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Examiners' Report
June 2024

Int GCSE Physics 4PH1 2P

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Introduction

As in examinations for previous sessions, most candidates handled the calculations well.

Candidates who gave the best practical descriptions usually appeared to be writing from first-hand experience. 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.

There was a wide range of responses and it was good to see that many candidates could give full and accurate answers.

Question 1 (a)

Most candidates correctly identified area Q as the main sequence. The majority of candidates went on to correctly identify area P and area R as the white dwarf star and red giant star areas respectively. The primary misconception was to think that the other objects had positions on the H-R diagram.

Question 1 (b)

Many candidates answered this perfectly. Those that did not missed out or miscommunicated the idea of a standard distance requirement.

Question 2 (a)

Most candidates correctly quoted the formula from the sheet and multiplied the force and the perpendicular distance. A sizable minority of candidates made an error with the unit, either because of a misconversion from cm to m or putting a 'slash' between the two units. This gives N/cm or N/m, which is clearly incorrect.

Question 2 (b)

Virtually all candidates selected at least one correct change that could be made to increase the size of the moment. Most of those candidates that got one correct change also got a second reasonable change to score full marks.

Question 2 (c)(i)-(ii)

Using the provided formula for the circumference of the circle, many candidates successfully calculated the distance over which the force was applied, ie one quarter of the circumference.

After that point most candidates went on to calculate the product of force and distance travelled, although a sizeable minority of candidates forgot to convert the distance travelled into metres before completing the calculation.

(c) Diagram 2 shows the wrench as it is turned through 90°

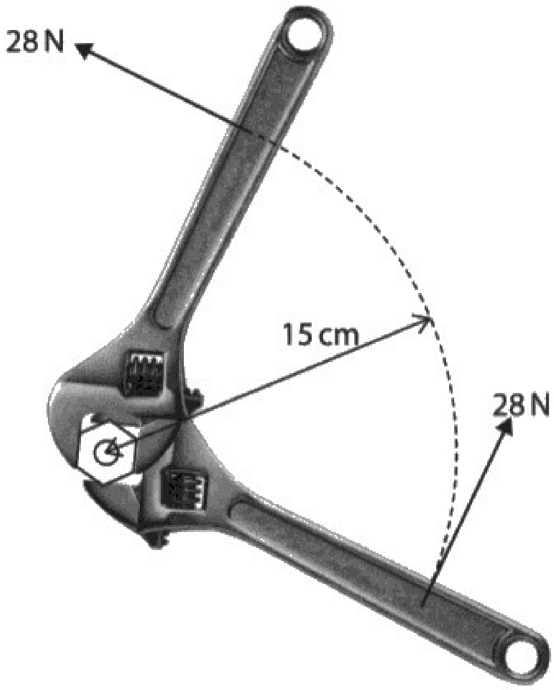


Diagram 2

(Source: https://www.shutterstock.com/image-photo/adjustable-spanner-isolated-on-white-chrome-1794553030)

(i) The force is applied over a distance that is equal to a quarter of the circumference of a circle.

The circle has a radius of 15 cm.

Calculate the distance over which the force is applied.
[circumference of circle = 2 × π × radius]

(2)

2π15cm × 1/4

= 23.56

= 23.6

distance = 23.6 cm

(ii) Calculate the work done by the force as the wrench is turned through a quarter of the circumference of the circle.

(3)

~~workdone=power×time~~

Force × distance moved

= 28N × 23.6cm

= 28N × 0.236m

= 6.608

= 6.6

work done = 6.6 J

(Total for Question 2 = 10 marks)

ResultsPlus Examiner Comments

This candidate has completed everything perfectly. They have remembered to convert the distance into metres so that the work done is calculated in joules.

ResultsPlus Examiner Tip

Check what unit is on the answer line.

Question 3 (a)

This experiment is perhaps not a familiar one to some candidates, hence the mark scheme was developed to be relatively generous, rewarding solid experimental planning.

The focus here is for the candidate to determine how each of the variables should be treated.

For example, the independent variable here is the colour of the bottles.

The dependent variable is the temperature change.

There are several variables that should be controlled from reading the question ie distance from the heater, the heater setting, volume of water inside the bottles.

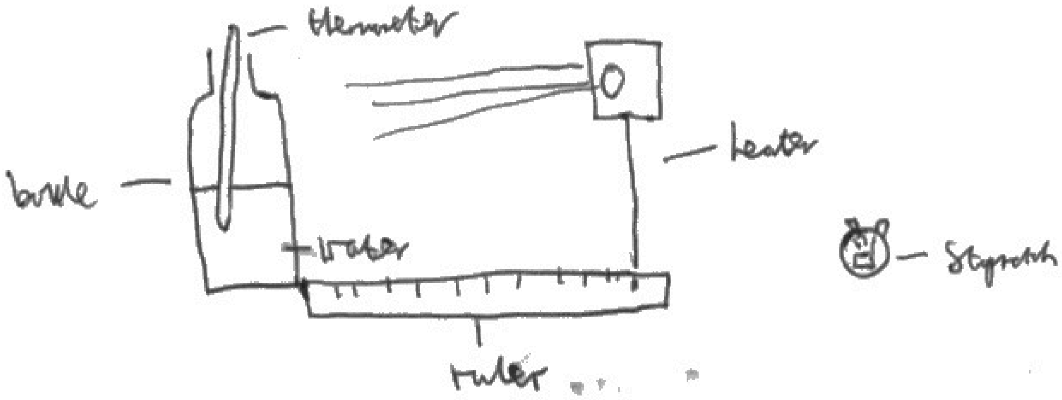
If the candidate covered these points and made some further attempt at either data quality or safety, then they would secure full marks.

The student pours some water into each bottle.

Describe a method the student could use to investigate how the colour of the bottle affects the amount of infrared radiation absorbed by the bottle.

You may draw a diagram to help your answer.

