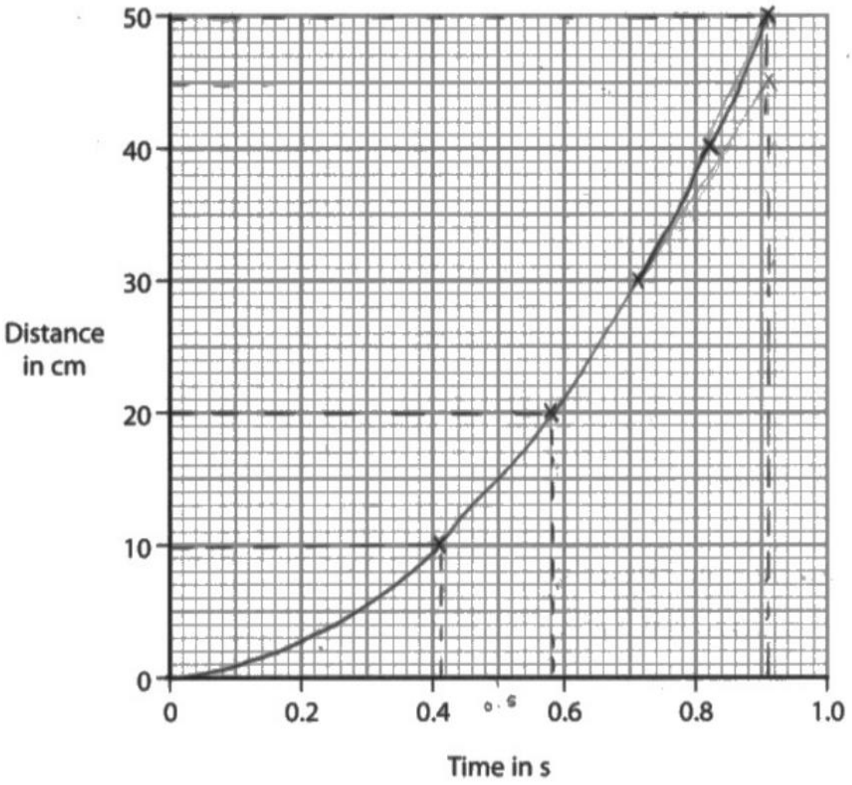
An excellent and comprehensive response typical of a candidate working at Grade 9.

Question 10 (a)

The majority of candidates were able to answer this question correctly. Incorrect responses were seen evenly spread between the four different variables. However, there was a clear pattern that some candidates confused the independent and dependent variables, getting these the wrong way round.

Question 10 (b)

The plotting and curve drawing in Q10(b)(i) and Q10(b)(ii) were completed to a high standard. It was very pleasing to see most candidates make competent attempts at the data analysis in Q10(b)(iii). However, it was clear that many candidates thought the constants had to be exactly the same for the conclusion to be valid. Centres should guide candidates towards the idea that constants can be considered such as long as they are approximately equal due to experimental errors.



(iii) The student concludes that the results obey this relationship

distance ÷ (time²) = constant

Use the student's data to deduce whether the student's results support this conclusion.

(4)

if i take a point of the graph and use the formula distance ÷ (time)² = constant, e.g 10 ÷ (0.41)² = ~~62.5~~ 59.5, if i try it for another value e.g. 20 ÷ (0.58)² = 59.5, and another, e.g. 50 ÷ (0.91)² = 60, all these values round up to ~~60~~ 60 (2 s.f.) proving that the students conclusion is correct.

ResultsPlus
Examiner Comments

This response scored full marks. There is an understanding shown that although the constants are not identical, they all round to 60 and so can be considered "constant".

Question 11 (a)

This multi-step calculation was intentionally challenging and most candidates only scored 2 marks. This was usually due to the selection of the wrong voltage, which was deemed a physics error. However, it was encouraging to see many candidates correctly convert their answers to milliamps at the end of the calculation.

