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Examiners' Report
June 2023

Int GCSE Physics Science Double Award 4SD0 1PR

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Introduction

As in examinations for previous series, most candidates were able to either recall or use the extra formula sheet effectively. More often than not, candidates handled the related calculations well. Candidates who gave the best practical descriptions usually appeared to be writing from first-hand experience. While it may be possible to only use simulations online for some or all of these investigations, there is the “Guide for core practicals” on the Pearson IGCSE Physics webpage, in the “Teaching and Learning” section.

Responses to the longer questions showed that less able candidates tend to struggle when assembling a logical description or when asked to offer more than one idea. This is particularly prevalent in questions about energy, electric circuits and thermal transfer. There is an excellent guide to energy stores and transfers in the topic support section of the aforementioned webpage. That said, there was a wide range of responses, enabling all candidates to show what they could do. It was pleasing to see that many candidates could give full and accurate answers.

Question 1 (a)

A straightforward opening to the paper requiring the candidate to recall simple facts about electromagnetic waves.

1 This question is about the electromagnetic spectrum.

(a) The table gives some statements about the electromagnetic spectrum.

Place three ticks (✓) in the table to show which statements are correct.

(3)

Statement	Correct
all electromagnetic waves are longitudinal	✓
all electromagnetic waves travel at the same speed in free space	✓
radio waves have the longest wavelength in the electromagnetic spectrum	\
x-rays have the highest frequency in the electromagnetic spectrum	✓
all electromagnetic waves transfer energy	\
all electromagnetic waves can cause cancer	✓

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Examiner Comments

We took the most tick-like shape to represent the candidate's intention. They supplied 4 ticks of which only 1 was correct. The mark scheme required a 1 mark penalty for each tick above 3. This candidate therefore scored 0 marks.

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Examiner Tip

Make your intentions as clear as possible.

1 This question is about the electromagnetic spectrum.

(a) The table gives some statements about the electromagnetic spectrum.

Place three ticks (✓) in the table to show which statements are correct.

(3)

Statement	Correct
all electromagnetic waves are longitudinal	~~✗~~
all electromagnetic waves travel at the same speed in free space	✗
radio waves have the longest wavelength in the electromagnetic spectrum	✗
x-rays have the highest frequency in the electromagnetic spectrum	
all electromagnetic waves transfer energy	✗
all electromagnetic waves can cause cancer	

ResultsPlus
Examiner Comments

In this case, we took the tick and tick/cross indications as the candidate's intention of a tick. 3 correct indications and no 1 mark penalty as there are only three indications. 3 marks scored.

Question 1 (b)(i)

Lots of scope for the candidates to recall something relevant here. Many candidates did precisely that. We were not convinced about the onset of cancer from microwave radiation nor did we accept skin burns (as that is broadly reserved for the harmful effect of infrared radiation).

(b) Electromagnetic waves can be useful, but can also be harmful.

(i) Give one use and one harmful effect of microwaves.

(2)

use

Microwaves can be used to heat food.

harmful effect

Microwaves can cause ~~#~~ internal heating.

ResultsPlus
Examiner Comments

Both answers are concise and accurate.

ResultsPlus
Examiner Tip

The 'give' command word does not usually require a lengthy answer.

(b) Electromagnetic waves can be useful, but can also be harmful.

(i) Give one use and one harmful effect of microwaves.

(2)

use Can be used for ~~Wif Wi-Fi routers~~ ~~cooking~~ heating up food

harmful effect Can cause Skin burns

ResultsPlus
Examiner Comments

Skin burns here is not accepted. The stated use is perfectly acceptable.

Question 1 (b)(ii)

The candidates had plenty of scope here too, as in the previous item. Many candidates did well and produced both valid uses and harmful effects.

(ii) Give one use and one harmful effect of gamma rays.

(2)

use

Sterillise medical equipment

harmful effect

Damage cells

ResultsPlus
Examiner Comments

Sterilising medical equipment is perfectly acceptable.

The idea that gamma radiation damages cells was condoned, largely because this was part of the very first question. There is no guarantee that it will be an acceptable answer in future papers.

(ii) Give one use and one harmful effect of gamma rays.

(2)

use

gamma waves can be used for medical treatment

harmful effect

gamma waves might destory tissues in our body.

ResultsPlus
Examiner Comments

Again, we thought that "destroying tissues" was just about acceptable for this item. The candidate's use here is too vague though.

Question 2 (c)(i)

Many candidates successfully navigated this question. The relevant formula has always been included in the inside-front cover of the paper and most candidates use it correctly. Some candidates forgot to convert the time period into seconds or changed the distance into metres unnecessarily, making the question more difficult than intended.

(c) The ISS completes one orbit of the Earth in a time period of 93 minutes.

(i) The orbital radius of the ISS is 6.8×10^3 km.

Calculate the orbital speed of the ISS in km/s.

(3)

$$\text{orbital speed} = \frac{6.8 \times 10^3 \times 2 \times \pi}{5580}$$

$$= 7.65$$

orbital speed = 7.65 km/s

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Examiner Comments

This candidate made sure they used the correct formula and substituted correctly.

They have also remembered to convert the time period into seconds.

Since the distance is given in kilometres and the time has been converted into seconds, the resulting speed will be expressed in the given unit ie km/s.

Had this question been a 'show that' question, this candidate would still have gained all 3 marks.

ResultsPlus
Examiner Tip

Make sure your substitution is careful and obvious.

(c) The ISS completes one orbit of the Earth in a time period of 93 minutes.

(i) The orbital radius of the ISS is 6.8×10^3 km.

Calculate the orbital speed of the ISS in km/s.

(3)

$$V = \frac{s}{t} = \frac{6.8\times10^3 \text{ km}}{93\times60 \text{ s}} = 1.22 \text{ km/s}$$

orbital speed = 1.22 km/s

ResultsPlus
Examiner Comments

This candidate has not used the given formula for the relationship between orbital speed, orbital radius and orbital period.

The candidate has, however, made clear that they know that the time should be expressed in seconds, which has given them 1 mark.

ResultsPlus
Examiner Tip

Showing all of your working, even if some of it is wrong, is always better than not showing any working at all.

Question 2 (c)(ii)

There are a number of routes available to the candidate here. The most successful candidates converted the orbital period and a day into the same units and calculated the number of orbits directly. Furthermore, the 'approximately' word in the question suggests that the candidate should give their answers to more significant figures than the quoted value. Here that would require 3 significant figures or more.

(ii) Show that the ISS completes approximately 15 orbits of the Earth each day. **(2)**

93 × 15 orbits = 1395

1395 ÷ 60 = 23.25

15 orbits = 23.25 hours

1 orbit = 1.55 hours

ResultsPlus
Examiner Comments

This candidate worked out the time taken for 15 orbits, which on the face of it is sensible. The question does not ask this, however, and the candidate has answered the question backwards. Effectively, this question is asking the candidates to find the number of orbits of the Earth each day and demonstrate that this is about 15.

ResultsPlus
Examiner Tip

"Show that" questions require all relevant working and a last line which shows the candidate has arrived at an answer that is more precise than the 'approximate' value given in the question.

(ii) Show that the ISS completes approximately 15 orbits of the Earth each day.

(2)

1 orbit => 93 minutes

15 orbit => ?

15 orbits => 1395

$15 \times 93 = 1395$

~~= 13.95~~

$1395 \div 24$

=> 58.13

~~=> 58~~

=> 58.22

$15 \div 60$

= 0.22

ResultsPlus Examiner Comments

This candidate has not ordered their thoughts very carefully, making it challenging for the marker to decipher the candidate's intentions.

ResultsPlus Examiner Tip

Put more words into a "show that" response, to flag where your thoughts are going. This makes it easy for the examiner to pick out your intention.

(ii) Show that the ISS completes approximately 15 orbits of the Earth each day.

(2)

~~$6.8\times10^3\times2\pi = 13600\pi$~~

$$\frac{7.66\times60\times60\times24}{13600\pi}$$

~~7.66 × 24 × 60 × 60~~

$= 15.49$ turns

≈ 15 turns.

ResultsPlus
Examiner Comments

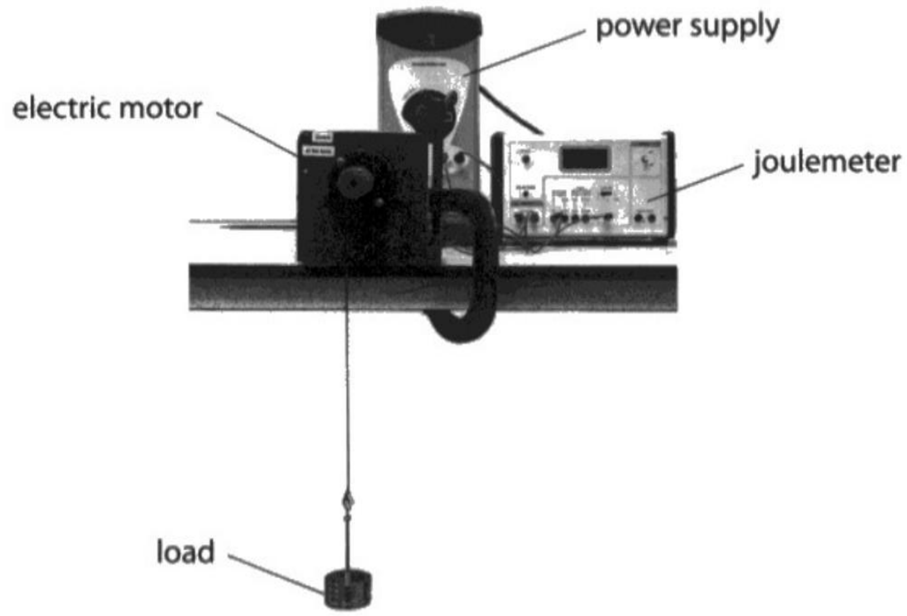
This candidate has not written any words however their intention is clear. They have calculated the total distance travelled by the ISS in 24 hours and divided that total distance by the circumference of the orbit itself.

The candidate has shown the total number of orbits to a greater number of significant figures than the approximate value and shown all relevant working, thus scoring both marks.

Question 3 (a)(i-ii)

Another calculation completed broadly successfully. There were some unit errors which prevented full marks. More seriously, some candidates forgot to use the value of *g* given in the paper and so could not score any marks for the calculation.

3 A model electric motor is used to lift a load through a vertical height.



(a) The load has a mass of 400 g and gains 3.2 J of energy in its gravitational store when lifted.

(i) State the formula linking gravitational potential energy, mass, gravitational field strength (*g*) and height.

(1)

GPE = m × g × h

(ii) Calculate the height the load is lifted.

(3)

GPE = 400 × 9.8 × x

3.2 = 400 × 9.8 × x

3.2 = 3920 · x

3920 · x = 3.2

$x = \frac{3.2}{3920} = 8.16$

height = 8.16 m

ResultsPlus
Examiner Comments

For this session, all candidates received all relevant formulae. This meant that almost all of the questions that started "State the formula..." were answered correctly.

A large proportion of candidates performed unnecessary unit conversions. The only unit conversion the candidate needed was to convert the given mass from grams to kilograms. Those candidates that made a unit conversion error often scored 2 marks.

ResultsPlus
Examiner Tip

Rehearse which units are the ones required by the formula. More often than not, this will be the SI unit ie kg for mass, m for distance, s for time.

Question 3 (a)(iii)

This question is a 'state' question, which means there was no need for any further calculation. Here, of course, the useful energy is the GPE given in the question ie 3.2 J. No other answer was acceptable.

Question 3 (b)

While many candidates got both marks here, there was a sizable minority that did not read the question fully. The load is travelling at constant speed, which requires there to be no resultant force. The question also asks for a single labelled arrow. This can only happen if the candidate's arrow is the same length and pointing in the opposite direction to the lifting force. The name of that force is not 'gravity' but the object's weight.

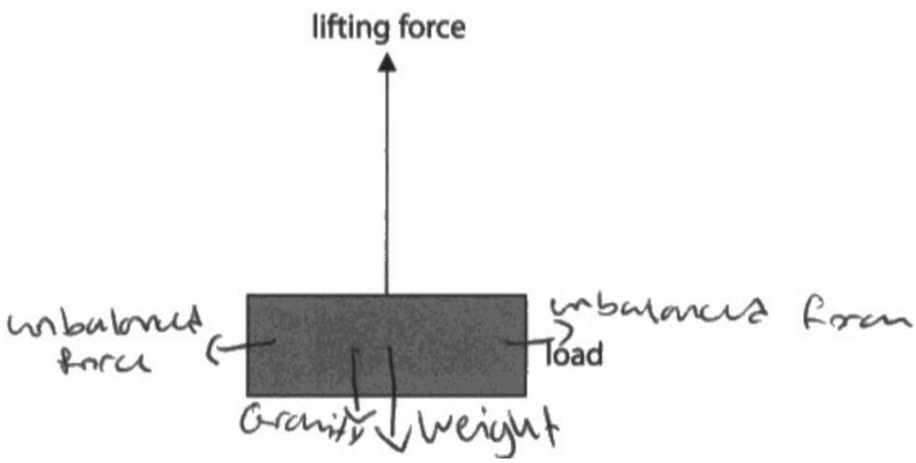
(b) The load is lifted at a constant speed.