(6)



Fill each bottle with water of the same temperature from the tap, and set one up 20cm away from the infrared heater. Place the thermometer in the first bottle, measure the initial temperature, then start the stopwatch and turn on the heater. Make recordings of temperature every 30 seconds and after 5 minutes, turn the heater off. Reset the stopwatch and repeat with the other bottle, using the ruler to make sure the distance between heater and bottle is the same in both experiments. At the beginning, when filling each bottle, use a measuring cylinder to make sure each bottle is filled with 100 ml of water, the same across both. After finishing both, record results in a neat table, then repeat and average, carrying out 5 repetitions. Plot the mean data in a temperature time graph and compare.

ResultsPlus Examiner Comments

This candidate has drawn a diagram showing how to perform the experiment with a single bottle. Later on they have stated that they will repeat the experiment with the other bottle.

They have discussed the control variables and the independent variables.

Finally, there is a reference to repeating and averaging the results towards the end.

ResultsPlus Examiner Tip

Drawing a diagram to accompany your description is always a good idea.

The student pours some water into each bottle.

Describe a method the student could use to investigate how the colour of the bottle affects the amount of infrared radiation absorbed by the bottle.

You may draw a diagram to help your answer.

(6)

The student should do repeats on the same coloured bottle. The carten one with each bottle heat it up via the infered heater then after the set time i.e 10 ~~minuets~~ minuets put the termometer in the bottles to see how much the temperature difference is. then repeat to get reliable data and to compare the colours absorption of temperatures.

ResultsPlus
Examiner Comments

In contrast, this response shows no reference to the two different colour bottles at all, which means that marking points 6 and 7 are not available.

There is, however, reference to measuring the starting temperature and the temperature after a period of 10 minutes.

Question 3 (b)

Only a small number of candidates muddled up which way the temperature change was going to be for this experiment.

The rest of the candidates completed this well, although a small number crossed the lines over.

The question does not expect the candidates to know exactly what the temperature graph looks like, so any shape in which there was no decrease was accepted, even if there was a plateau along the way.

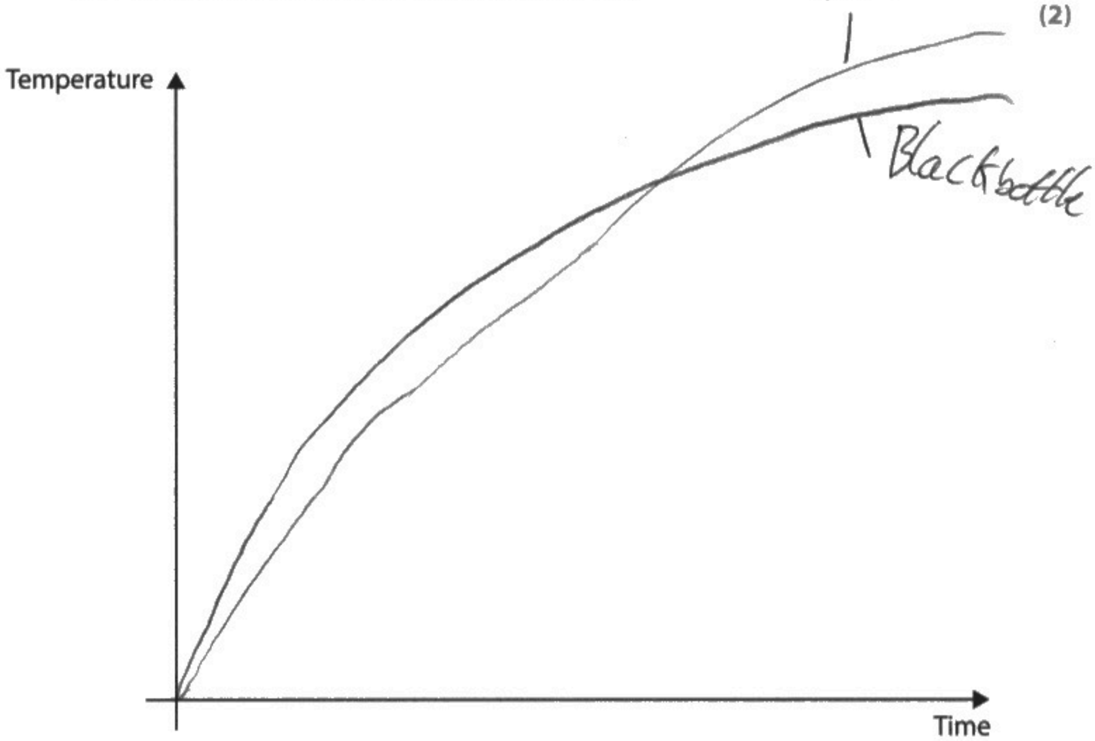
It was also acceptable for the candidates to show that both bottles reached the same temperature, provided that the black bottle arrived at that temperature first.

(b) The student plots a graph to show how the temperature of the water in each bottle varies with time.

Draw two curves to show the expected variation in temperature of the black bottle and the silver bottle during the investigation.

Label your curves with the colour of each bottle.

(2)



