Examiners' Report
June 2022

GCSE Physics 1PH0 2H

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June 2022

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Introduction

This was the fifth year of examining this specification, paper 2 of Physics, higher tier. This examination was part of the first live series since 2019. Questions were set to test candidates' knowledge, application and understanding from nine topics in the specification:

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

It was intended that the examination paper would allow every candidate to show what they knew, understood and were able to do. Within the question paper, a variety of question types were included, such as objective questions, short answer questions worth one or two marks each and longer questions worth three or four marks each. Several questions assessed candidates' knowledge of practical procedures, notably Q2(c) on electrical circuits, Q8(c)(i) concerning an experimental set-up to measure the temperature of a thermistor, Q8(c)(ii) concerning resistance measurement, Q9(b) concerning specific heat capacity final temperature measurement and Q10(a) about electromagnetic induction. The standard of answers on practical questions was variable with some candidates showing good procedural knowledge, whilst for others there was a clear lack of familiarity shown, especially with the more challenging questions asking candidates to employ critical reasoning.

Candidates continued to do well with most calculation questions, although some didn't cope well with the units involved.

Successful candidates were:

- well-acquainted with the content of the specification.
- skilled as a result of having been engaged with practical work during their course.
- competent in quantitative work, especially in using equations.

- well-focused in their comprehension of the question-at-hand.
- willing to apply physics principles to the novel situations presented to them.

Less successful candidates:

- had gaps in their conceptual knowledge of the topics of this paper.
- had gaps in their procedural knowledge, relating to their practical work.
- misread and / or misunderstood the symbols used in equations.
- did not focus sufficiently on what the question was asking.
- found difficulty in applying their knowledge to new situations.

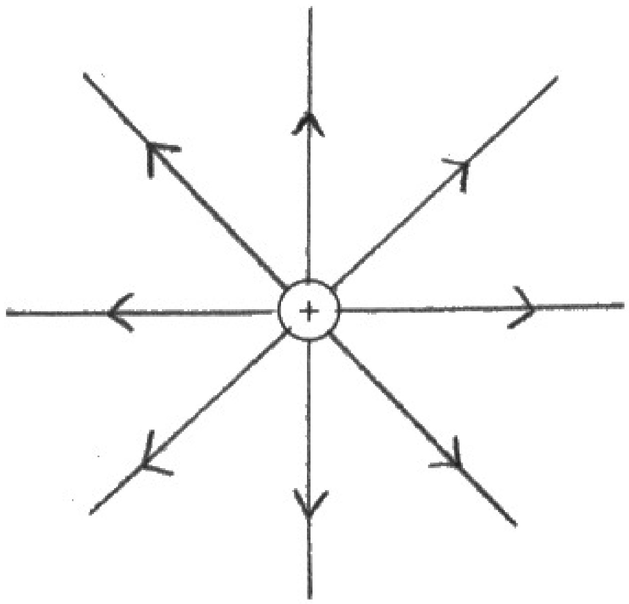
This report will provide exemplification of candidates' work, together with tips and/or comments, for a selection of questions. The exemplification will come from responses which highlight successes and pitfalls, with the aim of aiding future teaching of these topics.

Question 1 (a)

A straightforward knowledge test about the shapes of field and the rule for direction of field.

(a) Draw on Figure 1 the shape and direction of the electric field due to the positive point charge.

(2)



ResultsPlus
Examiner Comments

Fully correct answer.

ResultsPlus
Examiner Tip

It is worth committing to memory this field and also that between parallel plates.

Question 1 (b)

The specification content focuses on the role of electrons in facilitating charge separation, accomplished through the mechanism of friction.

(b) A student rubs a plastic ruler against a woolly jumper.

The student tests the ruler and finds it has a positive charge.

Explain how the ruler becomes positively charged.

(2)

The ruler becomes positively charged because when it's rubbed against the jumper friction is created, this friction causes the electrons from the ruler to jump to the jumper, leaving the ruler positively charged

ResultsPlus
Examiner Comments

This answer shows an understanding of the role that electrons play in transferring charge, as well as acknowledging the role of friction. Hence two marks were awarded.

(b) A student rubs a plastic ruler against a woolly jumper.

The student tests the ruler and finds it has a positive charge.

Explain how the ruler becomes positively charged.

(2)

The electrons from ruler is transferred to woolly jumper, leaves the ruler with positively charged suface, and the woolly jumper become negatively charged.

ResultsPlus
Examiner Comments

Friction is not mentioned but a second mark is achieved through noting that the jumper ends up with a negative charge as a result of that transfer.

Please note no marks are awarded for saying 'therefore the ruler ends up with a positive charge' because that would effectively just be restating the stem of the question.

Question 1 (c)

There was a good distribution of marks towards the highest mark, 3 out of 3, achieved by over half of all candidates.

Only a few candidates failed to get on the score sheet at all with this question.

Note that the mark scheme contains 7 marking points and the candidate only has to match 3 of them to score full marks.

Explain how charging the droplets helps to make sure that the leaf gets covered with insecticide.

You may add to Figure 2, including the sign (+ or –) of any charges, to help your answer.

(3)

The insecticide sprayer gets a charge.
The droplets have a charge.
The leaves have an opposite charge so the droplets will stick to it.
The droplets all have the same charge so when it hits leaf, it will stick but also repel each other so the leaf gets an even cover of insecticide.

ResultsPlus
Examiner Comments

The style of the candidate, in answering via building up discrete elements of an explanation, is a worthy one.

Full marks obtained. Mark points 1, 2, 4, 6 and 7 are matched.

Explain how charging the droplets helps to make sure that the leaf gets covered with insecticide.

You may add to Figure 2, including the sign (+ or –) of any charges, to help your answer.

(3)

When the sprayer is charged, all of the droplets of insecticide are also charged. If the droplets where negatively charged ~~thes~~ the leaf would be positively Charged. All of the droplets repel each other but are attracted to the leaf. This allows the insecticide to be spread evenly ~~acons~~ across the leaf. The leaf being earthed allows any excess charge to be grounded so nothing gets shocked.

ResultsPlus
Examiner Comments

The candidate uses prose style well, gaining the maximum of 3 marks.

The same mark points are matched as in the first example.

Explain how charging the droplets helps to make sure that the leaf gets covered with insecticide.

You may add to Figure 2, including the sign (+ or –) of any charges, to help your answer.

(3)

if the sprayer particles are + charged then they will attract to the - charged leaf

ResultsPlus
Examiner Comments

In just two lines this candidate manages to match mark points 1, 2 and 4.

Full 3 marks awarded.

Question 2 (a)(i)

Simple substitution of two numbers into R = V/ I .

Almost 100% of candidates got this question correct.

Question 2 (a)(ii)

A bit of a more complex V^2/R calculation, but still very high scoring. This was a very accessible opening question. Remember this is an overlap question with Foundation papers, also forming the opening question for the combined science paper.

Question 2 (b)

Better discrimination with this question, with a negatively skewed mark distribution curve peaking at 2/3 marks.

Most candidates could identify which circuit was brighter and why in terms of voltage or power, but rarely both.

A variety of approaches was allowed via 5 separate marking points.

State and explain the difference between the brightness of the lamp in Figure 3 and the brightness of a lamp in Figure 4.

(3)

The brightness of the lamps will be dimmer in Figure 4, because there is more resistance across the ~~cct~~ circuit, but the same current, so the potential difference across the components is halved and this makes them dimmer. Each bulb will have 2.25v instead of 4.5v.

ResultsPlus
Examiner Comments

A well-constructed logical answer is seen here.

Dimmer comment – marking point 1.

More resistance across the circuit – marking point 5.

Potential difference halved – marking point 3.

Full marks – 3/3.

Question 2 (c)

This proved to be a good differentiator. Around a third of candidates scored 3/3. There were a lot of 2-mark responses for drawing an ammeter in series and voltmeter in parallel.

Labelling and inserting resistance wire carefully was the key to scoring maximum marks.