11 Diagram 1 shows a light-emitting diode (LED) and a resistor in series with a cell and an ammeter.

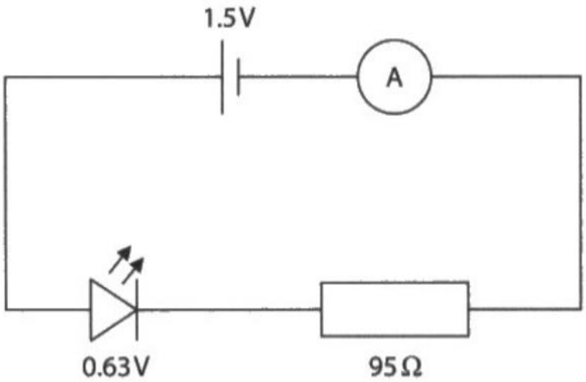


Diagram 1

(a) The voltage across the LED is 0.63V.

Calculate the current in the circuit.

Give your answer in milliamps. (x 1000)

(4)

voltage = current x resistance

current = $\frac{\text{voltage}}{\text{resistance}}$

$= \frac{0.63}{95} = 6.631 \times 10^{-3}$

$\times 1000 = 6.63157$

current = 6.63 mA

ResultsPlus
Examiner Comments

This response scored 2 marks. The candidate has the voltage of the LED with the resistance of the resistor to calculate the current. However, the conversion to milliamps at the end of the calculation is correct.

11 Diagram 1 shows a light-emitting diode (LED) and a resistor in series with a cell and an ammeter.

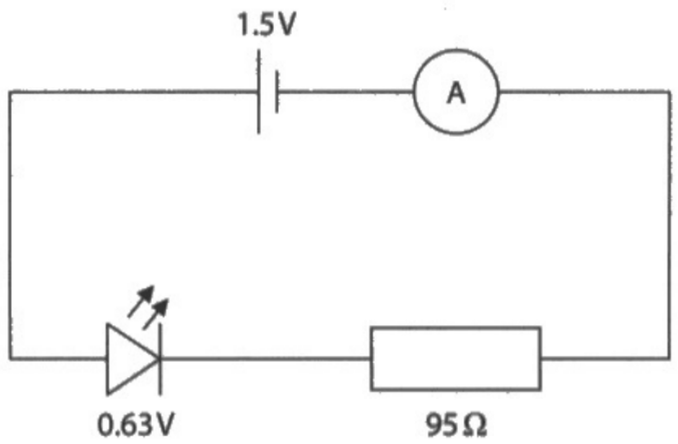


Diagram 1

(a) The voltage across the LED is 0.63V.

Calculate the current in the circuit.

Give your answer in milliamps.

(4)

$V = I \times R$

$I = \frac{V}{R} = \frac{1.5}{95} = \frac{3}{190} = \times 1000$

15.789

current = 15.8 mA

ResultsPlus
Examiner Comments

This response scored 2 marks. The candidate has the voltage of the cell with the resistance of the resistor to calculate the current. However, the conversion to milliamps at the end of the calculation is correct.

11 Diagram 1 shows a light-emitting diode (LED) and a resistor in series with a cell and an ammeter.

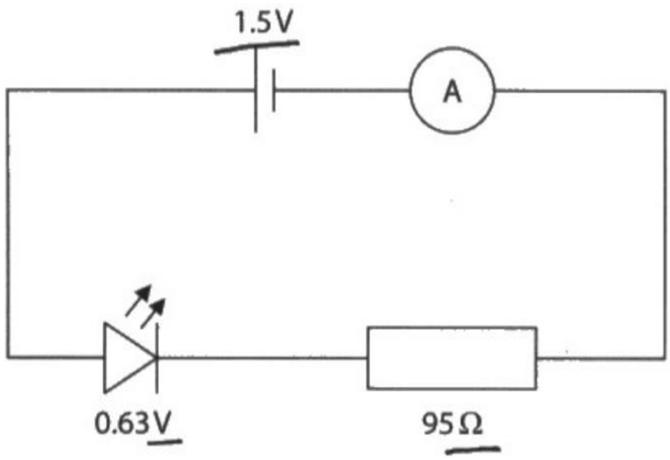


Diagram 1

(a) The voltage across the LED is 0.63 V.

