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Examiners' Report
June 2019

GCSE Combined Science 1SC0 2PH

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Introduction

This was the second examination of 'Physics 2PH', being paper 6 of combined science at higher level, for the new specification. Questions were set to test students' knowledge, application and understanding from the seven 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 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. Four questions assessed candidates' knowledge of practical procedures, namely Qu2(b)(iii) concerning circuits, Qu3(a)(ii) concerning a magnetic field, Qu4(a) about glass marbles – a 4 mark open response question, and Qu4(b)(i) about the extension of a rubber cord. The standard of answers on practical questions has improved since last year but there is still room for further improvement. Some candidates were well acquainted with the practical work involved e.g. in the plotting of a magnetic field, and it showed in their writing, where they wrote lucidly about what you would have to do with a plotting compass in order to map out a magnetic field. There were other candidates who showed little familiarity with such an exercise though.

Students continued to do well with most calculation questions, although a significant number 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 (b) (i)

Most candidates succeeded with their answers to this question. Where they didn't it was usually a failure to include a value for 'g' in the substitution needed in the equation. Candidates are required to recall its value - 10 m/s^2.

(b) A ball has a mass of 0.046 kg.

(i) Calculate the change in gravitational potential energy when the ball is lifted through a vertical height of 2.05 m.

Use the equation

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

(2)

0.046 × 10 × 2.05 = 0.943

change in gravitational potential energy = 0.943 J

ResultsPlus
Examiner Comments

Full marks in this case.

Clearly set out substitution and evaluation.

ResultsPlus
Examiner Tip

Do set out the calculation you make in a clear manner; that way you have a chance of getting the substitute mark even if the evaluation has a mistake in it.

(b) A ball has a mass of 0.046 kg.

(i) Calculate the change in gravitational potential energy when the ball is lifted through a vertical height of 2.05 m.

Use the equation

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

(2)

~~0.460~~

0.046 × 10 × 2.05 = 0.943

46 × 10 × 2.05 = 943

change in gravitational potential energy = 943 J

ResultsPlus
Examiner Comments

The substitution mark may be given because either of the two expressions is rewarded in the mark scheme where the bracket around (0.0)46 implies that 0.046 or 46 is acceptable.

Unfortunately, the candidate then chooses the wrong answer.

ResultsPlus
Examiner Tip

N.B. watch out with this giving of alternative answers. It can backfire on you. Credit cannot generally be given for an alternative route calculation if that is not the one leading to the chosen answer.

'Hedging your bets' is penalised.

(b) A ball has a mass of 0.046 kg.

(i) Calculate the change in gravitational potential energy when the ball is lifted through a vertical height of 2.05 m.

Use the equation

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

(2)

0.046 × 2.05 = 0.0943

×100. = 9.43

change in gravitational potential energy = 9.43 J

ResultsPlus

Examiner Comments

Unfortunately a significant number of candidates did score 0 marks through not including a value of 'g' in their calculation.

Question 1 (b) (ii)

Many candidates scored 2 or 3 marks; however some of them failed to get the final evaluation because of a failure with units, using '46' rather than the needed 0.046**kg.**

Others forgot the $^1/_2$ in the kinetic energy formula and still others forgot to square v in practice.

(ii) The ball is released.

Calculate the kinetic energy of the ball when the speed of the ball is 3.5 m/s.

(3)

$K = 0.5 \times m \times s^2$

$0.5 \times 0.046 \times 3.5^2$

$= 0.28175$

kinetic energy of the ball = 0.28175 J

ResultsPlus
Examiner Comments

Full marks 3/3.

Clearly written, including the intermediate calculation.

(ii) The ball is released.

Calculate the kinetic energy of the ball when the speed of the ball is 3.5 m/s.

(3)

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

$\frac{1}{2} \times 0.046 \times 3.5\,m/s = 0.0805$

kinetic energy of the ball = 0.0805 J

ResultsPlus
Examiner Comments

This gains a mark for the recall of the kinetic energy equation, but then forgets to square the v; this invariably negates further marks.

(ii) The ball is released.

Calculate the kinetic energy of the ball when the speed of the ball is 3.5 m/s.

(3)

½ × mass × speed²

½ × 46 × 3.5²

kinetic energy of the ball = 281.75 J

ResultsPlus
Examiner Comments

In the introduction to this paper a problem with units was highlighted.

This demonstrates that.

This candidate gets the first two marks for recall of the equation and a substitution mark.

The evaluation is flawed.

ResultsPlus
Examiner Tip

To get the energy in Joules requires mass in kilograms not grams.

Physics extensively uses metres, kilograms and seconds in its calculations.

The other GCSE sciences are not so heavily dependent upon the use of these units in calculations.

(ii) The ball is released.

Calculate the kinetic energy of the ball when the speed of the ball is 3.5 m/s.

(3)

$\frac{1}{2} \times h \times v^2$

$= \frac{1}{2} \times 2.05 \times 3.5^2$

kinetic energy of the ball = 12.56 J

ResultsPlus
Examiner Comments

The failure to recall the correct formula means no marks unfortunately.

$^1/_2$ h v^2 is unfortunate.

ResultsPlus
Examiner Tip

With kinetic energy the **mass** is involved. Have you understood the idea?

Eleven more complex equations are given to candidates on the formula sheet.

There are twelve key equations that need to be learnt for paper 2.

Record them and learn them to help you to be successful.

Question 1 (b) (iii)

The vast majority of students successfully read a value of maximum height from the figure, obtaining a value between 0.8 m and 0.95 m inclusive.

Question 1 (b) (iv)

A majority of candidates scored 1 or 2 marks with this question.

Most of these explained that the ball had lost energy, but fewer candidates identified what happened to the energy.

Of those sound and heat were the most often seen rewardable answers.

Quite a number of candidates talked about air resistance and friction to no avail.

An explanation in terms of energy was required.

(iv) Explain why the ball does not bounce back to its starting height of 2.05 m.

(2)

After it's first bounce, the ball loses some of it's energy as it gets disapated to the surroundings, This means that it cannot bounce as high as it doesn't have enough energy to.

ResultsPlus
Examiner Comments

This gets two marks for 'loses some of its energy' (1) and then it ends up 'dissipated into the surroundings' (1)

ResultsPlus
Examiner Tip

With questions involving energy always ask yourself 'What is the final destination of the energy involved?'

(iv) Explain why the ball does not bounce back to its starting height of 2.05 m.

(2)

Some of the kinetic energy in the ball is transfered to the surroundings. When it hits the floor kinetic and thermal energy are both transfered to surroundings. Therefor less energy = less bounce.

(Total for Question 1 = 9 marks)

ResultsPlus
Examiner Comments

Full two marks here.

The final destination of the energy 'to the surroundings' gets the second mark.

Then at the end there is the recognition of the ball having less energy as a consequence (mark point 1).

(iv) Explain why the ball does not bounce back to its starting height of 2.05 m.

(2)

because the kinetic energy is lost when it hits the ground. It turns into thermal energy. Then with the bit of kinetic energy it has left it bounces again

ResultsPlus
Examiner Comments

This is another way of getting the two marks. Quite a number of candidates showed this understanding.

'Turns into thermal energy' obtains the second mark.

'With the bit of energy it has left . .' expresses, in the candidate's own language, the essence of the explanation here.

(iv) Explain why the ball does not bounce back to its starting height of 2.05 m.

(2)

The ball loses Kinetic energy when it bounces therefore cannot reach the same height again.

ResultsPlus
Examiner Comments

This is a typical response from the many candidates scoring one mark, gaining the first mark point but lacking the second, where some identification of what happened to the energy is required.

ResultsPlus
Examiner Tip

There are 2 marks involved. this answer has a statement, followed by a repeat of what's in the question 'cannot reach the same height again'.

Aim for two pieces of content / an elaborated explanation if you see there are two marks allocated.

Question 2 (b) (i)

The vast majority of students scored the full three marks for this, often showing a R=V/I calculation.

Occasionally there was just a bald answer of 19Ω, also scoring 3 marks, as per the mark scheme.

That could have been obtained via a V/I calculation or via simple inspection of the trend in the table.

The principle of 'award full marks for the correct answer without working' was applied, as is often the case in calculation questions.

(b) A student investigates how the current in a lamp changes with the potential difference across the lamp.

The student uses the results to calculate the resistance of the lamp.

The results are shown in the table in Figure 2.

potential difference in V	current in A	resistance in Ω
1.0	0.09	11
2.0	0.14	14
3.0	0.18	17
4.0	0.22	18
5.0	0.26	19
6.0	0.30	20

Figure 2

(i) One value of resistance is missing from the table in Figure 2.

Calculate the value of resistance that is missing from the table.

(3)

V = IR

voltage = current × resistance

5 = ~~0.26 × resistance~~

resistance = voltage / current

= 5 / 0.26

= 19.2307

= 19 (2 sf)

missing resistance = 19 Ω

ResultsPlus
Examiner Comments

Full marks.

Good clear understanding is shown by the candidate.

ResultsPlus
Examiner Tip

The principle of 'award full marks for the correct answer without working' is applied in many calculation questions.

However you should not presume upon it.

This candidate shows the best way forward, explaining their working clearly.

Question 2 (b) (ii)

This question discriminated well across the mark range.

For instance most grade 4 candidates recognised that as V increases so R increases but far fewer were able to quantify that relationship, including processing data to prove the point, as was seen in a number of grade 7+ responses.

(ii) The student writes this conclusion:

'The resistance of the lamp is directly proportional to the potential difference.'

Comment on the student's conclusion.
Use information from Figure 2 in your answer.

(3)

I think that the student is incorrect as when the ~~point~~ p.d increased by 2 times from 1v to 2V the resistance increased by less than 2 times. $\frac{14}{11} \approx 1.3$. When the potential difference increased by 25% from 4 to 5 the resistance only increased by $\frac{19}{18} = 1.05$ (5%). So the resistance is not directly proportional to p.d. as it increases by less amount than p.d.

ResultsPlus
Examiner Comments

This is an excellent well conceived answer addressing the nub of the situation.

Direct proportionality, examined by looking at whether variables actually double together or not, is perceptively gone into, using data effectively (mark point 3).

ResultsPlus
Examiner Tip

Direct proportionality happens when an independent variable doubling results in the dependent variable also doubling.

Look at data then, like this candidate has, to see if that is the case or not.

(ii) The student writes this conclusion:

'The resistance of the lamp is directly proportional to the potential difference.'

Comment on the student's conclusion.
Use information from Figure 2 in your answer.

(3)

It is not directly proportional, because when the potential difference doubles to 4, the resistance only goes from 14 to 18 Ω, therefore it didn't double. This means that student's conclusion is wrong

ResultsPlus
Examiner Comments

This also scores all three marks via a doubling argument, choosing different data points from the first example, to see if the resistance doubled when the potential difference doubled.

ResultsPlus
Examiner Tip

This is a coherent direct answer to the question involving refuting the contention, backed up with evidence.

Aim for this directness of approach in your answers.

(ii) The student writes this conclusion:

'The resistance of the lamp is directly proportional to the potential difference.'

Comment on the student's conclusion.
Use information from Figure 2 in your answer.

(3)

The Student is correct as the potential difference increases as the amount of resistance increases.
Potential difference = current x resistance.

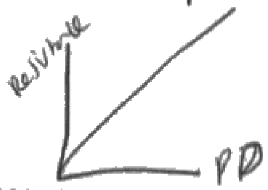
ResultsPlus
Examiner Comments

This is a characteristic answer from a grade 4 candidate, not going much further than seeing if V increases R does too.

(ii) The student writes this conclusion:

'The resistance of the lamp is directly proportional to the potential difference.'

Comment on the student's conclusion.
Use information from Figure 2 in your answer.



(3)

• Voltage is directly proportional to current.
• This is not supported by figure 2 because as the voltage increases the resistance also increases but is not directly proportional because as voltage doubles the resistance varies and does not double. It's a linear relationship.
• The resistance of lamp varies as it gets hot.

ResultsPlus
Examiner Comments

This matches mark point 1 and mark point 2, but the candidate has not supported their assertion with the use of some processing of data (mark point 3)

2 marks awarded

ResultsPlus
Examiner Tip

When the question says 'Use information from Figure 2' in your answer you ought to know that means select data and process it to prove the point or otherwise.

Question 2 (b) (iii)

A quarter of all the candidates knew that the obvious choice was to use a variable resistor.

Many fewer went on to explain that this needed to be associated with putting the variable resistor in series with the battery and the lamp.

(iii) The student used a power supply that had fixed output voltage settings. Each of these outputs was a whole number of volts.

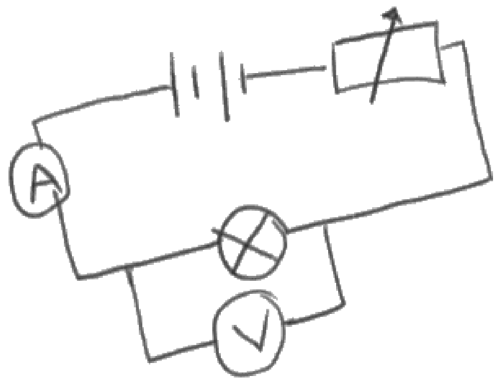
Describe how the student could add a component to the circuit that would provide a continuously variable voltage across the lamp.

(2)

The Student could add a Variable resistor which is ~~put~~ in a Series circuit at the Start next to the battery and opposite the ammeter on the other Side of the circuit.

(diagram)

(Total for Question 2 = 9 marks)



ResultsPlus
Examiner Comments

This is the most perfect answer, including the insertion of the variable resistor in series with the ammeter and power supply.

ResultsPlus
Examiner Tip

Diagrams are encouraged. They focus the mind in a question like this.

This diagram obtains all 2 marks by itself.

(iii) The student used a power supply that had fixed output voltage settings. Each of these outputs was a whole number of volts.

Describe how the student could add a component to the circuit that would provide a continuously variable voltage across the lamp.

(2)

The Student Could add a variable resistor in Series in the circuit. This would allow the voltage across the lamp to be changed up (to the output voltage of the power Supply) or down (to 0v) using a physical dial.

ResultsPlus
Examiner Comments

This scores mark point 1 and mark point 2 in the first sentence.

The candidate shows a good understanding, included in the physical dial comment.

(iii) The student used a power supply that had fixed output voltage settings. Each of these outputs was a whole number of volts.

Describe how the student could add a component to the circuit that would provide a continuously variable voltage across the lamp.

(2)

The student could add a variable resistor so that they can control the voltage across the lamp and circuit. The more resistance the dimmer the light.