ResultsPlus
Examiner Comments

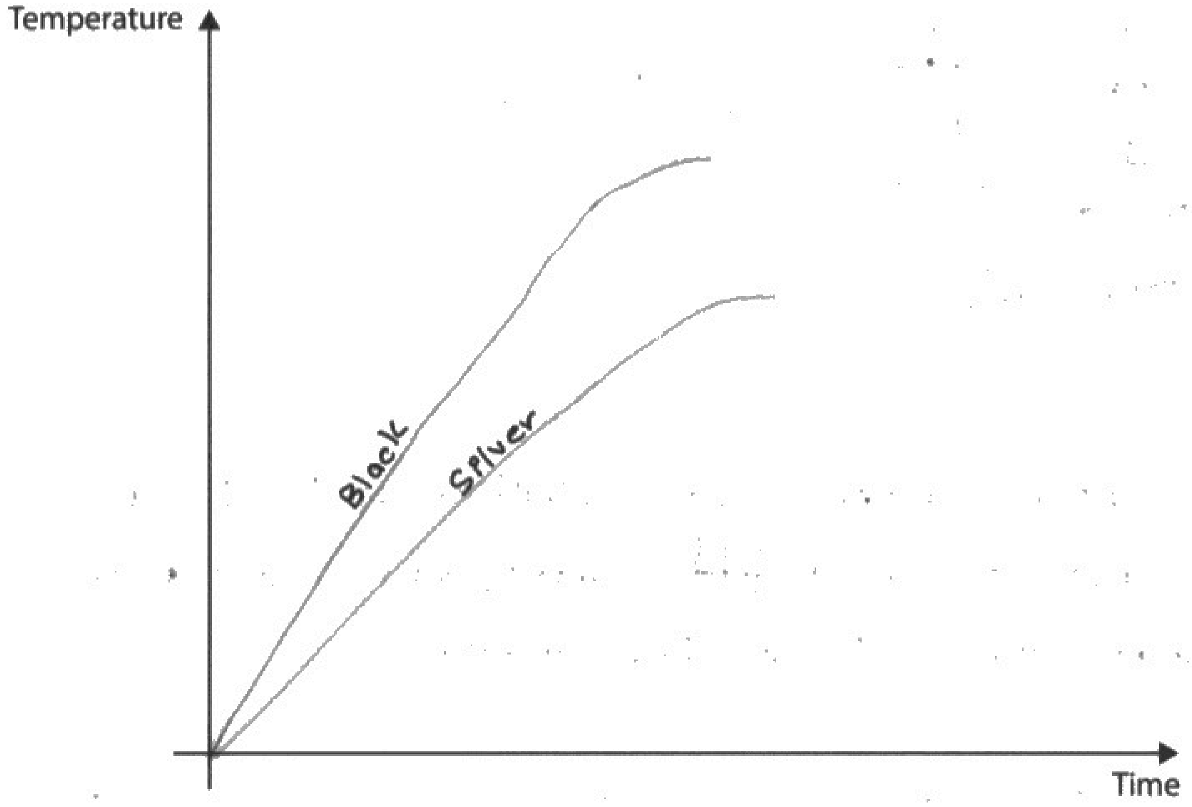
This candidate has scored a single mark because they have identified that the temperature of both bottles will increase over time.

(b) The student plots a graph to show how the temperature of the water in each bottle varies with time.

Draw two curves to show the expected variation in temperature of the black bottle and the silver bottle during the investigation.

Label your curves with the colour of each bottle.

(2)



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Examiner Comments

This candidate has determined that the black bottle will rise in temperature faster than the white bottle. They have surmised that this will always be the case, which is acceptable.

Question 4 (b)(i)-(iii)

Virtually all candidates selected the correct anomalous result. Many candidates correctly stated something appropriate in terms of how to deal with that result. That said, about half of the candidates did not exclude the anomalous result from their calculation of the mean.

Question 4 (b)(iv)

This item is designed to test both experimental technique and knowledge of electrostatically charged objects.

Provided that the candidate made satisfactory reference to how they would perform the experiment(s), then it was possible to gain two marks by implementing the idea that 'like charges repel, opposite charges attract'.

For the third mark here, the mark scheme makes clear that this idea is to be linked with what someone who performed this experiment would see ie the evidence for electrostatic repulsion and attraction. This required a statement linking repulsion with 'the objects moving away from each other' and a similar statement for attraction.

(iv) Describe how the student could use the rods to demonstrate that there are two different types of electric charge.

(3)

The student could place the polythene rod in a cradle, and hang it from a clamp stand. Then, without touching the ends of the rods, hold the glass, ebonite and acetate rods up to it. The polythene should swing towards the glass, and swing away from the ebonite and acetate. Therefore, as there are different responses from the polythene here, there must be two types of charge. The glass is attracted to the polythene but the ebonite and acetate are repelled, showing there must be two different charges, as like charges repel, and opposite charges attract

(Total for Question 4 = 9 marks)

ResultsPlus
Examiner Comments

This candidate has carefully explained how they are going to complete the demonstration (suspending the polythene rod) and then bring up the different rods.

They have explained what should happen (either attraction or repulsion) and how they would observe that (by the polythene rod either swinging towards or away from the rods presented). They have therefore scored all three marks.

(iv) Describe how the student could use the rods to demonstrate that there are two different types of electric charge.

(3)

The student could suspend the 2 rods from clamp stands, and bring them close together. As the rods are ~~attracted~~ oppositely charged, they will be attracted to each other. This would prove that the rods do not have the same charge, as this would cause them to repel.

ResultsPlus
Examiner Comments

In contrast, this candidate has not explained what they expect to see, stopping with statements of repulsion and attraction.

Question 5 (b)

This item tested the specification point around the accepted range of human hearing ie 20–20,000 Hz, so that answer C would be the only acceptable answer.

Understandably, large numbers of candidates wanted to include a comment about column E. This was condoned for the first mark, although there needed to be a reasonable qualification as described in the mark scheme.

Question 5 (c)(i)

This item is a 'show that' question, so the candidate needed to provide suitable working to demonstrate how they arrived at the correct answer.

They could achieve this by either starting from 2.0 ms and working towards a frequency of 500 Hz or starting with 500 Hz and working towards a period of 0.002 seconds, ie 2 milliseconds.

