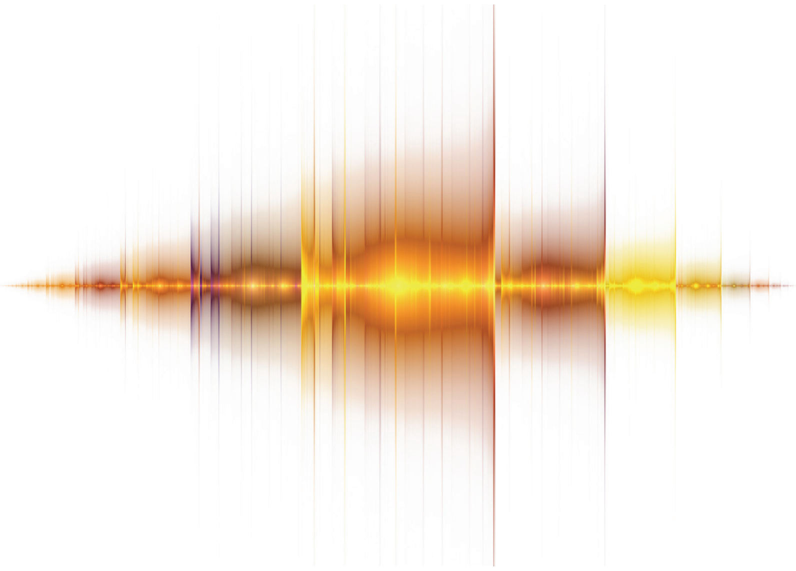
Cambridge Assessment
International Education

Example Candidate Responses

Paper 3

Cambridge IGCSE™
Physics 0625



Version 2.0

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Contents

Introduction

The main aim of this booklet is to exemplify standards for those teaching IGCSE Physics (0625), and to show how different levels of candidates' performance (middle and low) relate to the subject's curriculum and assessment objectives.

In this booklet candidate responses have been chosen to exemplify a range of answers. Each response is accompanied by a brief commentary explaining the strengths and weaknesses of the answers.

For each question, response is annotated with clear explanation of where and why marks were awarded or omitted. This, in turn, followed by examiner comments on how the answer could have been improved. In this way it is possible for you to understand what candidates have done to gain their marks and what they will have to do to improve their marks. At the end there is a list of common mistakes candidates made in their answers for each question.

This document provides illustrative examples of candidate work. These help teachers to assess the standard required to achieve marks, beyond the guidance of the mark scheme. Some question types where the answer is clear from the mark scheme, such as short answers and multiple choice, have therefore been omitted.

The questions, mark schemes and pre-release material used here are available to download from Teacher Support. These files are:

Question Paper 3, June 2016	
Question paper	0625_s16_qp_31.pdf
Mark scheme	0625_s16_ms_31.pdf

Question Paper 4, June 2016	
Question paper	0625_s16_qp_41.pdf
Mark scheme	0625_s16_ms_41.pdf

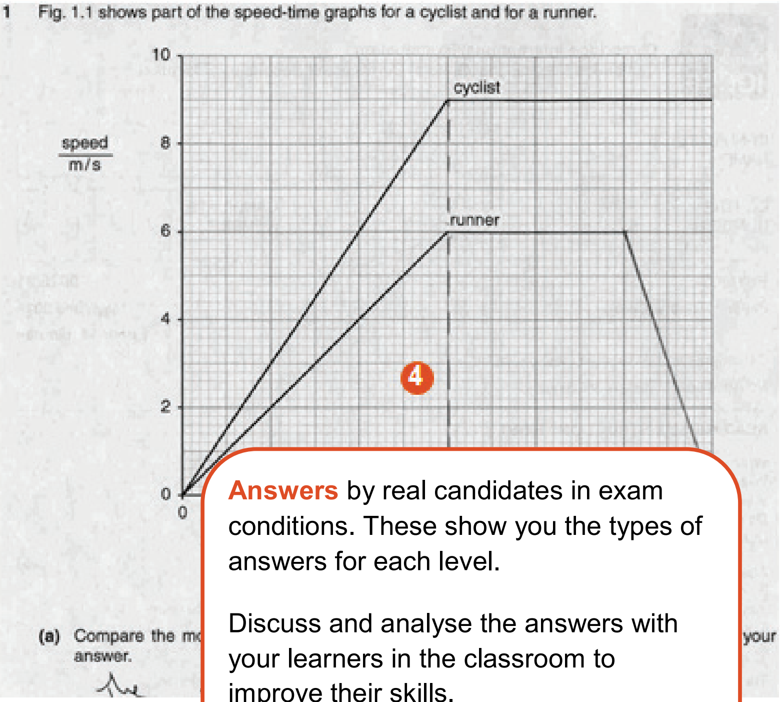
Question Paper 6, June 2016	
Question paper	0625_s16_qp_61.pdf
Mark scheme	0625_s16_ms_61.pdf

Other past papers, Examiner Reports and other teacher support materials are available on the School Support Hub at www.cambridgeinternational.org/support

How to use this booklet

Example Candidate Response – middle	**Examiner comments**

1 Fig. 1.1 shows part of the speed-time graphs for a cyclist and for a runner.



(a) Compare the mo… your answer.

Answers by real candidates in exam conditions. These show you the types of answers for each level.

Discuss and analyse the answers with your learners in the classroom to improve their skills.

Examiner annotations: Each response is annotated with clear explanation of where and why marks were awarded or omitted. In this way it is possible for you to understand what candidates have done to gain their marks.

① This response indicates that the cyclist is gaining speed but does not give details of the motion of the runner. A mark is scored for identifying correctly the faster speed of the cyclist.

Mark awarded for (a) = 1 out of 3

How the candidate could have improved the answer

(a) To achieve full marks candidate should have

(c) The candidate should have calculated the are
81m having to gain full marks.

Examiner comments This explains how the candidate could have improved the answer. This helps you to interpret the standard of Cambridge exams and helps your learners to refine exam technique.

Common mistakes candidates made in this question

(b) A common misconception was that the cycli

(c) A common incorrect value was 108m. Candid
the maximum speed by the total time. They did n

Common mistakes a list of common mistakes candidates made in their answers for each question.

Assessment at a glance

All candidates take must enter for three papers.

Core candidates take:		**Extended candidates take:**	
Paper 1	45 minutes	**Paper 2**	45 minutes
Multiple Choice	30%	Multiple Choice	30%
40 marks		40 marks	
40 four-choice multiple-choice questions		40 four-choice multiple-choice questions	
Questions will be based on the Core subject content		Questions will be based on the Extended subject content (Core and Supplement)	
Assessing grades C–G		Assessing grades A*–G	
Externally assessed		Externally assessed	
and:		**and:**	
Paper 3	1 hour 15 minutes	**Paper 4**	1 hour 15 minutes
Theory	50%	Theory	50%
80 marks		80 marks	
Short-answer and structured questions		Short-answer and structured questions	
Questions will be based on the Core subject content		Questions will be based on the Extended subject content (Core and Supplement)	
Assessing grades C–G		Assessing grades A*–G	
Externally assessed		Externally assessed	
All candidates take either:		**or:**	
Paper 5	1 hour 15 minutes	**Paper 6**	1 hour
Practical Test	20%	Alternative to Practical	20%
40 marks		40 marks	
Questions will be based on the experimental skills in Section 4		Questions will be based on the experimental skills in Section 4	
Assessing grades A*–G		Assessing grades A*–G	
Externally assessed		Externally assessed	

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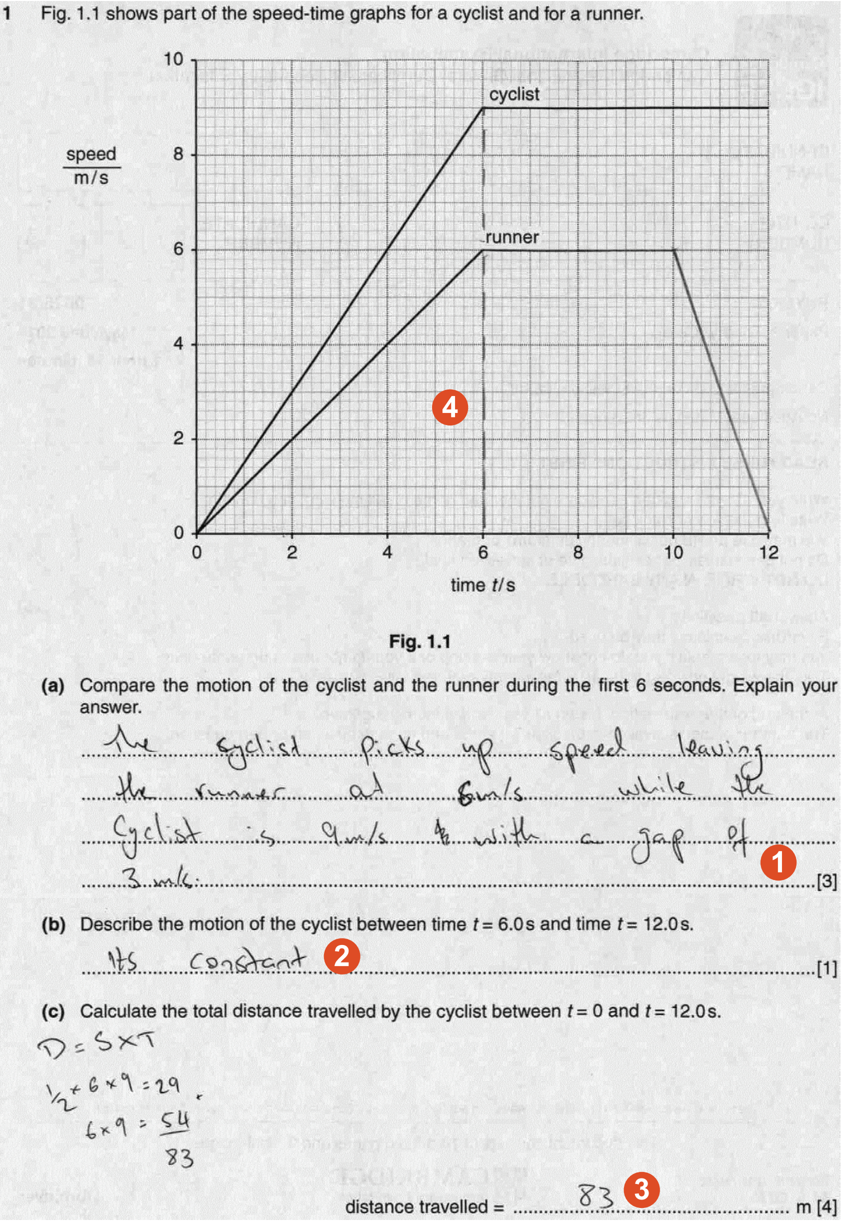
Paper 3 – Theory (Core)

Question 1

Example Candidate Response – middle



1 Fig. 1.1 shows part of the speed-time graphs for a cyclist and for a runner.

Fig. 1.1

(a) Compare the motion of the cyclist and the runner during the first 6 seconds. Explain your answer.