(Total for Question 2 = 9 marks)

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Examiner Comments

This candidate chooses the correct component but does not then add anything to the naming of that component to score the other mark.

Adding an explanation at the end does not answer the question 'describe how'.

(This was a more typical response; not many went on to include the in series aspect.)

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Examiner Tip

'Describe how' questions feature as common place in our exam papers these days.

Just stick to describing the experimental part - set up. A diagram, as with the earlier candidate, would have enabled both mark points to be achieved.

Question 3 (a) (ii)

This question differentiated well. Higher attaining candidates could often achieve several marks, with ideas about the use of a plotting compass or suggesting the use of iron filings.The responses varied a lot though. Where they had laboratory experience with this it tended to shine through with a spelling out of clear practical steps.

Lower attaining candidates could often achieve a mark, with some idea about the use of a plotting compass or suggesting the use of iron filings, but not going much further with that idea.

(ii) Describe how the student could develop the investigation to find the shape of the magnetic field produced by the current.

(3)

The student could then mark where the top of the needle ends and replace the compass at this point and continously repeat this round the wire. By joining up all the points the student is able to find the shape of the Magnetic field around the wire.

ResultsPlus
Examiner Comments

This answer follows the 'using single compass' route in the mark scheme, matching each of the mark points well.

ResultsPlus
Examiner Tip

Try to recall what you did in your lab work and describe it so someone else can follow your method.

This candidate has done that very well.

(ii) Describe how the student could develop the investigation to find the shape of the magnetic field produced by the current.

(3)

By plotting several compass needles around the wire and marking what direction the needle goes in. when all compasses are set around the wire join up the direction marks of the needle. it should make a circle around the wire. (a single wire's magnetic field is in the shape of a circle)

ResultsPlus
Examiner Comments

This is an excellent answer showing a grasp of the practical details and appreciation of the shape of the field, which helps access mark point 3.

ResultsPlus
Examiner Tip

This 'describe how' question requires you to convey practical steps that could enable someone to carry out what you've detailed.

This answer does just that, including telling you what to look out for in the final pattern of field expected.

(ii) Describe how the student could develop the investigation to find the shape of the magnetic field produced by the current.

(3)

put ~~Iron~~ iron filings on the card and shake it around a bit and see ~~the~~ the iron filings have made a curve around the wire with a current. That will then show the magnetic field.

ResultsPlus
Examiner Comments

This matches the third route of the mark scheme - using iron filings.

The candidate does particularly well in not forgetting the tap/shake the card aspect - most candidates missed that out taking this route.

They also appreciate the resultant field the iron filings pattern would show convincing the examiner that mark point 3 was met.

ResultsPlus
Examiner Tip

Such a simple thing: tap the card.

In practice if you don't do that you won't see the field pattern very clearly.

'Describe how' answers need small, seemingly insignificant, details like this to ensure the method works.

Please think about **stating the obvious**.

(ii) Describe how the student could develop the investigation to find the shape of the magnetic field produced by the current.

(3)

they could ~~#~~ turn the current off through the wire Spred Some iron fillings evenly around the wire on the Pice of card then turn the current back on and the iron fillings would move into the shape of the magnetic feild.

ResultsPlus
Examiner Comments

For the iron filings route the switching action was allowed as an alternative to mark point 2: tap card.

(ii) Describe how the student could develop the investigation to find the shape of the magnetic field produced by the current.

(3)

The student should place a plotting compass on the card near the charged wire then mark where the arrow is pointing with a pen/pencil. Then place the plotting compass so the back of the arrow is where the mark is then mark where the ~~the~~ arrow is pointing. Repeat this process.

ResultsPlus
Examiner Comments

This answer matches the first route of the mark scheme but only gets 2 marks because they fail to explain how connecting the marks will end up revealing the field pattern.

(ii) Describe how the student could develop the investigation to find the shape of the magnetic field produced by the current.

(3)

The student could put down mettel ~~filings~~ filings to find the exact magnetic field as they would move towards it.

ResultsPlus
Examiner Comments

'Metal filings' was not accepted. Iron filings would have been, for a mark.

(ii) Describe how the student could develop the investigation to find the shape of the magnetic field produced by the current.

(3)

An investigation taken could be the right-tumb rule. Where the right thumb is facing the direction of the current. The other fingers then coil up together and the direction they are in is the magnetic field's direction.

ResultsPlus
Examiner Comments

This was seen too often.

It is not describing practical steps.

No marks.

Question 3 (b) (ii)

Only a very few candidates achieved the mark here. Many thought that one force was greater than the other.

(ii) The interaction between the magnetic fields produced by the magnet and the current in the wire produces forces on the magnet and the wire.

Compare these two forces.

(1)

they are equal and opposite forces interacting with each other.

ResultsPlus
Examiner Comments

Full marks to this candidate.

ResultsPlus
Examiner Tip

Newton's third law is applied to this situation.

Not considered by the vast majority of candidates unfortunately.

Interacting forces occur with force on the magnet (object A) being equal and opposite to the force on the wire (object B)

(ii) The interaction between the magnetic fields produced by the magnet and the current in the wire produces forces on the magnet and the wire.

Compare these two forces.

(1)

The two forces form an action-reaction pair as they're equal but opposite.

ResultsPlus

Examiner Comments

Full marks; well pointed out application by the candidate.

Question 3 (b) (iii)

Over half of the candidates got 2 or 3 marks from this.

Some slipped up on the algebraic manipulation.

Some forgot to convert mm to m, resulting in an eventual power of ten error.

A number of candidates just tried multiplying the three numbers given in the question together.

(iii) Figure 5 shows a different wire inside a uniform magnetic field.

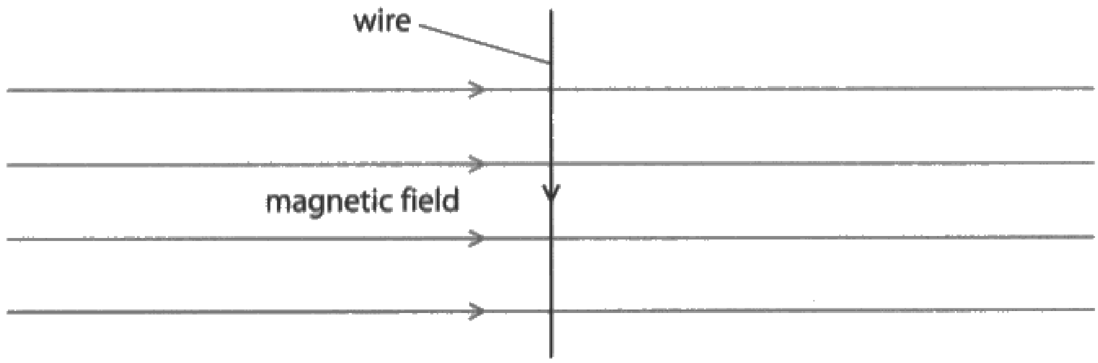


Figure 5

The magnetic flux density of the magnetic field is 0.72 N/A m.
The length of the wire inside the field is 30 mm.
The size of the force due to the magnetic field on the wire is 0.045 N.

Calculate the size of the current in the wire.

Use an equation selected from the list of equations at the end of this paper.

(3)

(Magnetic flux density × length) ÷ force

(0.72 × 30) ÷ 0.045 = 480

current in the wire = 480 A

(Total for Question 3 = 9 marks)

ResultsPlus
Examiner Comments

This answer scored the substitution mark only.

Allowed with the incorrect algebraic manipulation.

ResultsPlus
Examiner Tip

The candidate should have given a full equation, stating Current, I, =

Some benefit of doubt was applied.

When you re-arrange an equation you should state the full equation, not just the right hand side. . .

(iii) Figure 5 shows a different wire inside a uniform magnetic field.

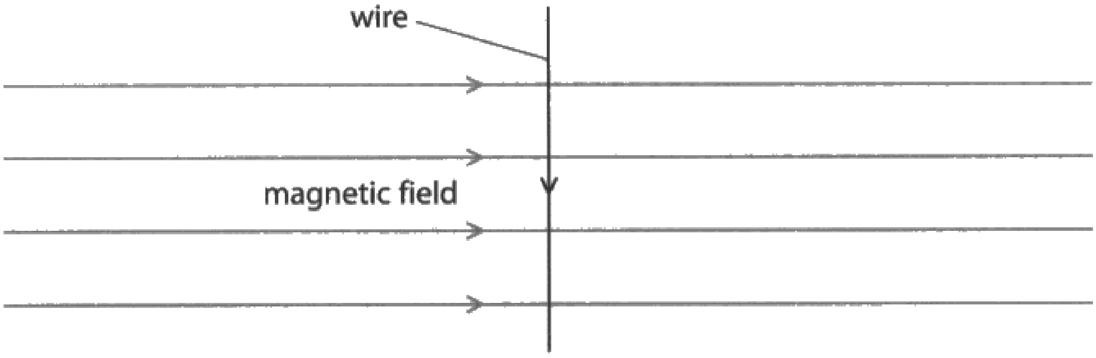


Figure 5

The magnetic flux density of the magnetic field is 0.72 N/A m.
The length of the wire inside the field is 30 mm. → 0.03 m
The size of the force due to the magnetic field on the wire is 0.045 N.

Calculate the size of the current in the wire.

Use an equation selected from the list of equations at the end of this paper.

(3)

$F = B \times I \times l$

$I = \frac{F}{B \times l} = \frac{0.045}{0.72 \times 0.03} = 2.083$

$= 2.1$

current in the wire = 2.1 A

(Total for Question 3 = 9 marks)

ResultsPlus
Examiner Comments

Full marks.

Very clearly set out, including converting millimetres correctly to metres.

Correct re-arrangement, substitution and evaluation.

ResultsPlus
Examiner Tip

Set your work out clearly as this candidate has.

This candidate shows the best practice doing the algebra first then substituting. That way minimises the chances of making mistakes with numbers, in copying them down from one part of the calculation to another.

(iii) Figure 5 shows a different wire inside a uniform magnetic field.

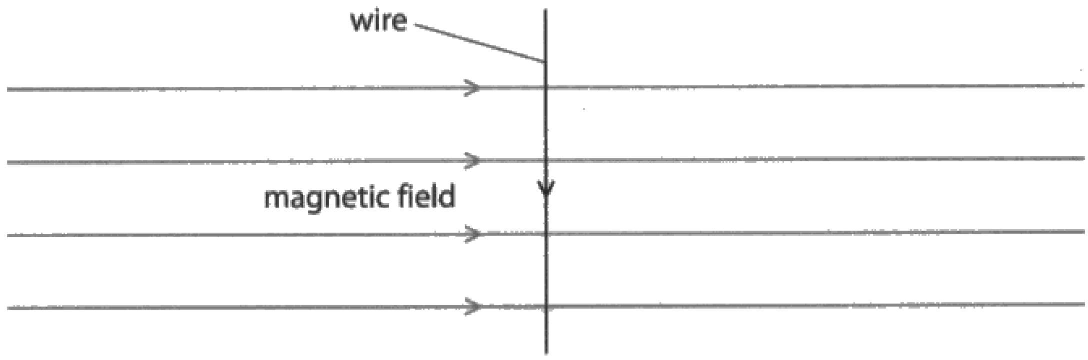


Figure 5

The magnetic flux density of the magnetic field is 0.72 N/A m.
The length of the wire inside the field is 30 mm.
The size of the force due to the magnetic field on the wire is 0.045 N.

Calculate the size of the current in the wire.

Use an equation selected from the list of equations at the end of this paper.

(3)

~~E = I x V x t~~

~~current = voltage x~~

$F = B \times I \times L$

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

$\frac{0.72 \times 30}{0.045} = 48$

current in the wire = 480 A

ResultsPlus
Examiner Comments

This is still 1 mark only for the substitution.

The working is clearer than the previous candidate.

ResultsPlus
Examiner Tip

More information was given by this candidate but the failure to re-arrange the equation correctly meant that only 1 mark could have been obtained.

Algebraic manipulation - changing the subject of an equation here - is a very important skill in physics calculations.

You should work on this.

(iii) Figure 5 shows a different wire inside a uniform magnetic field.

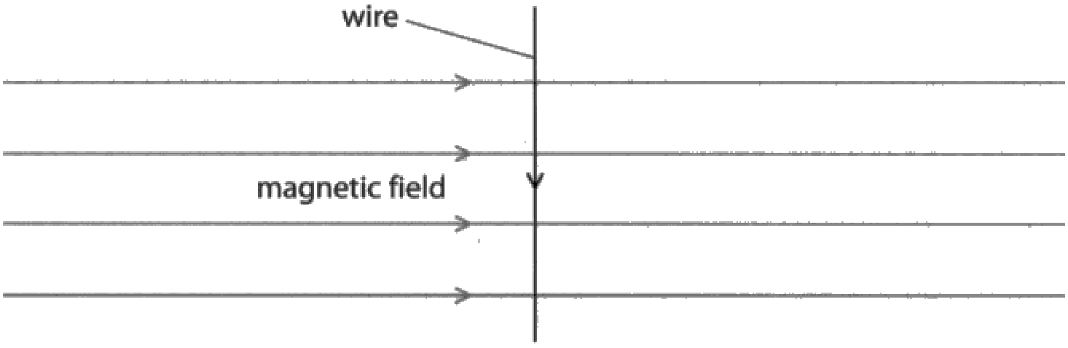


Figure 5

The magnetic flux density of the magnetic field is 0.72 N/A m.
The length of the wire inside the field is 30 mm.
The size of the force due to the magnetic field on the wire is 0.045 N.

Calculate the size of the current in the wire.

Use an equation selected from the list of equations at the end of this paper.

(3)

force on a conductor at right angles to a magnetic field carrying a current = magnetic flux density × current × length

0.72 × current × 30

~~0.72 ×~~

~~current =~~ ~~force / density × length~~ ~~density × force / length~~

current = force / density × length

~~current~~ ~~0.045 / 0.72 × 30 = 0.002083~~

~~0.72 × 0.045 / 30 = 1.08×10^-3~~

0.045 / 0.72 × 30

current in the wire = 0.002083 A

ResultsPlus
Examiner Comments

2 marks obtained, one for re-arrangement, one for substitution.

The failure to convert mm to m resulted in the answer being 1000 times too small.

ResultsPlus
Examiner Tip

Remember metres-kilograms- seconds for most calculations in physics. . . .

(iii) Figure 5 shows a different wire inside a uniform magnetic field.