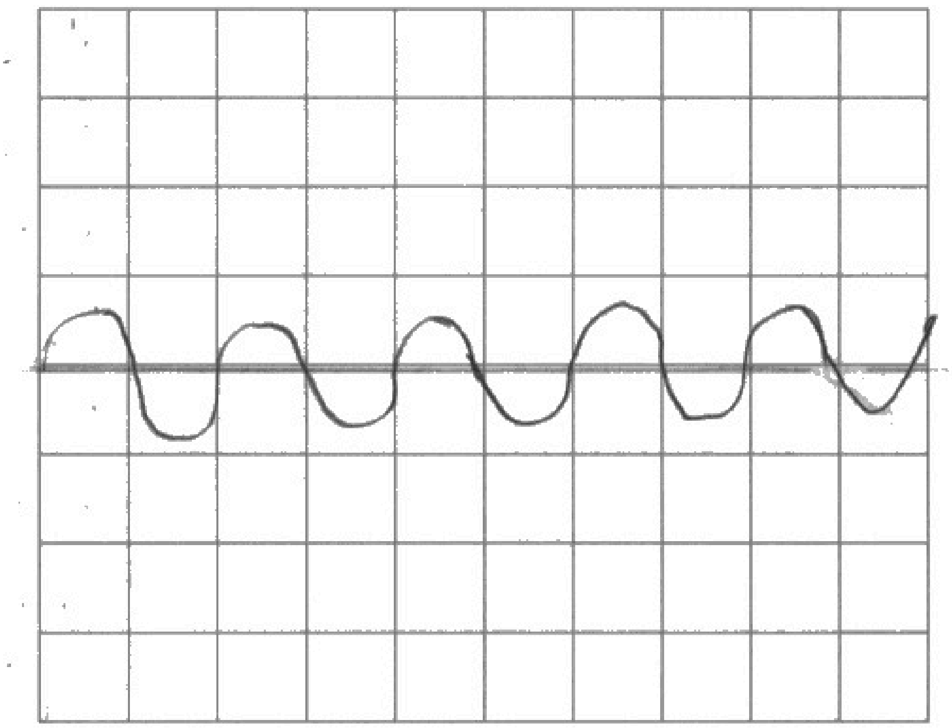
Question 5 (c)(ii)

The example response in the mark scheme is the minimally acceptable response, as it has one complete cycle. That cycle has two half-cycles that are the same length across the x-axis.

As the mark scheme suggests, the markers ignored changes in amplitude and only focused on the period of the wave that the candidates supplied.

(ii) The diagram shows the screen of an oscilloscope.

The timebase of the oscilloscope is 0.50 ms per square.



Draw the trace on the oscilloscope screen when the sound wave is detected.

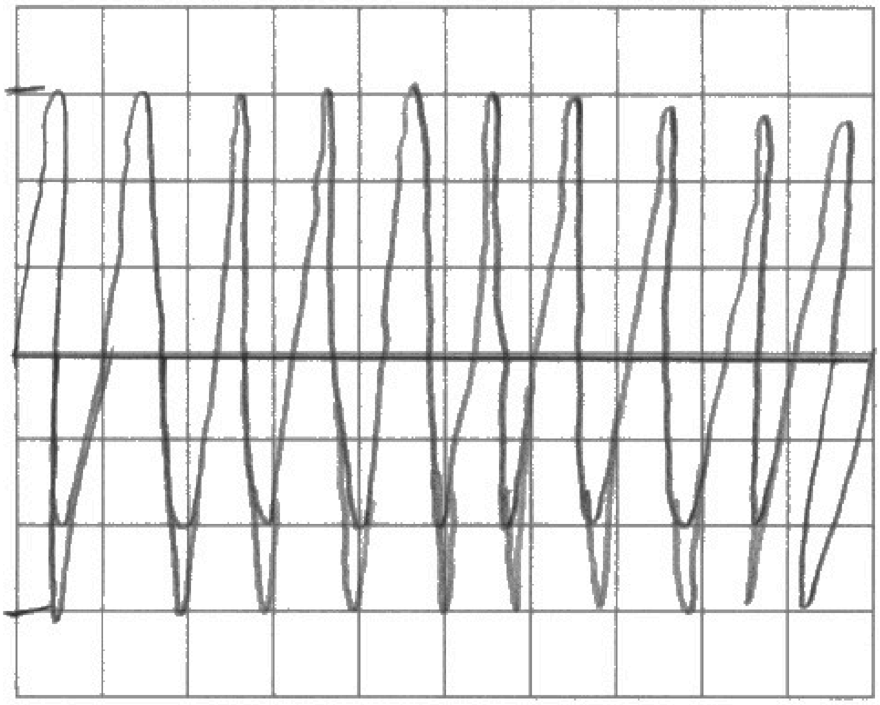
(2)

ResultsPlus Examiner Comments

This candidate has drawn multiple cycles which are the same half-periods, so was acceptable for 1 mark, since the period was not four squares.

(ii) The diagram shows the screen of an oscilloscope.

The timebase of the oscilloscope is 0.50 ms per square.



Draw the trace on the oscilloscope screen when the sound wave is detected.

(2)

ResultsPlus
Examiner Comments

At first glance, this example is very similar to the previous example.

The candidate, however, has drawn a shape that is decreasing in period as the wave continues. The period was not 4 squares at any point, so this scored no marks.

Question 6 (a)

A large majority of candidates described, drew or did both to show that they knew a coil of wire should be connected to some source of direct current.

Fewer candidates showed that a reasonable electromagnet should also have an iron core or some other magnetically soft material, around which the turns of wire should be wrapped.

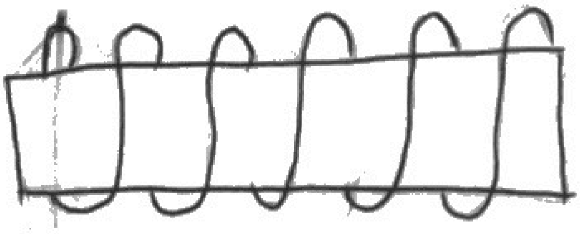
References to transformers or bar magnets were rejected and could not score the final mark.

6 This question is about electromagnets.

(a) Describe the construction of a simple electromagnet that is producing a magnetic field.

You may draw a diagram to help your answer.

(3)



current ~~[illegible]~~ carrying ~~[illegible]~~ wire is coiled around an ~~[illegible]~~ magnet inducing it

ResultsPlus
Examiner Comments

This candidate has answered concisely. The diagram isn't labelled however it does not detract from their text. The reference to a magnet is not acceptable for the third mark, however.

ResultsPlus
Examiner Tip

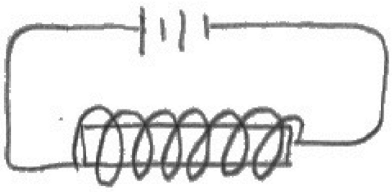
Label diagrams where time permits.

6 This question is about electromagnets.

(a) Describe the construction of a simple electromagnet that is producing a magnetic field.

You may draw a diagram to help your answer.