The cyclist picks up speed leaving the runner at 6m/s while the cyclist is 9m/s & with a gap of 3 m/s. ① [3]

(b) Describe the motion of the cyclist between time t = 6.0 s and time t = 12.0 s.

Its constant ② [1]

(c) Calculate the total distance travelled by the cyclist between t = 0 and t = 12.0 s.

D = S×T

½×6×9 = 29

6×9 = 54

83

distance travelled = 83 ③ m [4]

(d) After the first 6.0 seconds, the runner moves at constant speed for 4.0 seconds. He then slows down uniformly and stops in a further 2.0 seconds.

On Fig. 1.1, complete the graph for the runner's motion. [2]

[Total: 10]

Examiner comments

① This response indicates that the cyclist is gaining speed but does not give details of the motion of the runner. A mark is scored for identifying correctly the faster speed of the cyclist.

Mark awarded for (a) = 1 out of 3

② Constant speed is the required answer.

Mark awarded for (b) = 1 out of 1

③ The graph gives an indication of the areas of a triangle and a rectangle. The candidate has calculated the area of the triangle incorrectly. The final mark is a quality mark awarded to candidates who obtain the value of 81m having completed correctly all parts of the calculation.

Mark awarded for (c) = 2 out of 4

④ The graph completed correctly.

Mark awarded for (d) = 2 out of 2

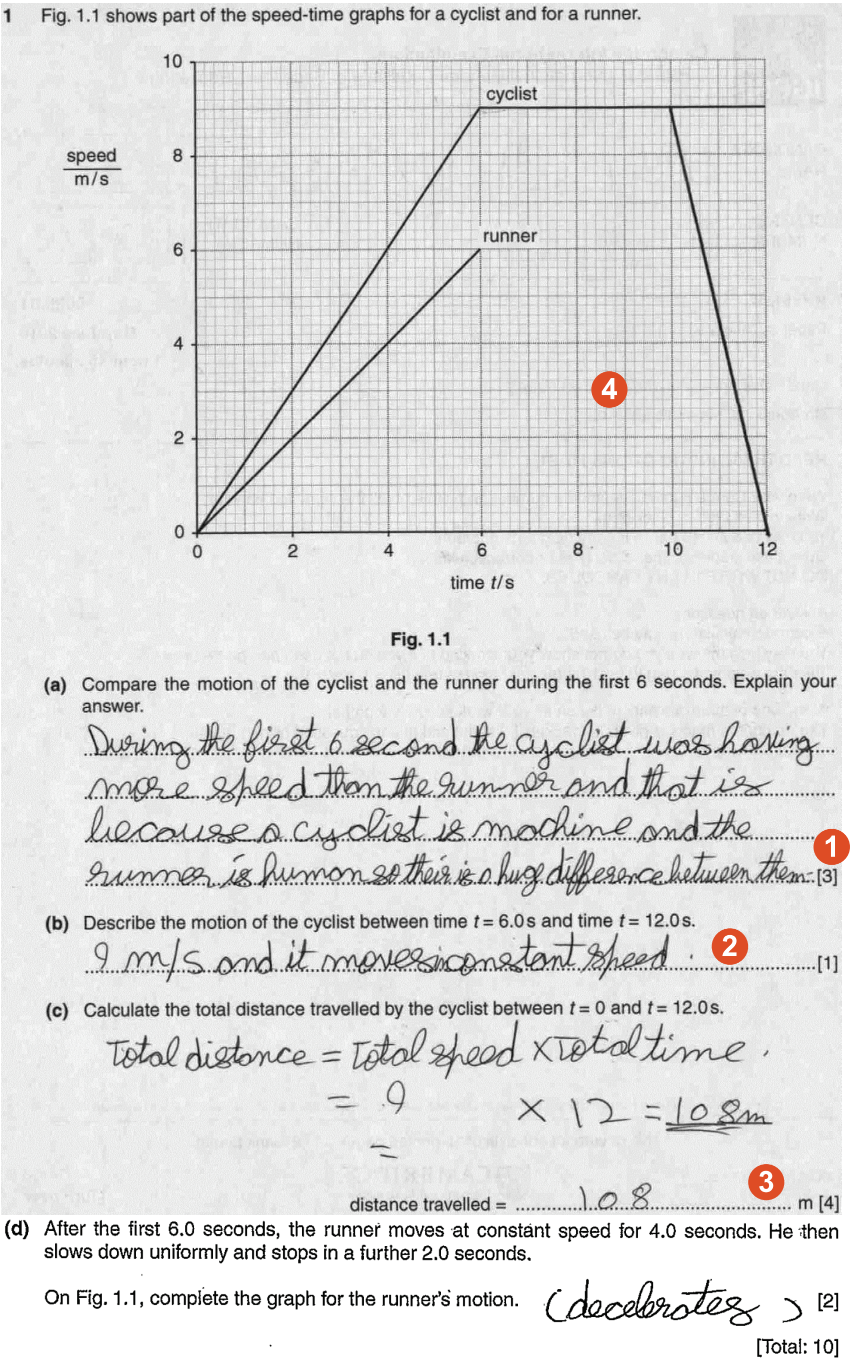
Total mark awarded = 6 out of 10

How the candidate could have improved the answer

(a) To achieve full marks candidate should have given details of the motion of the runner.

(c) The candidate should have calculated the area of the triangle correctly and reached the final value of 81m to gain full marks.

Example Candidate Response – low



1 Fig. 1.1 shows part of the speed-time graphs for a cyclist and for a runner.

Fig. 1.1

(a) Compare the motion of the cyclist and the runner during the first 6 seconds. Explain your answer.

During the first 6 second the cyclist was having more speed than the runner and that is because a cyclist is machine and the runner is human so their is a huge difference between them. ① [3]

(b) Describe the motion of the cyclist between time $t = 6.0$ s and time $t = 12.0$ s.

9 m/s and it moves in constant speed. ② [1]

(c) Calculate the total distance travelled by the cyclist between $t = 0$ and $t = 12.0$ s.

Total distance = Total speed x Total time.

= 9 × 12 = 108m

=

③ distance travelled = 108 m [4]

(d) After the first 6.0 seconds, the runner moves at constant speed for 4.0 seconds. He then slows down uniformly and stops in a further 2.0 seconds.

On Fig. 1.1, complete the graph for the runner's motion. (decelerates) [2]

[Total: 10]

Examiner comments

① Although the cyclist is moving faster there is no indication that the initial motion is acceleration. The higher acceleration of the cyclist has not been linked with the steeper gradient shown on the graph.

Mark awarded for (a) = 1 out of 3

② The value of the cyclist's speed is not required. The candidate obtains the mark for "constant speed".

Mark awarded for (b) = 1 out of 1

③ The candidate has not taken into account the acceleration takes place during the first six seconds of the journey.

Mark awarded for (c) = 1 out of 4

④ The question is about the runner but the response given uses the cyclist's graph. As an error has been carried forward the second mark has been awarded for the correct interpretation of the deceleration.

Mark awarded for (d) = 1 out of 2

Total mark awarded = 4 out of 10

How the candidate could have improved the answer

(a) The candidate has given no indication that the initial motion is acceleration. The higher acceleration of the cyclist should have been linked with the steeper gradient shown on the graph.

(c) The use of distance = speed x time does not take into account the acceleration taking place during the first six seconds of the journey. Subtracting 27m would have given a correct response.

(d) The question is about the runner. To gain full credit the candidate needs to complete the runner's motion rather than the cyclist's.

Common mistakes candidates made in this question

(b) A common misconception was that the cyclist had stopped moving.

(c) A common incorrect value was 108m. Candidates used the equation distance = speed x time, multiplying the maximum speed by the total time. They did not account for the initial acceleration.

Question 2

Example Candidate Response – middle

2 A boy steps off a high board into a swimming pool.

Fig. 2.1 shows the forces acting on the boy at one point in his fall.

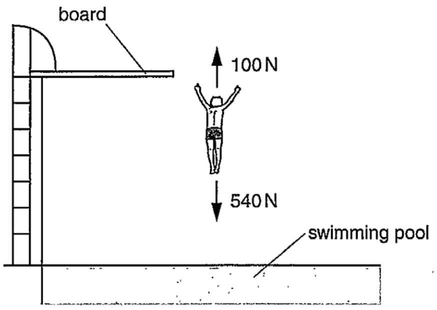


Fig. 2.1

(a) The 540 N force is caused by gravitational attraction.