Diagram 1 shows the lifting force acting on the load as it is lifted.

Draw a labelled arrow on diagram 1 to show the other force acting on the load.

Ignore the effects of air resistance.

(2)



ResultsPlus
Examiner Comments

This candidate has drawn many arrows, including one labelled weight which would have otherwise scored 1 mark. The presence of both a gravity and a weight arrow means that neither mark could be awarded.

ResultsPlus
Examiner Tip

Learn correct technical language for the forces that may act on an object and read the whole of the question before answering.

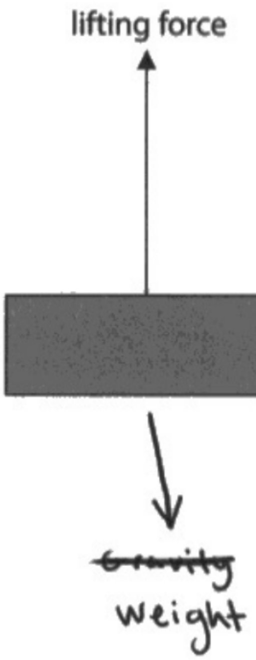
(b) The load is lifted at a constant speed.

Diagram 1 shows the lifting force acting on the load as it is lifted.

Draw a labelled arrow on diagram 1 to show the other force acting on the load.

Ignore the effects of air resistance.

(2)



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Examiner Comments

This candidate correctly identified the nature of the force (the weight) yet did not draw a suitably vertical line or a line long enough to get the second mark.

Question 3 (c)(i)

Almost all candidates successfully extracted the correct formula. Somewhat more candidates muddled up which energy transfer was the useful one. The answer line did not have the % symbol so candidates were free to express their answer as either a decimal in the range 0 to 1 or as a percentage between 0 and 100, provided they supplied the % symbol itself.

(c) A joulemeter measures the amount of energy transferred electrically to the motor as the motor lifts the load.

The joulemeter displays a reading of 11.0 J when the load has gained 3.2 J of energy in its gravitational store.

(i) Calculate the efficiency of the motor.

efficiency = $\frac{\text{useful energy output}}{\text{total energy output}}$ × 100

~~$\frac{3.2}{11}$ × 100 = 29.0909091~~

$\frac{7.8}{11}$ × 100 = 70.9

(3)

efficiency = 70.9 ~~29.09~~

ResultsPlus
Examiner Comments

The formula here is correct however the candidate has assumed that the 'rest' of the 11.0J is the useful energy output, rather than the intended 3.2 J. This means that the substitution (and hence the evaluation) is incorrect. This response was awarded 1 mark.

(c) A joulemeter measures the amount of energy transferred electrically to the motor as the motor lifts the load.

The joulemeter displays a reading of 11.0 J when the load has gained 3.2 J of energy in its gravitational store.

(i) Calculate the efficiency of the motor.

(3)

$$\text{efficiency} = \frac{\text{useful energy output}}{\text{total energy output}} \times 100\%.$$

$$\text{efficiency} = \frac{3.2}{11.0} \times 100 = 29.1\text{J}$$

efficiency = 29.1J

ResultsPlus
Examiner Comments

This candidate did everything correctly however they have made an error in using the unit for energy, rather than using the percentage sign, %. 2 marks awarded.

Question 3 (c)(ii)

Candidates find describing energy challenging. For this item, we wanted the idea that energy must be conserved as well as an indication that the candidate knew how it applied in this context.

(ii) Justify why 7.8 J of energy must be dissipated into the thermal store of the surroundings as the load is lifted.

(2)

3.2J ~~jule~~ gravitational is ~~used for use~~ useful energy. Total energy = 11J

11 - 3.2 = 7.8J wasted on thermal store

ResultsPlus
Examiner Comments

This candidate has concisely explained that they know energy has been conserved with a comparison between the 11J, 3.2J and 7.8J. They have contrasted useful with wasted energy which has to equate, in total, to 11J. 2 marks awarded.

Question 3 (c)(iii)

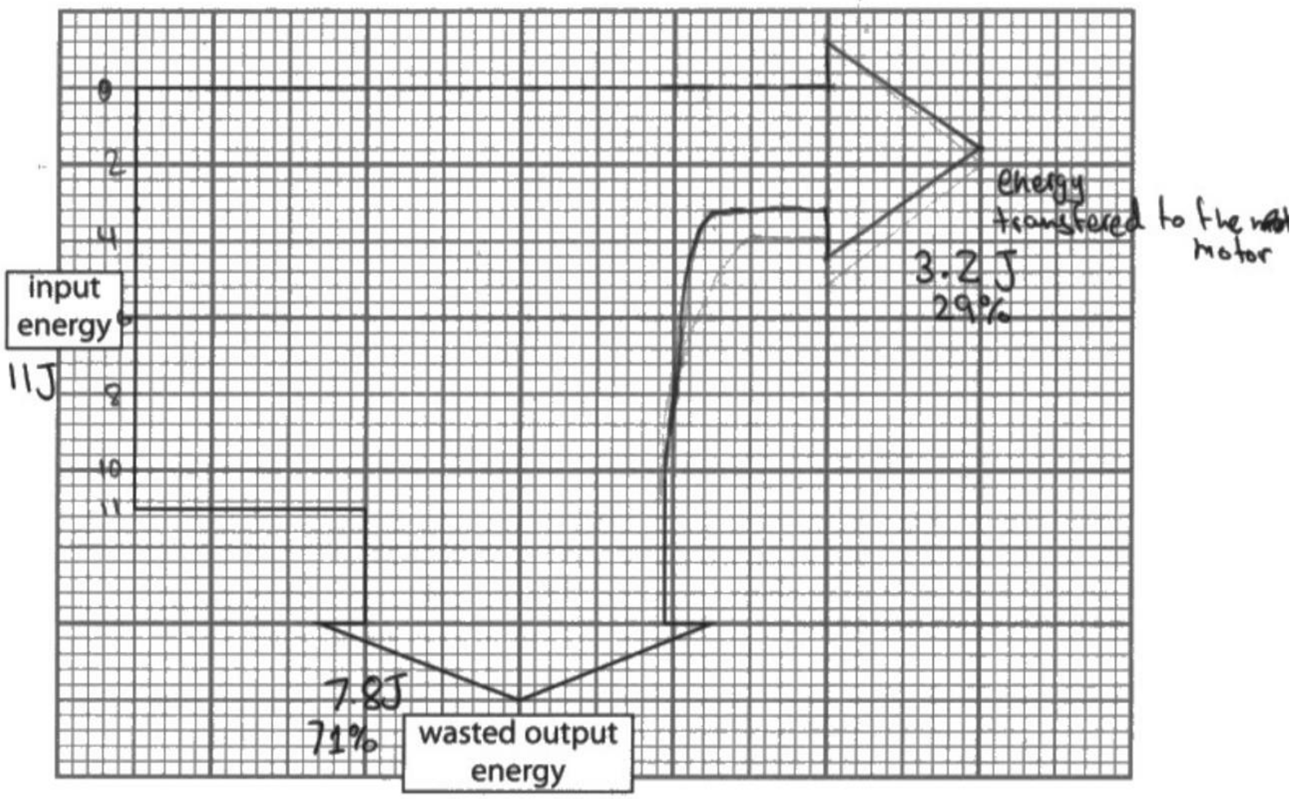
Sankey diagrams can be challenging to draw, which is why a grid was supplied for this paper's question on them. Typically, a Sankey diagram has at least two arrows, one of which points to the right showing the useful energy output.

The second arrow was supplied to the candidate so here, we were interested in the 'useful' arrow only. This arrow needed to point to the right and have a correct label, which many candidates did not manage successfully. The last mark was for the correct width which candidates did significantly better at.

(iii) Diagram 2 is an incomplete Sankey diagram.

Complete the Sankey diagram to show the energy transferred by the motor.

(3)



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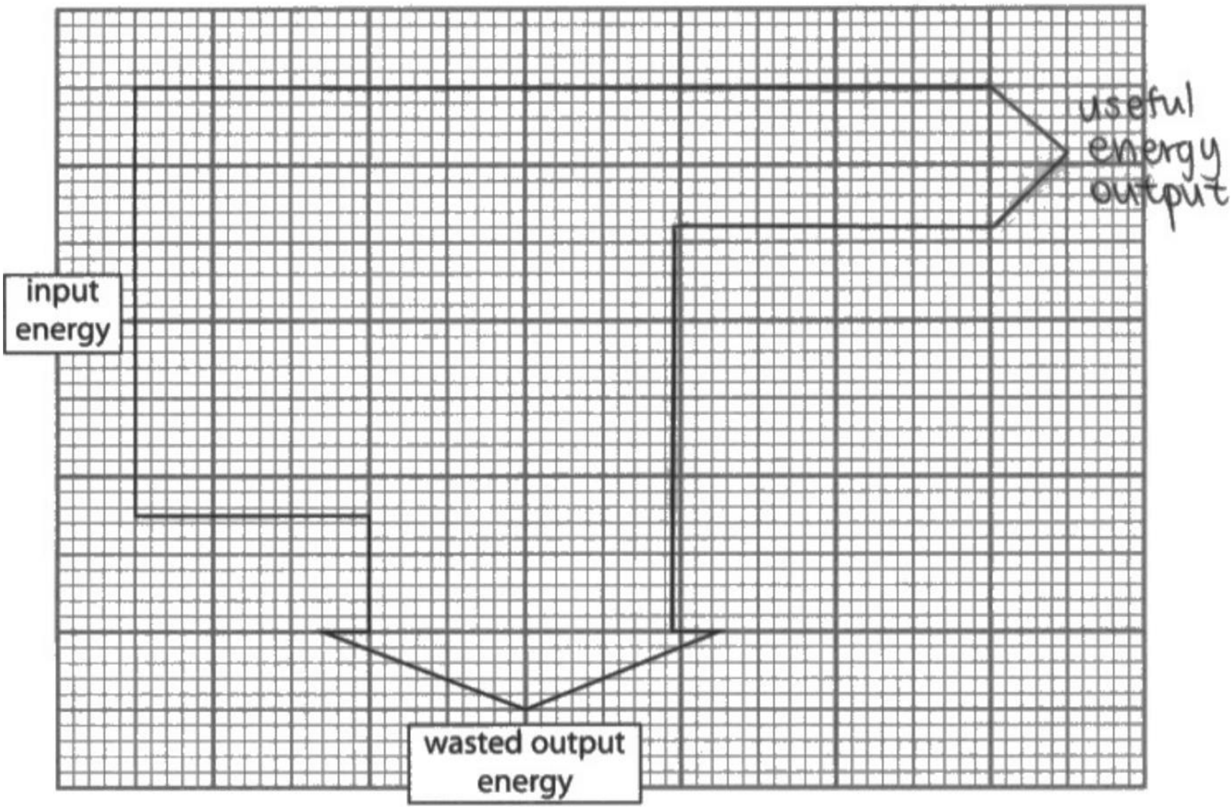
Examiner Comments

This candidate has done well, getting the width and direction of the right hand arrow correct. Unfortunately the arrow is incorrectly labelled.

(iii) Diagram 2 is an incomplete Sankey diagram.

Complete the Sankey diagram to show the energy transferred by the motor.

(3)



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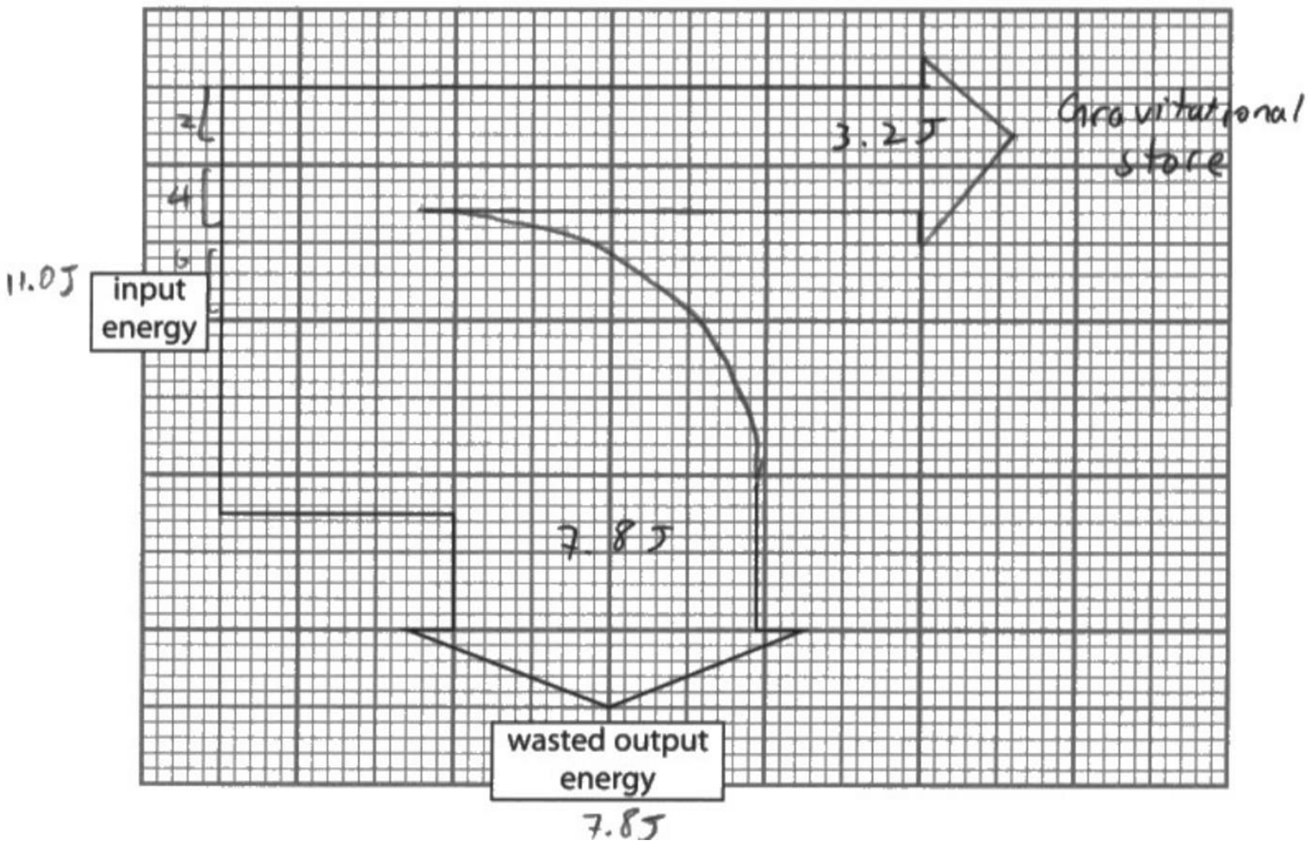
Examiner Comments

This candidate has been very successful in getting the direction and label correct. Unfortunately the width of the arrow is incorrect, having a width of 9 little squares as opposed to 8.