(3)



At first we need a soft iron and wrap the solenoid around the soft iron and pass the current which becomes an temporary magnet which is called electromagnet.

ResultsPlus
Examiner Comments

In contrast, this candidate has made it clear that the bar is some soft iron as well as describing a solenoid or coil of wire and a current passing through that wire.

Question 6 (b)

Candidates found this item challenging.

In part (b)(i) the candidates were advised to use the left hand rule. In conjunction with the idea of the current running from left to right and the field as directed, the force is clearly upwards or towards the top of the page.

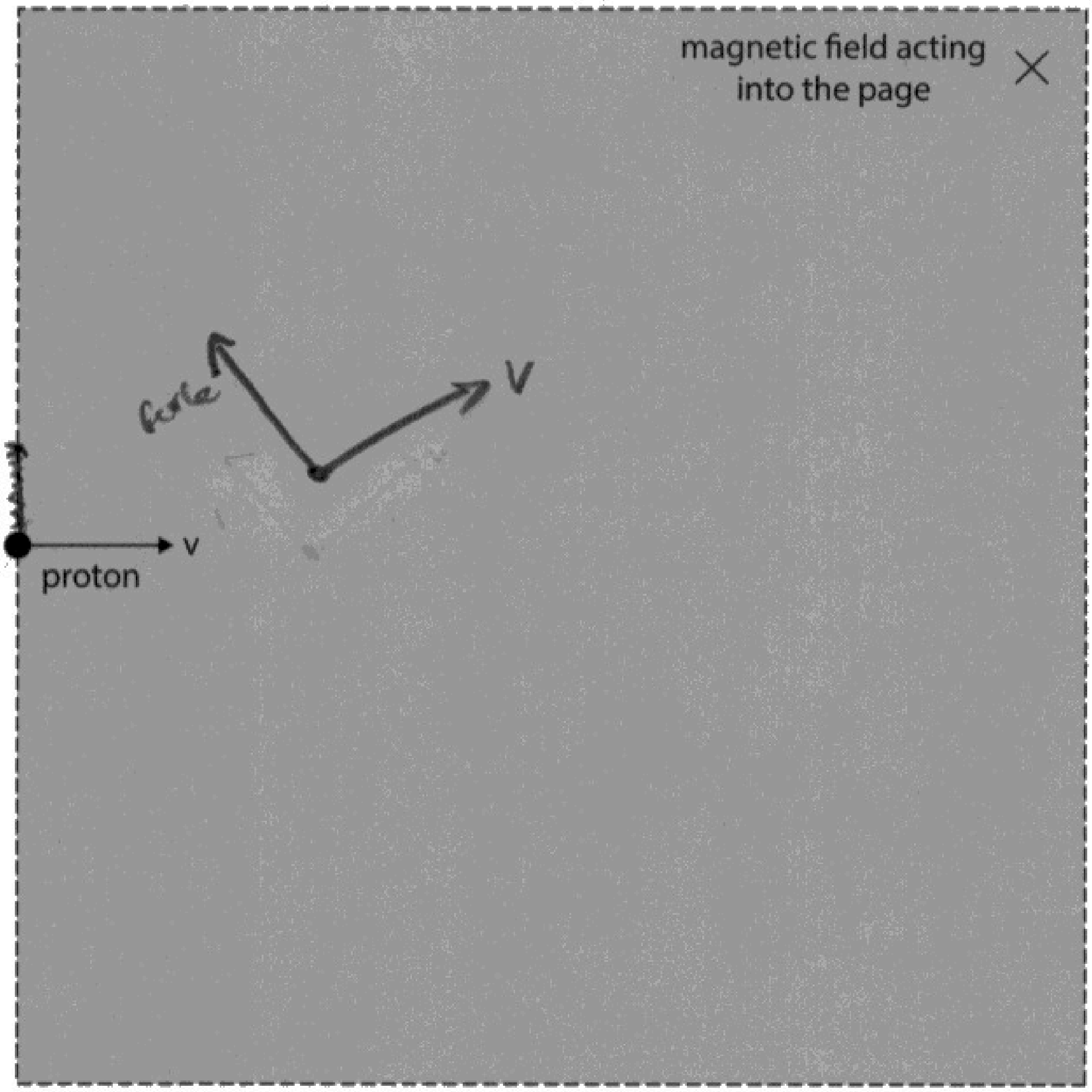
Part (b)(ii) brought together the idea that the particle would experience a force that would bend the particle's path yet the force would still be at right angles to the direction of motion.

Part (b)(iii) was a question about vectors and scalars. The velocity has changed however the speed did not. This can only happen if the velocity changes direction.

(b) A proton moves through a uniform magnetic field produced by a strong electromagnet.

The shaded area in the diagram represents the magnetic field.

The initial velocity, v, of the proton is also shown.



(i) Use the left-hand rule to determine the direction of the force acting on the proton.

(1)

upwards

(ii) Explain how the force on the proton changes as the proton moves through the magnetic field.

You may add to the diagram to help your answer.

(2)

As the proton moves through the magnetic field the force on the proton makes it change direction. As the direction of the proton changes so does the direction of the force. By using The direction of the force can be worked out using the left hand rule.

(iii) Suggest why the velocity of the proton changes.

(1)

The force acting on the proton ~~changes~~ ~~becomes~~ ~~more or less powerful~~ increases or decreases.

ResultsPlus
Examiner Comments

The diagram and the text scores the mark for part (b)(i) for this candidate.