State the cause of the 100 N force.

air resistance ① [1]

(b) Calculate the mass of the boy.

m =

540 ÷ 10 = 54

mass of boy = 54 ② kg [2]

(c) Calculate the resultant force on the boy. State its direction.

100 ÷ 10

~~540 ÷ 100 = 5.4~~

~~100N~~

resultant force = 5.4 10 ③ N

direction = Downwards

[2]

[Total: 5]

Examiner comments

① Correct response.

Mark awarded for (a) = 1 out of 1

② Although the equation is not stated, the calculation shows correct use of the equation and a correct value.

Mark awarded for (b) = 2 out of 2

③ There is an appreciation that the resultant force acts downwards but the value of the force has been calculated incorrectly.

Mark awarded for (c) = 1 out of 2

Total mark awarded = 4 out of 5

How the candidate could have improved the answer

(b) To improve the answer, the candidate should have stated the equation.

(c) The candidate should have stated the correct value for resultant force which was (540-100) = 440(N).

Example Candidate Response – low

2 A boy steps off a high board into a swimming pool.

Fig. 2.1 shows the forces acting on the boy at one point in his fall.

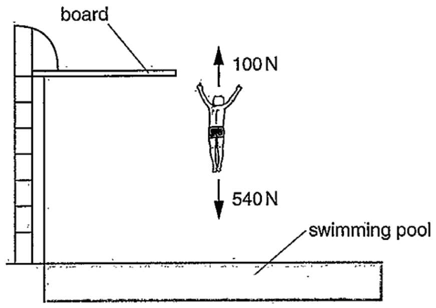


Fig. 2.1

(a) The 540 N force is caused by gravitational attraction.

State the cause of the 100 N force.

Energy force ① [1]

(b) Calculate the mass of the boy.

540 – 100

$\frac{440}{10}$

mass of boy = 44 ② kg [2]

(c) Calculate the resultant force on the boy. State its direction.

resultant force = 640 N

direction = Down ③

[2]

[Total: 5]

Examiner comments

① The candidate is not aware that a frictional force, air resistance or drag, acts against the boy.

Mark awarded for (a) = 0 out of 1

② The candidate is aware that there is a link between mass and weight. However, this response suggests that the boy has a lower mass as he falls.

Mark awarded for (b) = 0 out of 2

③ The value of the resultant force is incorrectly calculated. It is not appreciated that the forces act in opposite directions. The direction, in which the resultant force acts, is correct.

Mark awarded for (c) = 1 out of 2

Total mark awarded = 1 out of 5

How the candidate could have improved the answer

(a) The candidate should have indicated that a frictional force, air resistance or drag, acts against the boy.

(b) This response suggests that the boy has a lower mass as he falls. The correct response for resultant force was (540-100) = 440(N)

Common mistakes candidates made in this question

A variety of responses in the range of 44 to 640 was seen. Candidates used the numbers provided in a variety of ways to obtain incorrect values.

Question 3

Example Candidate Response – middle

3 Fig. 3.1 shows a metal plate-warmer.

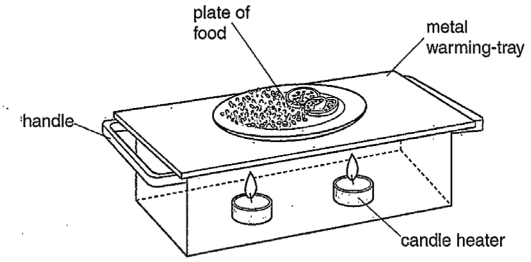


Fig. 3.1

The plate-warmer contains two small candle heaters. Plates of food are placed on top of the warming-tray.

(a) **(i)** State the name of a process by which the thermal energy from the candles passes to the warming-tray.

radiation ① [1]

(ii) State the name of the process by which thermal energy moves through the warming-tray.

convection ② [1]

(b) The outside of the plate-warmer is shiny.

Suggest how this helps the plate-warmer to stay hot.

~~It conducts heat and~~ prevents heat from being lost [1] ③

(c) The handles of the plate-warmer are made from metal.

Identify a problem with this, and suggest how the problem could be solved.

problem: metal conducts heat hence the handles will be ~~toohot~~ too hot to touch.

action: make the handles out of somthing that does not conduct alot of heat. ④ [2]

[Total: 5]

Examiner comments

① Correct response.

② The response suggests confusion between convection and conduction.

Mark awarded for (a) = 1 out of 2

③ This is a vague response that is just repeating the question.

Mark awarded for (b) = 0 out of 1

④ Correct response

Mark awarded for (c) = 2 out of 2

Total mark awarded = 3 out of 5

How the candidate could have improved the answer

(a) (ii) The candidate should have stated the correct answer which was ‘conduction’.

(b) The candidate should have answered in terms of shiny surfaces being poor emitters of thermal radiation.

Example Candidate Response – low

3 Fig. 3.1 shows a metal plate-warmer.

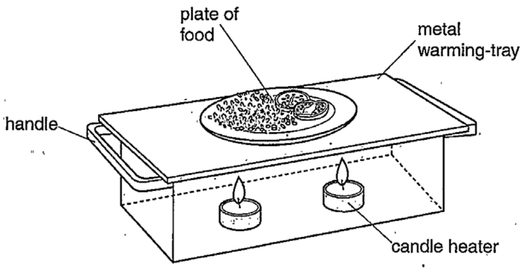


Fig. 3.1

The plate-warmer contains two small candle heaters. Plates of food are placed on top of the warming-tray.

(a) **(i)** State the name of a process by which the thermal energy from the candles passes to the warming-tray.

thermal energy ① [1]

(ii) State the name of the process by which thermal energy moves through the warming-tray.

it moves the smoke up to the tray ② [1]

(b) The outside of the plate-warmer is shiny.

Suggest how this helps the plate-warmer to stay hot.

get reflection ③ [1]

(c) The handles of the plate-warmer are made from metal.

Identify a problem with this, and suggest how the problem could be solved.

problem: The handle could be heated and difficult to touch ④

action: using a product that is against heat or use gloves [2]

[Total: 5]

Examiner comments

① The response just repeats part of the question.

② The process is not named.

Mark awarded for (a) = 0 out of 2

③ "Reflection" is too vague to be credited worthy.

Mark awarded for (b) = 0 out of 1

④ The problem (hot handles) and a suitable action (gloves) are identified.

Mark awarded for (c) = 2 out of 2

Total mark awarded = 2 out of 5

How the candidate could have improved the answer

(a) (i) The response repeated part of the question. The name of the process by which thermal energy is transferred was required.

(a) (ii) The name of the correct thermal process was required.

(b) To gain credit the candidate must have indicated that it was reflection of thermal radiation. 'Reflection' on its own is too vague.

Common mistakes candidates made in this question

(a) Few candidates confused the terms conduction, convection and radiation.

(b) There were many responses given in terms of light rather than thermal energy being reflected.

Question 4

Example Candidate Response – middle	**Examiner comments**

4 Fig. 4.1 is a simplified diagram of a geothermal power station.

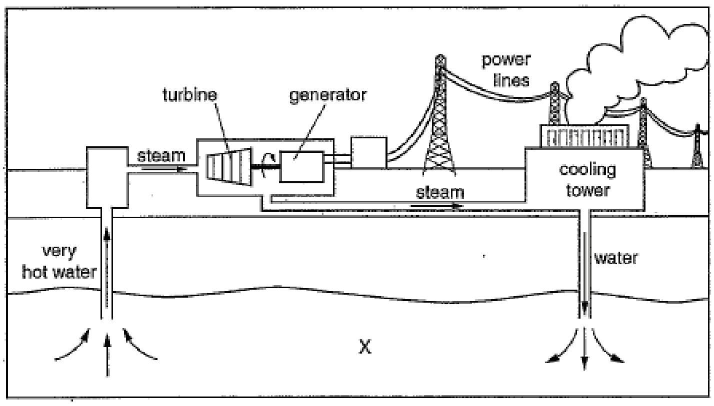


Fig. 4.1

(a) Describe the energy resource labelled X in Fig. 4.1.

Renewable ① [1]

(b) Identify the useful energy transformation that takes place in the geothermal power station.
Tick **one** box in each column.

input energy		output energy	
chemical	☐	chemical	☐
electrical	☐	electrical	☑
gravitational	☐	gravitational	☐
sound	☐	sound	☐
thermal	☑	thermal	☐

② [2]

(c) State two disadvantages of obtaining energy from fossil fuels.

1. It is ~~better~~ pollutant .

2. It is non - renewable . ③

[2]

[Total: 5]

① The response does not answer the question. The correct answer is 'hot rocks'.

Mark awarded for (a) = 0 out of 1

② Correct response.

Mark awarded for (b) = 2 out of 2

③ The first point is too vague. The second point scores a mark for non-renewable energy source.

Mark awarded for (c) = 1 out of 2

Total mark awarded = 3 out of 5

How the candidate could have improved the answer

(a) The candidate needed to identify what caused the water to become very hot.

(c) To obtain full marks the candidate must have identified atmospheric pollution or the pollution of air.