(iii) Diagram 2 is an incomplete Sankey diagram.

Complete the Sankey diagram to show the energy transferred by the motor.

(3)



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Examiner Comments

This candidate has been completely successful. The right hand arrow is completely correct. The curvature of the downward arrow wasn't taken into account, however this candidate has done an excellent job of maintaining the correct width here too.

Question 4 (b)

A large proportion of candidates scored well here. Many demonstrated their knowledge of field lines, including that the field lines must be labelled as going from N to S and that they connect the two poles.

(b) Diagram 1 shows a bar magnet.

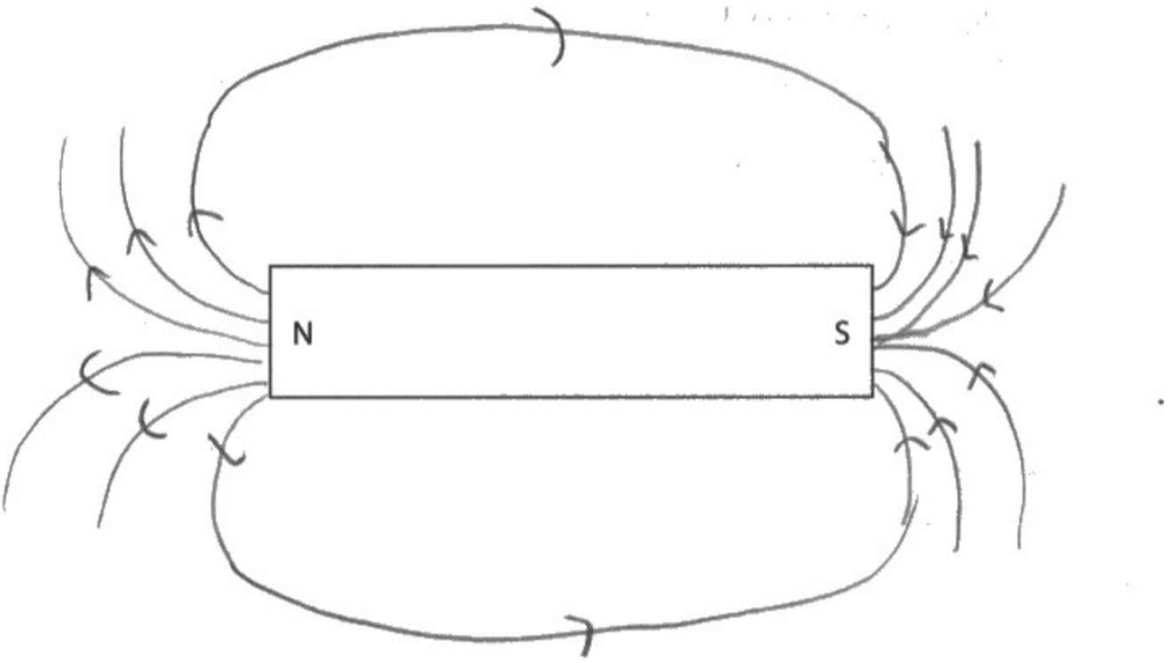

Diagram 1

Draw magnetic field lines on diagram 1 to show the shape and direction of the magnetic field around the bar magnet.

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Examiner Comments

This candidate has made a good attempt at the field line pattern. Unfortunately at the S pole end there are a couple of field lines that either cross or join up. 2 marks awarded.

(b) Diagram 1 shows a bar magnet.

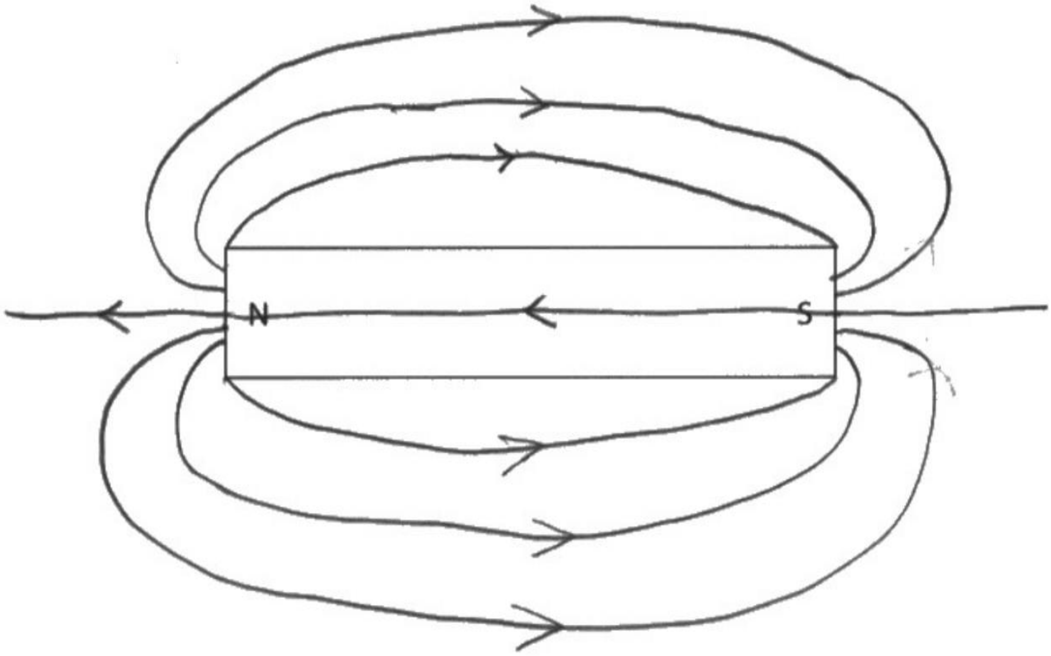

Diagram 1

Draw magnetic field lines on diagram 1 to show the shape and direction of the magnetic field around the bar magnet.

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Examiner Comments

Although the diagram is slightly simpler than the previous exemplar, it is a shade clearer. There are no overlapping lines and all lines have been labelled with arrows correctly. 3 marks awarded.

Question 4 (c)

Many candidates realised that the question required understanding of the properties of the material steel. Most decided, correctly, that this was about steel's magnetic properties yet could not quite find the right technical language to score both marks, with most candidates scoring 1 mark.

(c) Some bar magnets are made of steel.

Explain why steel is a good material for making bar magnets.

(2)

Because steel is a type of magnetic material and ~~stell~~ ~~steel~~ steel ~~is~~ has a high ~~metal~~ melting point.

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Examiner Comments

The candidate scored a single mark here for the reference to steel being magnetic. The comment about a high melting point is irrelevant.

(c) Some bar magnets are made of steel.

Explain why steel is a good material for making bar magnets.

(2)

- it is magnetically hard, meaning that it is hard to magnetise but also hard to demagnetise. It will work as a magnet for a long time, its not temporary.

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Examiner Comments

This candidate has plenty of evidence that they understand the concepts here. The statement at the beginning, that the steel is "magnetically hard" would have scored both marks. The candidate has gone on to explain what that means ie that it's magnetisable and that the magnetism is retained for some time.

Question 4 (d)(i)

This item tested knowledge of the left-hand rule. Large numbers of candidates got this correct although there was a minority that got the direction exactly backwards. A much smaller number of candidates drew either only field lines alone or misunderstood the question.

(d) Diagram 2 shows a cross-section through a wire placed between two magnetic poles.

The direction of the current in the wire is out of the page.

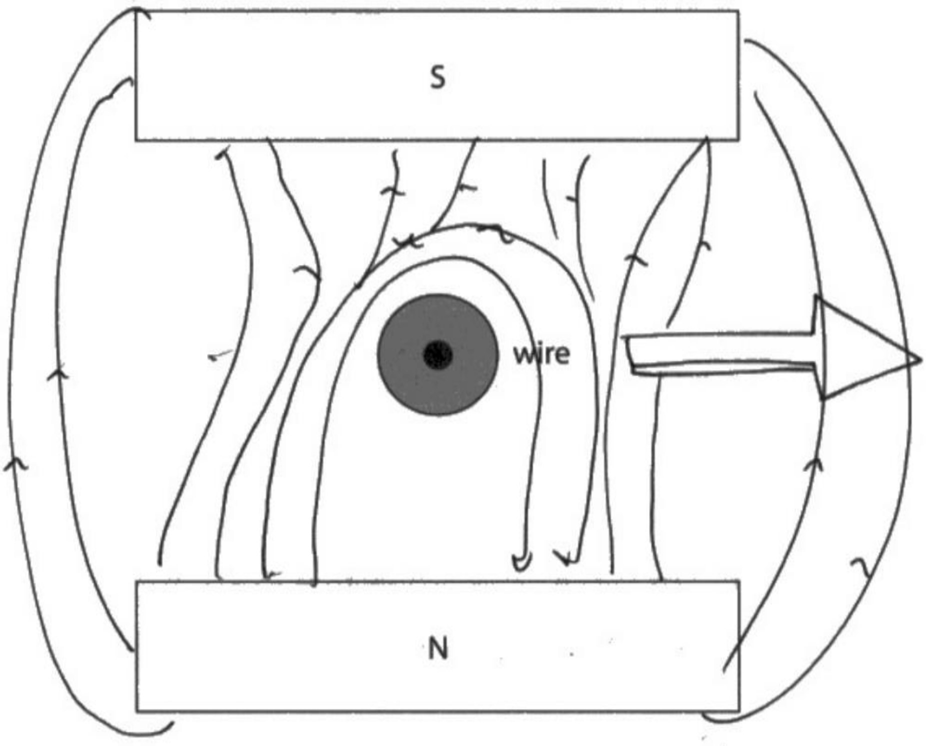

Diagram 2

(i) Draw an arrow on diagram 2 to show the direction of the force on the wire due to the magnetic field.

Assume that the magnetic field is uniform.

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Examiner Comments

This candidate has made a valid attempt at drawing the combined magnetic field present when there is a permanent uniform field and a field from the current carrying conductor. We treated these as 'construction' lines and focused on the large arrow pointing to the right. 1 mark scored.

(d) Diagram 2 shows a cross-section through a wire placed between two magnetic poles.

The direction of the current in the wire is out of the page.

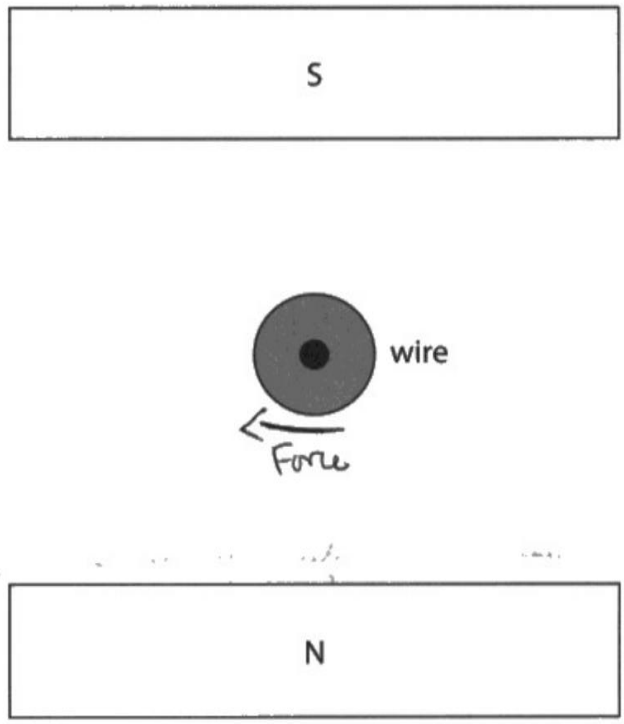

Diagram 2

(i) Draw an arrow on diagram 2 to show the direction of the force on the wire due to the magnetic field.