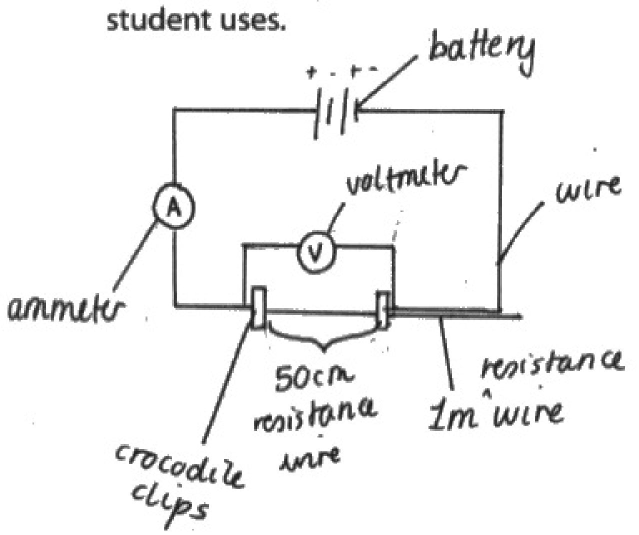
(c) A student is given a low voltage power supply and 1 m of resistance wire.

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

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

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

(3)



Use the ammeter and voltmeter to measure resistance using $R = \frac{V}{I}$.

Use the crocodile clips to ensure only 50cm of the resistance wire is included in the circuit.

ResultsPlus
Examiner Comments

A very neat answer. Excellent detail and well-drawn content.

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

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

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

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

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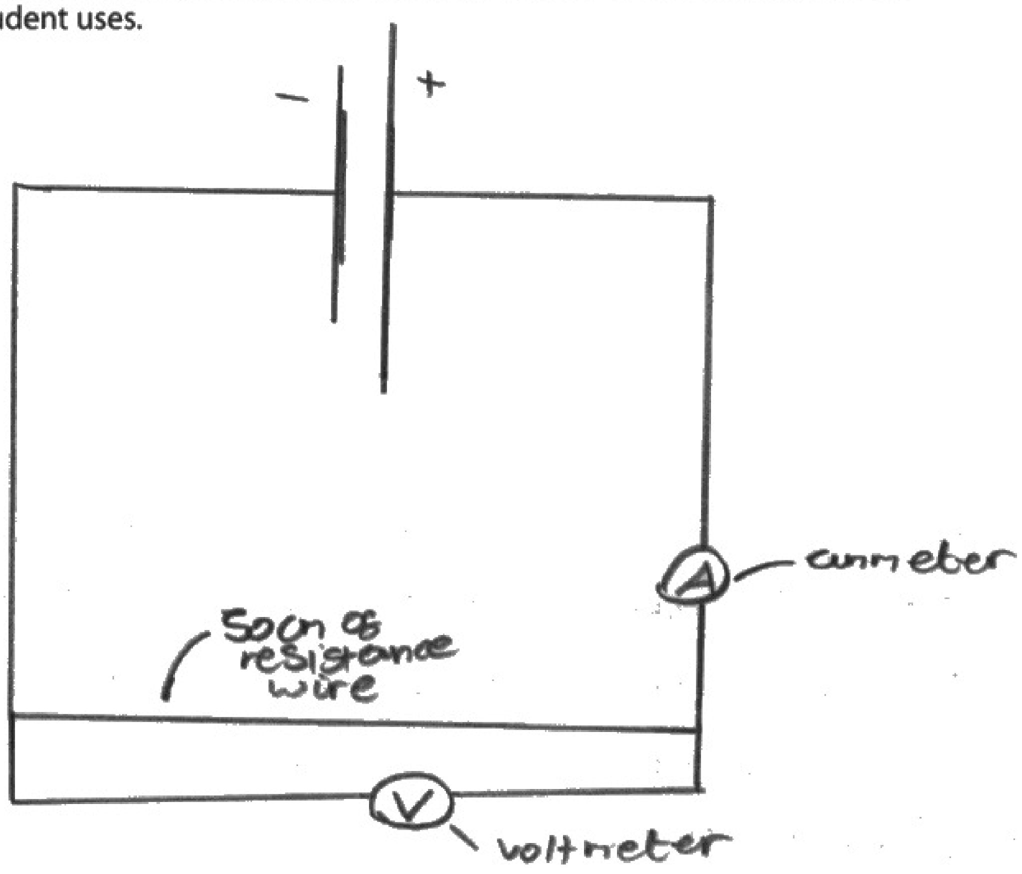

ResultsPlus
Examiner Comments

This is an exemplary response too.

Full marks obtained.

Question 3 (b)

The majority of candidates got 3 marks out of 4 for getting 316g. They lost 1 mark for not giving the final answer to 2 significant figures.

Marks were also lost by not calculating the volume of the iron correctly, perhaps showing a lack of familiarity with this method of finding volume, while the substitution and rearrangement was generally well done.

Calculate the mass of the lump of iron.

Use the equation

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

Give your answer to 2 significant figures.

(4)

rises - ~~30cm³~~ 40cm³ 530-490

$$7{\cdot}9 = \frac{?}{40}$$

mass = 320 g

ResultsPlus
Examiner Comments

This candidate makes it all appear very straightforward.

Volume found correctly, equation substituted into correctly and final answer rounded to 2 significant figures.

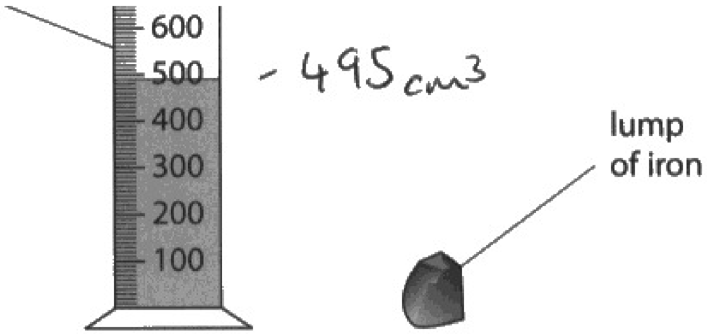

Figure 5

The lump of iron is lowered fully into the water.

The water level in the measuring cylinder rises to 530 cm³.

The density of iron is 7.9 g/cm³.

Calculate the mass of the lump of iron.

Use the equation

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

Give your answer to 2 significant figures.

(4)

Mass = density × volume

Mass = 7.9 × 35cm³

Mass = 276.5

2sf = 280g

530 − 495 = 035

mass = 280 g

ResultsPlus
Examiner Comments

The process the candidate uses is excellent, explaining their working clearly as they went along.

This meant they could be awarded 3 follow on marks.

Just a small misreading of the scale on the measuring cylinder is noted.

ResultsPlus
Examiner Tip

Setting out your working clearly like this enables the examiner to give you compensatory marks when strictly the evaluation could not be accepted.

Question 3 (c)

About a half of candidates scored the full 2 marks. Most candidates understood that wood is less dense than water and would float. Not many candidates scored a second mark for explaining that less water would be displaced or that consequently the volume couldn't be measured accurately.

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

(2)

Wood has a smaller density than water, so it will not sink in water as it floats. Therefore, it cannot completely submerge in water to displace water to determine change in volume, so mass cannot be calculated as volume is not known.

ResultsPlus
Examiner Comments

Excellent description linking the scientific fact with the consequence for measurement.

Question 3 (d)

The answer to this question required a recall of knowledge regarding sublimation.

Mark scheme allowed gas to solid, to good effect, since a good number of candidates put this.

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

(2)

A solid is converted into a gas

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Examiner Comments

A simple, direct answer.

Full marks awarded.

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

(2)

Particles in a substance go from solid state to a gas without first turning into a liquid (or vice versa).

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Examiner Comments

A more elaborate answer which also scores the full 2 marks.

Question 4 (a)(i)

This question involved a pressure calculation, taking into account four donkey hooves in that calculation. Many got full marks. The most common mistake was not correctly calculating the area as 4 x area of one hoof.