Example Candidate Response – low

4 Fig. 4.1 is a simplified diagram of a geothermal power station.

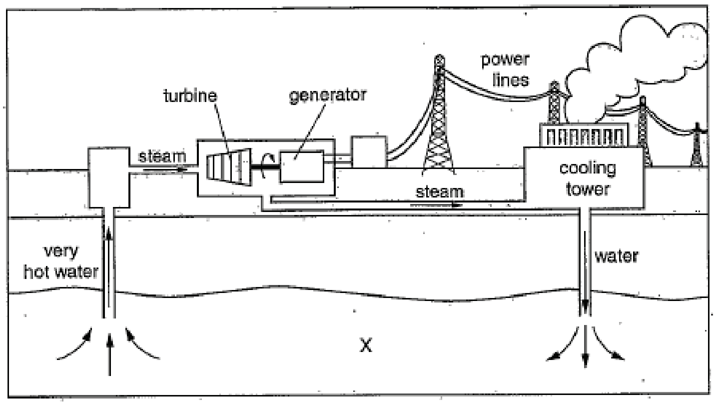


Fig. 4.1

(a) Describe the energy resource labelled X in Fig. 4.1. ①

hydro electric energy. [1]

(b) Identify the useful energy transformation that takes place in the geothermal power station. Tick **one** box in **each** column.

	input energy		output energy	
③	chemical	☐	chemical	☑ ②
	electrical	☐	electrical	☐
	gravitational	☐	gravitational	☐
	sound	☐	sound	☐
	thermal	☑	thermal	☐

[2]

(c) State two disadvantages of obtaining energy from fossil fuels.

1. air pollution from the power station

2. Noisy from the Power Station ④

[2]

[Total: 5]

Examiner comments

① The candidate does not appreciate that water becomes hot as a result of passing through hot rocks.

Mark awarded for (a) = 0 out of 1

② Only one of the boxes has been ticked correctly. The output energy is electrical.

③ Input energy has been identified correctly. The output energy is electrical.

Mark awarded for (b) = 1 out of 2

④ Noisy is a general term and does not score a mark.

Mark awarded for (c) = 1 out of 2

Total mark awarded = 2 out of 5

How the candidate could have improved the answer

(a) The candidate needed to identify what causes the water to become very hot.

(b) The candidate should have ticked electrical for output energy.

(c) Noisy is a general term and did not gain credit. There is a range of specific disadvantages e.g. global warming or non-renewable that could have been used to gain credit.

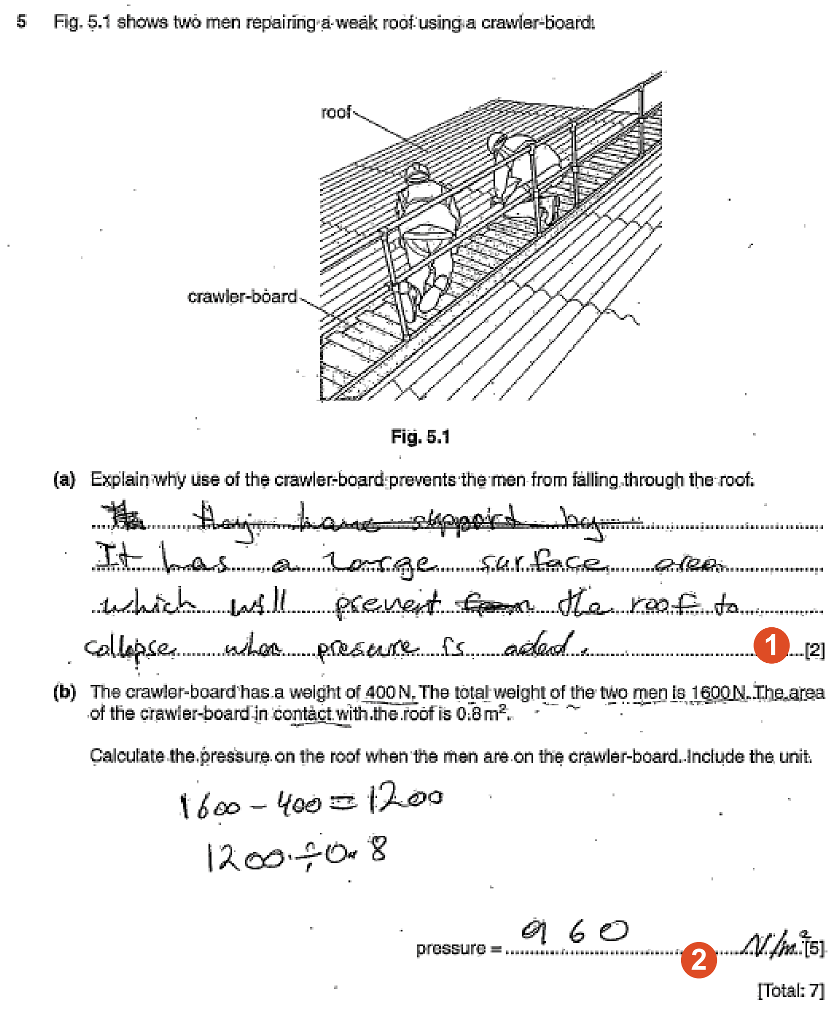
Common mistakes candidates made in this question

(a) A variety of wrong responses was seen linked to renewable sources of energy, e.g. wave, tidal and hydroelectric.

(b) A small number of candidates had reversed the input and output energies.

Question 5

Example Candidate Response – middle



5 Fig. 5.1 shows two men repairing a weak roof using a crawler-board.

Fig. 5.1

(a) Explain why use of the crawler-board prevents the men from falling through the roof.

~~they have support by~~
It has a large surface area
which will prevent ~~from~~ the roof to
collapse when pressure is aded. [2]

(b) The crawler-board has a weight of 400 N. The total weight of the two men is 1600 N. The area of the crawler-board in contact with the roof is 0.8 m^2.

Calculate the pressure on the roof when the men are on the crawler-board. Include the unit.

$1600 - 400 = 1200$

$1200 \div 0.8$

pressure = 960 N/m^2 [5]

[Total: 7]

Examiner comments

① Large surface area is identified but no indication of how this affects the pressure exerted by the workers.

Mark awarded for (a) = 1 out of 2

② The calculation of the total force is incorrect. P=F/A is not stated. An error carried forward is allowed for candidate's force divided by the area. The value obtained for the pressure is incorrect, but credit is given for the nit that is stated correctly.

Mark awarded for (b) = 2 out of 5

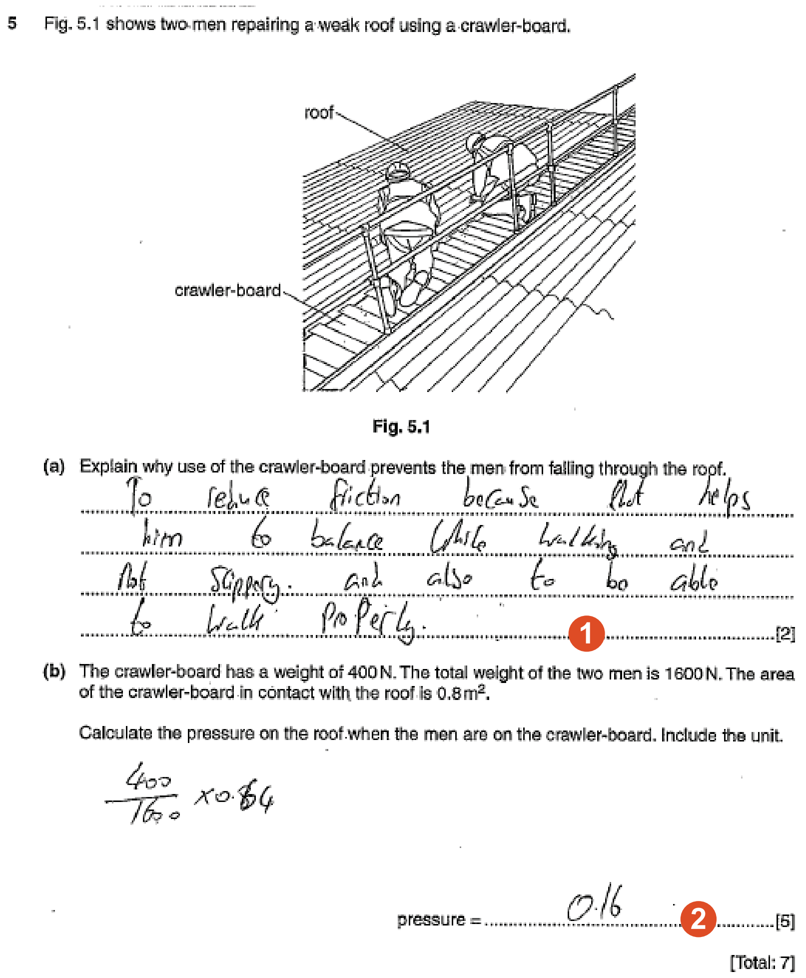
Total mark awarded = 3 out of 7

How the candidate could have improved the answer

(a) The candidate should have indicated how large surface are affects the pressure exerted by the workers.

(b) The candidate should have calculated the total force correctly by adding the forces. Pressure = force/area should have been stated.

Example Candidate Response – low



5 Fig. 5.1 shows two men repairing a weak roof using a crawler-board.

Fig. 5.1

(a) Explain why use of the crawler-board prevents the men from falling through the roof.

To reduce fiction because that helps him to balace while walking and not slipping. and also to be able to walk proPerly. ① [2]

(b) The crawler-board has a weight of 400 N. The total weight of the two men is 1600 N. The area of the crawler-board in contact with the roof is 0.8 m^2.

Calculate the pressure on the roof when the men are on the crawler-board. Include the unit.

$\frac{400}{1600} \times 0.64$

pressure = 0.16 ② [5]

[Total: 7]

Examiner comments

① The response here indicates a misconception that the crawler board is for safety and to prevent the workers from slipping.

Mark awarded for (a) = 0 out of 2

② There is no indication that the candidate is aware of the need to use the equation P=F/A. The numbers appear to have been randomly applied to an equation.

Mark awarded for (b) = 0 out of 5

Total mark awarded = 0 out of 7

How the candidate could have improved the answer

(a) The candidate should have explained that the crawler has a large surface and prevents the roof from collapsing by spreading the men's weight.