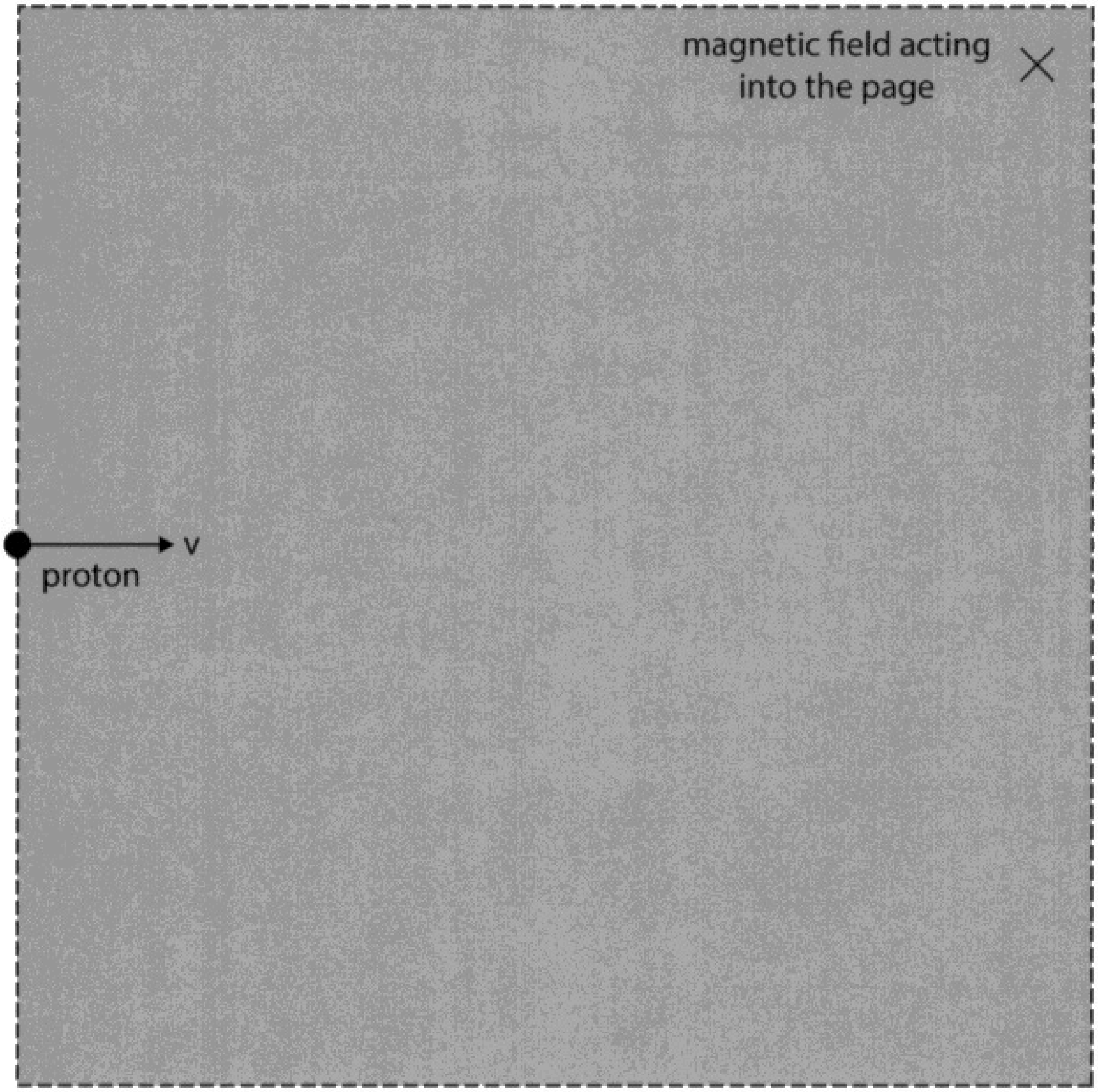
The candidate's response to part (b)(ii) is excellent. The diagram again is convincing as the path has changed direction and the direction of the force has changed. The text confirms this understanding.

Unfortunately in part (b)(iii), the candidate has slipped by saying that the velocity decreases or increases.

(b) A proton moves through a uniform magnetic field produced by a strong electromagnet.

The shaded area in the diagram represents the magnetic field.

The initial velocity, v, of the proton is also shown.



(i) Use the left-hand rule to determine the direction of the force acting on the proton.

(1)

to the right upwards

(ii) Explain how the force on the proton changes as the proton moves through the magnetic field.

You may add to the diagram to help your answer.

(2)

the force that the proton experiences increases as it moves through the magnetic field as it moves closer to the electromagnet. The force on the proton ~~Ma~~ will change direction

(iii) Suggest why the velocity of the proton changes.

(1)

because the strength of force increases drawing it ~~the~~ to the electromagnet, the velocity will change direction

(Total for Question 6 = 7 marks)

ResultsPlus
Examiner Comments

Part (b)(i) is correct here.

Part (b)(ii) is incorrect. The candidate shows a misconception here that the field direction indicator is the only field line in the diagram. The information at the top of the question is clear that the field in the shaded area in uniform and so does not change as the particle moves through it.

The candidate scores the mark in part (b)(iii), even though they have repeated the misconception about the strength of the magnetic field. They have stated that the velocity changes direction – this is good enough for the mark.

Question 7 (a)

Candidate used a wide variety of ways to express their understanding of renewable resources. Many candidates scored the mark. Those that did not either showed that they thought renewable meant that the resource was 'always available' (not the case for wind power, for example) or there was some element of recycling happening.

Question 7 (b)

As ever with questions about energy transfers and energy sources, there are two alternative routes to a full description.

The first, as set out in the 'answer' column of the mark scheme, describes each 'object' in the train of thought and which 'store' is increasing or decreasing. There are eight such stores listed in the specification.

The mark scheme goes on to describe the transfers that are taking place. There are four acceptable transfers listed in the specification.

The second route is described in the 'notes' column of the mark scheme. In this version, the candidates can write about types of energy transferring into each other and the device or object which performs that transformation.

Both routes need to be of equivalent demand.