(i) Calculate the average pressure that the donkey exerts on the ground.

Use the equation

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

(2)

0.022 x 4 = 0.088

$\frac{2500}{0.088}$ = 28409.09 = 28400 (2 sf)

average pressure = 28400 Pa

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Examiner Comments

This candidate has set out their calculations well, first calculating the area and then taking F/A.

Full marks achieved.

(i) Calculate the average pressure that the donkey exerts on the ground.

Use the equation

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

(2)

$= \frac{2560}{0.022}$

$= 113636$ Pa (6sf)

average pressure = 113636 Pa

ResultsPlus
Examiner Comments

This response is a typical one where there was a failure to reckon with the four donkey hooves.

Hence the score was one mark out of the two.

Question 4 (a)(ii)

Most candidates scored 2 marks here, mostly for recognising the greater surface area with the camel hooves, and then continuing to state that therefore the camel exerts less pressure.

Explain how a camel's hoof is a more suitable shape than a donkey's hoof for walking on soft ground.

(2)

It has a larger area and therefore less pressure is exerted on the ground, so it doesn't struggle on softer ground.

ResultsPlus
Examiner Comments

Full response seen here, matching the two major mark points of the mark scheme.

Explain how a camel's hoof is a more suitable shape than a donkey's hoof for walking on soft ground.

(2)

The camel hoof has a larger area than the donkey hoof. The mass is more spread out compared to the donkey hoof.

ResultsPlus
Examiner Comments

This response earns one mark for the greater area comment.

The mass spread out comment is unworthy of a second mark.

Force, or weight, spread out would have achieved a second mark.

Question 4 (b)(i-ii)

Good graph work was seen.

Points were plotted accurately and best fit lines drawn well.

Question 4 (b)(iv)

Candidates were asked to find the pressure at the surface from the graph.

Most read off the graph correctly.

Question 4 (c)

The question asked for what the effect would be of having sea water regarding the graph.

This question differentiated well.

The most two commonly scored marking points were:

- Most candidates recognised that increasing the density increased the pressure.
- Many referred to a steeper gradient.

Compare the graph for seawater with the graph in Figure 10.

(2)

Both graphs will be linear with a stronger positive correlation, but the denser sea water will have a steeper line.

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Examiner Comments

This candidate scores with mark point 2 (steeper line) and mark point 3 (both linear).

(c) The student repeats the investigation in part (b) using seawater and draws a graph of the results.

The seawater is more dense than the water used in part (b).

Compare the graph for seawater with the graph in Figure 10.

(2)

the line would be steeper than the line in figure 10 however they both begin at 98.70 on the y axis and 0 on the x axis as that is a measurement of the pressure of the air not water.

ResultsPlus
Examiner Comments

This response shows a good understanding obtaining one mark for the steepness comment (mark point 2) and one mark for the intercept comment (pressure of air realisation, mark point 4).

Question 5 (a)(i-ii)

The drawing of field lines proved to be a fairly good discriminator, with all marks well represented.

To achieve the first mark it was necessary that all arrows drawn should be consistent – out of the N pole, and into the S-pole.

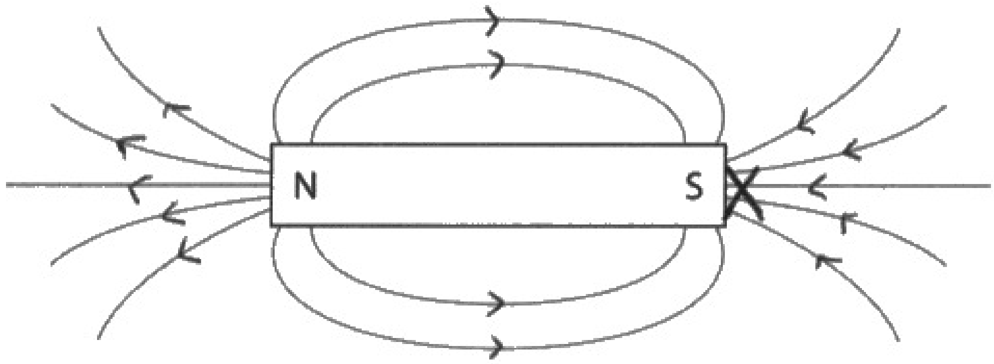

Figure 11

(i) Draw arrows on the field lines in Figure 11 to show the direction of the magnetic field.

(1)

(ii) Place a letter X on Figure 11 at a place where the magnetic field is strongest.

(1)

ResultsPlus
Examiner Comments

Perfection achieved here. All the arrows drawn consistently and a point where the field was strongest was well identified.

Question 5 (a)(iii)

The uniform field idea was unfamiliar to many candidates. However, some showed a good understanding scoring full marks.

Marks could be obtained by describing any two from five possible descriptions.

(iii) Describe **two** differences between the magnetic field shown in Figure 11 and a uniform magnetic field.

(2)

A uniform magnetic field has straight parallel lines whereas the one in Figure 11 doesn't. The strength of the magnetic field varies in Figure 11 but in a uniform field the strength of the magnetic field is the same everywhere.

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Examiner Comments

This candidate scores on any two from three ideas that they mention:

- straight lines (mark point 2).
- parallel lines (mark point 3).
- same strength of field (mark point 5).

Question 5 (b)

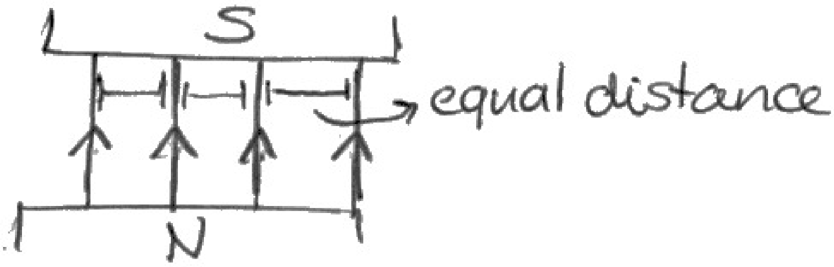
This ‘How to obtain a uniform field’ question was expected to target medium demand.

However the responses showed a general lack of knowledge of how such a field may be obtained practically, indicating, perhaps, that this was of higher demand. The word “solenoid” was not often seen.

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

(1)

Place the South Pole of one magnet above the North Pole of another magnet.



ResultsPlus
Examiner Comments

'Solenoid' was not seen very often, but this response was occasionally seen.

It is perfectly acceptable.

ResultsPlus
Examiner Tip

Notice how the candidate reinforces demonstrating their knowledge through a well-drawn exemplary diagram.

Question 5 (c)(i)

Some reasonable field lines were drawn outside the Earth through the compass needles but very few candidates appeared to know what happened with the field lines inside the Earth.