(b) The candidate should have used the correct formula P=F/A . The numbers appear to have been randomly applied to an equation.

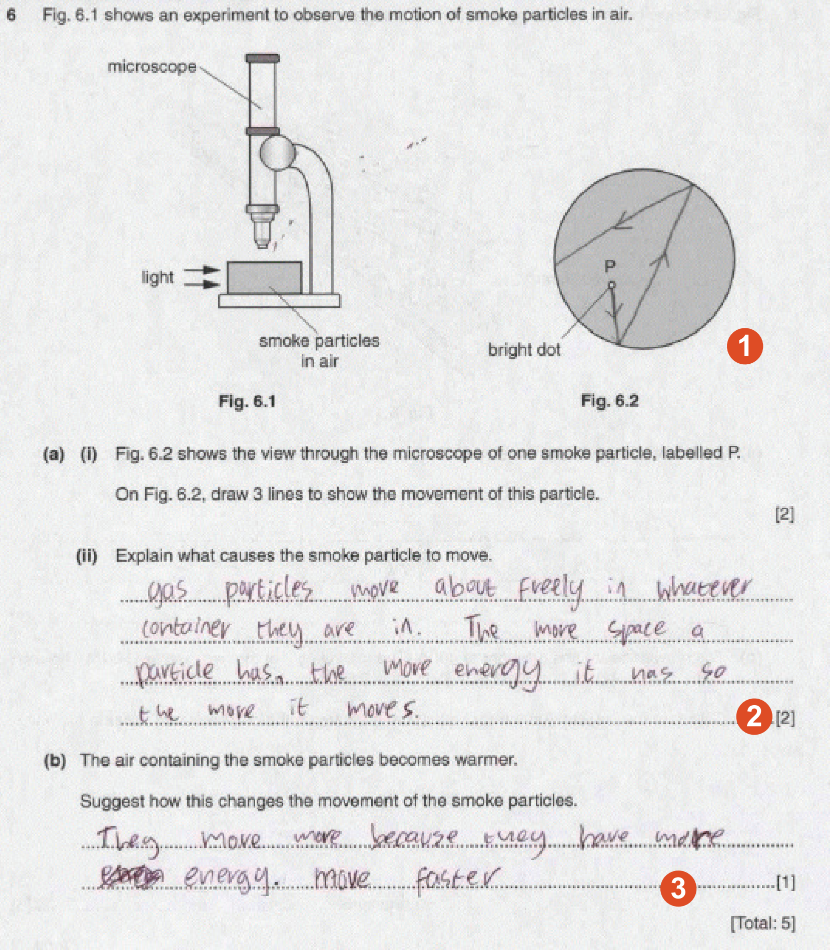
Common mistakes candidates made in this question

(a) A common misconception was answers that suggested the crawler board is for safety and to prevent the workers from slipping.

(b) Stating the equation incorrectly: pressure = force x area.

Question 6

Example Candidate Response – middle



6 Fig. 6.1 shows an experiment to observe the motion of smoke particles in air.

Fig. 6.1

Fig. 6.2

(a) (i) Fig. 6.2 shows the view through the microscope of one smoke particle, labelled P.

On Fig. 6.2, draw 3 lines to show the movement of this particle.

[2]

(ii) Explain what causes the smoke particle to move.

gas particles move about freely in whatever container they are in. The more space a particle has, the more energy it has so the more it moves. ② [2]

(b) The air containing the smoke particles becomes warmer.

Suggest how this changes the movement of the smoke particles.

They move more because they have more energy. move faster ③ [1]

[Total: 5]

Examiner comments

① Correct response.

Mark awarded for (a) = 2 out of 2

② The response is not answering the question.

Mark awarded for (b) = 0 out of 2

③ Correct response.

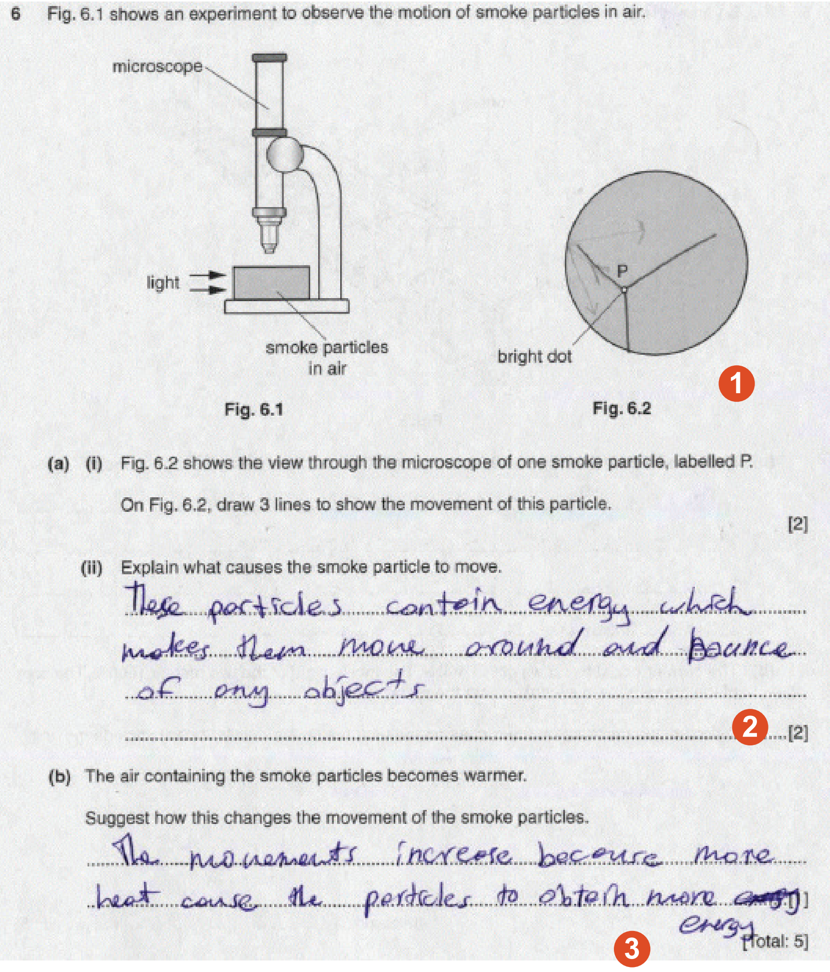
Mark awarded for (b) = 1 out of 1

Total mark awarded = 3 out of 5

How the candidate could have improved the answer

(a) (ii) The candidate must have referred to collisions of smoke particles with air molecules.

Example Candidate Response – low



6 Fig. 6.1 shows an experiment to observe the motion of smoke particles in air.

Fig. 6.1

Fig. 6.2

①

(a) (i) Fig. 6.2 shows the view through the microscope of one smoke particle, labelled P.

On Fig. 6.2, draw 3 lines to show the movement of this particle. [2]

(ii) Explain what causes the smoke particle to move.

These particles contein energy which makes them move around and bounce of any objects

② [2]

(b) The air containing the smoke particles becomes warmer.

Suggest how this changes the movement of the smoke particles.

The movements increese because more heat cause the perticles to obtein more ~~energ~~ energy [1]

③ [Total: 5]

Examiner comments

① There is no appreciation of particles moving in straight lines until deflected by collisions.

Mark awarded for (a) = 0 out of 2

② The idea of collisions between objects gains partial credit.

Mark awarded for (b) = 1 out of 2

③ Increased movement is too vague and does not indicate an increase in speed or an increase in collisions.

Mark awarded for (c) = 0 out of 1

Total mark awarded = 1 out of 5

How the candidate could have improved the answer

(a) (i) The candidate must have clearly indicated the movement of one particle.

(a) (ii) For full credit the candidate must have stated that the collisions occurred between smoke particles and air molecules.

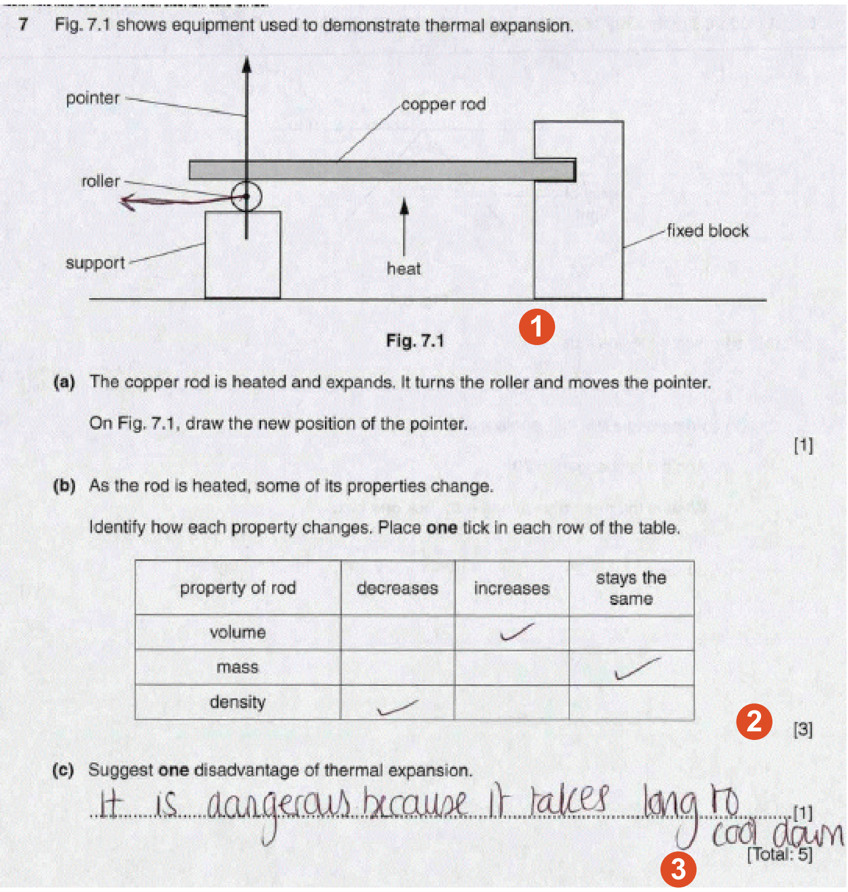
(b) The candidate should have indicated that smoke particles would change directions or there would be an increase in collisions.