Calculate the current in the circuit.

Give your answer in milliamps.

(4)

Voltage = Current × resistance

Current = $\frac{\text{Voltage}}{\text{resistance}}$

$\frac{1.5 - 0.63}{95}$

= 0.92

0.00092 Ma

current = 0.00092 mA

ResultsPlus
Examiner Comments

This response scored 3 marks. The candidate has the correct voltage with the resistance of the resistor to calculate the current. However, the conversion to milliamps at the end of the calculation is incorrect.

Question 11 (b)

This question was very challenging and most candidates scored no marks due to thinking that the resistance of the circuit increased when adding the resistor in parallel. More able candidates knew that the resistance decreased (or the current increased) but lacked sufficient detail in their explanations to merit more than 2 marks. Only the most able candidates were able to access full marks following a comprehensive analysis of the new circuit.

(b) Diagram 2 shows a second LED and an extra resistor connected in parallel with the cell.

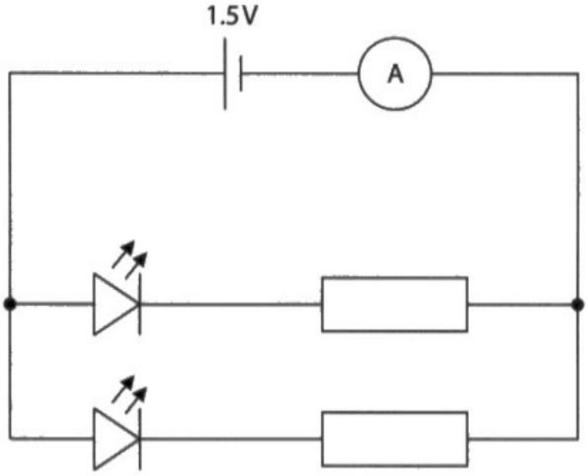


Diagram 2

The resistor and the LED are the same as the components used in diagram 1. The two resistors are identical and the two LEDs are identical.

Explain how the ammeter reading will change.

(4)

- The ammeter reading will double
- As there are now two circuits with the same reading
- And as they are in parallel, they add up to give a final reading

ResultsPlus Examiner Comments

This response scored 2 marks. The candidate's recognition that the current doubles gains Mark Point 5 and Mark Point 6, but there are no further details to support this conclusion.

(b) Diagram 2 shows a second LED and an extra resistor connected in parallel with the cell.

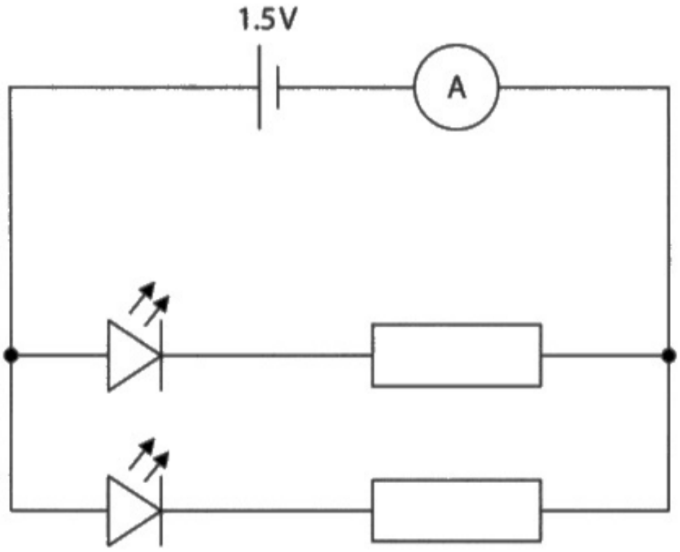


Diagram 2

The resistor and the LED are the same as the components used in diagram 1.
The two resistors are identical and the two LEDs are identical.