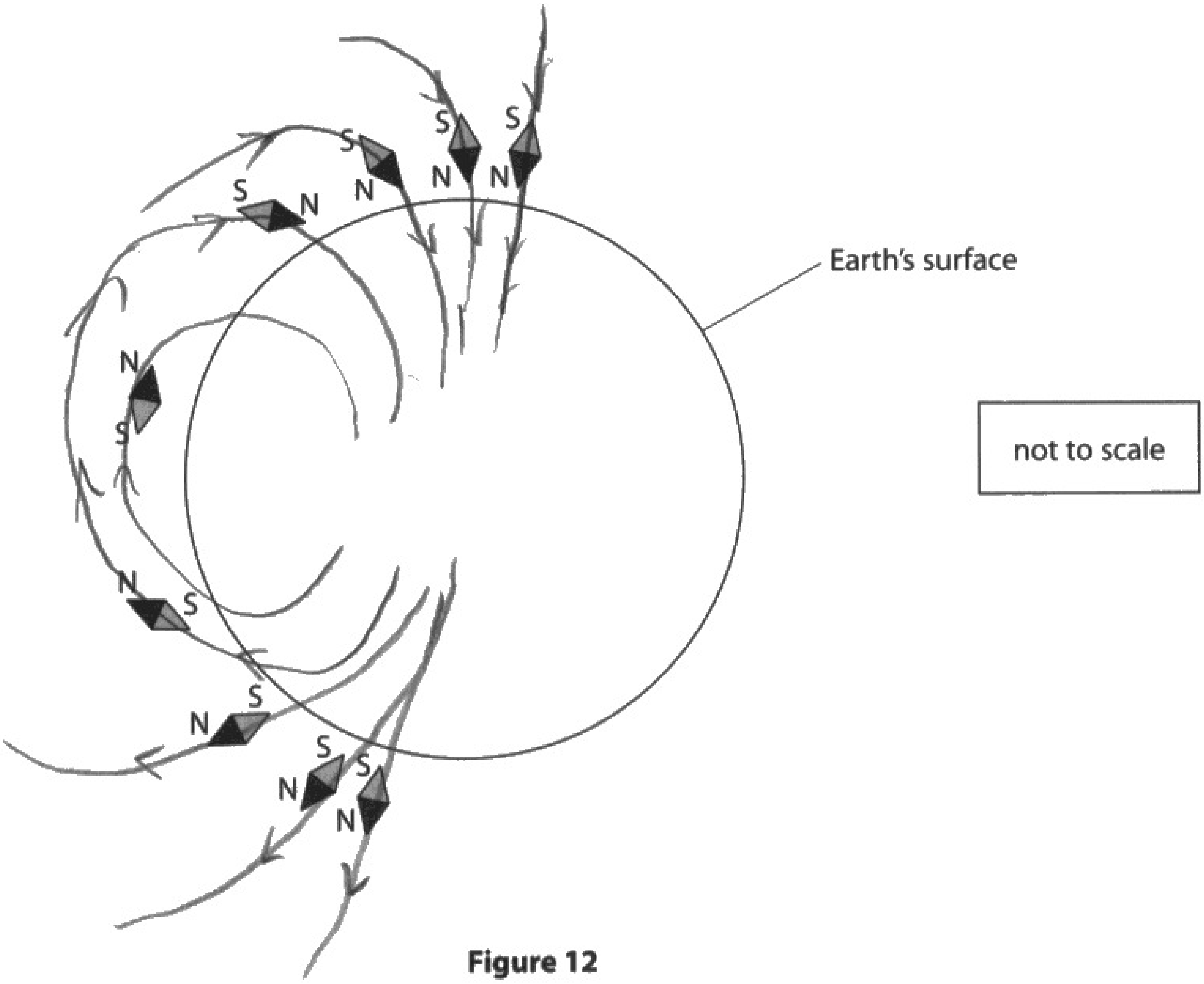


Figure 12

(i) Sketch, on Figure 12, the Earth's magnetic field outside and inside the Earth.

(2)

ResultsPlus
Examiner Comments

This response has field lines outside the earth well aligning with the compasses.

They also have arrows in the right directions AND the lines continue inside the earth towards imaginary poles.

An excellent answer.

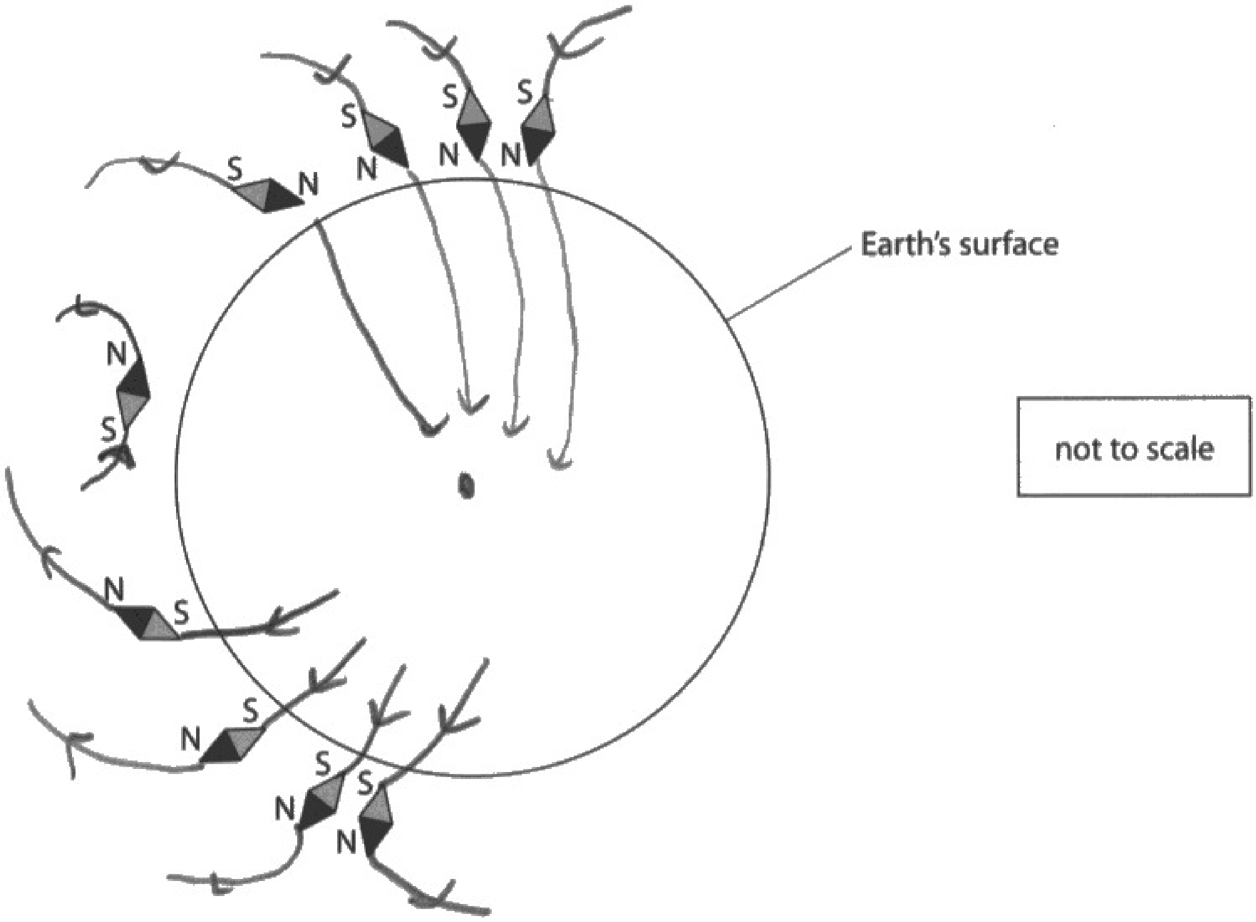


Figure 12

(i) Sketch, on Figure 12, the Earth's magnetic field outside and inside the Earth.

(2)

ResultsPlus
Examiner Comments

This candidate draws the magnetic field lines outside the earth with sufficient accuracy, worth two marks itself. Furthermore they continue those field lines inside the earth towards possible potential poles, worthy of the third marking point.

Full two marks scored.

Question 5 (c)(ii)

Recall of **core** (for the part of the Earth generating the magnetic field), was well known by most candidates.

Question 5 (d)

F = BIl rearrangement and substitution. There was an even distribution across the 3 scores available.

Candidates had to convert mA to A to get full marks. This eluded many.

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

Use the equation

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

(2)

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

$$B = \frac{1.11 \times 10^{-5}}{0.6 \times 0.0931}$$

$$= 1.987110634 \times 10^{-4}$$

magnetic flux density = $1.987110634 \times 10^{-4}$ T

ResultsPlus
Examiner Comments

A well set out answer, including a clear conversion of milliamps to amps.

ResultsPlus
Examiner Tip

Candidates need to get to know all the SI prefixes as detailed in Topic 1 of the specification.

Question 6 (b)(i)

A majority of candidates achieved success with this question.

The most common detracting mistake was not converting cm to m.

(i) The moment of C about point P is 0.60 Nm.

Calculate the weight of C.