Common mistakes candidates made in this question

(a) Candidates did not give a response in terms of the movement of a single particle.

Question 7

Example Candidate Response – middle



7 Fig. 7.1 shows equipment used to demonstrate thermal expansion.

Fig. 7.1

(a) The copper rod is heated and expands. It turns the roller and moves the pointer.

On Fig. 7.1, draw the new position of the pointer.

[1]

(b) As the rod is heated, some of its properties change.

Identify how each property changes. Place **one** tick in each row of the table.

property of rod	decreases	increases	stays the same
volume		✓	
mass			✓
density	✓		

② [3]

(c) Suggest **one** disadvantage of thermal expansion.

It is dangerous because it takes long to cool down [1]

[Total: 5]

③

Examiner comments

① Candidate correctly identifies that, as the rod expands, the pointer rotates in an anti-clockwise direction.

Mark awarded for (a) = 1 out of 1

② A correct response. The candidate recognises that a volume increases and mass remains constant density decreases.

Mark awarded for (b) = 3 out of 3

③ A vague response that did not address the question asked.

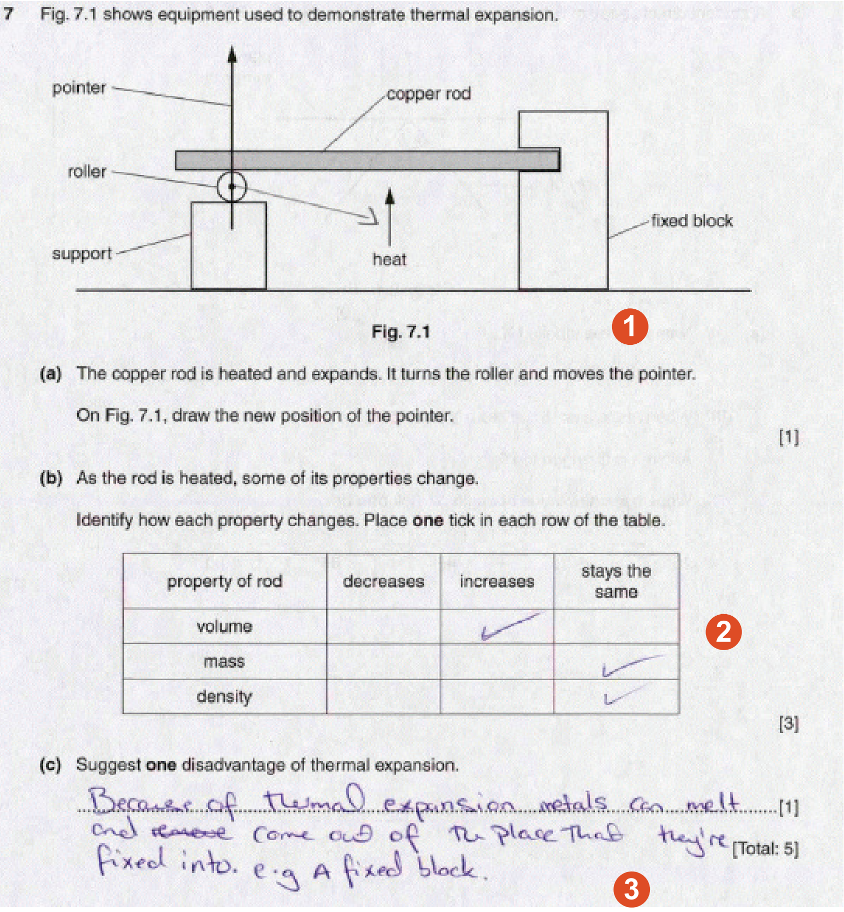
Mark awarded for (c) = 0 out of 1

Total mark awarded = 4 out of 5

How the candidate could have improved the answer

(c) The candidate should have indicated that electrical cables would be lower to the ground.

Example Candidate Response – low



7 Fig. 7.1 shows equipment used to demonstrate thermal expansion.

Fig. 7.1

①

(a) The copper rod is heated and expands. It turns the roller and moves the pointer.

On Fig. 7.1, draw the new position of the pointer.

[1]

(b) As the rod is heated, some of its properties change.

Identify how each property changes. Place **one** tick in each row of the table.

property of rod	decreases	increases	stays the same
volume		✓	
mass			✓
density			✓

②

[3]

(c) Suggest **one** disadvantage of thermal expansion.

Because of thermal expansion metals can melt [1]
and ~~release~~ come out of the place that they're [Total: 5]
fixed into. e.g A fixed block.

③

Examiner comments

① The candidate realises that the pointer moves but indicates the wrong direction.

Mark awarded for (a) = 0 out of 1

② The candidate correctly identifies that volume increases and mass stays the same. There is a misconception that density is also constant as the rod is heated.

Mark awarded for (b) = 2 out of 3

③ An incorrect response that did not address the question.

Mark awarded for (c) = 0 out of 1

Total mark awarded = 2 out of 5

How the candidate could have improved the answer

(a) The candidate should have indicated the correct direction which was 'to the left' or 'anticlockwise'.

(b) The candidate needed to follow through the correct responses to identify that density would decrease.

(c) An example of a disadvantage of thermal expansion was required, e.g. buckling of railway lines.

Common mistakes candidates made in this question

(b) There were a range of misconceptions about mass, volume and density changing when a material is heated.

(c) There were many vague responses in terms of buildings, bridges and railways that were not given credit.

Question 8

Example Candidate Response – middle

8 A student directs a ray of light towards a plane mirror, as shown in Fig. 8.1.

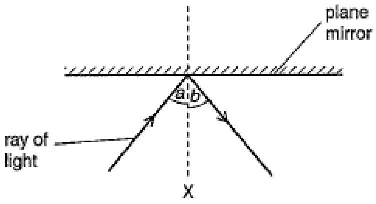


Fig. 8.1

(a) (i) Name the line labelled X.

①

Line of ~~incidence~~ ~~reflection~~ Symmetry [1]

(ii) When angle *a* is 45°, angle *b* is also 45°.

Angle *a* is changed to 20°.

What is the new value of angle *b*? Tick **one** box.

②

20° ☑ 25° ☐ 45° ☐ 65° ☐ 80° ☐ [1]

(b) The student now makes the ray of light from Fig. 8.1 pass into a glass block, as shown in Fig. 8.2.

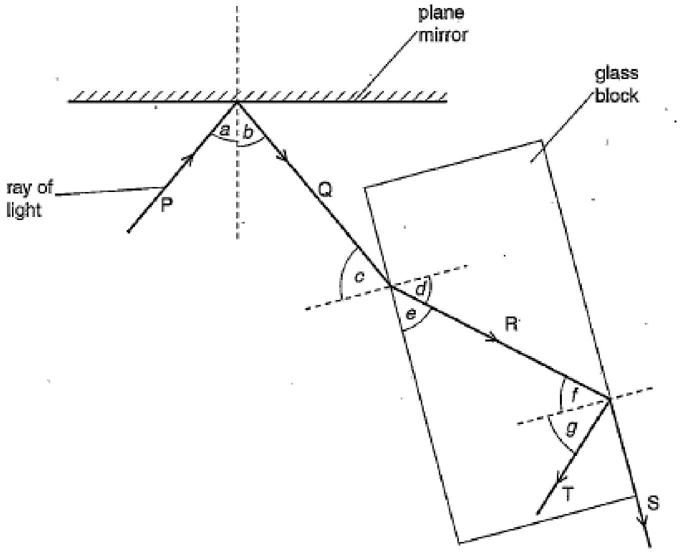


Fig. 8.2

Complete the table, using the labels from Fig. 8.2. The first label is done for you.

description	label
an angle of incidence	*a*
an angle of refraction	d
an internally reflected angle	g
a critical angle	f
a refracted ray	R

③

[4]

Examiner comments

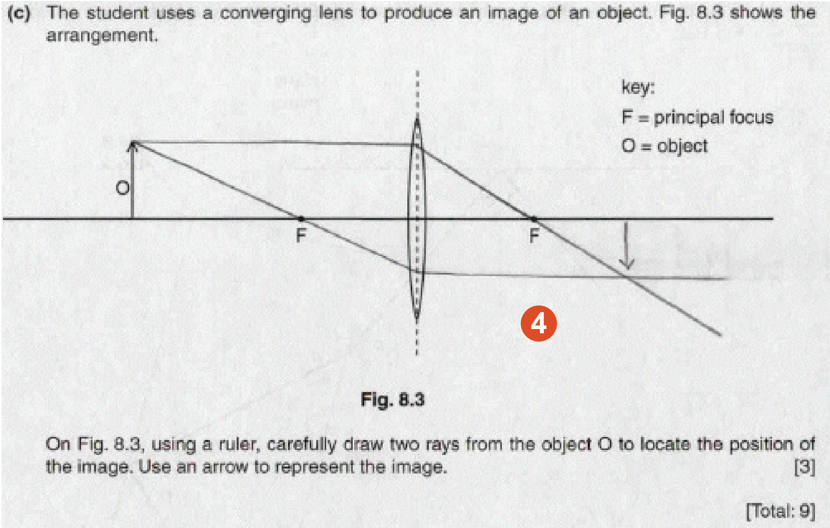
① An incorrect response that did not use Physics terminology.