Assume that the magnetic field is uniform.

ResultsPlus
Examiner Comments

This candidate has correctly shown the direction of force on the wire, hence scoring both marks. It was not necessary to draw the force coming from the wire, although many candidates did that.

Question 4 (d)(ii)

Candidates remembered this portion of the specification very well, choosing either to describe the two different factors that affect the size of the magnetic force, or, alternatively, select one factor and then describe how that factor could be changed experimentally.

(d) Diagram 2 shows a cross-section through a wire placed between two magnetic poles.

The direction of the current in the wire is out of the page.

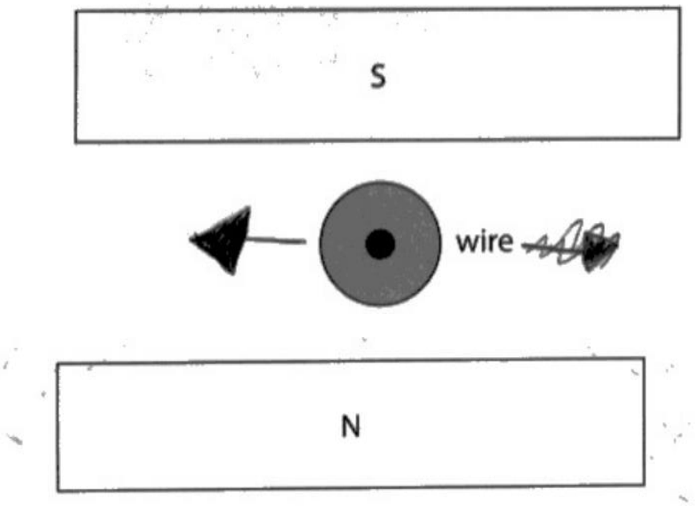

Diagram 2

(i) Draw an arrow on diagram 2 to show the direction of the force on the wire due to the magnetic field.

Assume that the magnetic field is uniform.

(2)

(ii) State two changes that could be made that would decrease the magnitude of the force on the wire in diagram 2.

(2)

1 Less Powerfull Magnets

2 Place Magnets further apart

ResultsPlus Examiner Comments

This candidate chose to focus on reducing the strength of the magnetic field and went into more detail about how that could be achieved. 2 marks awarded.

(d) Diagram 2 shows a cross-section through a wire placed between two magnetic poles.

The direction of the current in the wire is out of the page.

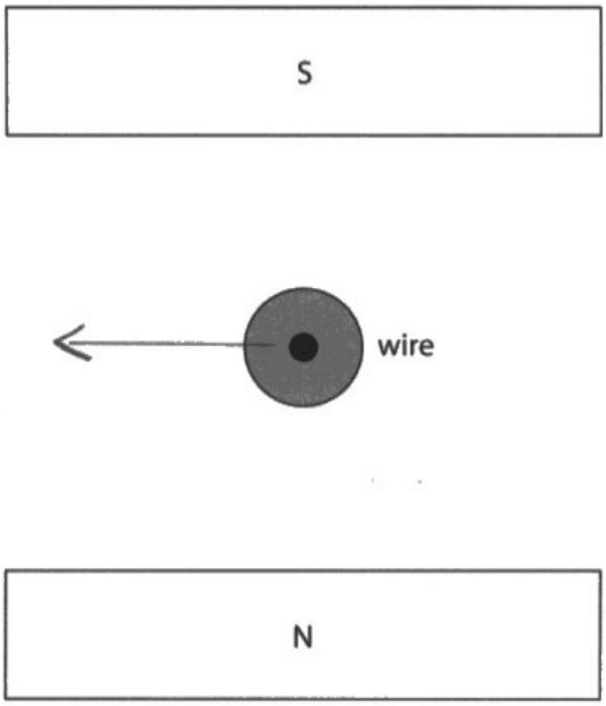

Diagram 2

(i) Draw an arrow on diagram 2 to show the direction of the force on the wire due to the magnetic field.

Assume that the magnetic field is uniform.

(2)

(ii) State two changes that could be made that would decrease the magnitude of the force on the wire in diagram 2.

(2)

1 Reduce the magnitude of current.

2 Reduce the magnetic field strength.

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Examiner Comments

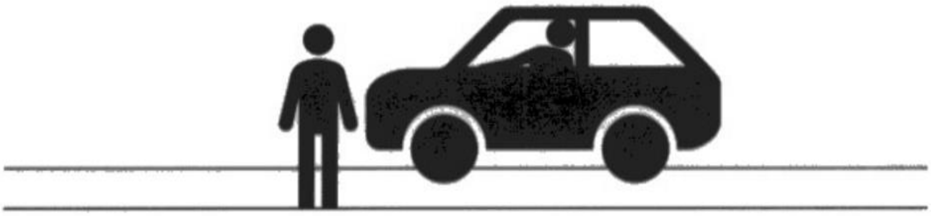
Just as legitimately, this candidate chose to state the two different factors that could reduce the size of the magnetic force on the wire. 2 marks awarded.

Question 5

The Doppler effect and how it arises has been examined several times since it was included in the specification for first examination in 2019. Candidates used previous mark schemes well to rehearse the required technical language. Significant numbers of candidates correctly identified the logical steps, although fewer remembered to include reference to the wave equation ($v = f \times \lambda$) and that the speed of the waves were unchanged.

Some candidates lost marks even if their explanation of the Doppler effect was complete. The question specifically asks for comments about the driver's experience.

5 A car is travelling in a straight line along a road. The car passes a person standing at the side of the road.



Before passing the person, the driver of the car presses the car's horn. The horn makes a loud sound of constant frequency.

The horn continues to make a sound until after the car has passed the person.

Discuss the differences in the frequencies of the sound heard by

- the driver of the car
- the person at the side of the road

This is an example of doppler effect. the sound is in constant frequency, therefore the wavefronts are evenly spaced. The loudness of the sound does not change for the driver. However, when the car approaches the person at the side of the road, the ~~wavefro~~ waves between the person and the car are compressed, therefore wavelength decreases. Due to the formula $v = f\lambda$, when wave length decreases, frequency increases, therefore the person hears a high pitch sound. As the car leaves the person, wavelength starts to increases, so frequency decreases and so the person hears ~~the~~ a low pitch sound.

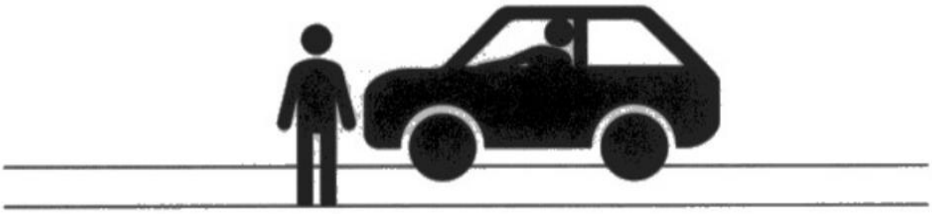
(Total for Question 5 = 6 marks)

ResultsPlus
Examiner Comments

In this exemplar, the candidate explains the effect on the frequency observed by the person at the side of the road. They complete this well, only missing out the step about a constant wave speed.

Unfortunately they have made no reference to the frequency experienced by the driver. Early on in this response the candidate mentions constant frequency, which is stated in the question and is true (the horn continues to emit at a constant frequency). The candidate does mention about constant volume, which is true yet not the instruction in the question. 5 marks awarded.

5 A car is travelling in a straight line along a road. The car passes a person standing at the side of the road.



Before passing the person, the driver of the car presses the car's horn. The horn makes a loud sound of constant frequency.

The horn continues to make a sound until after the car has passed the person.

Discuss the differences in the frequencies of the sound heard by

- the driver of the car
- the person at the side of the road

As the person is in front of the car, the driver presses the horn, and the sound waves travel in the air, at a constant frequency. As the car moves closer to the person, the wavefronts become closer together, so the wavelength decreases and the frequency of the horn increases. The person on the side of the road will hear a higher pitch, but the driver will hear the same pitch of the horn all the time. ~~As the car~~ This is due to the Doppler effect. As the car passes the person, the wavefronts become further apart behind the car as it is travelling, so the wavelength increases. Since the speed of the sound waves is the same, the frequency decreases, so the person will hear a lower pitch of the horn. Since the driver is travelling with the car, it will hear a constant pitch throughout, as the frequency is the same

(Total for Question 5 = 6 marks)

ResultsPlus
Examiner Comments

This candidate has answered the question fully and as a result has scored maximum marks. Right at the bottom of the response, they refer to the driver's experience and why the pitch is constant, ie due to there being no relative motion between the driver and the horn.

Question 6 (a)

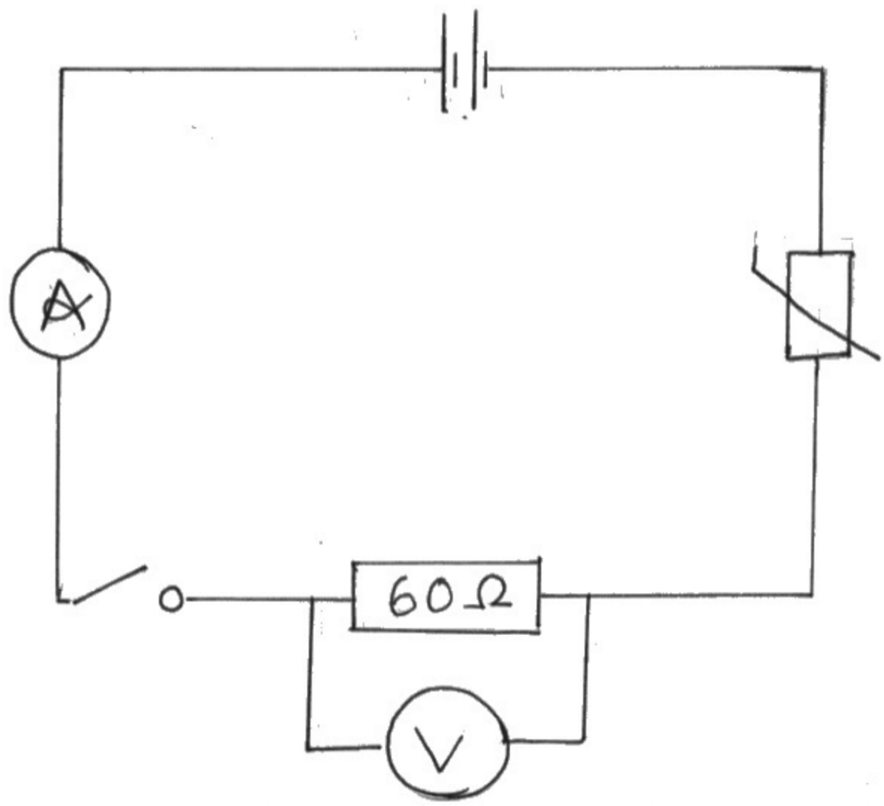
This experiment is mentioned in the specification and as such, most candidates have either seen this procedure or completed it themselves. Many candidates remembered the majority of the symbols although some confused the variable resistor with a thermistor. Some candidates also put the voltmeter in parallel with the incorrect component.

6 A student investigates how the current in a 60 Ω resistor varies with the voltage across the resistor.

(a) The student has access to this equipment

- 12 V battery
- ammeter and voltmeter
- 60 Ω resistor
- variable resistor
- switch
- connecting wires

Draw a circuit diagram to show how the student could connect this equipment to carry out the investigation.



ResultsPlus
Examiner Comments

This candidate has fulfilled all of the requirements for this item, except that they have drawn a thermistor instead of a variable resistor.

ResultsPlus
Examiner Tip

Learn the circuit symbols as well as you can.

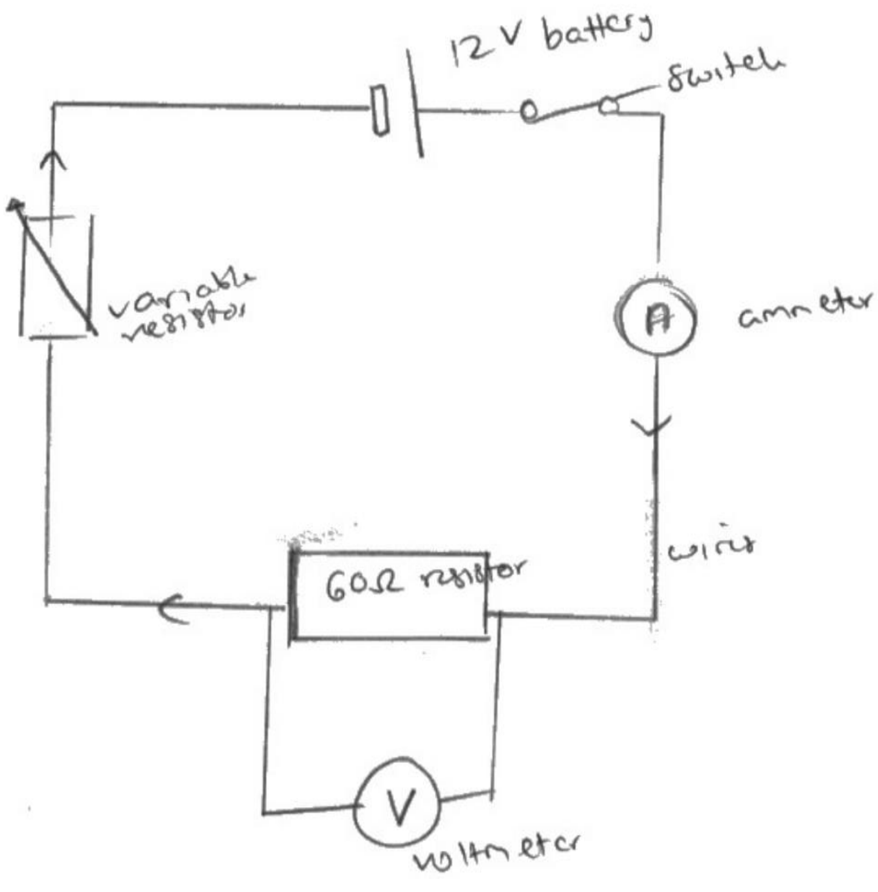
6 A student investigates how the current in a 60 Ω resistor varies with the voltage across the resistor.