Use the equation

moment = F × d

40 - 10 = 30
30cm = 0.3m

(2)

moment = force × distance
0.6 Nm = force × 0.3 m
$\frac{0.6}{0.3}$ = force
force = 2 N

weight of C ....2........ N

ResultsPlus
Examiner Comments

This is a well set out response.

Every step of the calculation is clearly communicated.

ResultsPlus
Examiner Tip

Clearly communicating your answer helps you get more marks. Aim to set out your answer with brief explanations of what you are doing, as you go along.

(i) The moment of C about point P is 0.60 Nm.

Calculate the weight of C.

Use the equation

$$\text{moment} = F \times d$$

(2)

0·60Nm = F × 10 m

F = 0·60 Nm / 30 m

= ~~0·06~~ N
0·02

weight of C ~~0·06~~ 0·02 N

ResultsPlus
Examiner Comments

The working here is easy to follow.

That enabled the substitution and rearrangement mark to be awarded, seen in the second line of working.

(The first line was ignored.)

The candidate has forgotten to convert the 30cm to 0.30 m, ending up with an evaluation 100x too small.

Question 6 (b)(ii)

A large majority of candidates obtained success with this question.

As with many questions, candidates help themselves towards gaining method marks where they set out their working clearly.

This was a 'show that' question. The question had a simple structure that helped candidates towards their successful outcomes.

(ii) Show that the total moment of S and R about P is 0.70 N m.

(2)

Moment of S = Fd
" = 2 × 0.1
= 0.2 Nm

Moment of R = Fd
" = 1 × 0.5
= 0.5 Nm

Total moment = moment of S + moment R
" = 0.2 + 0.5
" = 0.7 Nm //

ResultsPlus
Examiner Comments

This is an even fuller answer than the previous one, clearly spelling out what they are doing.

Doing so makes it easier for the examiner to award them the marks.

(ii) Show that the total moment of S and R about P is 0.70 N m.

(2)

S = 0.1 × 2 = 0.2 } from pivot point P
P = 0.5 × 1 = 0.5

0.5 Nm + 0.2 Nm = 0.70 Nm

ResultsPlus
Examiner Comments

The candidate sets out separate calculations for the moments of S and P, going on to sum them.

Full marks achieved.

Question 6 (b)(iii)

Full marks could be obtained from any three of four elements of the determination.

The first two mark points could be earned through a full statement of the principle of moments.

Some good ideas about the principle of moments used by candidates in this analyse information to make judgments question.

A majority of candidates scored two or three marks out of the three available.

(iii) Using the data in the question and the principle of moments, determine if the toy shown in Figure 13 is in equilibrium.

The rod is very light so its weight can be ignored.

(3)

The toy is not in equilibrium, as the total moments are not equal, as on the left of point P (the pivot) there is 0.6 Nm, wheras on the right there is 0.7 Nm, this meaning that the ~~[illegible]~~ moments are not ballenced and therefore will not be ~~[illegible]~~ even and in equilibrium ~~[illegible]~~, but instead it will be tilted more towards the right side.

ResultsPlus
Examiner Comments

The candidate clearly talks correctly about the **total** moments and, although they do not use the words clockwise and anticlockwise, it is clear that they understand the principle. They apply it well, using data from the question.

Full marks obtained.

ResultsPlus
Examiner Tip

Notice the emphasised **total** moments in the Examiner comments.

Missing this out eg by just saying clockwise moments = anticlockwise moments would not score a mark.

Some statements / definitions / explanations, like that of the principle of moments, are worth committing to memory.

(iii) Using the data in the question and the principle of moments, determine if the toy shown in Figure 13 is in equilibrium.

The rod is very light so its weight can be ignored.

(3)

The toy is not in equilibrium. For this to happen the sum of anticlockwise moment and sum of clockwise moment must be equal. The anticlockwise moment is 0.6 Nm whilst the clockwise moment is 0.7 Nm. They are not equal so the toy is not in equilibrium as the clockwise moment is greater than the anticlockwise moment.

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Examiner Comments

Well argued for the full three marks.

This includes the key words 'sum of' regarding the clockwise and anticlockwise moments and mark point 3 which is addressed numerically.

Question 6 (c)

The question was a rack and pinion one, involving interpreting a diagram.

A large majority of candidates scored full marks on this question.

Calculate how far along the rack the train moves when the pinion turns through one complete revolution.

(2)

no of teeth = 20

8x20 = 160 cm

distance = 1.6 m

ResultsPlus
Examiner Comments

Full marks obtained, including converting 160 cm to 1.6m.

Calculate how far along the rack the train moves when the pinion turns through one complete revolution.

(2)

8x20

distance = 160 m

ResultsPlus
Examiner Comments

This candidate forgets to convert cm to m, as required on the answer line.

Calculate how far along the rack the train moves when the pinion turns through one complete revolution.

(2)

8 × 20 = 160 ÷ 1000

= 0.16

distance = 0.16 m

ResultsPlus
Examiner Comments

This candidate scores a mark for counting teeth on the pinion.

They then erroneously divide by 1000 to try to go from cm to m.

Question 7 (a)(i)

This question differentiated well, fulfilling grade targeting.

The hurdles of having to choose the correct distance, of converting km to m and of sf presentation at the end undoubtedly aided that differentiation.

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

Mass of rover = 1100 kg

Gravitational field strength on Mars = 3.7 N/kg

Give your answer to 2 significant figures.

(3)

$\Delta GPE = mg\Delta h$

$= (1100)(3.7)(1800)$

$= 7{,}326{,}000$

$\approx 7{,}300{,}000$

$= 7.3 \times 10^6$ J

7.3×10^6

change in gravitational potential energy = ~~7.3×10^6~~ J

ResultsPlus
Examiner Comments

Excellent working out is seen here.

Converts 1.8 km to 1800m and chooses 2 significant figures well.

Full marks.

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

Mass of rover = 1100 kg

Gravitational field strength on Mars = 3.7 N/kg

Give your answer to 2 significant figures.

(3)

1.8 km

= 1800 m

gPE = mgh

GPE = 1100 kg × 3.7 N/kg × (1.8 × 10³)

change in gravitational potential energy = 7326000 J

ResultsPlus Examiner Comments

This candidate scores on the first two marking points but fails at the end to state the final answer to 2 significant figures.

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

Mass of rover = 1100 kg

Gravitational field strength on Mars = 3.7 N/kg

Give your answer to 2 significant figures.

(3)

$\Delta GPE = mg\Delta h$

$\Delta GPE = 1100 \times 3.7 \times (1.60 - 1.80)$

$= 1100 \times 3.7 \times (-0.2 \times 10^{-3})$

$=$ ~~814~~ -0.814

$= -0.81$

change in gravitational potential energy = ~~814~~ 0.81 J

ResultsPlus Examiner Comments

Erroneous working, misrecognising the vertical height needed.

One mark for the significant figures choice at the end.

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

Mass of rover = 1100 kg

Gravitational field strength on Mars = 3.7 N/kg

Give your answer to 2 significant figures.

(3)

$GPE = 1100 \times 3.7 \times (\sqrt{1.6^2 + 1.8^2})$

$= 9801.8579\ldots$

change in gravitational potential energy = 9800 J

ResultsPlus
Examiner Comments

Erroneous choice of a vertical height again.

The solitary mark was obtained via the significant figures choice at the end again.

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

Mass of rover = 1100 kg

Gravitational field strength on Mars = 3.7 N / kg

Give your answer to 2 significant figures.

(3)

~~GPE = weight / mass~~

~~weight = 1100 × 3.7 = 4070~~

ΔGPE = m × g × Δh

= 1100 × 3.7 × (1.80)

= 7326

change in gravitational potential energy = 7326 J

ResultsPlus
Examiner Comments

This candidate scores the first selection and substitution mark only.

Their evaluation is wrong because they do not convert 1.8 km to 1800m.

They do not make a 2 significant figures choice at the end.

Question 7 (a)(ii)

This involved a kinetic energy calculation, with a vast majority of candidates scoring full marks on this question.