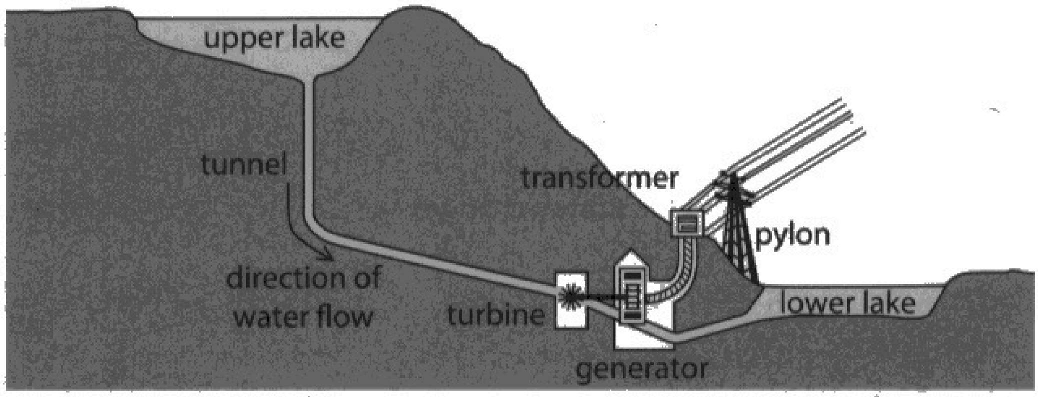
Many candidates made successful references to the gravitational potential energy (GPE) and kinetic energy (KE) of the water.

The challenging part comes at the turbine/generator stage, which candidates often got muddled.

There is a helpful guide to energy stores and energy transfers on the Pearson website:
https://qualifications.pearson.com/content/dam/pdf/International%20GCSE/Physics/2017/teaching-and-learning-materials/Energy%20stores%20and%20transfers.pdf

Example 6 refers specifically to a Hydroelectric Power (HEP) station.

(b) The diagram shows the design of a HEP station.



Water flows from the upper lake to the lower lake through the turbine.

The turbine is connected to a generator, which generates electricity.

Describe the energy transfers involved in generating electricity in the HEP station.

(4)

The gravitational potential energy of the water in the upper lake will be mechanically transfered to kinetic energy of water in the tunnel. This kinetic energy of the water will then be mechanically transfered to the kinetic store of the turbine. This energy is then transferred mechanically to the kinetic store of the generator, which can then be transfered away electrically into the national grid through the transformer.

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Examiner Comments

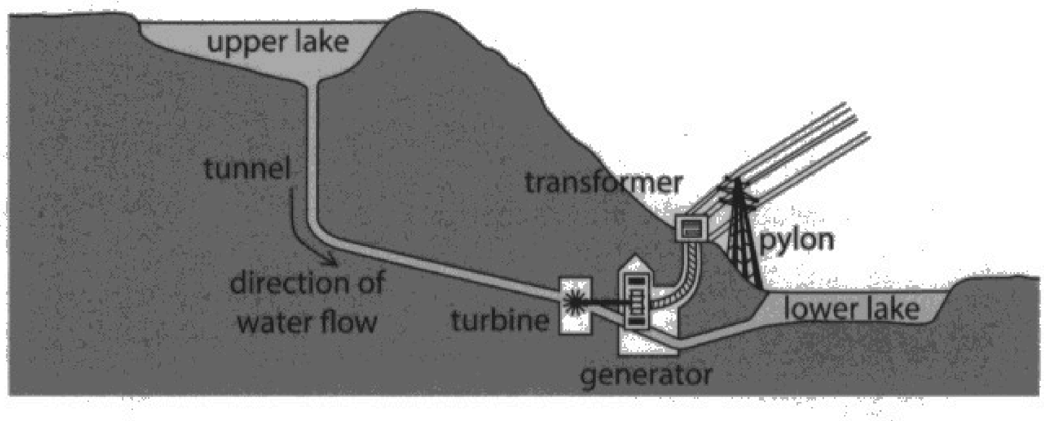
This is an excellent response, with the first three marking points all present in the first sentence.

After this first sentence, the description is clear and accurate and would easily score the rest of the marking points.

ResultsPlus
Examiner Tip

If there is specific guidance on a topic on the Pearson website, then it is a good idea to read it carefully.

(b) The diagram shows the design of a HEP station.



Water flows from the upper lake to the lower lake through the turbine.

The turbine is connected to a generator, which generates electricity.

Describe the energy transfers involved in generating electricity in the HEP station.

(4)

Kinetic energy from the water turns the turbine Kinetic energy then transfers into ~~mechanic~~ electricity and electric energy. mechanical energy turns into the electricity needed to be put into the pylons

ResultsPlus
Examiner Comments

This response is clear about the KE of the water transferring to the KE of the turbine and then to electrical energy, hence scoring 2 marks. There are some more correct words in the rest of the response however the meanings are unclear and disjointed.

Question 7 (c)(i)

Many candidates successfully identified at least one of the advantages of a hydroelectric power station over a wind turbine farm.

Question 7 (c)(ii)

Many candidates successfully described one of the disadvantages of a hydroelectric power station.

Question 7 (c)(iii)

Candidates had a broad understanding of the context; however it was the quality of technical language that prevented some candidates from scoring most of the marks. Often candidates repeated large portions of the question yet did no processing of their own.

Few candidates stated the first marking point at all. Rather more stated some acceptable version of the next three marking points.

The last marking point did not appear very often at all.

(iii) The HEP station has an electric pump that can pump water from the lower lake back to the upper lake.

The pump can be powered using electricity generated by the wind farm.

Explain how the HEP station and wind farm can be used together to maximise the effectiveness of generating electricity.

(3)

If the wind farm powers the pump when wind speeds are high and demands are low the excess electricity it creates will power the pump. the water will go into the top lake ready for when there is a large demand as HEP stations can generate electricity when demand is high. this overall reduces electricity wasted when wind speeds are high. As electricity cannot be stored effectively.

ResultsPlus
Examiner Comments

All of the relevant ideas are here. Crucially, the candidate did not use much of the wording from the question itself, increasing the likelihood of saying something creditworthy.

ResultsPlus
Examiner Tip

Try to avoid repeating large chunks of the question.

(iii) The HEP station has an electric pump that can pump water from the lower lake back to the upper lake.

The pump can be powered using electricity generated by the wind farm.

Explain how the HEP station and wind farm can be used together to maximise the effectiveness of generating electricity.

(3)

The HEP station ~~creates more elc~~ generates more electricity as it is more reliable. so by using electricity generated by wind farm water in the lower lake can be moved to the upper lake so electricity can be produced when there is a higher demand for it.