(a) The student has access to this equipment

- 12 V battery
- ammeter and voltmeter
- 60 Ω resistor
- variable resistor
- switch
- connecting wires

Draw a circuit diagram to show how the student could connect this equipment to carry out the investigation.

(4)



ResultsPlus
Examiner Comments

This candidate has got all of the circuit symbols correct and also has the meters in the right place.

Question 6 (b)

Physics is a practical subject. This item focuses on the steps a viable method should include to complete an investigation into the current-voltage characteristics of a component. Most candidates scored some marks but progressively fewer scored 3 or 4 marks.

(b) Describe a suitable method the student could use for this investigation.

(4)

The student should use the voltmeter and the ammeter on the resistor and variable resistor. The student should measure the current at different voltages.

ResultsPlus
Examiner Comments

This candidate has included the minimum required information to complete the method. However, there are no indications of how to get the best quality data.

(b) Describe a suitable method the student could use for this investigation.

(4)

Connect all the equipment.
~~Start the~~ Turn on the switch and make sure the variable resistor ~~is~~ has 0 ohms.
Record the current and the voltage using the voltmeter and ammeter.
Turn off the switch.
Repeat the method making sure to increase the resistance of the variable resistor gradually.
~~For each value~~ Repeat 3 times and take average.

ResultsPlus
Examiner Comments

By contrast this candidate has adopted a 'bullet point' approach and all of the information the previous candidate mentioned is here too.

The candidate has gone further by mentioning ***how*** to get the required results ie if they were doing the investigation what would they do. Unusually, this candidate has also remembered to switch off the circuit between values and to mention what must happen to get a range of voltage and current readings. All 4 marks awarded.

ResultsPlus
Examiner Tip

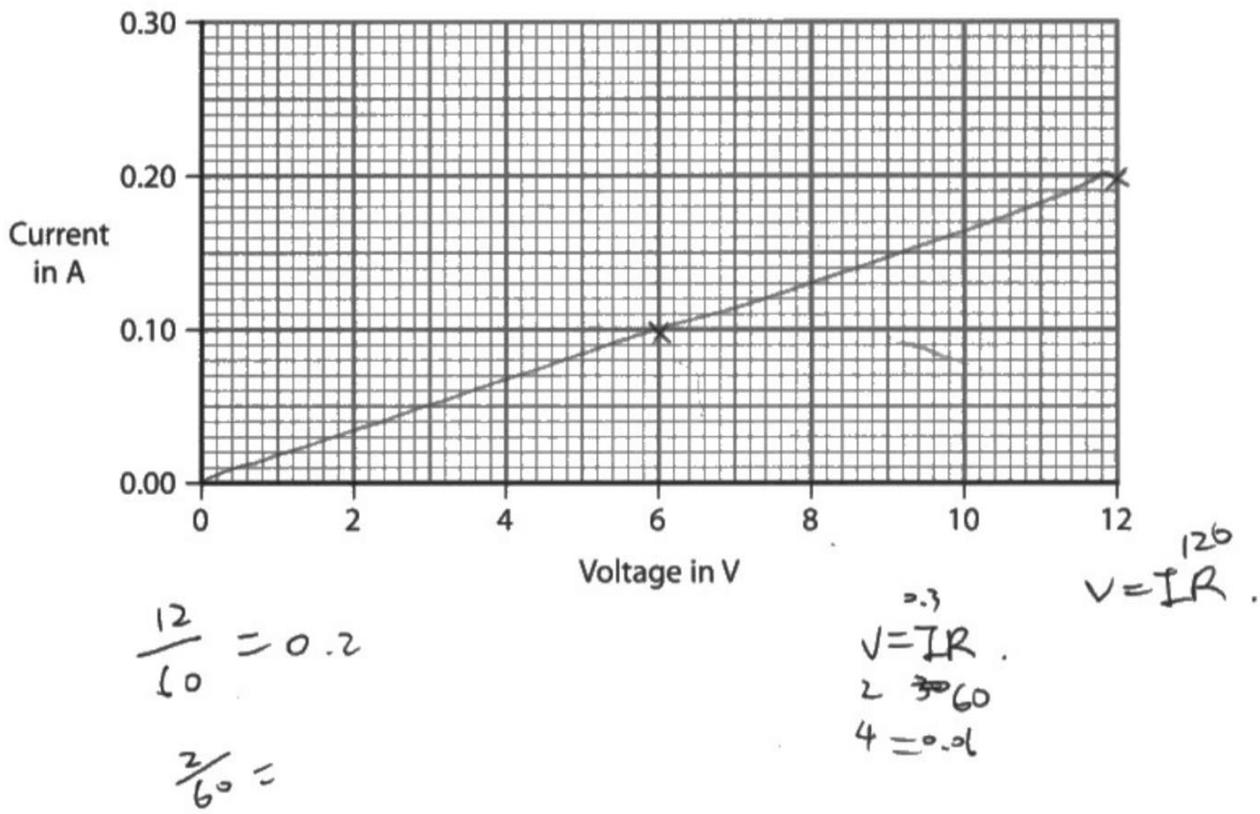
Practice and plan how you would perform each detailed step of all of the practicals mentioned in the specification. There are twelve denoted with a 'P', plus the focus of this question.

Question 6 (c)(i-ii)

Throughout this question, most candidates realised that the current would be lower for the circuit with the highest resistance. There were some excellent fully correct answers, although some candidates could not reconcile their (correct) instinct with the correct underlying physics or how the graph should look. Graphs with negative gradients were common for that reason.

(c) (i) Complete the current–voltage graph by drawing a line that shows the expected results of the investigation.

(3)



(ii) The student repeats their investigation with a 120 Ω resistor.

Explain how a current–voltage graph for a 120 Ω resistor compares with the current–voltage graph for the 60 Ω resistor.

(3)

~~V=IR~~ x2

~~If voltage stays the same and resistance times by 2, current will decrease by (divide by 2).~~

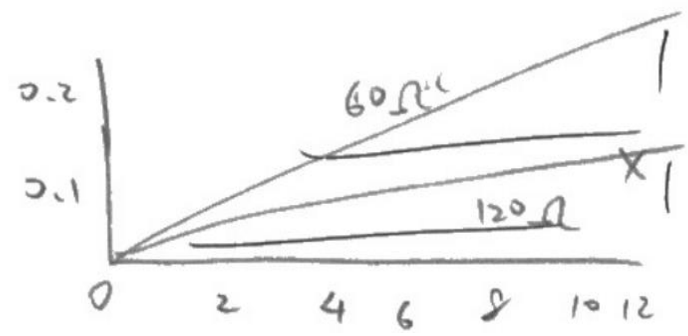
~~- so the line will gridient is decreasing~~

V=IR

If resistance increases and voltage stays the same, current reduce to. In the ~~gridient~~ the graph the gridient is reducing, which means less current ~~increases~~ as same voltage compared to the 60 Ω graph. 120 Ω only has half gridient ~~con~~ then the 60 Ω graph.

(Total for Question 6 = 14 marks)

60 Ω graph more steeper, they all direct ~~pr~~ proportional graph.



ResultsPlus
Examiner Comments

This candidate scored well on this question throughout. The graph in Q06(c)(i) was very nearly perfect however the line missed the cross they had placed at the correct point. 2 marks.

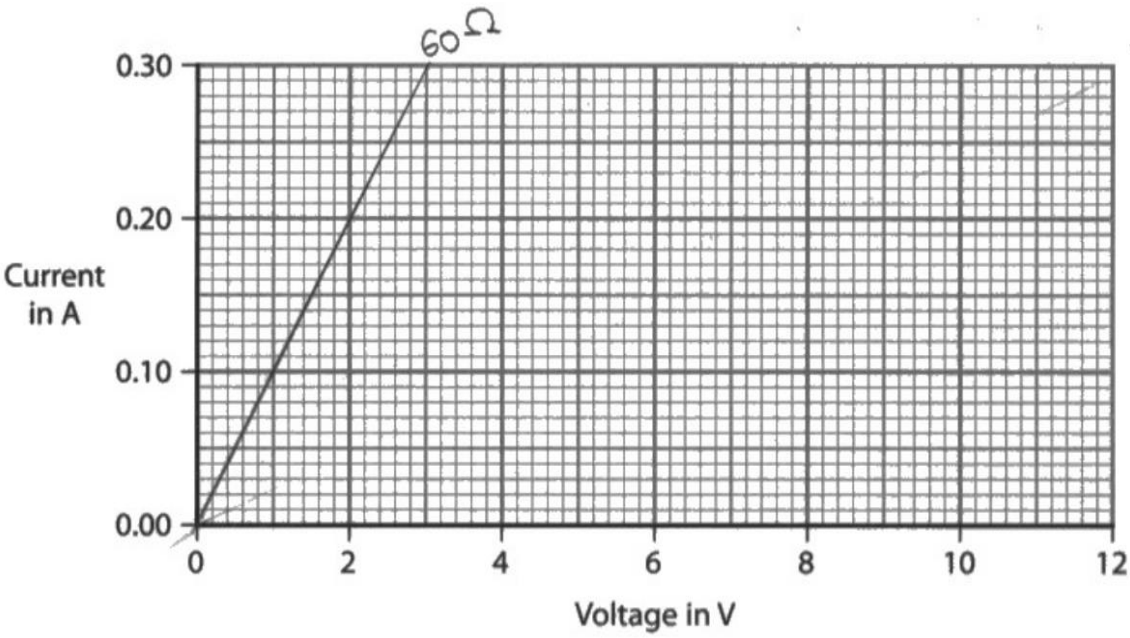
The explanation in Q06(c)(ii) is very convincing, aided by the sketch at the bottom of the page.

ResultsPlus
Examiner Tip

Candidates can make short work of this type of 'explain how' question by spotting which equation is relevant, then explaining what the effect is on one variable by changing the other. In doing this, mentioning which variable is constant (here the voltage – by comparing the currents delivered at the same voltage with the two different resistors) and then what effect this has on the graph.

(c) (i) Complete the current–voltage graph by drawing a line that shows the expected results of the investigation.

(3)



V↑ = I↑

V = IR

↑ I = V↑ / R ×2   I↓

(ii) The student repeats their investigation with a 120 Ω resistor.

Explain how a current–voltage graph for a 120 Ω resistor compares with the current–voltage graph for the 60 Ω resistor.

(3)

A current voltage graph for a 120 (Ω) resistor would have a less steep gradient and have ~~same~~ increased voltage but ~~different~~ decreased current as V = I × R and I = V/R.

ResultsPlus
Examiner Comments

Q06(c)(i) is on the right lines, however the gradient is too steep. The candidate has not used the data available to them correctly, if at all. 2 marks.

In contrast to the previous Q06(c)(ii), this candidate's explanation is not as convincing. There is a reference to the right equation however the relevance to the graph is jumbled. The candidate has, however, grasped the correct change in gradient and that this is caused by a lower current for a higher resistance. 2 marks awarded.

Question 7 (a)(i)

Most candidates correctly remembered a unit of radioactivity relevant to count rate.

7 Protactinium is an element with several different radioactive isotopes.

(a) Protactinium-234 has a half-life of 6.7 hours.

A sample of protactinium-234 has an initial activity of 800 units.

(i) Give a suitable unit for activity.

(1)

kBq

ResultsPlus
Examiner Comments

The unit 'kBq' is perfectly acceptable even though it is not the base SI unit ie the becquerel.

ResultsPlus
Examiner Tip

Take time to learn the SI units relevant to the course.