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

Mass of rover = 1100 kg

Gravitational field strength on Mars = 3.7 N/kg

Give your answer to 2 significant figures.

(3)

GPE = 1100 × 3·7 × 1800

change in gravitational potential energy = 7300 000 J

(ii) Use data from Figure 15 to calculate the change in kinetic energy of the rover as it descends from position P to position Q.

(2)

KE = $\frac{1}{2}$ × 1100 × 88 = 48400

change in kinetic energy = 48400 J

ResultsPlus Examiner Comments

When candidates don't progress with this question it is invariably via a failure to square the velocity in the formula ½ m v^2

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

Mass of rover = 1100 kg

Gravitational field strength on Mars = 3.7 N/kg

Give your answer to 2 significant figures.

(3)

$\Delta GPE = m \times g \times \Delta h$

$= 1100 \times 3.7 \times 1.8$

$= 7326$

change in gravitational potential energy = 7326 J

(ii) Use data from Figure 15 to calculate the change in kinetic energy of the rover as it descends from position P to position Q.

(2)

$KE = \frac{1}{2} \times m \times v^2$

$= \frac{1}{2} \times 1100 \times 88^2$

$P = 4259200$

$= \frac{1}{2} \times m \times v^2$

$= \frac{1}{2} \times 1100 \times 0^2$

$Q = 0$

change in kinetic energy = 4259200 J

ResultsPlus
Examiner Comments

Full marks obtained for correct working and evaluation, which was well set out.

Question 7 (a)(iii)

This question asked how **work done** contributed towards energy changes / conservation of energy. An expanded mark scheme had 8 separate marking points, from which the candidate only had to match 3 appropriate responses to gain full marks.

Not many candidates were adept at using the phrase “doing work” or “work done” in a coherent sentence.

Many understood that the parachute increased air resistance but didn’t get the idea that KE was transferred from the rover to the thermal energy store of the air via that force.

A lot of responses mixed up force and energy. They wrote more about the forces on the rover and how they affected its speed rather than describing the work done by those forces.

The most common mistake was to say "as GPE decreases so KE increases", making this the basis of any further development of their ideas. This probably comes from examples of free fall, ignoring air resistance, to illustrate the principle of conservation of energy.

Hardly any candidates talked about work being done against gravity.

(iii) The rover is slowed down safely using thrusters and a parachute (not shown in Figure 15).

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

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

(3)

The ~~GPE~~ kinetic KE energy IS ~~dow~~ decreased by the the Air resistance on they Parachute wich decreases Speed. The Jet gas engine IS Putting resistance against the gravity to make It land Safer

ResultsPlus
Examiner Comments

This candidate is getting to grips with the heart of the question.

They realise that:

- kinetic energy is decreasing (mark point 4).
- as a result of the air resistance on the parachute acting (mark point 3).
- and the 'jet gas engine' working against gravity (which could get mark points 1 or 2).

Note that their term 'putting resistance against' is not exactly the same as work is done against, but examiners' professional judgment tells us it is near enough to accept with some benefit of doubt.

This candidate shows understanding and is well worth the full three marks.

ResultsPlus
Examiner Tip

It would help candidates to spend time getting acquainted with the correct scientific use of the phrase 'work done'.

It is an important physics concept.

(iii) The rover is slowed down safely using thrusters and a parachute (not shown in Figure 15).

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

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

(3)

The gravitational potential energy decreases as the rover descends, the kinetic energy increases as the rover moves. Gravity causes the rover to descend as it pulls it down onto Mars

ResultsPlus Examiner Comments

This scored one mark – mark point 5, for recognising a decrease in the gravitational potential energy as the rover descended.

Question 7 (b)(i)

This was a 'show that' question where the end point required was 2.16 MJ.

One mark available.

It was unacceptable to work back from the answer to the original data.

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

The solar panels can provide 1200 W of power.

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

(1)

$P = \frac{E}{t}$

$E = P \times t$

$E = 1200 \times (60 \times 30)$

$E = 2160000\ J = 2160\ kJ$

$E = 2.16\ MJ$

ResultsPlus
Examiner Comments

Well set out answer, including converting 30 minutes to (60 x 30) seconds, and joules to Megajoules.

Question 7 (b)(ii)

This question had significant mathematics demand; an input amount being asked for, given an output amount and the efficiency.

This proved to be mathematically challenging for many.

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

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

(2)

$0.27x = 2160000\ J$

$x = \frac{2160000}{0.27} = 8000000$

energy received = 8000000 J

ResultsPlus
Examiner Comments

Well set out, easy to follow.

27% converted to 0.27 to use as a decimal appropriately.

The candidate appreciates that 0.27 x asked for input = given output.

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

Calculate the solar energy received by the panels that provides the 2.16 MJ of energy. **(2)**

$27\% = \frac{\text{Useful}}{\text{total}}$ ~~x 100~~

~~$27\% = \frac{\text{Useful}}{2160000} \times 100$~~

~~27% x 2160000~~

~~= 583200~~

$27\% = \frac{2160000}{\text{total}}$

$\text{total} = \frac{2160000}{27\%}$

= 8 000000

energy received = 8000000 J

ResultsPlus
Examiner Comments

The candidate navigates from the definition of efficiency to work out the total input with competence.

Question 8 (b)(i)

By now this question should be realised as asking for a familiar pattern of response in describing a curve on a graph.

Most candidates could identify the trend but fewer talked of the non-linearity aspect.

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

(2)

The resistance of this thermistor decreases as temperature increases. This happens at a non-linear rate.

ResultsPlus
Examiner Comments

Both mark points are addressed here.

Full marks are obtained.

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

(2)

As temperature increases, resistance of the thermistor decreases. Rate of decrease is not constant and decreases and the relationship is ~~inversely~~ non linear. Temperature is inversely proportional to ~~temp~~ resistance.

ResultsPlus
Examiner Comments

This gets both marks as well.

A range of alternative answers to the second marking point were accepted, including inversely proportional, even though that may not strictly be true. The idea of non-linearity is embedded in such a comment however and so would be accepted in this this context.

Question 8 (b)(ii)

A wide, flat distribution of marks was noted, reflecting the demand of tangent drawing plus the demand of extracting units for the gradient of the graph.

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

Figure 16 shows a graph of the results of this investigation.

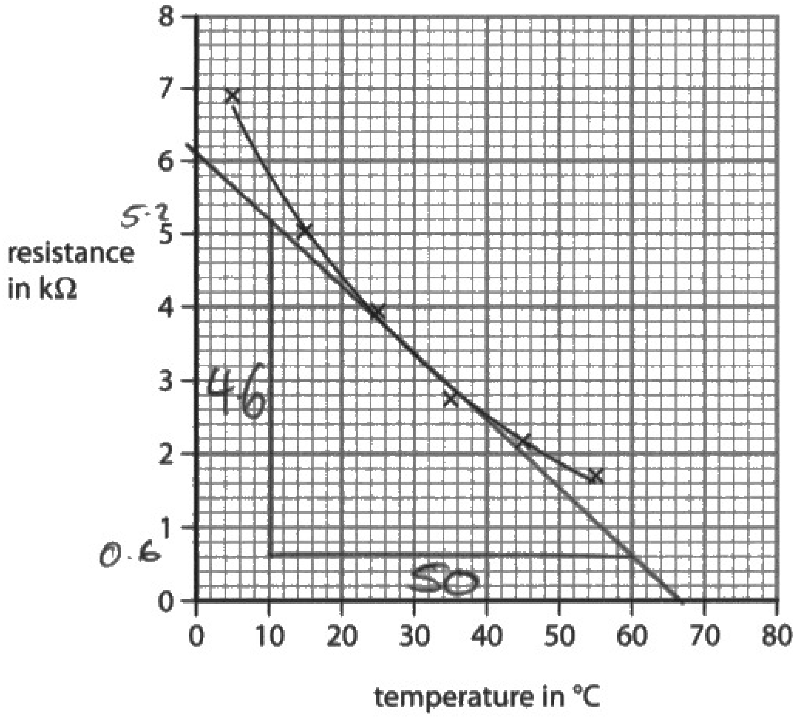

Figure 16

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

(2)

As temperature increases, the resistance decreases. The relationship is non-linear, as the temperature increases, the rate of change also decreases.