② The correct box is ticked.

Mark awarded for (a) = 1 out of 2

③ Here the candidate correctly identifies all items. Note that the final label could have been R or S.

Mark awarded for (b) = 4 out of 4

Example Candidate Response – middle, continued	Examiner comments
 **(c)** The student uses a converging lens to produce an image of an object. Fig. 8.3 shows the arrangement. **Fig. 8.3** On Fig. 8.3, using a ruler, carefully draw two rays from the object O to locate the position of the image. Use an arrow to represent the image. [3] [Total: 9]	④ A good ray diagram is drawn by the candidate to gain two marks. The image inverted but does not meet the intersection of two rays. The third mark is not awarded. Mark awarded for (c) = 2 out of 3 **Total mark awarded = 7 out of 9**

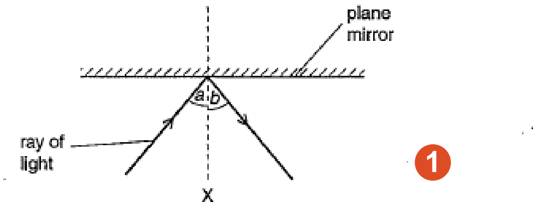
How the candidate could have improved the answer

(a) (i) Candidate was required to use the correct terminology; the correct response was ‘normal’.

(c) The candidate should have shown that the image is inverted but does not meet the intersection of the two rays.

Example Candidate Response – low

8 A student directs a ray of light towards a plane mirror, as shown in Fig. 8.1.



①

Fig. 8.1

(a) (i) Name the line labelled X.

~~Angle of~~ reflection. [1]

(ii) When angle *a* is 45°, angle *b* is also 45°.

Angle *a* is changed to 20°.

What is the new value of angle *b*? Tick **one** box.

②

20° ☑ 25° ☐ 45° ☐ 65° ☐ 80° ☐ [1]

(b) The student now makes the ray of light from Fig. 8.1 pass into a glass block, as shown in Fig. 8.2.

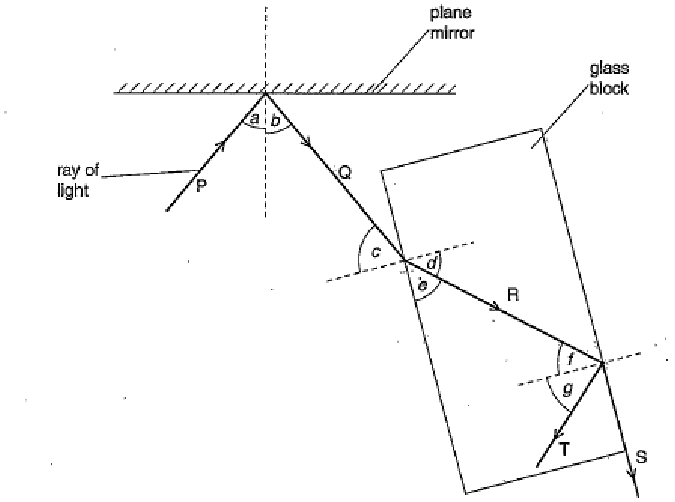


Fig. 8.2

Complete the table, using the labels from Fig. 8.2. The first label is done for you.

description	label
an angle of incidence	*a*
an angle of refraction	c
an internally reflected angle	e
a critical angle	~~d~~ f.
a refracted ray	g

③

[4]

Examiner comments

① The candidate correctly identifies one of the angles shown but gives an incorrect response for the name of the line at right angles to the mirror

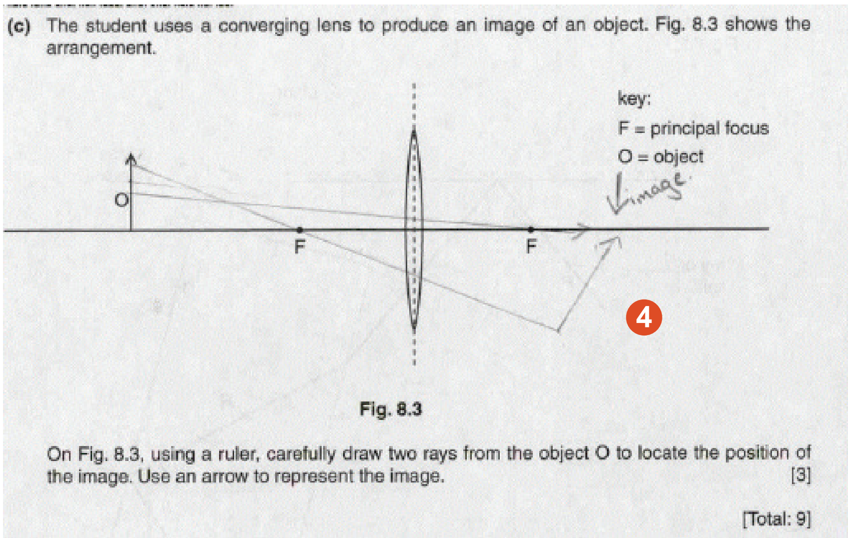
② The correct box is ticked.

Mark awarded for (a) = 2 out of 2

③ In this question the candidate is required to identify various labels from a ray diagram. Only one is correct; the critical angle f.

Mark awarded for (b) = 1 out of 4

Example Candidate Response – low, continued



(c) The student uses a converging lens to produce an image of an object. Fig. 8.3 shows the arrangement.

Fig. 8.3

On Fig. 8.3, using a ruler, carefully draw two rays from the object O to locate the position of the image. Use an arrow to represent the image. [3]

[Total: 9]

Examiner comments

④ The candidate is aware that rays need to pass through F but is unable to complete the ray diagram to obtain an inverted image.

Mark awarded for (c) = 0 out of 3

Total mark awarded = 2 out of 9

How the candidate could have improved the answer

(a) (i) The correct response was normal.

(b) Only one of the labels was correct: critical angle – f. The candidate needed to have a clear understanding of the use of terms reflection and refraction to complete the table correctly.

(c) The candidate should have constructed the ray diagram correctly to obtain an inverted image.

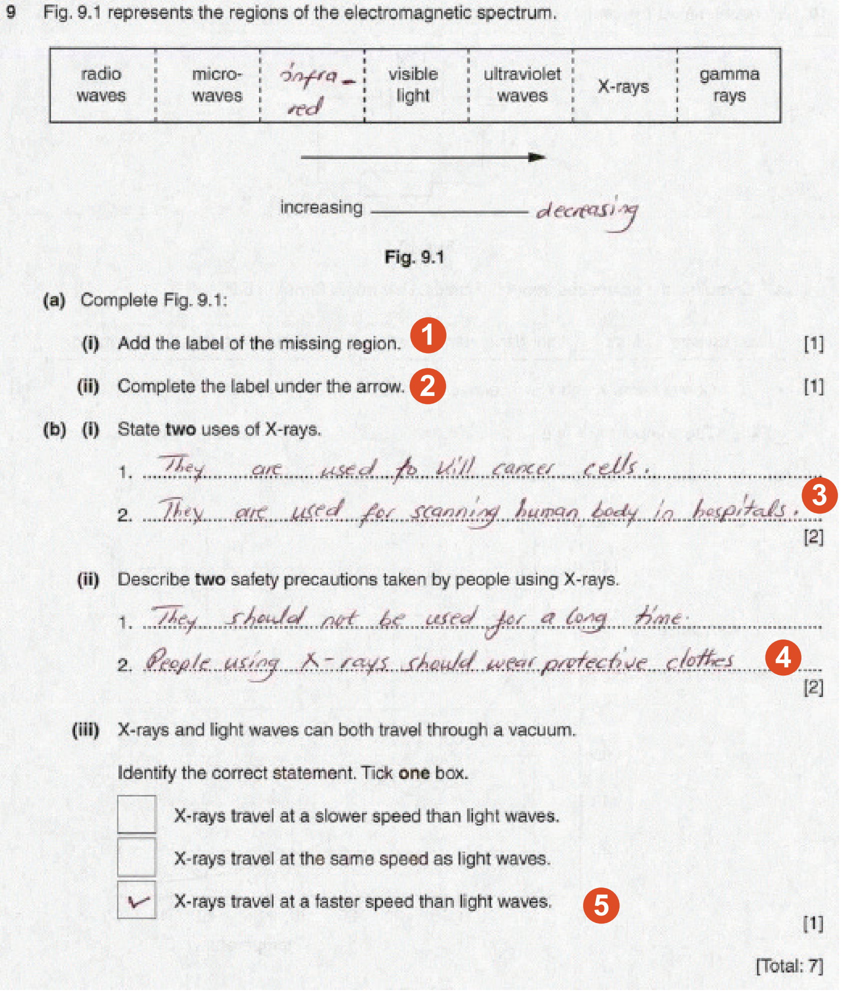
Common mistakes candidates made in this question

(b) Less well prepared candidates gave a variety of labels when completing the table.

(c) A common misconception was the lack of refraction of a ray passing through the lens.

Question 9

Example Candidate Response – middle



9 Fig. 9.1 represents the regions of the electromagnetic spectrum.

radio waves	micro-waves	infra-red	visible light	ultraviolet waves	X-rays	gamma rays

increasing ______ decreasing

Fig. 9.1

(a) Complete Fig. 9.1:

(i) Add the label of the missing region. ① [1]

(ii) Complete the label under the arrow. ② [1]

(b) (i) State **two** uses of X-rays.

1. They are used to kill cancer cells.
2. They are used for scanning human body in hospitals. ③ [2]

(ii) Describe **two** safety precautions taken by people using X-rays.