ResultsPlus
Examiner Comments

This candidate scored a mark towards the end of their response for suggesting that the HEP station can be used to respond to higher demand.

Question 8 (a)

Most candidates successfully converted the temperature in degrees C to kelvin. Some candidates subtracted 273 to give a negative number, which cannot be correct.

Question 8 (b)(i)

Virtually all candidates recognised that the energy of the molecules increases with temperature. The majority of candidates also described that it was the kinetic energy that increases.

Question 8 (b)(ii)-(iii)

Part (b)(ii) is a relatively straightforward calculation. As with previous items of this sort, if candidates responded at all, then the only common error was to omit the conversion from minutes into seconds.

Part (b)(iii) is a little more complex as there are more variables to consider. Some candidates confused the energy transfer with the specific heat capacity, for instance. Others completed the re-arrangement incorrectly. The majority of candidates, though, completed both parts relatively successfully.

If the calculation was incorrect in part (b)(ii) then ECF was applied as ever.

(ii) The table shows some information about the heating element in the water bath and the heating process.

Initial temperature of water	15 °C
Final temperature of water	60 °C
Voltage of heating element	230 V
Current in heating element	1.5 A
Time taken to heat water	45 minutes

Calculate the energy transferred by the heating element in the water bath during the heating process.

(3)

$Q = I \times t$ $\quad Q = 1.5 \times 45 = 67.5$ $\quad 1.5 \times 230 \times 45$

$E = 67.5 \times 230 = 15525$

energy transferred = 15525 J

(iii) Calculate the mass of water being heated.

Assume that all the energy is transferred to the thermal store of the water.
[for water, specific heat capacity = 4200 J / kg °C]

(3)

$60 - 15 =$ $\quad 4200 \times 45 = 189000$

$15525 = m \times 4200 \times 45$

$\frac{15525}{18900} = 0.821 = 0.82$

mass of water = 0.82 kg

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Examiner Comments

Other than forgetting to convert the time from 45 minutes into 2700 seconds, this candidate provided an excellent response.

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Examiner Tip

Check which unit is the correct unit for a substitution into a formula.

Typically:

- time should be in seconds;
- current should be in amps, rather than milli-amps;
- voltage should be in volts, rather than milli-volts;
- distances should be in metres, rather than in centimetres except where it is clear that is acceptable to do so, perhaps in moments calculations giving N cm as the unit;
- areas could be in cm^2 or m^2 depending on the context.

(ii) The table shows some information about the heating element in the water bath and the heating process.

Initial temperature of water	15 °C
Final temperature of water	60 °C
Voltage of heating element	230 V
Current in heating element	1.5 A
Time taken to heat water	45 minutes

Calculate the energy transferred by the heating element in the water bath during the heating process.

(3)

$E = I \times V \times T$

$= 1.5 \times 230 \times 45$

$= 15525$

energy transferred = 15525 J

(iii) Calculate the mass of water being heated.

Assume that all the energy is transferred to the thermal store of the water.
[for water, specific heat capacity = 4200 J/kg °C]

(3)

$\Delta Q = m \times c \times \Delta\theta$

$m = \dfrac{\Delta Q}{c \times \Delta\theta}$

$=$

mass of water = ... kg

ResultsPlus
Examiner Comments

This candidate also made the conversion slip in part (b)(ii).

In part (b)(iii), they have rearranged the formula from the inside front cover correctly but have proceeded no further.

ResultsPlus
Examiner Tip

Even if you don't think you can complete a question, always do what you can. For calculation questions, that includes either re-arranging the formula with the required quantity as the subject, or simply substituting the numbers into the correct places in the formula.

Question 8 (c)(i)

Many candidates answered this question very well. By far, most candidates scored at least one mark for mentioning the randomness of gas particles.

Less frequently, candidates mentioned that the particles are spread apart widely, however they expressed it.

(c) Some water evaporates as a gas from the water bath.

(i) Describe the arrangement of particles in a gas.

(2)

Particles are widely spread and in an irregular arrangement. Particles are often in random places due to their random, fast movements and are not closely packed or regularly arranged.

ResultsPlus
Examiner Comments

This candidate has scored both marks. They have scored the mark for 'widely spaced' very early in the response. In addition, they have made clear their knowledge about the random nature of the position of particles in a gas.

Question 8 (c)(ii)

The final item required the candidates to compare two definitions of changes of state: boiling and evaporating.

The mark scheme is very clear here about what is acceptable.

(ii) Describe **two** differences between evaporation and boiling.

(2)

1. Evaporation can occur at temperatures below boiling point whereas boiling only occurs at boiling point ~~B~~ and above.
2. Evaporation involves fewer particles changing state

ResultsPlus
Examiner Comments

The first comment by the candidate here is creditworthy. The second comment may well be true but does not cover the idea of where the two processes are happening.

(ii) Describe **two** differences between evaporation and boiling.

(2)

Evaporation can only occur on the surface of the liquid, while boiling occurs throughout the liquid. Also, evaporation can occur at many temperatures, while boiling can only occur at one temperature, which is boiling point.

ResultsPlus
Examiner Comments

This candidate has, conversely, made their knowledge of these two state changes as clear as they can.

ResultsPlus
Examiner Tip

Learn definitions from reputable sources such as the specification and endorsed textbooks where you can.

Paper Summary

Based on their performance on this paper, candidates should:

- Take care when drawing diagrams to add labels and draw accurately. To do this, they should be familiar with the names of standard apparatus used in different branches of physics.
- Ensure that they have either seen or performed practicals which test the candidate's ability to plan and investigate. There are many examples in the specification, appendix 6.
- Take note of the number of marks given for each question and use this as a guide as to the amount of detail expected in the answer.
- Take note of the command word or any specific instructions used in each question to determine how the examiner expects the question to be answered, for instance whether to give a description, an explanation or to use a particular idea ie forces.
- 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.
- Recall the units given in the specification and use them appropriately, for instance resistance.
- 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.
- Allow time at the end of the examination to check answers carefully and correct basic slips in wording or calculations.

Grade boundaries

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

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