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

State the unit.

(3)

$\frac{\Delta y}{\Delta x} = \frac{-4.6\ k\Omega}{50\,°C} = -0.092\ k\Omega/°C$

rate of change of resistance with temperature at 30 °C = -0.092 unit kΩ/°C

ResultsPlus
Examiner Comments

This candidate does extremely well, getting the gradient from a well-drawn tangent and associated triangle, choosing an easy horizontal interval to base their gradient calculation upon.

Correct units chosen as well.

ResultsPlus
Examiner Tip

Choosing an easy horizontal interval for gradient calculations may well lessen the chances of making a mistake in such calculations.

Question 8 (c)(i)

Very few candidates scored marks on this question. This question asked for critical thinking in an experimental context.

This seems to be a weakness for the present cohort of candidates.

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

(2)

Place thermometer closer to the thermistor to ensure that the temperature recorded is closer to that of the thermistor

ResultsPlus
Examiner Comments

This candidate has got the right idea.

Their response matches the mark scheme very well for both marks – improvement, with reason.

Question 8 (c)(ii)

This lived up to its expectation in targeting grades 8 and 9.

A minority of candidates did say that the ammeter / voltmeter had more decimal places but failed to apply this to having more decimal places in the resistance calculation answer.

Method 1 $V = I \times R$ Method 2

using an ohmmeter using an ammeter and voltmeter

$R = \frac{V}{I} = \frac{1}{(439.9/1000)} = 2.273243919$

Figure 18

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

(2)

Method 2 gives more precise results than method 1 because it measures the current & voltage (p.d.) ~~I~~ in smaller increments (to more decimal places). Resistance can be worked out ~~B~~ in method 2 using $R = \frac{I}{V} = 2.273243919$.

(Total for Question 8 = 10 marks)

Whereas the resistance on Method 1 is rounded to a single decimal place. (2.3).

ResultsPlus
Examiner Comments

A superb comprehensive, well-explained answer is seen from this candidate.

It is exemplary.

Question 9 (a)

Candidates were asked to reflect on the difference between specific heat capacity and specific latent heat.

A half of candidates could do this effectively for the two marks, often by quoting definitions.

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

(2)

Specific heat Capacity = amount on energy to increase 1kg by 1°c (liquid or what have you'
Specific latent heat = amount energy to break ~~bonds~~ bonds to go from Solid to Liquid and Liquid - to gases and [illegible]

ResultsPlus
Examiner Comments

The candidate uses the definition of specific heat capacity and shows a good understanding of latent heat which includes the idea of breaking bonds.

Full marks awarded.

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

(2)

Specific heat Capacity measures the energy ~~to ...~~ needed to change the temperature of a substance whereas the specific latent heat measures the energy needed to change the state of ~~an~~ a substance without changing the temperature.

ResultsPlus
Examiner Comments

This candidate puts their finger on the difference between the two quantities, showing great insight.

Question 9 (b)

This question demanded procedural knowledge of observation – how to obtain a final maximum temperature in a specific heat capacity experiment.

It was found to be extremely challenging for most candidates. It matched the grade targeting of grades 7-9.

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

(3)

The ~~to~~ student should keep the thermometer in the water and ~~&~~ ~~let~~ keep stirring the water. Remain at eye level with the thermometer & note the maximum temperature reached while ~~k~~ stirring the water. This maximum temp. is more accurate as it is taken after evenly spreading the heat in the water, so ~~it~~ the ~~tem~~ thermometer reading is more accurate

ResultsPlus
Examiner Comments

This candidate shows clear knowledge of experimental practice. They match mark points 1, 2, 3 and 4 of the mark scheme.

ResultsPlus
Examiner Tip

The more that candidates can have hands on laboratory experience the better. By 'doing', candidates get to know procedures more memorably and realistically than by just book learning.

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

(3)

The student should be at eye level with the thermometer and as soon as the power is turned off, the student should start recording temperatures every 30 seconds. This allows the liquid to finish heating based on it's surroundings. When the temperatures become consistent or start to drop, finish recording. The highest temperature found is the final temperature.

ResultsPlus
Examiner Comments

A well expressed answer showing familiarity with experimental practice.

The 'based on its surroundings' comment may be ignored.

Full marks obtained.

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

(3)

To obtain an accurate result they should immediately note down the reading on the joulemetre and on the thermometre. Then using $\Delta Q = m \times c \times \Delta \theta$, they can calculate the specific heat capacity. They should redo the experiment.

ResultsPlus
Examiner Comments

This was typical of many answers which stated that you take the temperature immediately after switching off and this would be fed into a Dq calculation.

0 marks possible.

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

(3)

The student should read the temperature of the water as soon as the power supply is switched off so that the temperature does not start to decrease as energy is transferred to the surroundings. Then student should be at eye level with the thermometer so that the student sees the height of the liquid accurately and reads it off the markings accurately.

ResultsPlus
Examiner Comments

The 'eye level' response scores a mark – for mark point 4.

Question 9 (c)

This was a well answered question, with a fair number of 6-mark responses seen.

The key step required to access level 3 was a clear involvement of force going from the molecular level to macroscopic pressure.

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

The gas is then heated.

The volume of the container remains the same.

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

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

(6)

As the gas is heated the particles in the container gain more kinetic energy in their internal energy stores, as energy is transferred from the heat source to the particles. Because they have an increased kinetic energy store, the particles have more energy so move faster and at greater velocities inside the container. The faster moving particles collide with each other, and the walls of the container more often (with more energy) therefore exerting a greater average force, perpendicular to the surface. on the walls of the container (and on each other). As the volume of the container has not changed, the surface area is the same and so as the particles exert a greater average force over the same area as before, the pressure exerted on the walls of the container increases. This is because pressure = force / area, and force and pressure are directly proportional, so when area is constant (which it is for the same container) a greater average force exerted on the walls of the container (perpendicular to the surface) results in increased pressure on the walls of the container too.

ResultsPlus
Examiner Comments

An excellent answer, well deserving of a level 3, full marks. The candidate delves into the role of increased forces giving an increased pressure, realising that it is the aggregate of all the small collisions with the walls of the container that contributes to the total pressure.

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

The gas is then heated.

The volume of the container remains the same.

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

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

(6)

Temperature is the measure of how quickly a particle is moving. As heat increases, so does the particles' temperature, meaning that they move faster. As a result of this, the average kinetic energy of the particles increases as the temperature does. Now that the particles are moving faster, the pressure exerted on the container walls will increase. This is because particles now bounce off the container walls more frequently due to their enhanced speed and kinetic energy. Because the volume remains unchanged, the particles have less space to move around in despite their faster speed.

ResultsPlus
Examiner Comments

This was typical of a secure level 2 answer where the candidate delves into kinetic theory quite well, including how an increased frequency of collisions with container walls equates with increased pressure. The lack of involvement of a force argument limited the level to a maximum at level 2.

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

The gas is then heated.

The volume of the container remains the same.

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

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

(6)

the average kinetic energy and the pressure of the particles will increase because the gas will have more energy, making the particles move around a lot faster, the pressure will increase because the particles will be trapped in a container with increasing energy

ResultsPlus
Examiner Comments

This is a level 1 answer, making the connection between increased kinetic energy and faster molecular speeds but failing to go much further. 'Trapped with increasing energy' isn't creditable.

Question 10 (a)

This was a very effective differentiating question, tapering from 0 marks to 3 marks. Some good answers were seen.

Five possible marking points were identified in the mark scheme, for this 3 marks question.

Explain what will be observed on the meter when the magnet is pushed in and pulled out of the coil, repeatedly.