Explain how the ammeter reading will change.

(4)

the resistance ~~will~~ of the whole circuit will half because another branch has been added. V = I × R If the resistance has been halved, the current will double because the voltage is constant. the ammeter is at the end of the circuit so will measure the current of both branches combined. the current going into a branch equals the current coming out.

ResultsPlus
Examiner Comments

This comprehensive answer received full marks. All the marking points in the mark scheme are met.

Question 12 (a)

The majority of candidates scored the mark in this question for identifying the presence of a current in the wire. Inappropriate answers included the wire being an electromagnet and the wire being made from a magnetic material.

Question 12 (b)(i)

Most candidates knew the difference between a.c. and d.c. but often there was insufficient detail in the description of a.c. to award both marks. Candidates were expected to know that the current in a.c. changes direction **continuously**.

(b) The cell supplies direct current (d.c.). The electronics in diagram 1 change the direct current into alternating current (a.c.) in the coil.

(i) Describe the difference between direct current (d.c.) and alternating current (a.c.).

(2)

A direct current is when the current only flows one way. An alternating current is when the current can flow either way/it can change direction.

ResultsPlus
Examiner Comments

This response scored 1 mark only. The description of a.c. does not refer to a continuous change in direction.

Question 12 (b)(ii)

A wide range of responses were seen in this question. Induced current instead of voltage was one of the main reasons marks were missed. The use of "cutting" field lines was not seen very often and, surprisingly, "interacting" (not scoring) etc was seen more frequently.

(ii) Alternating current is supplied to the transmitter coil.

Diagram 2 shows a gold ring in the soil below the metal detector.

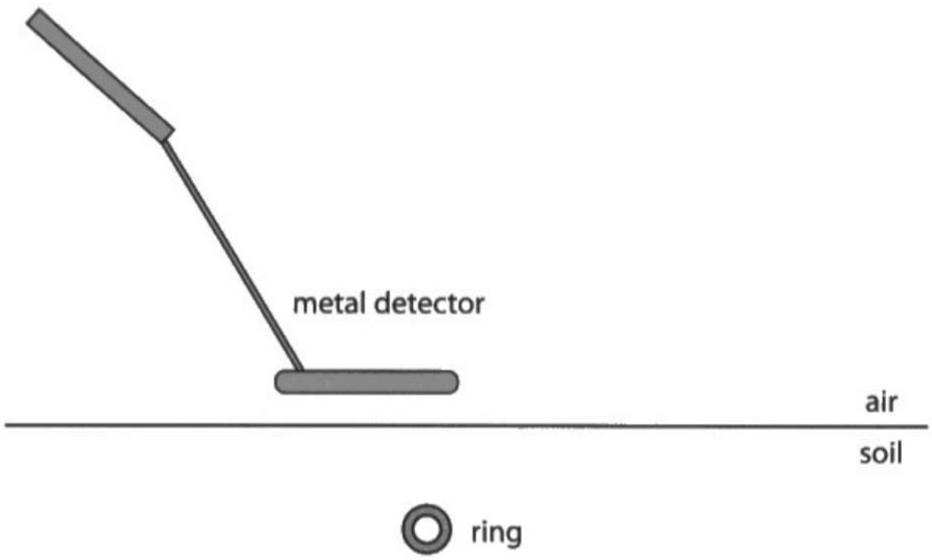


Diagram 2

Explain why there is an alternating current in the gold ring.

(3)

The there is an alternating current in the transmittor coil, as the electronic converts the direct current to an alternating current. so there is an alternating magnetic field around the transmittor coil. This magnetic field cuts through the ring and it induces an alternating voltage and then an alternating current, so the ring has an alternating current.