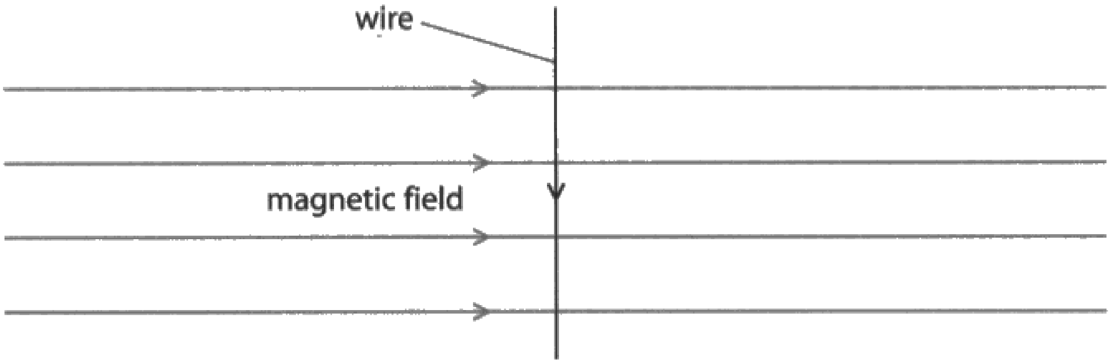


Figure 5

The magnetic flux density of the magnetic field is 0.72 N/A m.
The length of the wire inside the field is 30 mm.
The size of the force due to the magnetic field on the wire is 0.045 N.

Calculate the size of the current in the wire.

Use an equation selected from the list of equations at the end of this paper.

(3)

$F = B \times I \times l$

$0.045 = 0.72 \times I \times 0.03$

$0.045 = 0.0216 \times I$

$\frac{0.045}{0.0216} = I$

$\frac{25}{12} = I$

$2.08\dot{3} = I$

current in the wire = $2.08\dot{3}$ A

ResultsPlus
Examiner Comments

This candidate substitutes first then re-arranges.

Either this way or as the first candidate did secures all the marks.

ResultsPlus
Examiner Tip

The first candidate chose the preferred way, one which limits the chances of making mistakes on the way.

Question 4 (a)

The answers to this question were many and varied. Some obtained full marks, but those candidates were few in number.

In answering this question candidates did some illogical things eg weighing the measuring cylinder with water, then with water and marbles, but then neglecting to find volume.

There were some very mixed responses to this item.

4 (a) A student measures the density of glass.

The student has

- a bag of marbles, all made from the same type of glass
- a weighing balance
- a plastic measuring cylinder containing water

Describe how the student could find, as accurately as possible, the density of the glass used for the marbles.

(4)

Density is calculated using the equation density = mass ÷ vol. So the first measure they have to take is the mass of the marbles. This is done by placing them on the weighing balance. This mass needs to then be recorded. After that, the measuring cylinder containing water must be recorded with the value of original volume of water. Then the marbles must be added to it. This final value must then be recorded. The volume of the marbles is final volume - initial volume. The mass and volume must then be put into the equation.

ResultsPlus
Examiner Comments

This is one of the few responses talked about in the introductory comments to this question.

This student gains all four of the marking points with exemplary clarity and focus on all that needs to be done.

ResultsPlus
Examiner Tip

In 'describe how' questions, like this, consider all that has to be done, including recalling how to calculate the density, which is part of finding the density.

'Describe how' not only requires practical details but also for you to state how you would calculate the desired result. In that way it's similar in structure to an average speed question, where you would need to quote speed = total distance / time

4 (a) A student measures the density of glass.

The student has

- a bag of marbles, all made from the same type of glass
- a weighing balance
- a plastic measuring cylinder containing water

Describe how the student could find, as accurately as possible, the density of the glass used for the marbles.

(4)

The student should find the mass of the marbles using the weighing balance. Then ~~to~~ measure out 100 cm³ ~~50cm³~~ of water in the measuring cylinder, place the marbles into the measuring cylinder and ~~measure the~~ record the new volume of water. ~~the~~ Subtract the initial volume by the final volume of the water to find the volume of the marbles. Then use the calculation Density = mass ÷ volume to find the density

ResultsPlus
Examiner Comments

Also full marks, with this candidate leaving it until the end to explain the calculation needed.

Note that mark point 4, using several marbles not just one ie a method yielding greater accuracy, was often achieved by candidates in passing - an explicit reference to improved accuracy was not needed.

ResultsPlus
Examiner Tip

The more the merrier.

To find the thickness of one sheet of paper measure the thickness of 50 or a hundred sheets and then divide.

Here, use as many marbles as possible to incorporate this increase in accuracy.

4 (a) A student measures the density of glass.

The student has

- a bag of marbles, all made from the same type of glass
- a weighing balance
- a plastic measuring cylinder containing water

Describe how the student could find, as accurately as possible, the density of the glass used for the marbles.

(4)

~~As you add~~ Start off by measuring the weight of each marble and measure how much water you have in the cylinder. As you put in a marble (one at a time) you measure on the cylinder how much the water has gone up by. Write down your results and see how much the water has raised altogether. You would then get the initial weight of the marbles and take it away from how much the water increased to find the density of the glass.

ResultsPlus
Examiner Comments

This candidate scores mark point 1 - find the mass of a marble, followed by how to find the volume - mark point 2 well described.

Unfortunately they forget to quote the formula to be used and neglected to think about why using a whole bag of marbles together, when weighing, might benefit them

4 (a) A student measures the density of glass.

The student has

- a bag of marbles, all made from the same type of glass
- a weighing balance
- a plastic measuring cylinder containing water

Describe how the student could find, as accurately as possible, the density of the glass used for the marbles.

(4)

Measure the weight of ~~the~~ a marble using the weighing ~~scale~~ balance. Measure the amount of water dispesed from the plastic measuring cylinder when a marble is added. times the two results together to get the density.

ResultsPlus
Examiner Comments

Gains mark point 1 first of all - finding the mass of a marble.

Doesn't get a mark for finding the volume - their term 'measure the amount of water dispersed' is insufficient. 'Measure the volume of water displaced' would have been credited for the second mark point. Unfortunately, the candidate also can't recall the correct equation for density, limiting themselves even further.

Question 4 (b) (i)

Most candidates scored 2 or 3 marks out of 3 for this item.

Substituting values generally proved to be no problem but some had trouble with the re-arrangement, the units (e.g. kg needed) and powers of 10 on their calculators

(b) A beaker contains 0.25 kg of water at room temperature.
The beaker of water is heated until the water reaches boiling point (100 °C).
The specific heat capacity of water is 4200 J/kg °C.
The total amount of thermal energy supplied to the water is 84 000 J.

(i) Calculate the temperature of the water before it was heated.

Use an equation selected from the list of equations at the end of this paper.

(3)

Δthermal energy = mass × specific heat capacity × Δ temperature.

$$\Delta\text{temperature} = \frac{\Delta\text{thermal energy}}{\text{mass} \times \text{specific heat capacity}}$$

$$= \frac{84000}{0.25 \times 4200} = 80$$

100 − 80 = 20

temperature before heating = 20 °C

ResultsPlus
Examiner Comments

This is a model answer, re-arranging the equation, then substituting and not forgetting to perform the final subtraction.

(b) A beaker contains 0.25 kg of water at room temperature.
The beaker of water is heated until the water reaches boiling point (100 °C).
The specific heat capacity of water is 4200 J/kg °C.
The total amount of thermal energy supplied to the water is 84 000 J.

(i) Calculate the temperature of the water before it was heated.

Use an equation selected from the list of equations at the end of this paper.

(3)

~~Thermal energy~~
change in thermal = mass × SHC ~~SEH~~ × change in temp.
84'000 = 0·25 × 4200 × (100 − heat before)
84'000 = 1050 × (100 - heat before
80 = 100 - heat before
heat before = 20

temperature before heating = 20 °C

ResultsPlus
Examiner Comments

This is an answer that scores all three marks, arriving at the correct evaluation.

The misnomer of using the term 'heat before' when the correct term is initial temperature / temperature before is not penalised when you get the correct answer.

(b) A beaker contains 0.25 kg of water at room temperature. volume (m³)
The beaker of water is heated until the water reaches boiling point (100 °C).
The specific heat capacity of water is 4200 J/kg °C.
The total amount of thermal energy supplied to the water is 84 000 J.

(i) Calculate the temperature of the water before it was heated.

Use an equation selected from the list of equations at the end of this paper.

(3)

~~thermal energy for change of state=~~

Change in thermal energy = mass x specific heat capacity x temperature

$$\frac{\text{change in thermal energy}}{\text{mass x specific heat capacity}}$$

$$\frac{84{,}000}{0.25 \times 4200} = 80^\circ$$

temperature before heating = 80 °C

ResultsPlus
Examiner Comments

There is a substitution mark and a re-arrangement mark. Unfortunately the final answer given (Δθ) misses out calculating the final temperature.

ResultsPlus
Examiner Tip

Look what the question asks for.

Understand that Δθ measures a temperature difference, but needs an extra subtraction to get the final temperature of the water.

(b) A beaker contains 0.25 kg of water at room temperature.
The beaker of water is heated until the water reaches boiling point (100 °C).
The specific heat capacity of water is 4200 J/kg °C.
The total amount of thermal energy supplied to the water is 84 000 J.

(i) Calculate the temperature of the water before it was heated.

Use an equation selected from the list of equations at the end of this paper.

(3)

Change in thermal energy = mass × specific heat × change in temp

84000 = 0.25 × 4200 × ____

$0.0125 = \frac{0.25 \times 4200}{84000} = 0.0125$

100 − 0.0125

= 99.9875

temperature before heating = 99.9875 °C

ResultsPlus
Examiner Comments

This candidate scores a mark for substituting into the chosen equation from the equation sheet.

Unfortunately they do not progress due to a wrong re-arrangement.

ResultsPlus
Examiner Tip

Although limited progress has been made, every mark counts.

So at least choose an equation, when requested, and put in values.

It would be best to master the skill of changing the subject of an equation.

(b) A beaker contains 0.25 kg of water at room temperature.
The beaker of water is heated until the water reaches boiling point (100 °C).
The specific heat capacity of water is 4200 J/kg °C.
The total amount of thermal energy supplied to the water is 84 000 J.

(i) Calculate the temperature of the water before it was heated.

Use an equation selected from the list of equations at the end of this paper.

(3)

250g water $\frac{84000}{4200} = 20$

~~250 × 20~~ $\frac{250}{20} = 12.5$

temperature before heating = 12.5 °C

ResultsPlus
Examiner Comments

Paradoxically 84000/4200 gives a number equating to the final answer, but this calculation is based upon a totally erroneous equation. No credit.

The second calculation, which the candidate chooses for their final answer has no credit either.

ResultsPlus
Examiner Tip

It's of little use randomly putting numbers into multiplications or divisions without any basis.

This is just conjuring with numbers and it is immediately recognised by examiners.

It's best to learn some physics. . .

Question 4 (b) (ii)

Most candidates scored 2/2 on this one.

Candidates found it to be a much more straightforward simple choice of equation and re-arrangement than the previous item.

(ii) The heating continues until 0.15 kg of the water has turned into steam.
The thermal energy needed to turn the boiling water into steam is 0.34 MJ.

Calculate the specific latent heat of vapourisation of water.
Use an equation selected from the list of equations at the end of this paper.

(2)

$Q = m \times L$

~~340000~~

$L = \frac{Q}{m}$

$L = \frac{0.34}{0.15}$

specific latent heat = 2.26 MJ/kg

ResultsPlus
Examiner Comments

Full marks.

Well set out answer explaining what the candidate has done.

ResultsPlus
Examiner Tip

Even if it is simple / straightforward for you, communicate what you've done in order to gain intermediate marks in case you slip up on the way.

(ii) The heating continues until 0.15 kg of the water has turned into steam. ↗ × 10³
The thermal energy needed to turn the boiling water into steam is 0.34 MJ.

Calculate the specific latent heat of vapourisation of water.
Use an equation selected from the list of equations at the end of this paper.

(2)

thermal energy = mass × slh

$0.34 \times 10^3 = 340$ J

340 J = 0.15 × slh

slh = 2266.6̇

specific latent heat = 2266.6̇ MJ/kg

ResultsPlus
Examiner Comments

A typical loss of a mark here when the candidate misunderstood the units involved.

ResultsPlus
Examiner Tip

The question had a value for energy in MJ and the final answer was in MJ / kg, so no conversion of units was needed!

No need to make it more complicated than it is.

Question 4 (b) (iii)

A majority of candidates scored 0 on this question, commenting on the basic shape of the graph thinking it (wrongly) represented the variation of density directly.

A few candidates went beyond what greeted the eye to show comprehension that density behaved in an opposite manner to the volume and so produced correct descriptions of before and after 4°C.

(iii) The graph in Figure 6 shows how the **volume** of 1 kg of water changes with temperature.

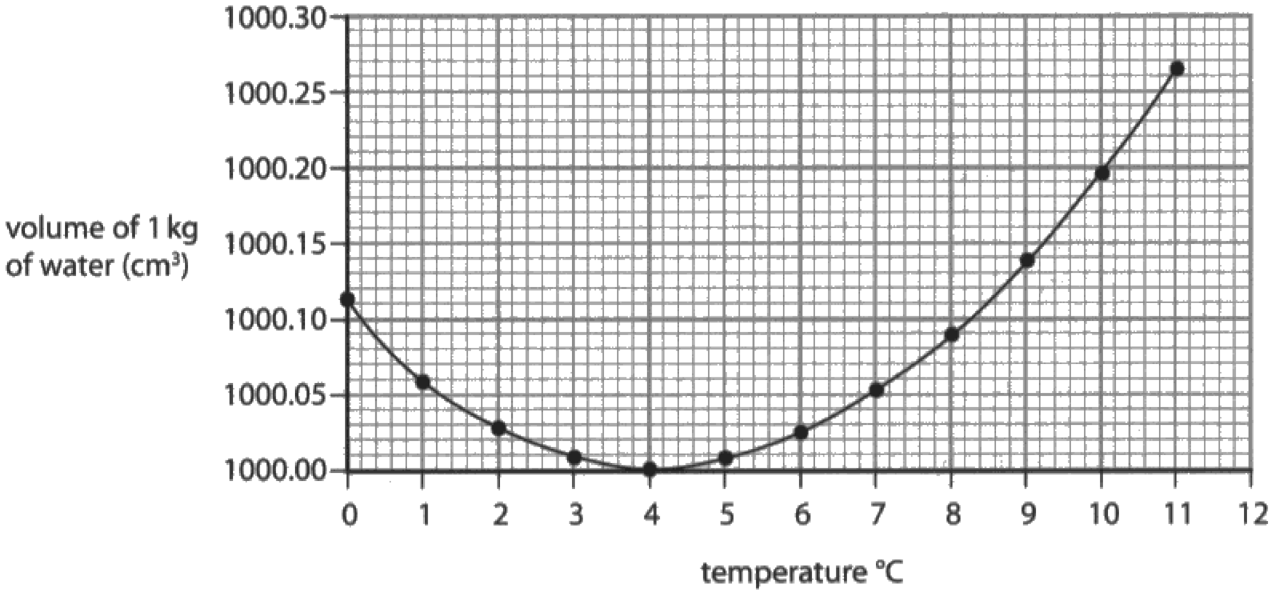


Figure 6

Describe how the **density** of water changes with temperature over the range of temperature shown in Figure 6.