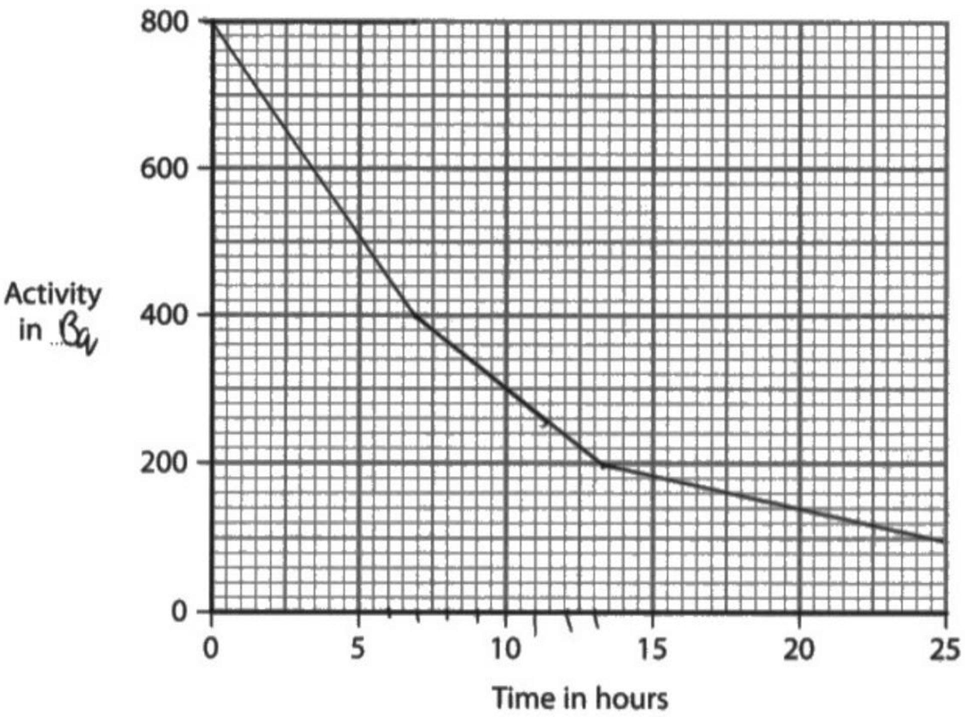
Question 7 (a)(ii)

This challenging question brought together ideas about half-life and graphical skills. Perfection was not required for full marks as the candidates needed to construct at least two data points and remember the shape of the curve.

Many candidates got at least 1 mark and the majority gained 2 marks.

(ii) On the axes below, sketch a graph for the decay of the sample of protactinium-234 during its first three half-lives.

(3)



ResultsPlus
Examiner Comments

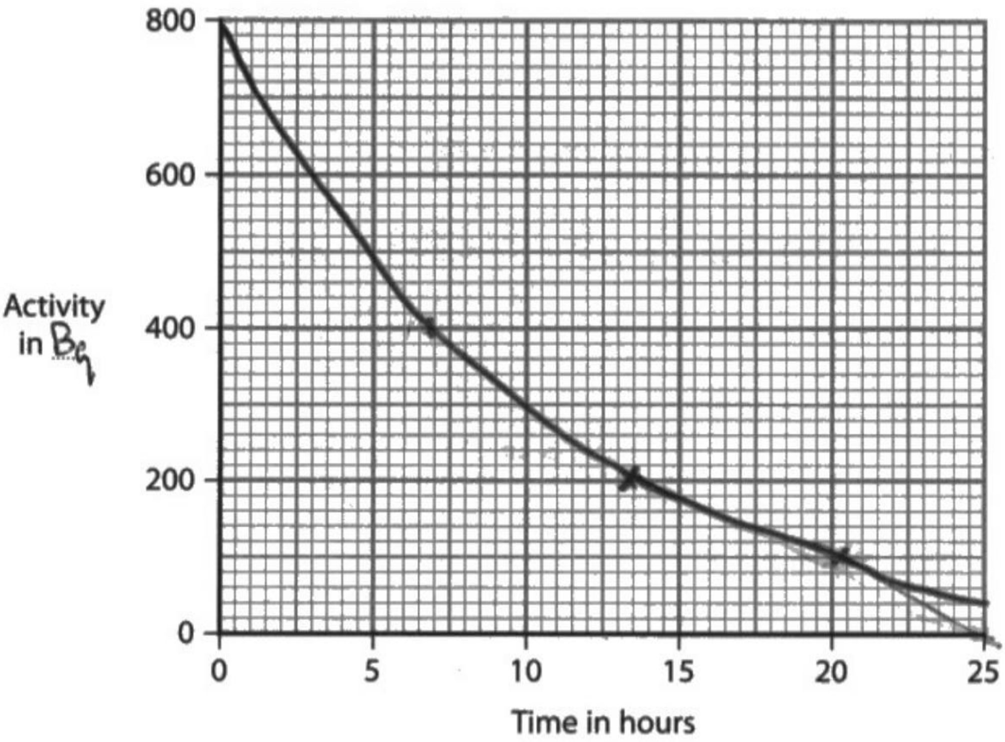
This candidate clearly understood the concept of half-life as they have correctly found three correct points on the graph, hence scoring 2 marks. The only concept they have missed is that this graph should be a curve as the rate of decay is continuous.

ResultsPlus
Examiner Tip

Think carefully about the graphs you might have encountered during your studies and how questions about them may be similar yet in a different context.

(ii) On the axes below, sketch a graph for the decay of the sample of protactinium-234 during its first three half-lives.

(3)



ResultsPlus
Examiner Comments

This candidate has determined the starting point and the activity after both one and two half-lives. The difference here is that the candidate has completed a smooth curve, certainly between the three (and possibly four) important data points. The candidate had done enough for us to not penalise the possible double curve towards the end. 3 marks.

Question 7 (a)(iii)

Those candidates that remembered the properties of the beta particle correctly tended to get both marks in this relatively straightforward item.

(iii) When protactinium-234 undergoes beta (β^-) decay it becomes uranium-234.

The incomplete nuclear equation shows this process.

$$ {}^{234}_{93}\mathrm{Pa} \longrightarrow {}^{234}_{92}\mathrm{U} + {}^{0}_{1}\beta $$

Complete the nuclear equation to show the beta decay of protactinium-234.

Write your answers in the dashed boxes.

ResultsPlus
Examiner Comments

While this equation balances, the lack of a minus sign on the beta has meant the candidate can't get the first or second mark.

Question 7 (b)(ii)

Many candidates were able to demonstrate their knowledge of background radiation by recalling the need to take a background count and then subtracting it from the overall count to get the count from just the source. Rather fewer candidates mentioned the need to take the background count with no other sources present, however they might have worded it.

(ii) The student's method does not allow for background radiation.

Describe how the student's method should be modified to allow for background radiation.

(3)

after connecting a suitable radiation detector, Geiger muller tube, measure background radiation for ~~4~~ 1 minute away from the isotope. Then after measuring the count rate for each material, ~~sdtr~~ subtract the background radiation from the isotope count rate to find the true value for the isotope's count rate.

ResultsPlus
Examiner Comments

Two of the marking points on the mark scheme are clear. The third marking point here was the acceptable idea of measuring background **away from the source**. 3 marks.

(ii) The student's method does not allow for background radiation.

Describe how the student's method should be modified to allow for background radiation.

(3)

Shorten Path us Place everything inside a lead box and reduce objects that emmit radiation

ResultsPlus
Examiner Comments

Although the source is kept in a lead box before and after use, putting everything in a lead box would prevent the student from taking a background count at all.

Question 7 (b)(iii)

Most candidates remembered that taking repeat readings is standard experimental practice. A reasonable majority of candidates went further to explain what they would do with those repeats, either calculating a mean or, more unusually, being able to spot anomalous results. Given the random nature of radioactive decay, either approach was acceptable.

(iii) Describe how the student's method could be modified to improve the reliability of the results.

(2)

to improve the reliability of the results the student should test the ~~ste~~ elements atleast 8 times each

ResultsPlus
Examiner Comments

The candidate has the idea here of repeating the readings, scoring 1 mark. The idea of determining a mean or identifying anomalies is not present, however.

ResultsPlus
Examiner Tip

Merely repeating results is never enough in experimental work.

Question 7 (b)(iv)

The first and third marks were more straightforward for candidates to access. Many remembered that the principal way of identifying alpha radiation is its inability to penetrate through a sheet of paper or a few mm of air. The somewhat less accessible mark was for appreciating how to eliminate the possibility of gamma or beta radiation coming from the source. This was achieved by reference to both the aluminium and the lead and that the count rate didn't change much in the presence of either of these materials.

(iv) Evaluate the data from the experiment to conclude the type of radiation emitted by protactinium-231.

(3)

(1) it can across 3cm of air, ~~so it~~ and ~~it ca~~ most of it can't pass a paper, so most of it is alpha ray
(2) but less of it can pass the lead and aluminium with ~~dms~~ almost no ~~(3) small~~ change, so it is the background radiation.
(3) so ~~the~~ it include most of alpha ray ~~with a little gamma~~ gamma ray. so it ~~is~~ the type of radiation emitted by protactinium-231 is alpha ray.

ResultsPlus
Examiner Comments

This candidate has made a logical deduction that the remaining count rate when the paper, aluminium or lead is present must be due to background radiation. This eliminates the possibility that the source is emitting beta of gamma radiation. All 3 marks scored.

ResultsPlus
Examiner Tip

For this type of source identification, consider each of the three types of radiation, rather than just the evidence that supports the presence of the most likely type.

(iv) Evaluate the data from the experiment to conclude the type of radiation emitted by protactinium-231.

(3)

~~alpha α radiation~~ The radiation emitted is α radiation. Because the difference between the count without materials and the count with a sheet of paper is so big. which means paper can stop most of ~~α~~ this type of radiation
α radiation is weakly penetrate and it can be stopped by paper. ~~so it is α ra~~ So the radiation emitted is α radiation.

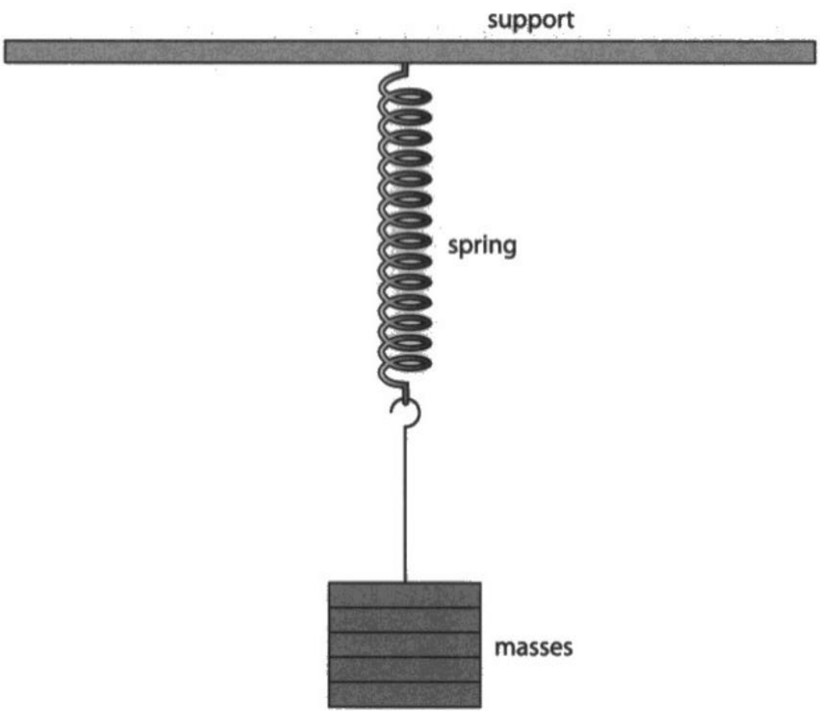
ResultsPlus
Examiner Comments

This candidate did not exclude the possibility of beta or gamma radiation so scored 2 marks only.

Question 8 (a)

This item tested knowledge of the required practical to investigate the stretching of a spring. When performing this experiment, it can be useful to demonstrate what happens to a spring when it is overloaded and thus plastically deformed. Most candidates correctly calculated the original length with the majority also stating a valid extension to demonstrate understanding of elastic behaviour.

8 Diagram 1 shows a set of masses attached to a spring, which is suspended from a support.



(a) After the masses are added, the length of the spring is 14.6 cm.

The student measures the extension of the spring as 11.5 cm.

(i) Calculate the original length of the spring.

(1)

after masses = 14.6 cm

extension = 11.5 cm

14.6 − 11.5 = 3.1cm

original length = 3.1 cm

(ii) The student removes the masses and notices that the spring does **not** show elastic behaviour.

Predict a value for the new length of the spring after the masses have been removed.

(1)

new length of spring = 3.1 cm

ResultsPlus
Examiner Comments

This candidate correctly calculated the original length of the spring. In Q08(a)(ii) they did not spot the instruction that the spring "does not show elastic behaviour".

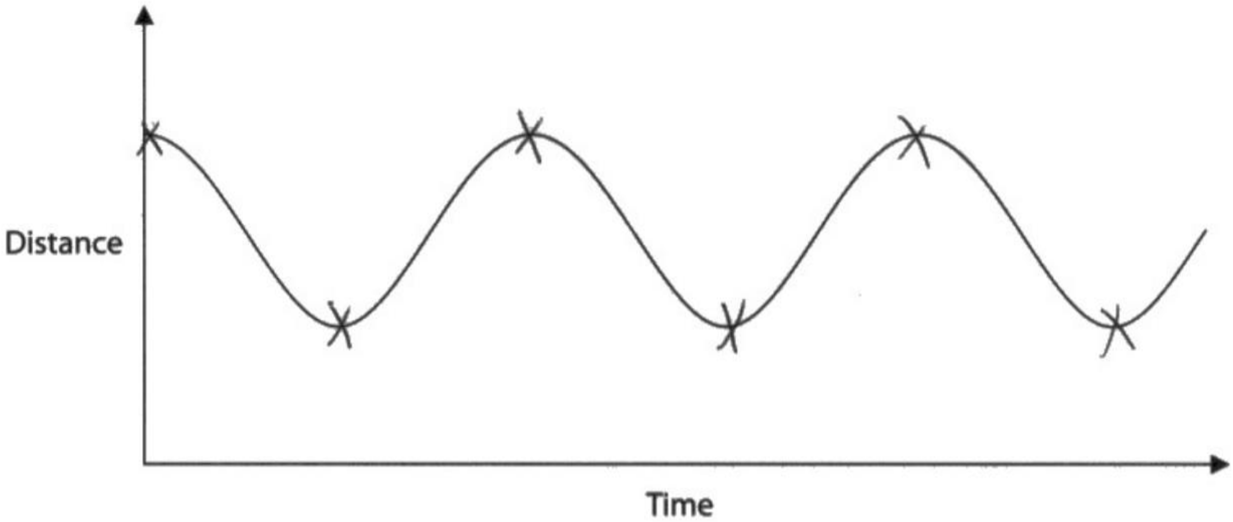
ResultsPlus
Examiner Tip

Think about which item on the specification is being tested.