ResultsPlus
Examiner Comments

This high-level response scored full marks for the comprehensive explanation.

Question 12 (c)

This challenging question discriminated well at the top end of the grades range. There was some confusion about the magnetic field of the receiver coil affecting the inner workings of the loudspeaker in many responses. Weaker responses usually only scored 1 mark for a reference to a vibrating part of the loudspeaker. Only the most able candidates went beyond this to give detailed explanations of how these vibrations were produced.

(c) Diagram 3 shows the circuit for the receiver coil.

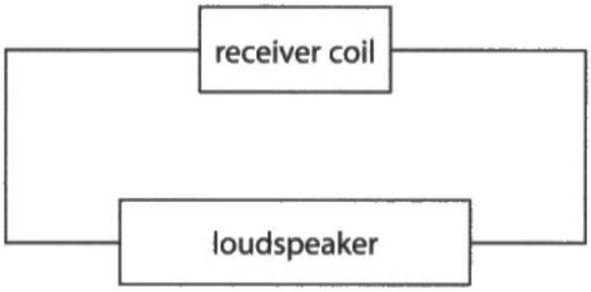


Diagram 3

As a result of the alternating current in the gold ring, there is an alternating current in the receiving coil.

Explain how an alternating current in the receiving coil causes a sound to be emitted from the loudspeaker.

(4)

The alternating current flows into the loudspeaker which is connected to the reciever coil. The alternating current flows into the cone in the loudspeaker and pushes it out the alternating current then pushes it back in and does this repeatedly causing there to be a sound emitted from the speaker

ResultsPlus
Examiner Comments

This response scored 2 marks for Mark Point 1 and Mark Point 5. There is no valid link made between the current in the loudspeaker and the vibration.

(c) Diagram 3 shows the circuit for the receiver coil.

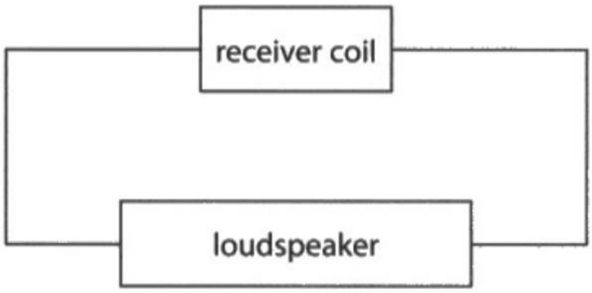


Diagram 3

As a result of the alternating current in the gold ring, there is an alternating current in the receiving coil.

cone
magnet
vibrations

Explain how an alternating current in the receiving coil causes a sound to be emitted from the loudspeaker.

(4)

The alternating current is passed through the loudspeaker and ~~this~~ because the coil in the loud speaker, has it's own magnetic field and is surrounded by a permenant magnet, the two magnetic fields interact and the result is a force on the coil. Because it is an a.c. current, the force produced, changes direction which causes the coil to move back and forth inside the permenant magnet and the cone. These vibrations are where the sound comes from, as sound waves are oscillations.

(Total for Question 12 = 10 marks)

ResultsPlus
Examiner Comments

This excellent response scored 4 marks. There is a comprehensive explanation given that links the current in the loudspeaker to the vibration.

Paper Summary

Based on their performance on this paper, candidates should:

- Take note of the number of marks available for each question and use this as a guide for the amount of detail expected in the answer.
- Take note of the command word used in each question to determine how the examiner expects the question to be answered, for example whether to give a description or an explanation.
- Be able to use the formulae listed in the specification confidently in terms of substitution, rearrangement and evaluation.
- Know the SI units for physical quantities and be able to convert from non-SI units to SI units when required.
- Show all working so that some credit can still be given for answers that are only partly correct.
- Take advantage of opportunities to draw labelled diagrams as well as, or instead of, written answers.

Grade boundaries

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