Calculations are not required.

(2)

From 0-4°C, the density is ~~decreasing~~ increasing as the volume is decreasing. However from 4-11°C, the density is decreasing as the volume is increasing.

ResultsPlus
Examiner Comments

This answer is spot on.

Full marks.

Going beyond what greets the eye in the graph.

ResultsPlus
Examiner Tip

Notice how the candidate has had a moment of reflection and has corrected themselves.

It probably came through having another look at the question and the graph y-axis and thinking it through.

Such a process can save you marks and improve your grade.

Don't jump too readily to conclusions; pause for thought.

(iii) The graph in Figure 6 shows how the **volume** of 1 kg of water changes with temperature.

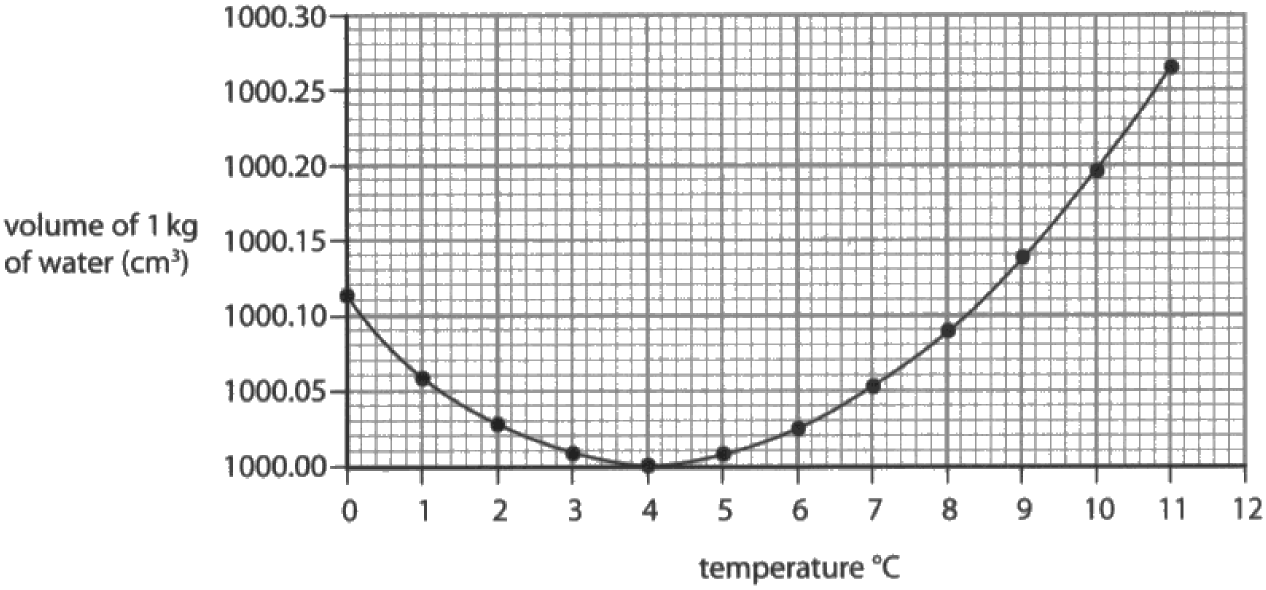


Figure 6

Describe how the **density** of water changes with temperature over the range of temperature shown in Figure 6.

Calculations are not required.

(2)

Over the range of temperatures, the volume of water increases & decreases. Density = mass / volume and so when volume increases, density of water decreases and vice versa

ResultsPlus
Examiner Comments

This response gets 1 mark for the 'Additional guidance' statement in the mark scheme:

"if no other marks scored then credit reference to large volume means low density (OWTTE) for 1 mark only"

ResultsPlus
Examiner Tip

If you are to describe what's going on, 'over the range', as the question puts it, there must be a response to what happens below and above 4°C.

(iii) The graph in Figure 6 shows how the **volume** of 1 kg of water changes with temperature.

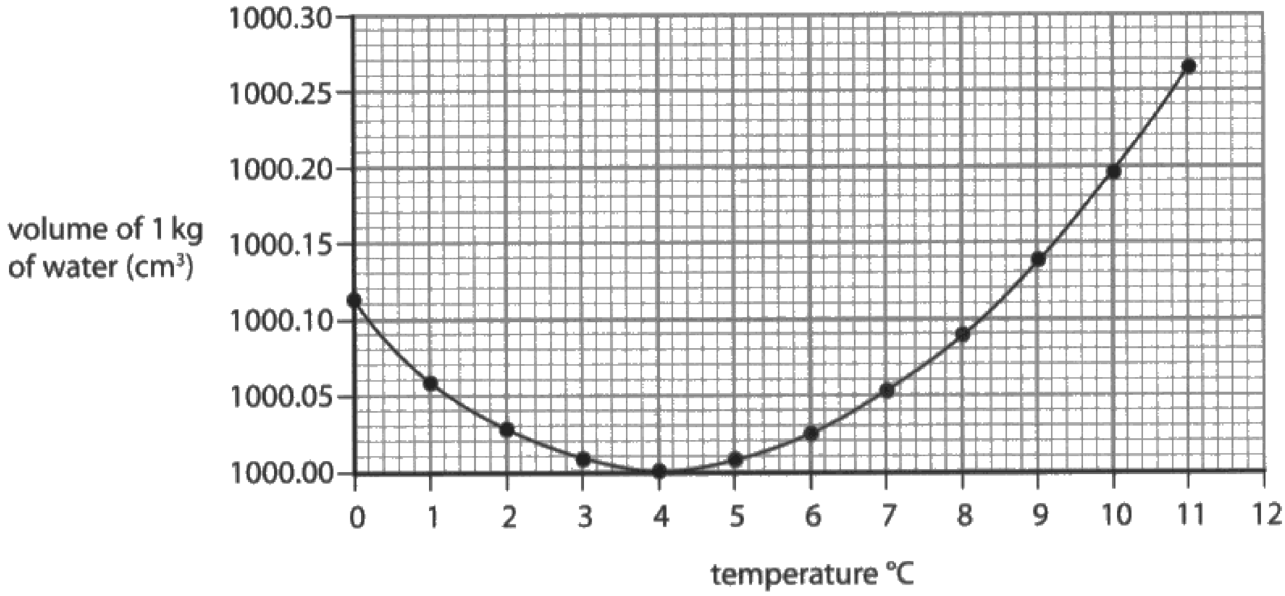


Figure 6

Describe how the **density** of water changes with temperature over the range of temperature shown in Figure 6.

Calculations are not required.

(2)

As the temperature levels rise, firstly the density of the water becomes lower due to the substance melting, however once it gets to 4°C the density of the water starts to rise again.

ResultsPlus
Examiner Comments

This was a typical response unfortunately just regarding the y-axis as representing density, which it didn't.

ResultsPlus
Examiner Tip

Read the question carefully.

Study axes of graphs carefully; the y-axis is **volume** of 1kg of water.

As volume of this fixed mass goes up density goes down.

So the entire behaviour is the opposite to that which the candidate describes here.

(iii) The graph in Figure 6 shows how the **volume** of 1 kg of water changes with temperature.

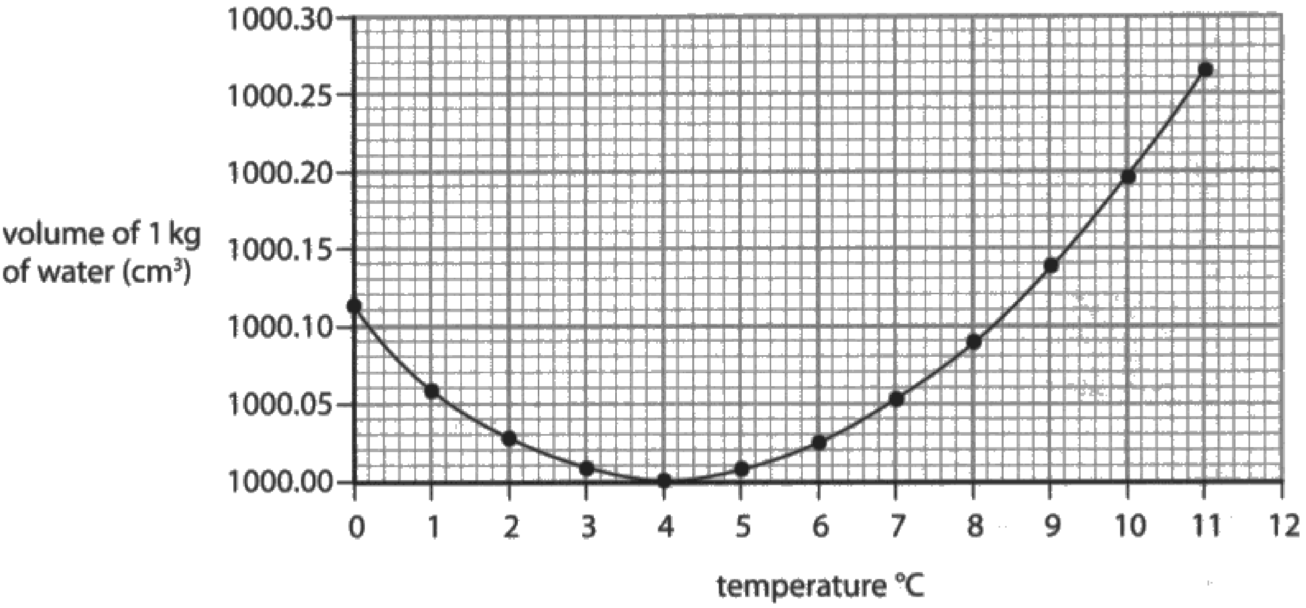


Figure 6

Describe how the **density** of water changes with temperature over the range of temperature shown in Figure 6.

Calculations are not required.

(2)

As the temperature increases the volume and the density also increases.

ResultsPlus Examiner Comments

0 marks

No such general trends exist in this scenario.

Question 5 (a) (i)

Approximately a third of the candidates scored one or two marks on this.

The successful candidates could sift through the three pieces of information and select P= E/t from memory.

5 (a) Figure 7 shows an athlete using a fitness device.

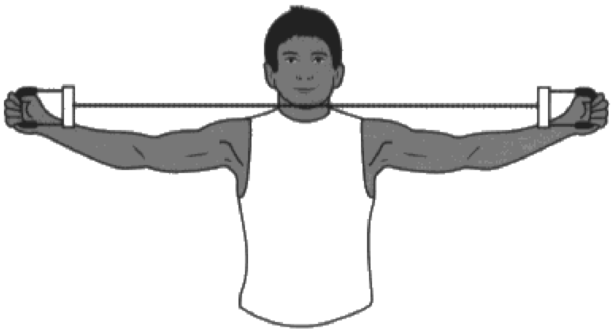


Figure 7

The athlete stretches the spring in the device by pulling the handles apart.

The spring constant of the spring is 140 N/m.

The athlete does 45 J of work to extend the spring.

The athlete takes 0.6 s to expand the spring.

(i) Calculate the useful power output of the athlete when stretching the spring.

(2)

$$power = \frac{energy}{time}$$

$$= \frac{45}{0.6} = 75$$

useful power output of the athlete = 75 W

ResultsPlus
Examiner Comments

Correct answer; scores 2 marks.

This candidate recalls the needed equation and selects the correct two out of the three pieces of information to use.

5 (a) Figure 7 shows an athlete using a fitness device.

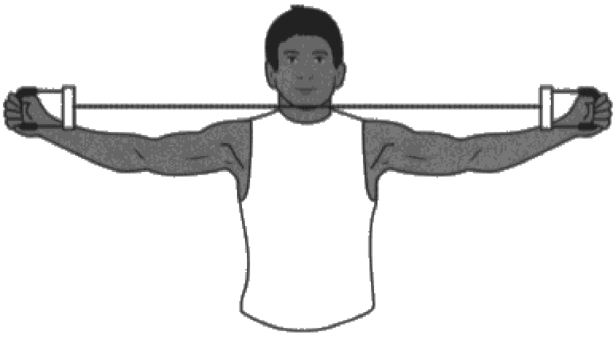


Figure 7

The athlete stretches the spring in the device by pulling the handles apart.

The spring constant of the spring is 140 N/m.

The athlete does 45 J of work to extend the spring.

The athlete takes 0.6 s to expand the spring.

(i) Calculate the useful power output of the athlete when stretching the spring.

(2)

useful = 140 × 45 × 0.6 = 3780

power = E / t

useful power output of the athlete = 3780 W

ResultsPlus
Examiner Comments

This student recalls the correct equation to use - 1 mark.

But then they accompany this by a 'multiply all in sight' approach.

ResultsPlus
Examiner Tip

In P = E / t, E equates to 'work' (45J) in the question. this should have been used together with t = 0.6s in the recalled equation.

Question 5 (a) (ii)

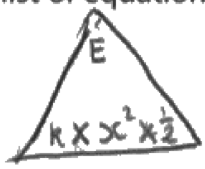
Many candidates made a lot of progress with this question, with a majority scoring marks and many full marks. The complexities of re-arrangement and having to take a square root reduced achievement though eg some forgot to take the square root at the end.

(ii) Calculate the extension of the spring.

Use an equation selected from the list of equations at the end of this paper.

(3)

$$E = \frac{k \times x^2 \frac{1}{2}}{2}$$



$$x^2 = \frac{E}{k \times \frac{1}{2}}$$

$$x^2 \approx \frac{45}{140 \times \frac{1}{2}}$$

$$\sqrt{\ } \; x^2 \approx 0.6428571 \sqrt{\ }$$

$$x \approx 0.802$$

extension of the spring = 0.8 m

ResultsPlus
Examiner Comments

Full marks.

Well set out.

ResultsPlus
Examiner Tip

This is best practice observed once again.

- Select the equation.
- Re-arrange with the needed subject.
- Substitute.
- Evaluate, not forgetting the final square root.

(ii) Calculate the extension of the spring.