Question 8 (b)(i)

Most candidates scored at least one mark on this item, predominantly for spotting the non-linearity of the graph. Many candidates also inferred that this meant that the speed wasn't constant, without possibly mentioning explicitly that the gradient of this graph gave the speed.

The distance–time graph shows how the distance between the top of the masses and the support changes with time as the masses vibrate.



(i) Explain how the gradient of the graph shows that the masses accelerate as they vibrate.

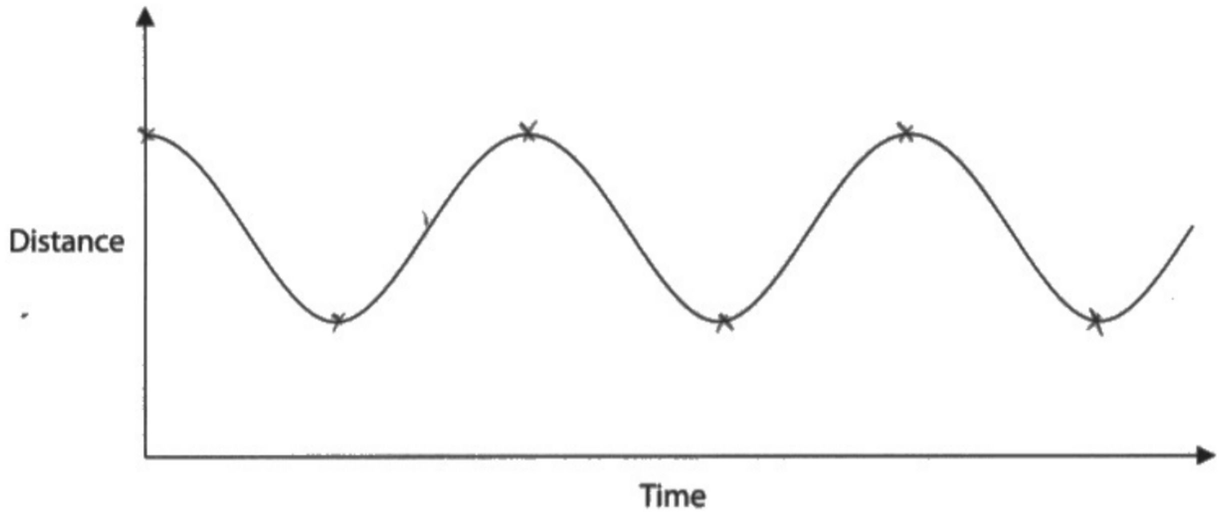
(3)

As the line ~~at~~ is not linear, and it is not a straight line, it shows how the ~~speed is not constant.~~ mass is not vibrating at constant speed. So, it shows how increases in its speed which means acceleration

ResultsPlus
Examiner Comments

This candidate has scored 2 marks, as did many candidates, for recording that the distance-time graph is not linear and that this implies non-constant speed. There is no explicit mention of the gradient, however.

The distance–time graph shows how the distance between the top of the masses and the support changes with time as the masses vibrate.



(i) Explain how the gradient of the graph shows that the masses accelerate as they vibrate.

(3)

- gradient = speed since gradient is calculated by rise over run which is also distance over time
- The speed decreases and increases as they vibrate since the gradient is sometimes negative or positive
- A curved line shows acceleration as speed gradually increases
- at the bottom of each curve the gradient is zero and the gradient rises again slowly [illegible] speed accelerates from zero

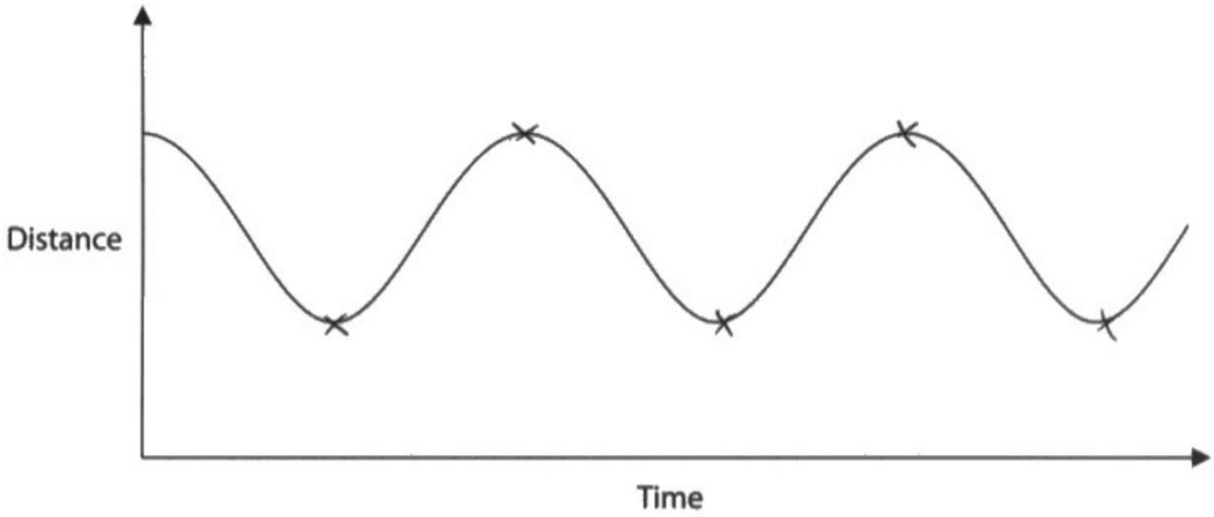
ResultsPlus
Examiner Comments

This candidate, in contrast, specified that they knew that the gradient of a distance-time graph yielded the speed. The rest of the response is very detailed and easily scored all 3 marks.

Question 8 (b)(ii)

Virtually all candidates drew a cross to show a point where the speed was zero. Rather fewer labelled the majority of the points and very few candidates labelled all of the points. The most likely omitted point was the one right at the start.

The distance–time graph shows how the distance between the top of the masses and the support changes with time as the masses vibrate.



(i) Explain how the gradient of the graph shows that the masses accelerate as they vibrate.

(3)

The mass acceleration fast to the top ~~and then~~ which then stop at the top ~~not acceleration~~ deceleration and then acceleration fast to go down. and repeat this process

(ii) Add crosses (X) to the distance–time graph to show all the times when the masses are not moving.

ResultsPlus
Examiner Comments

This candidate was one of many that did an excellent job of identifying all but one of the points where the speed was momentarily zero. 1 mark only.

ResultsPlus
Examiner Tip

Check graphical work carefully.

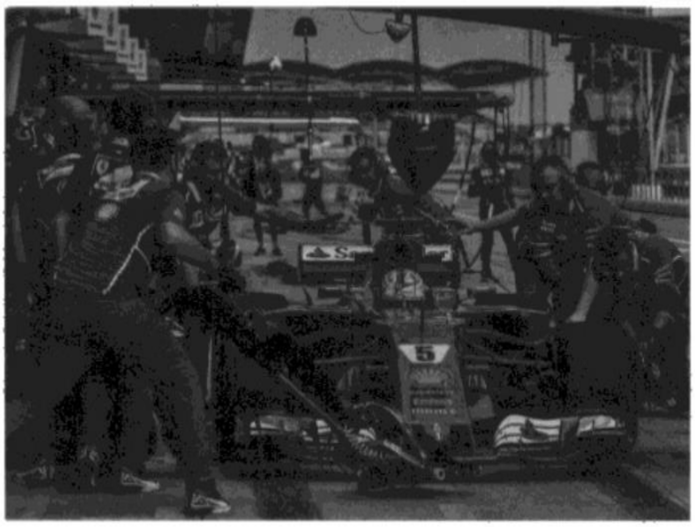
Question 9 (a)

A very large proportion of candidates scored the first two marks in Q09(a)(i). The predominant reason for not scoring all three marks was not evaluating the rearranged expression.

In Q09(a)(ii), many candidates selected the correct formula (for which there was not a mark) yet struggled to, or didn't, substitute the values in the correct places. This is a formula that candidates and centres could rehearse more effectively.

9 The driver of a racing car makes a pit stop during a race to change the tyres on the racing car.

The area where the tyres are changed is called the pit lane.



(Source: © Hafiz Johari/Shutterstock)

(a) Before entering the pit lane, the speed of the car must decrease for safety reasons.

(i) The mass of the racing car is 830 kg.

The maximum braking force is 41 000 N.

Show that the maximum deceleration of the racing car is approximately 50 m/s^2.

(3)

$$\frac{41000 \text{ N}}{830} \approx 50 \text{ m/s}^2$$

(ii) The racing car is travelling at an initial speed of 72 m/s.

Calculate the minimum distance needed to decrease the speed of the racing car from 72 m/s to 26 m/s.

(3)

final speed

= (initial speed)^2 + (2×acc × distance)

72m/s to 26/s.

distance = ... m

ResultsPlus
Examiner Comments

In Q09(a)(i), the candidate has provided the minimal solution for achieving the first two marks. They have not evaluated their expression to more than 2 significant figures so cannot achieve the third mark. 2 marks scored.

The formula quoted in Q09(a)(ii) is incorrect – there is a missing power of 2 on the final speed which meant this candidate was unlikely to score any marks.

9 The driver of a racing car makes a pit stop during a race to change the tyres on the racing car.

The area where the tyres are changed is called the pit lane.

(Source: © Hafiz Johari/Shutterstock)

(a) Before entering the pit lane, the speed of the car must decrease for safety reasons.

(i) The mass of the racing car is 830 kg.

The maximum braking force is 41 000 N.

Show that the maximum deceleration of the racing car is approximately $50\,m/s^2$.

(3)

$F = ma$

$a = \frac{41000}{830} = 49.4\,m/s^2 \approx 50\,m/s^2$

(ii) The racing car is travelling at an initial speed of 72 m/s.

Calculate the minimum distance needed to decrease the speed of the racing car from 72 m/s to 26 m/s.

(3)

$26^2 = 72^2 + 2 \times 50s$

$s =$ ~~45.08~~ -45.08

45.08

distance = ~~45.08~~ m

ResultsPlus
Examiner Comments

This candidate has provided a perfect response in Q09(a)(i). Q09(a)(ii) has also gone well – they have substituted the given variables into the correct equation and arrived at a negative answer. We ignored this as, by implication, they had defined the deceleration to be the positive direction.

ResultsPlus
Examiner Tip

Attempt to justify why you would ignore a negative value if you were expecting a positive value.

Question 9 (b)

Energy stores and energy transfers rank amongst some of the more challenging concepts on the specification. There are two alternate descriptions to any question about this topic, which the mark scheme reflects. In either case, a valid response should include not only the store or type of energy but also which object possesses it. Many candidates lost marks because they referred to the idea that kinetic energy turns into thermal energy or heat without mentioning either the car or the brakes. The nature of the transfer itself should also be fully described, as laid out in the third marking point on the mark scheme. This can be done either by mentioning one of the transfers on the specification or by being specific about which force is doing work.

(b) **The racing car slows down using its brakes.**

The brakes work using friction.

The brakes become very hot when the racing car slows down.

Using ideas about energy, explain why the brakes become hot.

(3)

During the brake. Friction does work and some of the energy transfers to thermal energy.
So the ~~wheels~~ brakes get hot.

ResultsPlus
Examiner Comments

This response scores 1 mark for being clear about friction doing work. There's no mention of kinetic energy or its reduction for the car. There is a mention of thermal energy however no indication of which object possesses that (extra) thermal energy.

(b) The racing car slows down using its brakes.

The brakes work using friction.

The brakes become very hot when the racing car slows down.

Using ideas about energy, explain why the brakes become hot.

(3)

The brakes become hot as the kinetic energy store of the racecar is transferred mechanically to the thermal energy store of the brakes. This causes the brakes to increase in heat as the kinetic energy store is decreasing, and energy cannot be destroyed so it is transferred to thermal energy store.

ResultsPlus
Examiner Comments

This candidate's answer is well constructed and covers all of the marking points. By itself the first sentence is insufficient for all three marks. The candidate makes it clear in the second sentence that they understand that the kinetic energy of the car has decreased. 3 marks scored.

Question 9 (c)

There were plenty of marking points available, so candidates had lots of scope for scoring marks by writing something valid. As a result, the majority of candidates scored at least one mark, with a significant fraction scoring both marks.

(c) The tyres of the racing car also get very hot during a race.