(3)

The current will ~~switch polarity, will~~ alternate back and fourth from above OA to below OA as ~~and~~ an alternating current is ~~formed~~ produced by the changing magnetic field. When pushing in current will be positive and when pulled out it will be negative. The alternating ~~mag~~ magnetic field will induce an alternating current.

ResultsPlus
Examiner Comments

This matches mark points 2, 4 and 5 most closely.

Full marks obtained.

Explain what will be observed on the meter when the magnet is pushed in and pulled out of the coil, repeatedly.

(3)

The magnet has a magnetic field so when it is pushed in to the coil the magnetic field will induce a voltage causing a current in one direction in the coil, causing the needle of the ammeter to point to one end of the dial. When the magnet is removed, the effect of the magnetic field on the coil will be less so there will be less of a voltage so less of a current. This ~~alternating~~ repeated movement of the magnetic field causes the alternating magnetic field to induce an alternating current which is shown as the dial on the ammeter will flip constantly from one end to the other.

ResultsPlus
Examiner Comments

Careful reading of this response will realise that all five possible mark points have been addressed.

The very final phrase helped clinched mark points 1 and 2.

Full 3 marks awarded.

Question 10 (b)

This question required the use of two equations, substituting an outcome of one into the second. There were many competent answers seen, with half of all candidates scoring the full 3 marks. This was more than expected in the grade targeting.

A mark of 2 marks proved to be largely redundant. This is often the case with calculations involving some complexity. Candidates either get it or don't.

Calculate the current in the primary coil.

Use the information given in Figure 21 and equations selected from the list of equations at the end of this paper.

The transformer is 100% efficient.

(3)

pd in pc × current in pc = pd in sc × current in sc

$\frac{\text{pd in p}}{\text{pd in s}} = \frac{\text{turns in p}}{\text{turns in s}}$

$\frac{230}{?} = \frac{700}{400}$

$\frac{230}{?} = 1.75$

$? = \frac{230}{1.75}$

$= 131.4\ V$

$230 \times ? = 131.4 \times 1.75\ A$

$230 \times ? = 230$

$230 \div 230 = 1$

current in the primary coil = 1 A

ResultsPlus
Examiner Comments

This candidate handles the two equations and substitutions extremely well.

They work from left to right.

Their working is very clear and easy to follow.

Full marks obtained.

Calculate the current in the primary coil.

Use the information given in Figure 21 and equations selected from the list of equations at the end of this paper.

The transformer is 100% efficient.

(3)

~~V/C = V/C~~ = voltage p / voltage s = No turns p / No turns s

~~Vp x Ip = Vs x Is~~ = 230 / 1 x = 700 / 400

Vp x Ip = Vs x Is

(voltage s) x = 230 / 1·75 = 131·428571

= 230 x Ip = 131·4 x 1·75

= 230

current = 1

current in the primary coil = 1 A

ResultsPlus
Examiner Comments

On the right hand side of the answer given, the candidate uses the turns ratio equation to deduce the output voltage. They then equate power in = power out for a 100% efficient transformer to obtain the required primary current.

Full three marks obtained, with a correct evaluation.

Question 10 (c)

This 6-mark question was about distributing electricity via the National Grid, asking for efficiency considerations. It allowed many candidates to show their knowledge and was high scoring. The need for low current for the transmission of electricity over long distances seemed to be well known. Candidates were able to explain the heating effect of a current and its effect on the efficiency of the system.

Point P generates the electricity and sends the electrical power ~~the T~~ to the step up transformer in point Q that is 100% efficient and steps up voltage to decrease the current so less energy dissapated due to resistance via heating because $P = I^2 \times R$. R ~~has~~ are low ~~resistance~~ resistance transmission cable that transfer the electrical power to point S. It is low resistance to reduce power lost due to resistance and energy dissipating however it is not 100% efficient and energy is still lost. Point S is a step down ~~transforme~~ transformer which is 100% efficient and it decreases the voltage and increase the current to ~~mak~~ make the ~~potential~~ potential difference safe for consumers and their appliances. ~~The~~ Power is then transported from point S to R ~~T~~ T to provide power for ~~their~~ ~~tra~~ consumers and their home appliances

(Total for Question 10 = 12 marks)

ResultsPlus
Examiner Comments

This response has all the elements required of level 3. A full 6 marks is well deserved. The transformers are accurately and well-spoken of. Energy losses in the network cables are fully considered via an excellent I^2 R argument. Other potential sources of energy losses that could affect efficiency are also expertly discussed.

Electricity exits the power station and enters a step-up transformer. This increases the voltage and decreases the current. The increases energy efficiency because when there is a high current, energy is lost through heating which goes to the environment. Step-up transformers decrease the current to stop this. R should have ~~high~~ low resistance to decrease build up of thermal energy, (thicker wires, cool metals, etc) to increase efficiency. S is a step-down transformer that decreases voltage and increases current because the voltage cannot be too high in houses because it is dangerous. The current

(Total for Question 10 = 12 marks)

can be high because electricity does not travel long distances.

TOTAL FOR PAPER = 100 MARKS

ResultsPlus

Examiner Comments

This is a level 3 answer which lacks the detail and accuracy to be fully convincing for 6 marks. Hence 5 marks were awarded.

Holistic judgements are required when assessing 6-mark questions and this is a good example of where examiners assessed the attainment as being worth less than the full level 3.

Note it is not marked negatively ie examiners are not seeking to pick holes in the candidate's discussion.

If this answer is compared with the previous one worth 6 marks and seen against some of the indicative content, it would be seen that this answer doesn't come up to the full mark.

Electricity is first produced ~~A~~ at P, ~~vs~~ by using ~~fossil fuels to spin turbines, which generates~~ gas from burning fossil fuels to spin turbines. // This electricity is then put through a step-up transformer* to travel across the power lines at R. A step-up transformer is necessary because it increases the voltage and because of this lowers the current. A low current is safe because ~~of~~ there is less risk of a fire because of the heat from friction. // The electricity is then put through a step-down transformer at 'S' to decrease the voltage ~~current~~ and increase the current. ~~&~~ This makes the electricity suitable to use in home appliences.

* at 'Q'

ResultsPlus Examiner Comments

This is a level 2 answer. The candidate deals well with the transformer aspects and realises the need for a low current and high voltage in the transmission cables.

Thereafter there aren't any convincing level 3 arguments about energy losses and efficiency.

Electricity goes from the powerstation to the primary transformer to make sure it's safe. It then goes to the pylons which travel to the secondary transformer which transfers the electricity we need to our homes.

ResultsPlus
Examiner Comments

This is a clear level 1 answer recognising the transformers in a rudimentary way and the pylons which distribute the electricity, without mentioning the necessary transmission cables.

Paper Summary

Overall this exam gave ample opportunity for candidates to display their knowledge and understanding at grades 4-9.

Candidates have continued to do well with most calculation questions, although some didn't cope well with significant figures and some of the units involved, even including the prefixes kilo and Mega.

Based on their performance on this paper, candidates should:

- make the most of opportunities afforded in school laboratories where they become acquainted with practical work from the specification. This concerns both core practicals and the suggested practicals. It would benefit candidates to always question 'What is the purpose of this experiment?', making sure that they are clear in their minds about it. After the event evaluations are also useful, especially when reflecting on how the experiment could have been improved. Such approaches would have reaped dividends in answering Q8(c)(i) and Q8(c)(ii) on this paper especially.
- The use of wrong units caused candidates to miss out on some marks. Candidates do need to know what the S.I. prefixes stand for. In this exam even the prefixes kilo and Mega were not known by some candidates. Candidates also need to have the mathematical skill of being able to round off results of calculations to a given number of significant figures.
- Candidates seem to need more practice on handling powers of ten in their calculations. They should be able to use their calculators with numbers in standard form when needed. It often helps to put answers in standard form rather than risk writing too many or too few 000s in an answer.
- In constructing explanations, candidates need to take note of the marks allocated to a particular question and respond with a corresponding number of points in their answer. Candidates should take opportunities, where they can, to use diagrammatic illustrations to aid and prompt their explanations.

Grade boundaries

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

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