Use an equation selected from the list of equations at the end of this paper.

(3)

$E = \frac{1}{2} \times k \times x^2$

$\frac{E}{\frac{1}{2} \mid k \mid x^2}$

$\text{extension}^2 = \frac{E}{\frac{1}{2} \times k}$

$= \frac{45}{0.5 \times 140} = 0.6\dot{4}2857\dot{1}$

≈ 0.64

extension of the spring = 0.64 m

ResultsPlus
Examiner Comments

Selects, re-arranges well, substitutes correctly.

Just forgets to take the square root at the end.

Hence 2 out of 3 marks.

(ii) Calculate the extension of the spring.

Use an equation selected from the list of equations at the end of this paper.

(3)

$$E = \frac{1}{2} \times k \times x^2$$

$$x^2 = \frac{\frac{1}{2} \times k}{e} = \frac{0.5 \times 140}{45} = 1.5$$

extension of the spring = 1.5 m

ResultsPlus
Examiner Comments

Selects the correct equation but then wrongly re-arranges.

Still gets a mark for substituting values though.

Question 5 (b) (i)

This item differentiated well.

Most students scored 1 or 2 marks out of 2.

Most could get a mark though either specifying a length (of rubber) or specifying the measuring instrument. Specifying extension as a difference in two measurements was the added detail required to get full marks.

(b) A student investigates the stretching of a long piece of rubber.

Figure 8 shows the apparatus to be used.

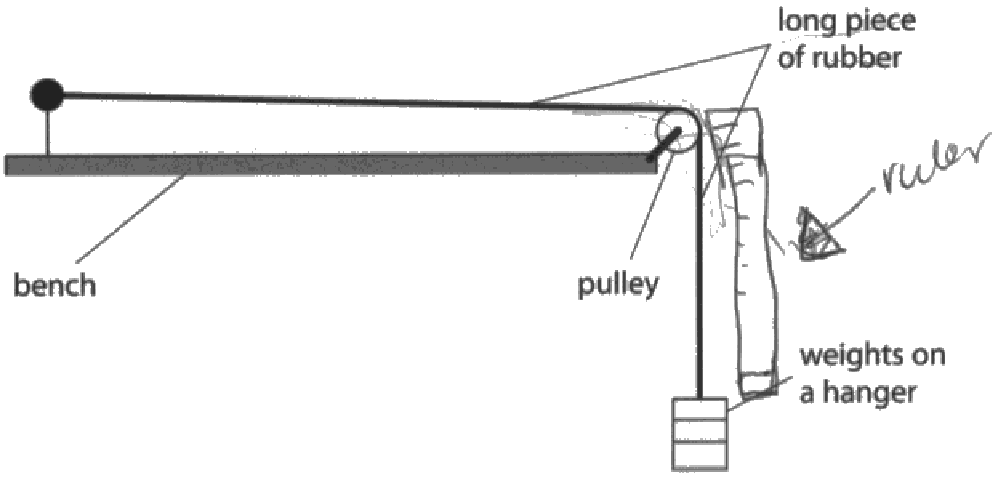


Figure 8

The student puts just enough weight on the weight hanger to make the piece of rubber just tight.

The student wants to plot a graph to show how the extension of the piece of rubber varies with the force used to stretch it.

The student adds a known weight to the weight hanger.

(i) Describe how the student could measure the extension of the rubber when he adds another weight to the weight hanger.

(2)

By measuring the length of the rubber from the top of the pulley down to where it is attached onto the weights ~~before~~ then measure the ~~extension~~ length of the rubber after adding a weight from the same points. Then takeaway the initial length from the final length and you have calculated the extension.

ResultsPlus
Examiner Comments

This spells out the measurements to be made very clearly, and how you find the extension, for both marks.

Specifying exactly what length is to be measured is especially commendable.

The addition of the ruler alongside in the diagram additionally commends itself.

ResultsPlus
Examiner Tip

This answer is excellent. Try and include as much detail, as you can in answering practical questions.

Labelled additions to a diagram help and may themselves be worthy of credit.

(b) A student investigates the stretching of a long piece of rubber.

Figure 8 shows the apparatus to be used.

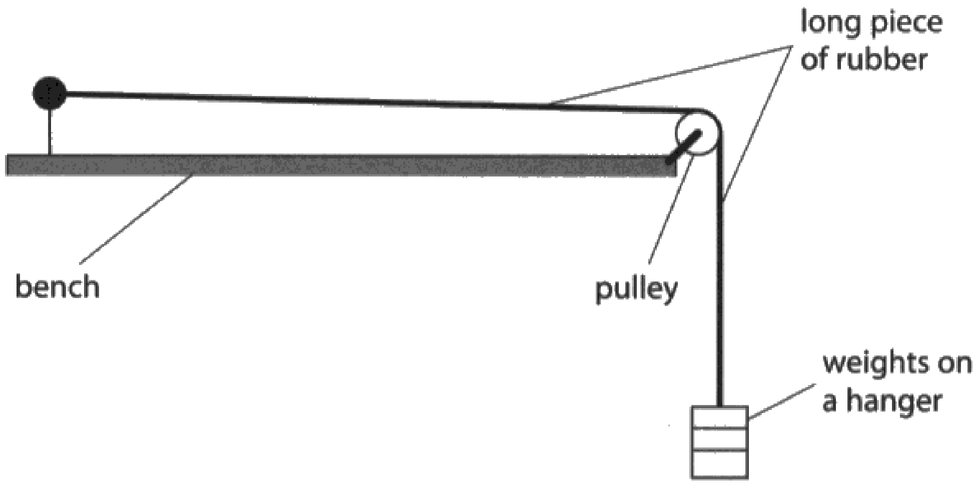


Figure 8

The student puts just enough weight on the weight hanger to make the piece of rubber just tight.

The student wants to plot a graph to show how the extension of the piece of rubber varies with the force used to stretch it.

The student adds a known weight to the weight hanger.

(i) Describe how the student could measure the extension of the rubber when he adds another weight to the weight hanger.

(2)

~~We~~ The student could measure how long the piece of rubber is with nothing on it the each time a weight is added remeasure the rubber and subtract ~~that from~~ the origional length from the streatched length to find ~~the~~ how much the rubber extends

ResultsPlus
Examiner Comments

This is a full answer for 2 marks.

Measuring the length of the rubber (1 mark) and then add a weight, remeasure and **find the difference** clearly stated (1 mark).

The length to be measured is not as well spelt out as the first exemplar given, but it still matches the mark scheme point.

ResultsPlus
Examiner Tip

When you compose an answer to a 'how could you' practical question make sure, like this candidate, that the steps you write are clear and that they address what the question is looking for - in this case the extension.

(b) A student investigates the stretching of a long piece of rubber.

Figure 8 shows the apparatus to be used.

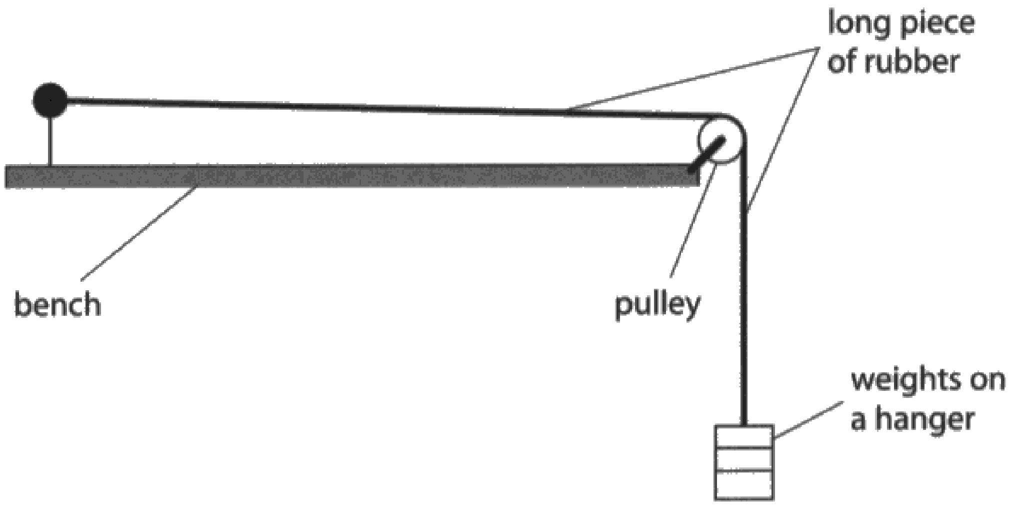


Figure 8

The student puts just enough weight on the weight hanger to make the piece of rubber just tight.

The student wants to plot a graph to show how the extension of the piece of rubber varies with the force used to stretch it.

The student adds a known weight to the weight hanger.

(i) Describe how the student could measure the extension of the rubber when he adds another weight to the weight hanger.

(2)

Measure the length of the rubber from the pulley to the hanger using a ruler.

ResultsPlus
Examiner Comments

This scores 1 mark for the first mark point on the scheme.

It omits to say how the extension would be found.

ResultsPlus
Examiner Tip

Ask yourself 'Have I answered the question?'

Here the question says 'how you could measure the extension'. This candidate does not address that question fully, do they?

(b) A student investigates the stretching of a long piece of rubber.

Figure 8 shows the apparatus to be used.

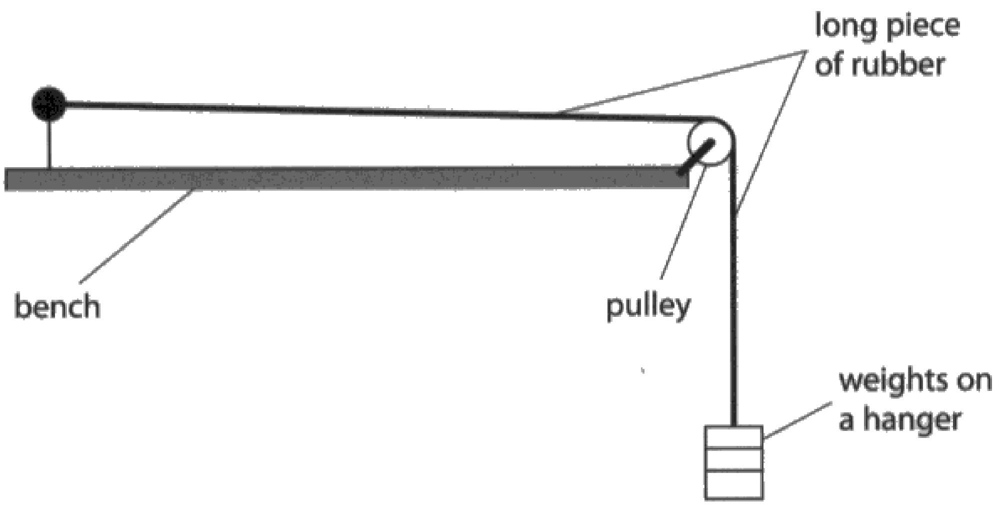


Figure 8

The student puts just enough weight on the weight hanger to make the piece of rubber just tight.

The student wants to plot a graph to show how the extension of the piece of rubber varies with the force used to stretch it.

The student adds a known weight to the weight hanger.

(i) Describe how the student could measure the extension of the rubber when he adds another weight to the weight hanger.

(2)

The student could measure the length of the piece of rubber after each weight is added to the hanger to see how far its stretched out ~~wh~~ when more weight is added.

ResultsPlus
Examiner Comments

This scores a mark for measuring the length of the rubber.

'See how far it stretches' is insufficient for the second mark.

That needs an explicit description about taking the difference between two measurements.

(b) A student investigates the stretching of a long piece of rubber.

Figure 8 shows the apparatus to be used.

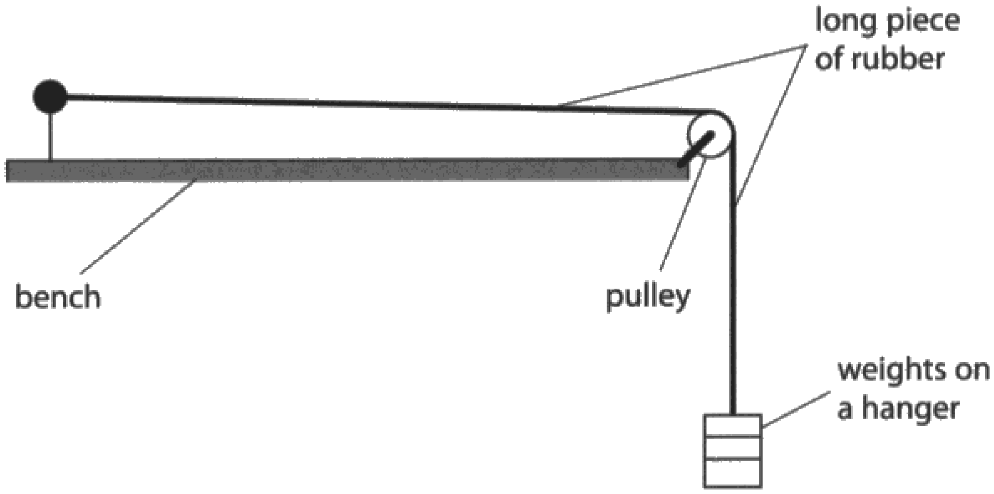


Figure 8

The student puts just enough weight on the weight hanger to make the piece of rubber just tight.

The student wants to plot a graph to show how the extension of the piece of rubber varies with the force used to stretch it.

The student adds a known weight to the weight hanger.

(i) Describe how the student could measure the extension of the rubber when he adds another weight to the weight hanger.

(2)

The Student
- ~~they~~ can measure the rubber before and after the rubber is stretched. The student ~~could~~ could do this by measuring it by a ruler.

ResultsPlus
Examiner Comments

This candidate gets a mark, just, by virtue of mentioning the ruler, in a reasonable context.

This is the second alternative in mark point 1 in the mark scheme.

ResultsPlus
Examiner Tip

The candidate says 'measure the rubber' which begs the question 'measure **what** about the rubber?'

Avoid vagueness; measure **what**? - the length of . . . . from . . to . . .

(b) A student investigates the stretching of a long piece of rubber.

Figure 8 shows the apparatus to be used.