A mechanic has to handle the hot tyres during the pit stop.

They wear protective gloves which have several layers of insulating materials.

Explain how the layers of insulating materials in the gloves reduce the risk of the mechanic burning their hands on the hot tyres.

(2)

The materials of the gloves is bad conductor of heat.

ResultsPlus
Examiner Comments

Whilst being quite brief, this response is still worth 1 mark. The candidate has interpreted the data in the question and said something sensible about it.

ResultsPlus
Examiner Tip

If you are stuck, start by writing what you know about the topic of the question that may be relevant.

(c) The tyres of the racing car also get very hot during a race.

A mechanic has to handle the hot tyres during the pit stop.

They wear protective gloves which have several layers of insulating materials.

Explain how the layers of insulating materials in the gloves reduce the risk of the mechanic burning their hands on the hot tyres.

(2)

insulating materials is poor conductor, so it's hard to transfer thermal energy by conduction. The layers decrease the chance of vibrate. Air in layers is also poor conductor.

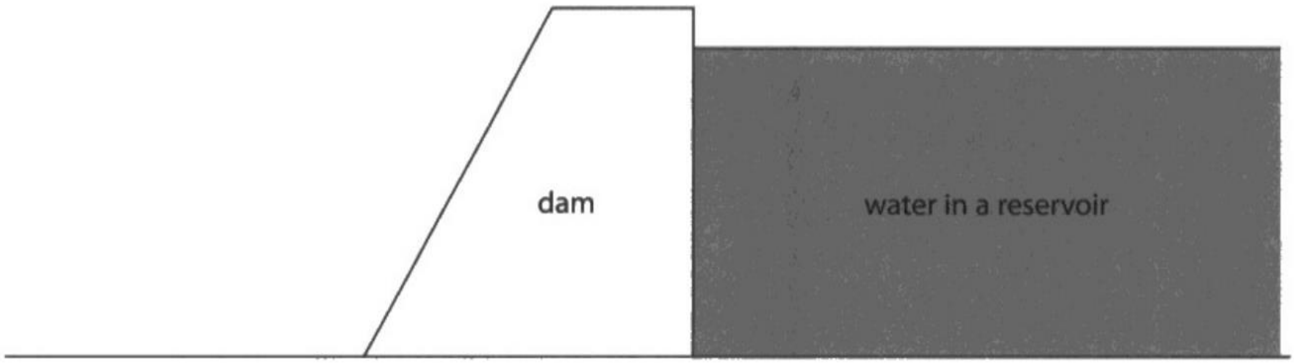
ResultsPlus
Examiner Comments

This response easily scores 2 marks. The candidate has made clear reference to conduction throughout, taking into account the thermal properties of both the insulating material and the air that is trapped between the layers.

Question 10 (a)

Virtually all candidates reproduced the formula from the additional sheet correctly. A large majority also achieved a correct calculation for the pressure difference due to the water. Some candidates found the conversion to kPa a challenge and rather more found getting the two pressures involved into the same unit beyond their skill at the time. At this late stage in the paper, unit conversions are quite likely.

10 A dam is a structure designed to hold water in a reservoir.



(a) The water in the reservoir has a depth of 35 m.

(i) State the formula linking pressure difference, height, density and *g*.

(1)

Pressure difference = height × density × gravitational field strength

(ii) Atmospheric pressure at the surface of the reservoir is 100 kPa.

Calculate the total pressure at the bottom of the reservoir.

[for water, density = 1000 kg / m³]

(3)

$p = h \times \rho \times g$

$p = 35 \times 1000 \times 9.8$

$p = 343\,000$

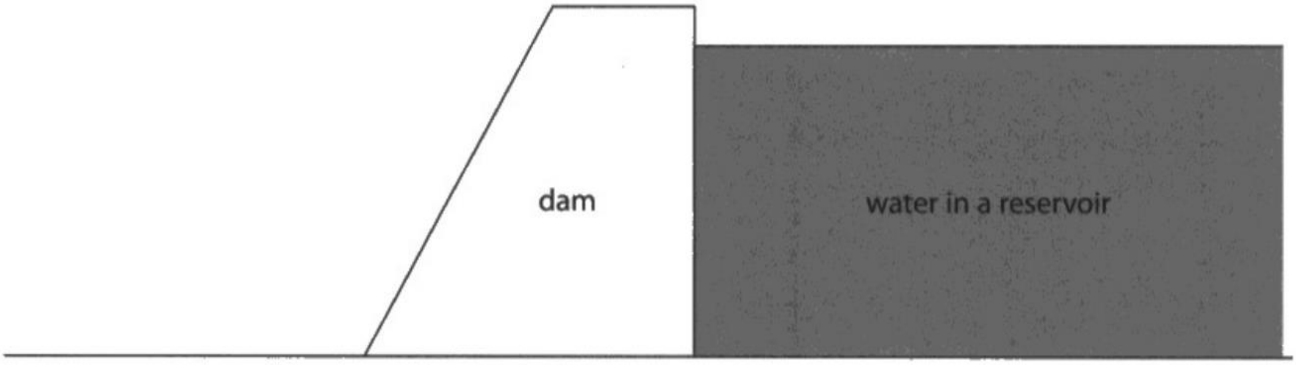
$p = 343$ kpa

pressure = 343 kPa

ResultsPlus
Examiner Comments

This candidate produced an excellent response. The formula is correct in Q10(a)(i). The only flaw in Q10(a)(ii) is that they did not add on the atmospheric pressure – an extra 100 kPa – to find the total pressure. The use of 9.8 N/kg is acceptable (as was 9.81) although not the value of *g* given on the paper.

10 A dam is a structure designed to hold water in a reservoir.



(a) The water in the reservoir has a depth of 35 m.

(i) State the formula linking pressure difference, height, density and *g*.

(1)

p = h × ρ × g

(ii) Atmospheric pressure at the surface of the reservoir is 100 kPa.

Calculate the total pressure at the bottom of the reservoir.

[for water, density = 1000 kg / m^3]

(3)

x − 100 = 35 × 1000 × 10

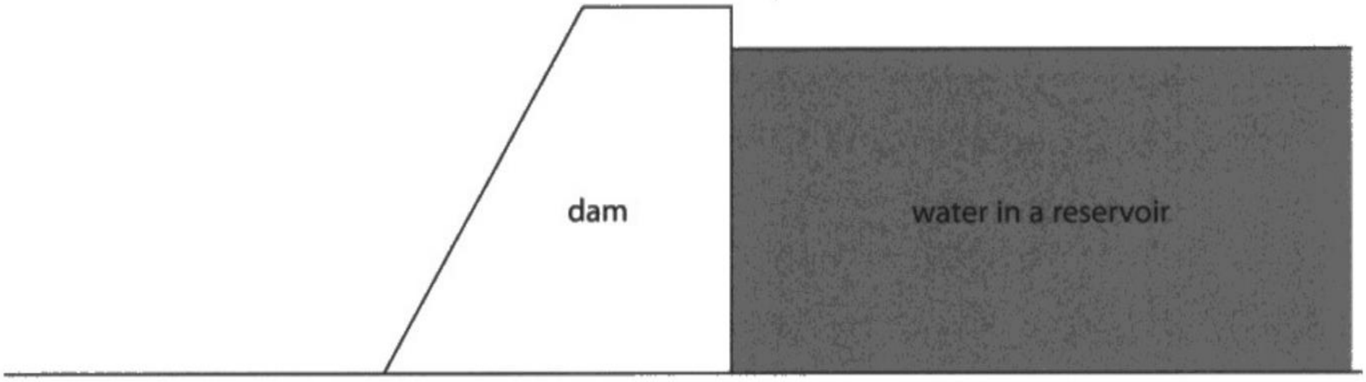
x = 350100

pressure = 350100 kPa

ResultsPlus
Examiner Comments

This candidate added the atmospheric pressure yet unfortunately did not have both pressures in the same unit before adding the two together.

10 A dam is a structure designed to hold water in a reservoir.



(a) The water in the reservoir has a depth of 35 m.

(i) State the formula linking pressure difference, height, density and *g*.

(1)

$p = \rho g h$

(ii) Atmospheric pressure at the surface of the reservoir is 100 kPa.

Calculate the total pressure at the bottom of the reservoir.

[for water, density = 1000 kg / m^3]

(3)

$P = 1000 \times 10 \times 35$

$= 350000 Pa$

$= 350 kPa$

$350 + 100 = 450 kPa$

pressure = 450 kPa

ResultsPlus
Examiner Comments

This candidate has completed both parts successfully.

Question 10 (b)

The large majority of candidates correctly quoted the formula and could substitute the relevant values into it. Many then completed the manipulation correctly. More often than not, it was assigning the unit or converting the kPa to Pa that presented a challenge to the candidates.

(b) An underwater camera is used in the water reservoir.

The camera lens experiences a force of 430 N at a pressure of 260 kPa.

(i) State the formula linking pressure, force and area.

(1)

$$\text{pressure} = \frac{\text{force}}{\text{area}}$$

(ii) Calculate the area of the camera lens.

Give a suitable unit.

(4)

$$260{,}000 \quad \frac{430}{\text{area}} \quad = 1.653846154 \times 10^{-3}$$

$$0.00165\ m^2 \times 10{,}000$$

area = ~~0.00165~~ 16.54 unit ~~[illegible]~~ cm²

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The formula in Q10(b)(i) is clearly correct.

In Q10(b)(ii) the candidate has substituted and evaluated the correct answer for the area of the camera lens. Since they have quoted the pressure in Pa and the force in N, their answer will be expressed in m^2. They have understood this yet decided to convert their answer into cm^2. There was no need to do this. Fortunately they have done this correctly by multiplying by 10 000.

Full marks awarded.

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Examiner Tip

Only do as much conversion as you need to get the answer in an acceptable form. Never introduce more steps as that might be risky.

Question 10 (c)

Most candidates scored a single mark because they understood that the pressure from the water was greater. Many candidates made an attempt at explaining what course of action should be taken, although some suggested reducing the depth of water even though this route was excluded by the question.

(c) Sea water has a density of 1030 kg / m^3.

Explain how the design of the dam would need to be changed to hold the same depth of sea water safely.

(2)

the bottom of the dam need to be wider.

because the pressure increase by sea water.

in same depth

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Examiner Comments

In this response, the candidate has made clear their thinking that the base should be wider. The reason for this is the increased pressure from the sea water.

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Examiner Tip

Check the question to see whether there is an extra condition to satisfy.

Question 11

The style of question in Q11(a) requires the candidate to use the data in the table to support or reject the given relationship. It isn't necessary to verify this for each row: a minimum of two rows should be selected. Provided that the candidate reaches a conclusion that is consistent with their evidence, the candidate should get maximum marks.

Q11(b) required the rearrangement of the given formula and then use of the candidate's own constant and the distance from the question. Candidates either performed this task seamlessly or they performed it poorly.

11 The gravitational field strength of a planet decreases with increasing distance from the planet.

The table shows the value of the gravitational field strength of Mars at different distances from the centre of Mars.

Distance from centre of Mars in km	Gravitational field strength in N/kg
4000	2.66
5000	1.70
6000	1.18
7000	0.87
8000	0.67
9000	0.53

(a) A student finds this formula in a textbook, which links distance from the centre of a planet to its gravitational field strength

gravitational field strength × distance^2 = constant

Use data from the table to justify this formula.

(4)

if the gravitational field strength is 2.66, 2.66 × 4000^2 = 42560000. if the gravitational field strength is 0.53, then 0.53 × 9000^2 = 42930000. if the GFS is 0.87. 0.87 × 7000^2 = 42630000. the formula is not constant however it is very close due to my calculations

(b) Olympus Mons is the tallest mountain on Mars.

The distance between the centre of Mars and the peak of Olympus Mons is 3410 km.

Calculate the gravitational field strength at the peak of Olympus Mons.

(3)

gravitational field strength = $\dfrac{\text{const } 42,560,000}{\text{distance}^2}$

= 3,660099

gravitational field strength = 3.7 N/kg

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Examiner Comments

For Q11(a), this candidate has either seen this style of question before or understood what steps to take to score maximum marks. They have calculated the constant for at least three rows of the table, even though merely two rows would have been sufficient. Moreover, they have come to a definite conclusion regarding how close these values for the constant are to each other.

Q11(b) has also gone very well. The candidate has used the relationship from Q11(a) and used the distance quoted in the question. Upon rearranging the relationship, the candidate has successfully calculated *g* at the top of the Martian Mountain.

Paper Summary

Based on their performance on this paper, candidates should:

- Either build or simulate circuits in which the number of components changes and note the effect on the currents and voltages in or across those components.
- Ensure, where possible, that they have either seen or performed the practicals named in the specification.
- Take note of the command word used in each question to determine how the examiner expects the question to be answered, for instance whether to give a description or an explanation.
- Be familiar with the equations listed in the specification and be able to use them confidently.
- Structure multi-step calculations as simply as possible to facilitate checking at each stage.
- Practise structuring and sequencing longer extended writing questions.
- Show all working so that some credit can still be given for answers that are only partly correct.
- Signpost working with words, it may help with structuring calculations clearly.
- Be ready to comment on data and suggest improvements to experimental methods.
- Take care to follow the instructions in the question, for instance when requested to use particular ideas in the answer.

Grade boundaries

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