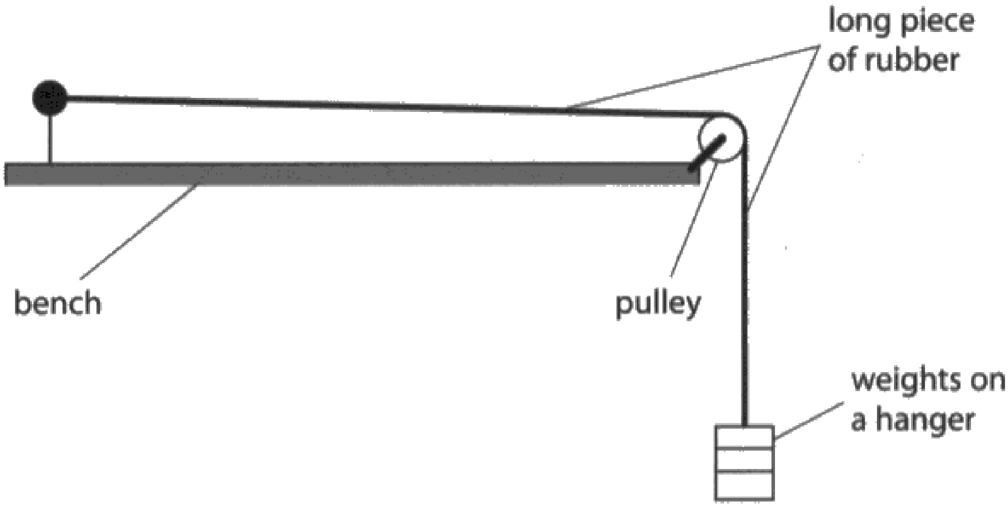


Figure 8

The student puts just enough weight on the weight hanger to make the piece of rubber just tight.

The student wants to plot a graph to show how the extension of the piece of rubber varies with the force used to stretch it.

The student adds a known weight to the weight hanger.

(i) Describe how the student could measure the extension of the rubber when he adds another weight to the weight hanger.

(2)

A student could measure the extension before adding the weight and after adding the weight and then compare.

ResultsPlus
Examiner Comments

0 marks

The question asks for a description of how the extension could be measured.

To just say 'measure the extension' is not saying 'how' and the last comment about 'compare' is too vague.

ResultsPlus
Examiner Tip

Many candidates fall into the trap of just repeating what's in the stem of the question.

Make sure that's not you.

Also avoid vague statements which don't make it clear what you are going to do **exactly.**

Question 5 (b) (ii)

Only a minority of candidates scored a mark for this, with hardly any scoring both marks.

To do that the idea of non-repeatability was needed - in simple words the curve does not go through the same points for unloading as it did when loading.

Most candidates did not make any progress with this question; some tried via talking of the rubber returning to its original shape – to no avail.

(ii) The student obtains a series of values of force and extension while loading the piece of rubber and then unloading it.

Figure 9 shows the graph of the student's values.

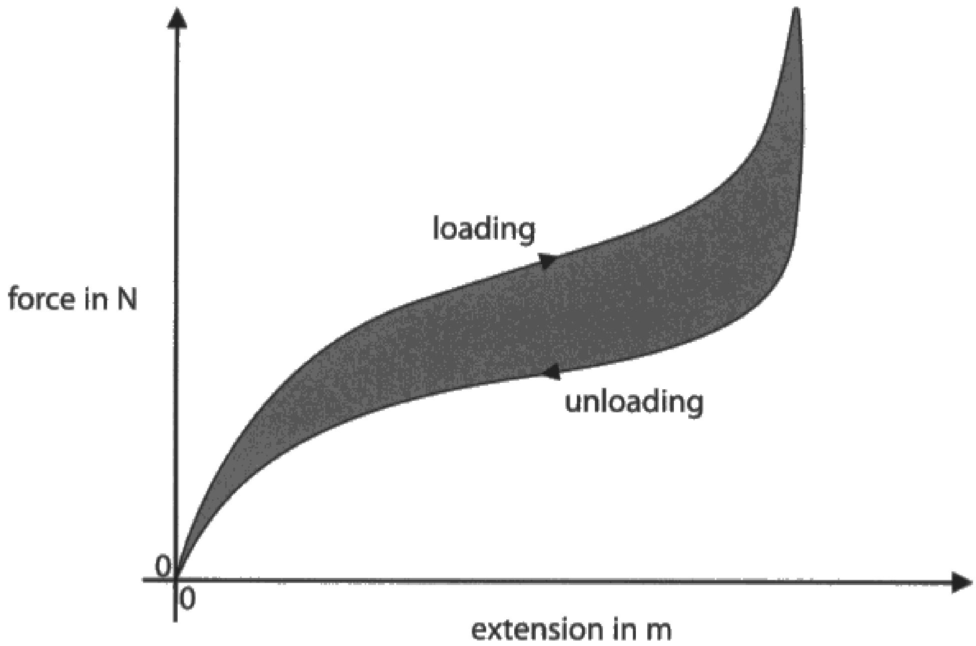


Figure 9

Explain how the shape of this graph shows that the distortion of the piece of rubber being stretched is different from the distortion of a spring being stretched.

(2)

When a string is stretched, the graph will be a straight line that follows the same values when being loaded and unloaded. This graph has different values for loading and unloading, making it a curve with 2 lines rather than a straight line

ResultsPlus
Examiner Comments

This is very well written scoring both mark points. The candidate clearly expresses the differences in terms of straight line and curve and in terms of the different values for loading and unloading.

2 marks

ResultsPlus
Examiner Tip

When asked for differences, and there are two marks, ask yourself '**What two separate things** make for the difference?'

(ii) The student obtains a series of values of force and extension while loading the piece of rubber and then unloading it.

Figure 9 shows the graph of the student's values.

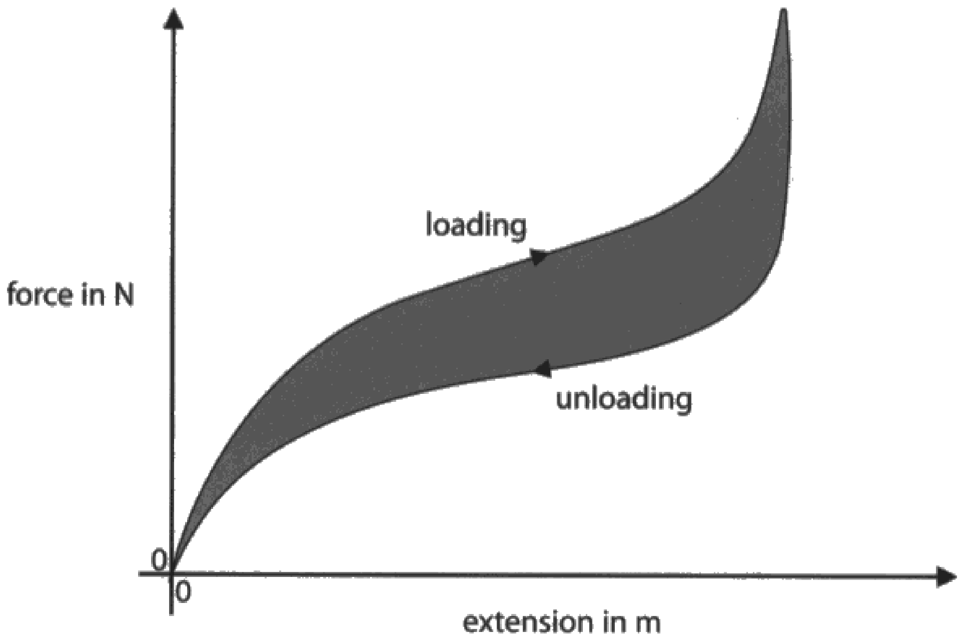


Figure 9

Explain how the shape of this graph shows that the distortion of the piece of rubber being stretched is different from the distortion of a spring being stretched.

(2)

The graph would be a linear straight line is a spring that was elastic was used, but not it two curved lines. In a elastic Spring, the ~~results~~ extension for loading and unloading would be the same ~~and~~ at the same force, but with a rubber its different.

ResultsPlus
Examiner Comments

clear two marks:

Curved graph for rubber (1) (cf straight line for spring)

PLUS non-repeatability idea - extensions different for the same force involved - well put.

(ii) The student obtains a series of values of force and extension while loading the piece of rubber and then unloading it.

Figure 9 shows the graph of the student's values.

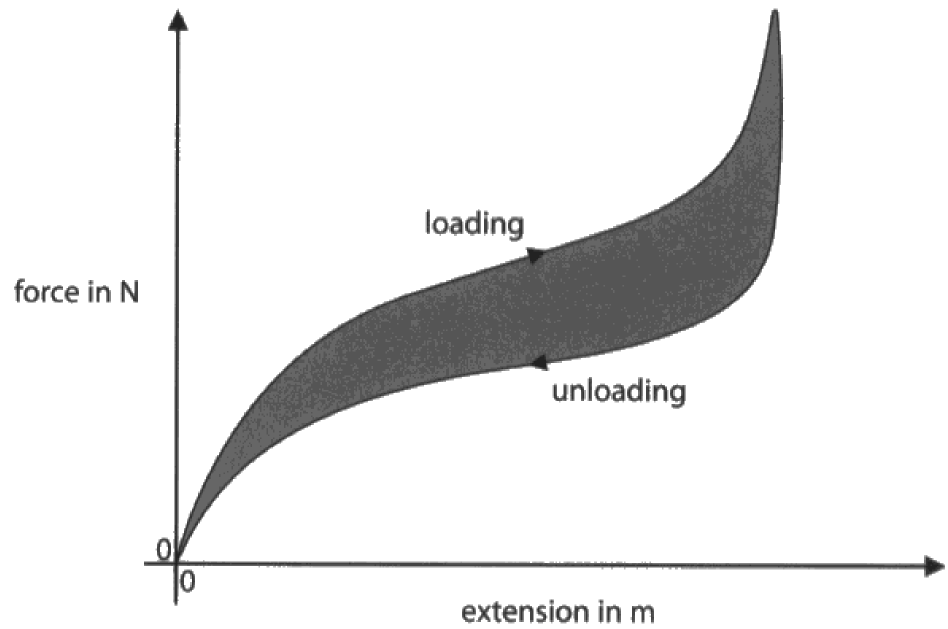


Figure 9

Explain how the shape of this graph shows that the distortion of the piece of rubber being stretched is different from the distortion of a spring being stretched.

(2)

In a spring the extension to force graph would show a straight line ~~as~~ because it is constant in extension. The graph here shows that the distortion of the rubber is not constant as the force used is not directly proportional to the extension.

ResultsPlus
Examiner Comments

This gets the first mark point for either saying the graph for a spring would be straight, or for noting the 'not directly proportional' for the rubber.

The second mark point is not there though.

ResultsPlus
Examiner Tip

Good as far as it goes but not looking at the graph and asking 'Why are there different curves for loading and unloading?' - that needs addressing as the second difference - mark point 2.

(ii) The student obtains a series of values of force and extension while loading the piece of rubber and then unloading it.

Figure 9 shows the graph of the student's values.

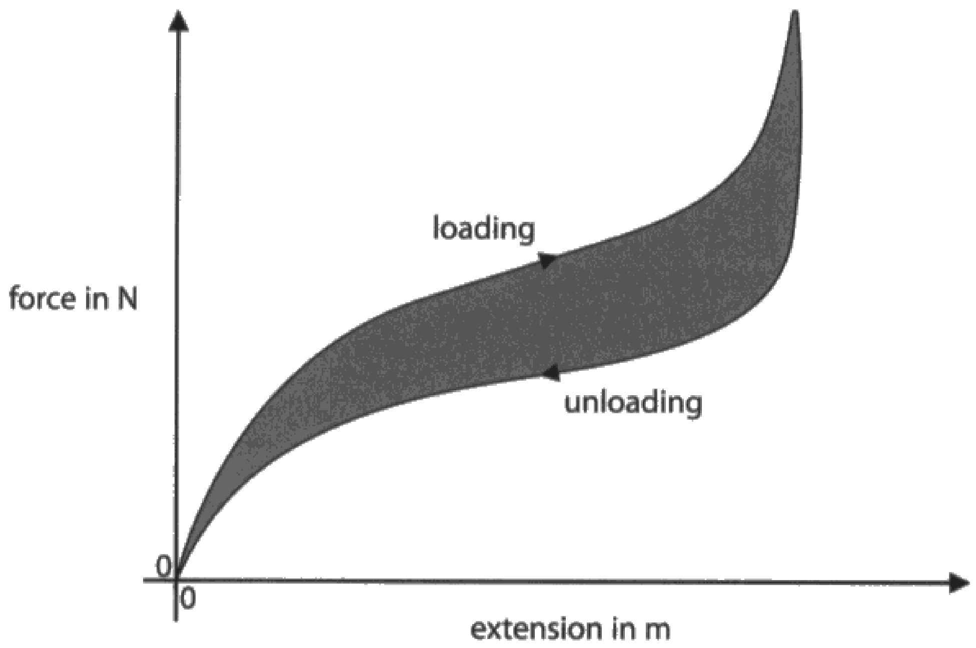


Figure 9

Explain how the shape of this graph shows that the distortion of the piece of rubber being stretched is different from the distortion of a spring being stretched.

(2)

The Shape of the graph ~~tells~~ Shows us that when rubber as been Stretched to distortion and then releases (unloaded) it will come back to is origonal Shape were a Spring will not.

ResultsPlus
Examiner Comments

This is representative of a very common misconception from the evidence given.

The mark scheme says explicitly 'ignore reference to returning to original shape'.

That may not occur with the spring as well.

ResultsPlus
Examiner Tip

Just because you have learnt something about going past an elastic limit, don't think it's got to be included / is a reasonable difference.

It's not necessarily so.

Question 5 (c)

As the paper progresses, some questions were targeted at the very top end of attainment; 5(c) was an example of that.

The stem of the question gave candidates the idea that the area under the graph represented work done / energy transferred. It was the job of candidates to interpret the shaded area as a difference in energy / work, and to explain how that difference may be accounted for - loss of energy transferred as thermal energy to the rubber / surroundings.

(c) The area between the curve and the extension axis of a force/extension graph corresponds to work done or energy transferred.

Suggest what the shaded area of the graph in Figure 9 represents.

(2)

The Shaded area could represent the difference in energy trasferred between loading and unloading. This excess energy has likely been dissapated to surroundings, which would explain why unloading is lower than loading.

ResultsPlus
Examiner Comments

This candidate clearly understands the significance of the area and its consequence in terms of how that difference may be accounted for

FULL MARKS

ResultsPlus
Examiner Tip

Such understanding, at such a high level, doesn't come easy.

This student has worked at trying to **understand the significance** of the area between the two curves.

Successful study requires this attention to detail and thinking things through in a questioning way.

(c) The area between the curve and the extension axis of a force/extension graph corresponds to work done or energy transferred.

Suggest what the shaded area of the graph in Figure 9 represents.

work done = Power X time

(2)

~~The gravitational~~ The elastic energy being stored into the rubber, mechanically.

ResultsPlus
Examiner Comments

A number of candidates falsely interpreted the shaded area as energy stored in the rubber.

(c) The area between the curve and the extension axis of a force/extension graph corresponds to work done or energy transferred.

Suggest what the shaded area of the graph in Figure 9 represents.

(2)

The shaded area will represent the ~~avera~~ difference in the energy transferred when a rubber is loaded and when it is unloaded.

ResultsPlus
Examiner Comments

Simple direct statement scoring the first mark point.

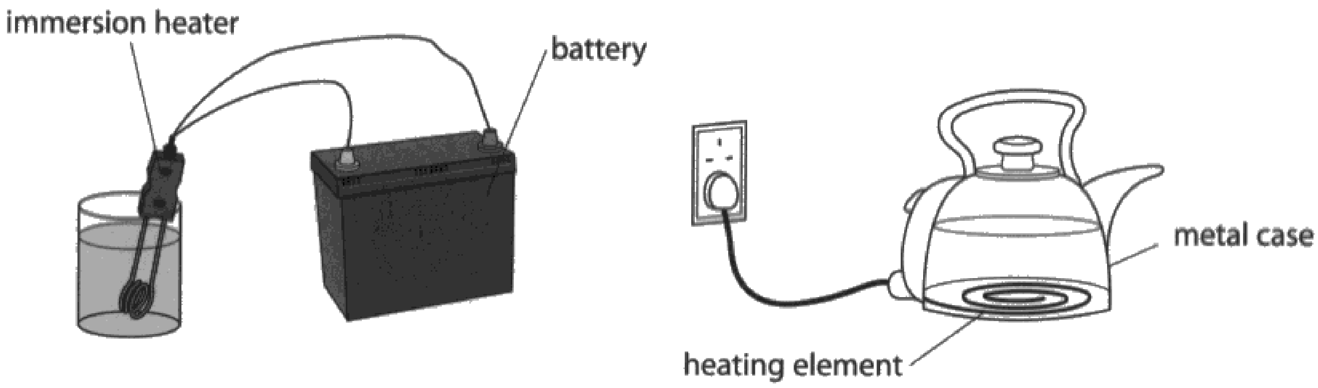
ResultsPlus
Examiner Tip

Going this far really is only observing what the stem of the question tells you and then making an observation from the graph.

Question 6 (a) (i)

A minority of candidates could recall $P = I^2 R$, re-arrange and substitute, and then arrive at the correct evaluation, which was required to be to two significant figures.

6 (a) Figure 10 shows two electrical devices for heating water.



immersion heater connected to a battery

kettle connected to domestic mains supply

Figure 10

(i) The current in the element of the immersion heater is 14 A.

The power of the immersion heater is 130 W.

Calculate the resistance of the immersion heater.

Give your answer to two significant figures.

(3)

Power = resistance × (current)^2

$\frac{\text{Power}}{(\text{Current})^2}$ = resistance $\qquad \frac{130}{(14^2)}$

resistance of immersion heater = 0.66 Ω

ResultsPlus
Examiner Comments

This is the correct answer for 3 marks.

Well recalled, re-arranged, substituted and evaluated to 2 significant figures.

ResultsPlus
Examiner Tip

Notice how easy the candidate makes it to follow what they are doing.

This is good practice to be emulated.

6 (a) Figure 10 shows two electrical devices for heating water.

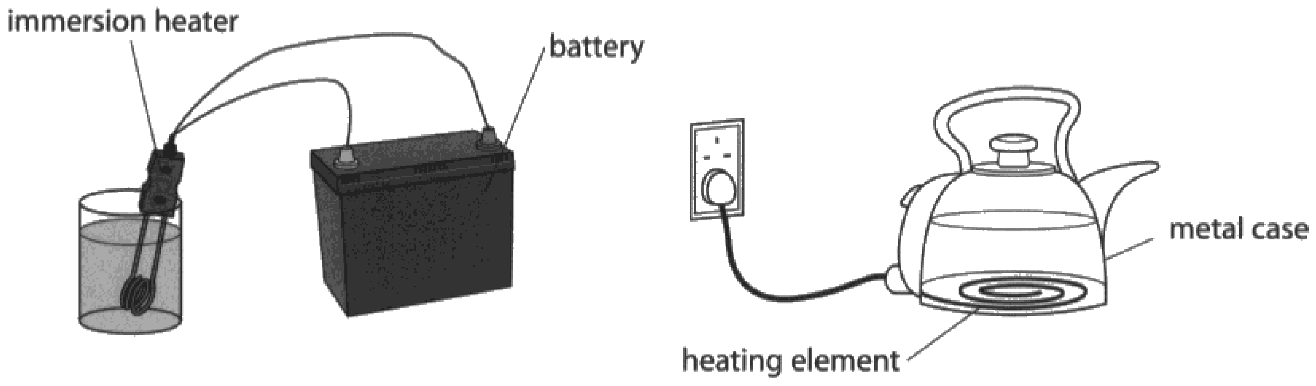


Figure 10

(i) The current in the element of the immersion heater is 14 A.

The power of the immersion heater is 130 W.

Calculate the resistance of the immersion heater.

Give your answer to two significant figures.

(3)

Power (W) = Current^2 × Resistance

$R = \frac{P}{I^2}$ $\frac{130}{14^2}$ = 0.663265

~~= 0.67~~ = 0.7

resistance of immersion heater = 0.7 Ω

ResultsPlus
Examiner Comments

This gets 2 marks.

Good recall and substitution.

Evaluation is correct but then does not give the final evaluation to 2 s.f. as asked for.

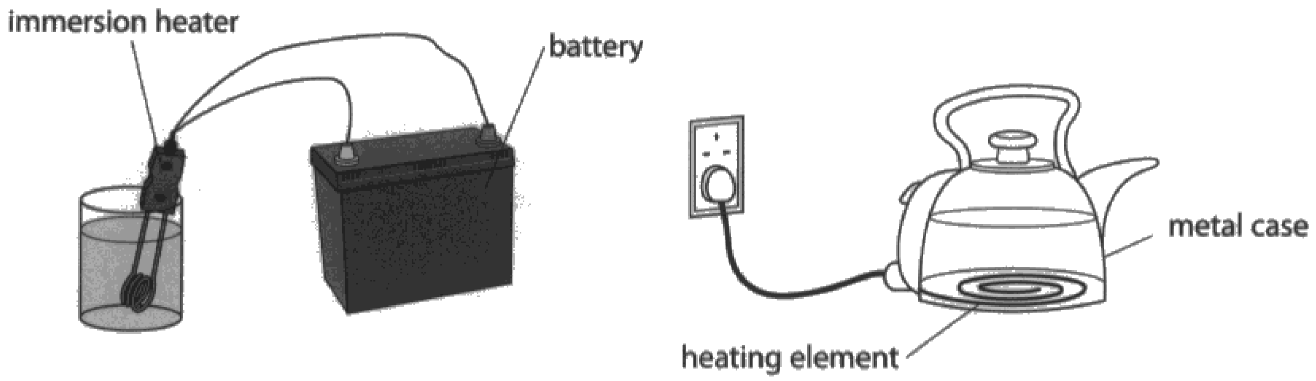
ResultsPlus
Examiner Tip

0.7 is to one significant figure.

It is 0.66 to two significant figures.

It is important to revise this correctly before an exam.

6 (a) Figure 10 shows two electrical devices for heating water.



immersion heater connected to a battery

kettle connected to domestic mains supply

Figure 10

(i) The current in the element of the immersion heater is 14 A.

The power of the immersion heater is 130 W.

Calculate the resistance of the immersion heater.

Give your answer to two significant figures.

(3)

$P = I^2 \times R$

$R = P/I^2$ $\quad R = \frac{130}{14^2} = 0.663$

resistance of immersion heater = 0.663 Ω

ResultsPlus
Examiner Comments

Two marks, with the failure at the end to write to 2 significant figures; the number quoted is to 3 significant figures.

Mark scheme additionally comments that 0.663 scores 2 marks because of this.

6 (a) Figure 10 shows two electrical devices for heating water.

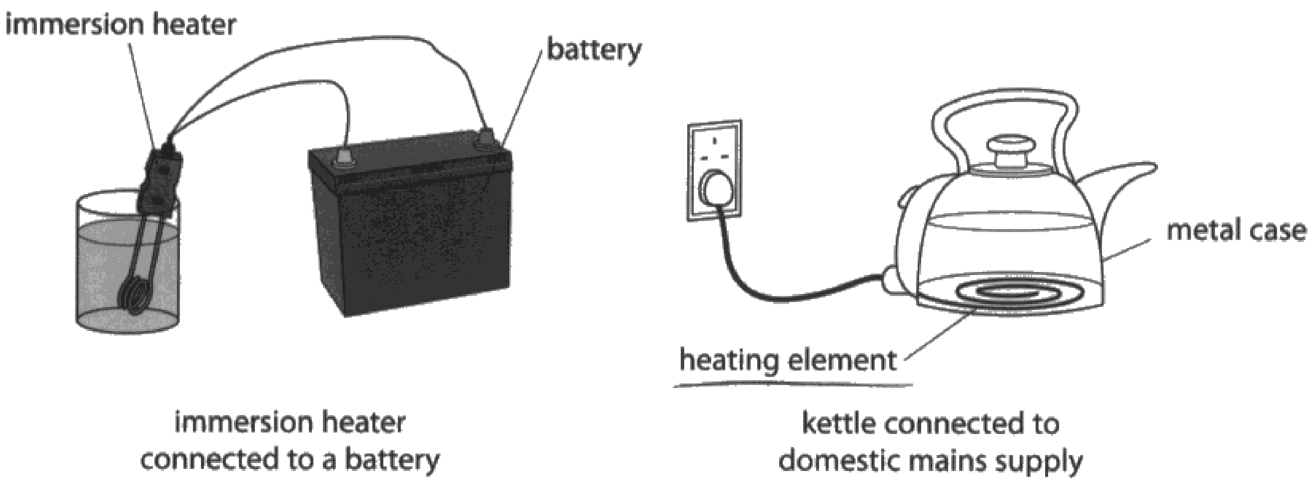


Figure 10

(i) The current in the element of the immersion heater is 14 A.

The power of the immersion heater is 130 W.

Calculate the resistance of the immersion heater.

Give your answer to two significant figures.

(3)

$P = V \times I$

$V = \frac{P}{I}$ $\quad V = \frac{130}{14}$

$V = 9.3$

resistance of immersion heater = 9.3 Ω

ResultsPlus
Examiner Comments

This candidate chooses the alternative route of finding 'V' first.

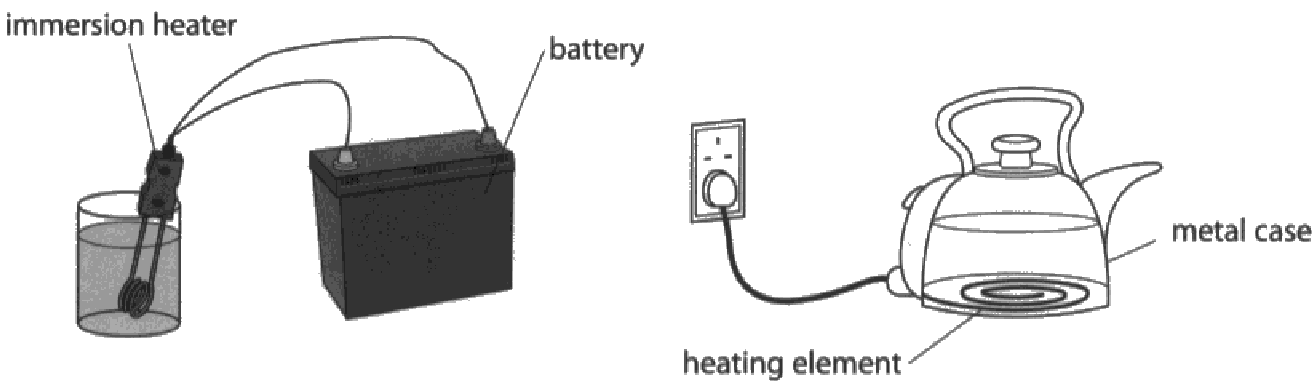
That gains a mark; it is clearly stated.

Unfortunately, they then wrongly equate this with resistance.

ResultsPlus
Examiner Tip

Watch out for contradictions. Can voltage, V = resistance R?

6 (a) Figure 10 shows two electrical devices for heating water.



immersion heater connected to a battery

kettle connected to domestic mains supply

Figure 10

(i) The current in the element of the immersion heater is 14 A.

The power of the immersion heater is 130 W.

Calculate the resistance of the immersion heater.

Give your answer to two significant figures.

(3)

$R = \frac{P}{I}$

$= \frac{130}{14} = 9.285714$

$= 9.3\,\Omega$

resistance of immersion heater = 9.3 Ω

ResultsPlus
Examiner Comments

Faced with the two pieces of data, as highlighted by this candidate, many chose wrongly to use R = P/I.

No marks

Question 6 (a) (ii)

Candidates found this question most challenging, often failing to focus on the movement of charge. However, some could get a mark by saying the charge in the immersion heater moves faster, and a few understood that the charge flowed in one direction in the immersion heater, whereas it flowed back and forth in the heating element of the kettle.

(ii) The current in the heating element of the kettle is 8.3 A.

State **two** differences between the movement of charge in the heating element of the kettle and the movement of charge in the immersion heater.

(2)

1 Charge flows at a higher rate in the immersion heater.

2 The charge flows back and forth in the kettle since it has an a.c. supply but ~~A~~ in the immersion heater it flows in one direction.

ResultsPlus
Examiner Comments

Maximum 2 marks clearly deserved here.

First of all the candidate concentrates on **rate of flow** of charge, which was exactly what was wanted.

The directional difference is then well explained for the second mark.

(ii) The current in the heating element of the kettle is 8.3 A.

State **two** differences between the movement of charge in the heating element of the kettle and the movement of charge in the immersion heater.

(2)

1 the current in the immersion heater is direct due to the battery used. This means that the charge flows only in one direction. In contrast, the flow of charge changes direction in the heating element due to the alternating current.

2 The current in the heating element of the kettle (8.3A) is small than the current in the immersion heater (14A) and so the Charge in the element of the immersion heater is flowing faster.

ResultsPlus
Examiner Comments

Full 2 marks obtained.

Charge flow is first of all correctly stated for mark point 2.

Then the charge in the immersion heater flowing faster gets mark point 1.

ResultsPlus
Examiner Tip

The question is about movement of charge.

Unlike many other candidates this one stayed focussed upon that and so was able to get 2 out of 2 marks.

Make sure you are answering what the question is aimed at too.

(ii) The current in the heating element of the kettle is 8.3 A.

State **two** differences between the movement of charge in the heating element of the kettle and the movement of charge in the immersion heater.

(2)

1 The movement of charge is slower in the kettle.

2 The strength of heat is stronger in the immersion heater as there are more amps.

ResultsPlus
Examiner Comments

This gets 1 mark for the candidate's first statement.

The second statement is not credit worthy.

(ii) The current in the heating element of the kettle is 8.3 A.

State **two** differences between the movement of charge in the heating element of the kettle and the movement of charge in the immersion heater.

(2)

1 The immersion heat would heat up the water faster than the kettle due to its charge.

2 The immersion has a higher charge than the kettle connected to domestic mains supply.

ResultsPlus
Examiner Comments

This was a commonly seen mistaken approach, showing a misunderstanding of what the question was asking.

The question is about **movement of charge**; it's nothing to with how fast the water heats up.

It's nothing to do with the rate of heating up the water and to say that the immersion heater has a higher charge is equally unhelpful.

Question 6 (b)

This question differentiated well. Many candidates could reach level 2 or even 3, especially where they focused on the role of the fuse, which they were more secure on than the earth.

In talking about the fuse candidates often realised a wire melted, cutting off the current to the kettle. Better answers related this to the current having exceeded a certain amount following on from the live wire touching the metal case, causing a current surge. Weaker answers regarded the melting of the fuse wire as being a result of an over production of heat in some way.

Some candidates think that the fuse and the earth operate as part of some kind of (electronic) control system, actively diverting current or tripping the fuse.

*(b) Figure 11 shows the three-pin plug used to connect the kettle to the mains.

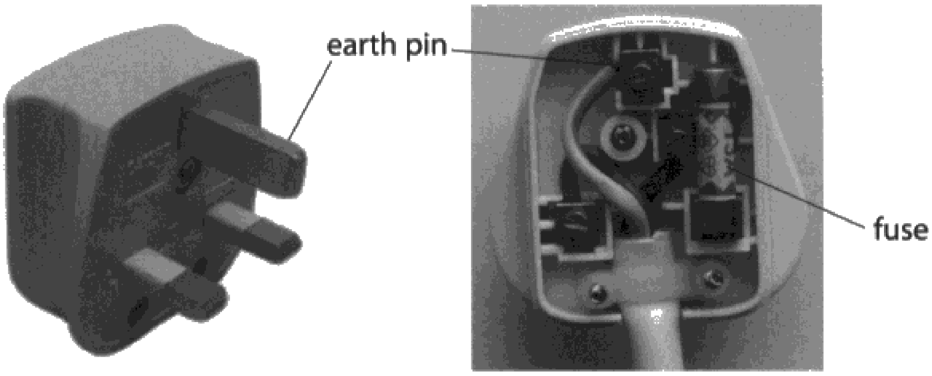


Figure 11

A fault occurs in the kettle causing the live wire to touch the metal case of the kettle.

Explain how the safety features of the plug operate when this fault occurs.

(6)

- The fuse has a thin ~~peice~~ piece of metal ~~in~~ it that melts when too much current flows through it (safety feature)
- When the fuse melts no more current can flow through the wires (fuse blows)
- The earth wire transfers the electricity/current from the metal case of the kettle to the ground to prevent an individual from being electricuted/shocked
- Live wire is the brown wire
- All the wires and held down by earth pins to prevent them from flying off anywhere
- There is also a cable grip to prevent wires from coming out,
* especially when there is a fault to prevent shock
* which is useful

ResultsPlus
Examiner Comments

This is a well balanced answer with a good understanding of both the fuse and the earth roles seen.

The candidate explains the action of the fuse well linking it to 'too much current' and explaining that then the current is then cut off.

This is also one of the better answers when it comes to the earth. The idea that the earth is there to divert current to it when the fault occurs is well dealt with, including a link back to the safety argument involved.

Shows sufficient detail on both aspects to be given a level 3 answer for 6 marks.

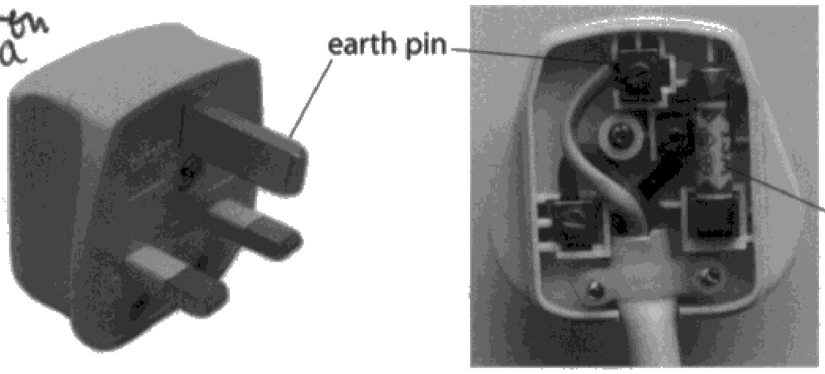
ResultsPlus
Examiner Tip

The key physics for both the earth and fuse is to do with **current**. Other answers containing vague statements about electricity or energy were not as good.

When you study/ revise ask yourself 'what is the key physics principle involved here?' That way you will be able to compose a better answer.

*(b) Figure 11 shows the three-pin plug used to connect the kettle to the mains.

* The Earth wire has a voltage of 0



*2 (blue and a voltage of 230)

*3 and the current is higher (in amps) than the fuse capacity eg: 5A

Figure 11

A fault occurs in the kettle causing the live wire to touch the metal case of the kettle.

Explain how the safety features of the plug operate when this fault occurs.

(6)

When the live wire touches the metal case of the kettle, the Earth wire (yellow and green) is used. The potential difference / ~~and~~ electricity will flow out through the Earth wire away from the device and the plug, preventing electric shocks. *

If there is still large amounts of electricity flowing through the live wire *2 or a power surge *3, this will cause the fuse to melt. This causes the circuit to break and no electricity will be received by the device or the live wire. This then prevents fires and electric shocks, due to the ~~prev~~ electricity not flowing in the circuit.

(Total for Question 6 = 11 marks)

ResultsPlus
Examiner Comments

This is a balanced answer focusing on the roles of the fuse and the earth.

It is written lucidly and is worth the level 3 mark of 6.

Notice it does not have to be perfect to get full marks.

'The potential difference / electricity will flow out through the earth' statement is not very good physics BUT the essence of arguments about what the earth does to remove the chance of shock and the story of the fuse melting, with the idea of cutting off the current, is well stated.

ResultsPlus
Examiner Tip

Right from the beginning where the candidate annotates the figure, this candidate shows a good focus on the storyline that the question is seeking after.

*(b) Figure 11 shows the three-pin plug used to connect the kettle to the mains.

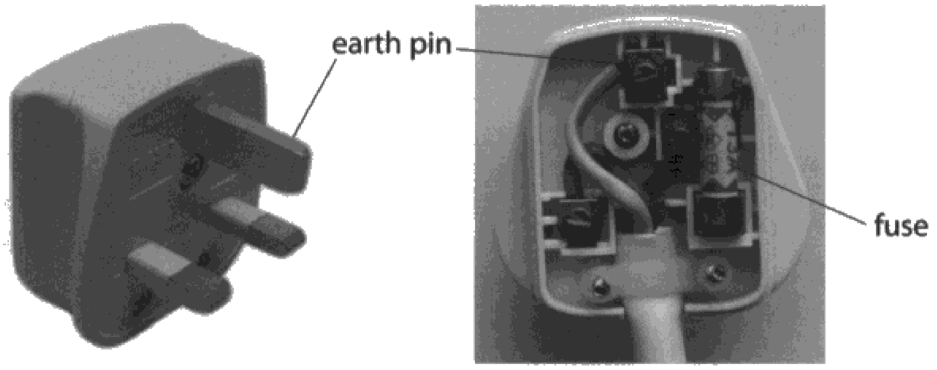


Figure 11

A fault occurs in the kettle causing the live wire to touch the metal case of the kettle.

Explain how the safety features of the plug operate when this fault occurs.

(6)

The Plug uses an earth wire that reduces the amount ~~of~~ of electricity in the live wire so it doesn't release an immense amount of electricity in the first Place. If that does occur, the huge current will go through the fuse, which has a small thin wire that will break if too much current ~~is~~ ~~re~~ goes through, breaking the wire in the fuse and stopping/breaking the Plugs circuit.

ResultsPlus
Examiner Comments

This is a level 2 answer, scoring 4 marks. The fuse aspect is well dealt with but the candidate doesn't talk about the earth arrangement with any real undertsanding.

The summary for guidance in the mark scheme explains that you can get 3-4 marks for a well-developed answer about one aspect.

This weakness concerning the earth connection role, with a decent answer concerning the fuse, was seen in very many candidates' responses.

ResultsPlus
Examiner Tip

To get to a level 3 requires more comprehensive knowledge, without neglecting any aspect that the question points to.

This requires thoroughness in study as you go through the course.

*(b) Figure 11 shows the three-pin plug used to connect the kettle to the mains.

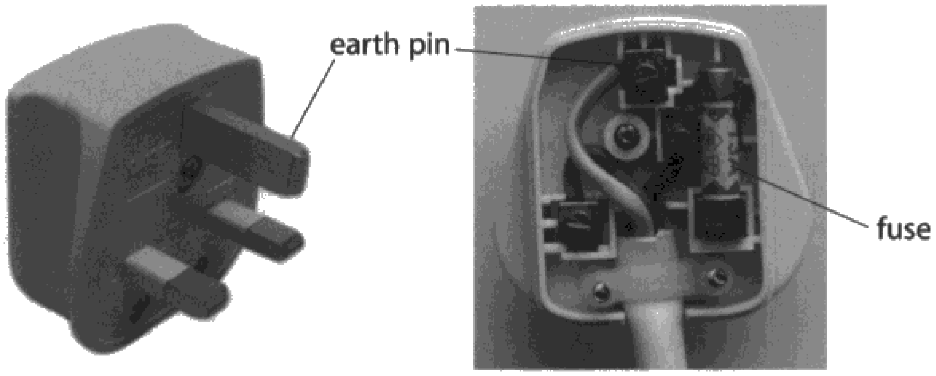


Figure 11

A fault occurs in the kettle causing the live wire to touch the metal case of the kettle.

Explain how the safety features of the plug operate when this fault occurs.

(6)

When this fault occurs, multiple things happen. Firstly, the earth pin shuts itself off, as to not cause a fire. Secondly, the fuse in the ~~switch~~ plug switches off, not giving any further electricity to the plug. When the plug switches off, the mains to the whole house gets turned off. This turns off all the electricity to the house and causes a power cut. This stops there being an electrical fire.

ResultsPlus
Examiner Comments

There is no rewardable content here.

A wrong control emphasis is evident with some active switching somehow occurring.

'The earth pin shuts itself off' and 'the plug switches off' betray a lack of understanding about what the earth and fuse are all about.

ResultsPlus
Examiner Tip

The focus has to be on

- The plug contains a fuse wire that melts.
- An earth connection enables current to flow harmlessly away preventing the metal case becoming live.

These are physical actions, not to do with any automatic control elements.

*(b) Figure 11 shows the three-pin plug used to connect the kettle to the mains.

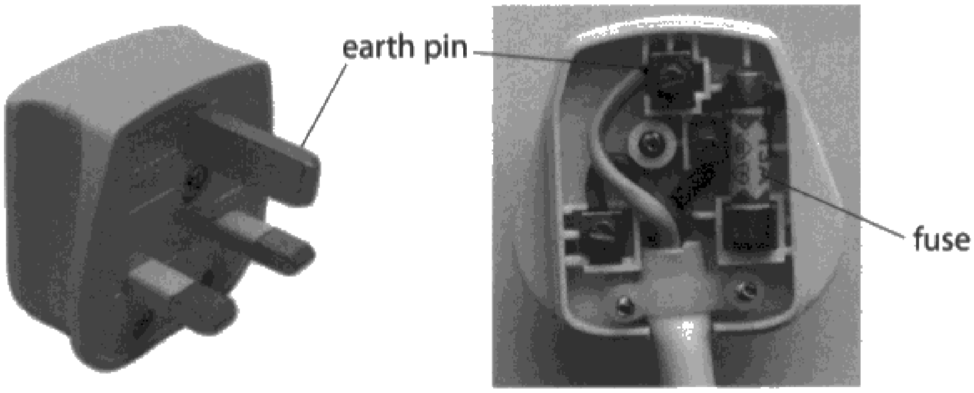


Figure 11

A fault occurs in the kettle causing the live wire to touch the metal case of the kettle.

Explain how the safety features of the plug operate when this fault occurs.

(6)

The plug has rubber outings on each of the wires which means that electricity cannot flow through and give out an electric shock. This is because rubber is not a conductor of electricity.

Secondly the plug has a plastic case which also prevent any electricity from escaping from the inside of the plug because it is also not a conductor of electricity.

Both of these things prevent someone from getting fatally electricuted.

ResultsPlus
Examiner Comments

This candidate is not answering the question set. It was asking about the key safety features that operate when the fault of the live wire touching the metal case occurs. The candidate does not address this but focuses narrowly on the construction of the plug.

This was seen a number of times.

ResultsPlus
Examiner Tip

Read the whole question and make sure you understand what the key focus of that question is.

The figure showing the details of plug construction clearly distracted some candidates into a pre-occupation with that construction.

The lesson is not to be distracted but to zero in on the "what is the basis of the question at hand".

Paper Summary

Based on their performance on this paper, candidates are offered the following advice:

- make the most of opportunities afforded in school laboratories where you 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 they are clear in their minds about it. After the event evaluations are also useful, especially when reflecting about how the experiment could have been improved.

- Some equations in physics are required to be learnt e.g. that for kinetic energy in Qu1(b)(ii) and density in Qu4(a). Some candidates lacked these and so missed out on associated marks. Candidates should be able to recall and apply all twenty equations from the combined science specification.

- The use of wrong units causes candidates to miss out on some marks. A focus needs to be made on the use of metres, kilograms and seconds, as well as derived units e.g. the joule, which requires metres, kilograms and seconds in calculations to end up with energy in joules. Qu3(b)(iii) required converting mm to m. Qu4(b)(i) required a mass in kg. Some mistakenly used grams there.

- Students seem to need more practice on handling powers of ten in their calculations. They should be able to use their calculators with number 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:

http://www.edexcel.com/iwantto/Pages/grade-boundaries.aspx

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