1. They should not be used for a long time.
2. People using X-rays should wear protective clothes ④ [2]

(iii) X-rays and light waves can both travel through a vacuum.

Identify the correct statement. Tick **one** box.

☐ X-rays travel at a slower speed than light waves.

☐ X-rays travel at the same speed as light waves.

☑ X-rays travel at a faster speed than light waves. ⑤ [1]

[Total: 7]

Examiner comments

① Correct response.

② An incorrect response that did not address the question asked.

Mark awarded for (a) = 1 out of 2

③ Candidate gives two correct responses.

④ A correct response in terms of restricting exposure is given along with a vague response about protective clothing that is not given any credit.

⑤ The candidate has ticked the wrong box indicating that X-ray travels faster than light waves.

Mark awarded for (b) = 3 out of 5

Total mark awarded = 4 out of 7

How the candidate could have improved the answer

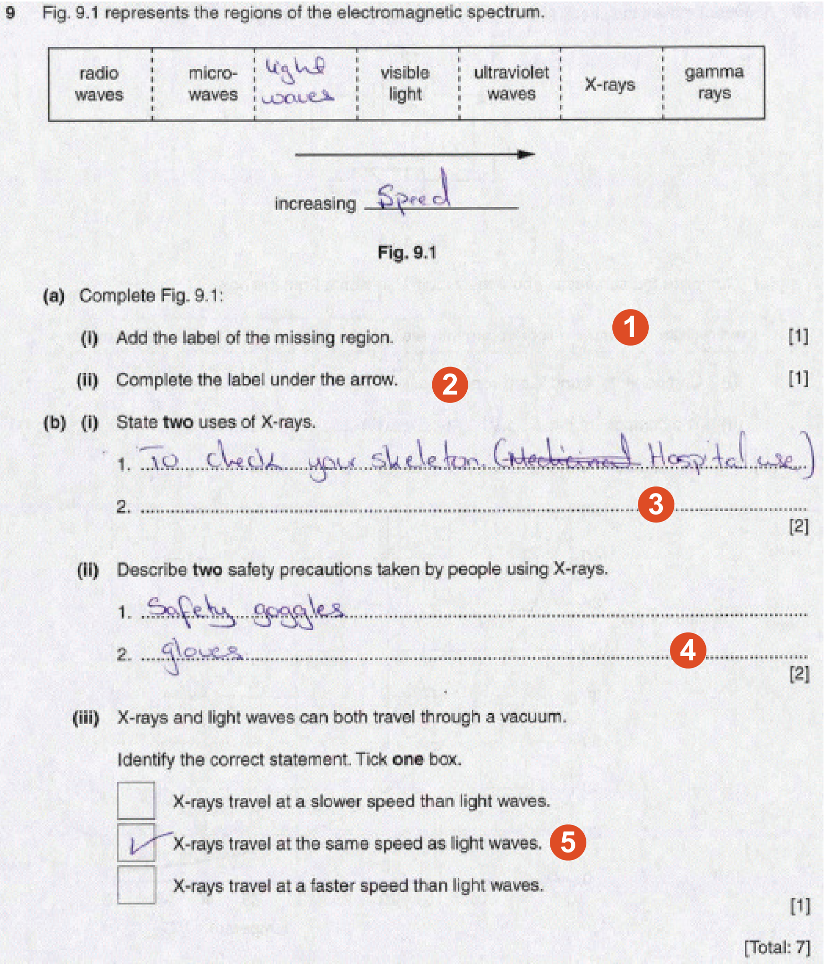
(a) (ii) The candidate should have recognised that the electromagnetic spectrum showed increasing frequency (decreasing wavelength) from left to right.

(b) (ii) A correct response in terms of restricting the user's exposure to X-rays gains credit. A vague second response about protective clothing did not gain any further credit. The candidate should have mentioned wearing 'lead apron' or 'standing behind a screen' to gain full marks.

(b) (iii) The candidate should have indicated that X-rays travel at the same speed as light waves.

.

Example Candidate Response – low



9 Fig. 9.1 represents the regions of the electromagnetic spectrum.

radio waves	micro-waves	light waves	visible light	ultraviolet waves	X-rays	gamma rays

increasing Speed

Fig. 9.1

(a) Complete Fig. 9.1:

(i) Add the label of the missing region. ① [1]

(ii) Complete the label under the arrow. ② [1]

(b) **(i)** State **two** uses of X-rays.

1. To check your skeleton (~~Medicinal~~ Hospital use)

2. ③

[2]

(ii) Describe **two** safety precautions taken by people using X-rays.

1. Safety goggles

2. gloves ④

[2]

(iii) X-rays and light waves can both travel through a vacuum.

Identify the correct statement. Tick **one** box.

☐ X-rays travel at a slower speed than light waves.

☑ X-rays travel at the same speed as light waves. ⑤

☐ X-rays travel at a faster speed than light waves.

[1]

[Total: 7]

Examiner comments

① An incorrect response repeating information already included in the electromagnetic spectrum.

② The candidate has not appreciated that all elements of the electromagnetic spectrum travel at the same speed.

Mark awarded for (a) = 0 out of 2

③ Hospital use is too vague but the candidate has indicated a particular area that can be given benefit of doubt.

④ Vague responses such as goggles and gloves do not gain marks.

⑤ A correct response identifying x-ray travel at the same speed as light waves.

Mark awarded for (b) = 2 out of 5

Total mark awarded = 2 out of 7

How the candidate could have improved the answer

(a) (i) The candidate should have indicated the correct response which was ‘infra-red’.

(a) (ii) The candidate should have appreciated that all elements of the electromagnetic spectrum travel at the same speed and gives an incorrect response.

(b) (i) Only one use was given. Hospital use was too vague to gain full marks; the candidate should have clearly stated where or for what purpose in hospitals.

(b) (ii) Vague responses such as goggles and gloves do not gain any credit. Screening from X-rays and limiting exposure would have gained full credit.

Common mistakes candidates made in this question

(a) (i) Incorrect responses included sound and ultra-sound.

(a) (ii) Wavelength and speed were common misconceptions.

(b) (i) Some very vague responses were seen, e.g. “use in pipes”.

(b) (ii) Goggles and gloves were common responses that did not gain any credit.

(b) (iii) There was a lack of appreciation that X-rays travelled at the same speed as light waves and consequently the top and bottom statements received equal numbers of incorrect responses.

Question 10

Example Candidate Response – middle

10 A student makes the circuit shown in Fig. 10.1 using a 12V battery.

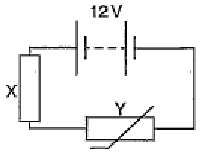


Fig. 10.1

(a) Complete the sentences about the circuit. Use words from the box.

fixed resistor lamp light-dependent resistor parallel series thermistor

(i) Components X and Y are connected in Series [1]

(ii) The component Y is a fixed resistor [1] ①

(b) Fig. 10.2 shows how the resistance of Y varies with temperature. ②

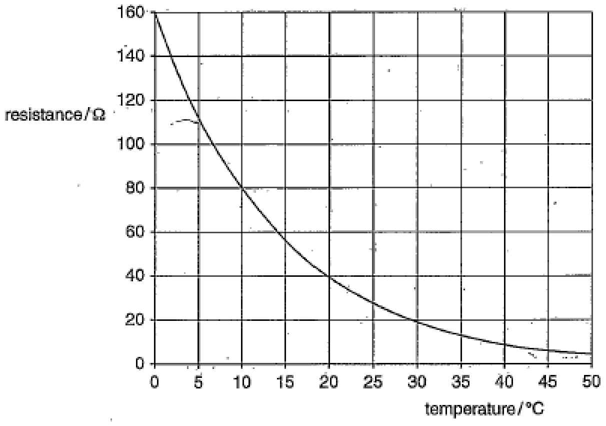


Fig. 10.2

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

The lesser the ~~resistance~~ temprature the the higher the resistance

[2] ③

(ii) The temperature of Y is 10°C. The resistance of X is 20Ω.

Calculate the combined resistance of Y and X.

80+20=10

resistance = 100 Ω [3] ④

(iii) Calculate the current in the circuit.

I = V/R

~~160+140+120+100+80+60+40+20~~
10

current = 0.02 A [3]

[Total: 10]

$I = \frac{12}{160+140+120+100+80+60+40+20} = \frac{12}{220}$ ⑤

Examiner comments

① Correct response.

② The candidate identifies X rather than Y.

Mark awarded for (a) = 1 out of 2

③ A partially correct response is given that gains 1 mark.

④ A correct response. The candidate used the graph to determine the value of the resistance of Y and then added the value of X to obtain the correct value for the total resistance.

⑤ The candidate states correctly the V=IR equation to gain 1 mark. A further calculation is then undertaken to determine the value of R instead of using the R value form part (b) (ii).

Mark awarded for (b) = 5 out of 8

Total mark awarded = 6 out of 10

How the candidate could have improved the answer

(a) (ii) The candidate needed to identify Y (thermistor) rather than X.

(b) (i) A partially correct response was given. The candidate should have the curve to explain the rate of change.

(b) (iii) The candidate should have made use of the R value from part (b)(ii) rather than incorrectly calculating the value of R.

Example Candidate Response – low

10 A student makes the circuit shown in Fig. 10.1 using a 12 V battery.

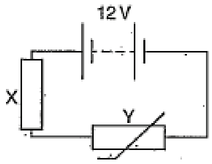


Fig. 10.1

(a) Complete the sentences about the circuit. Use words from the box.

fixed resistor	lamp	light-dependent resistor	parallel	series	thermistor

(i) Components X and Y are connected in ...parallel... ① ...[1]

(ii) The component Y is a ...fixed resistor. ...[1]

(b) Fig. 10.2 shows how the resistance of Y varies with temperature.

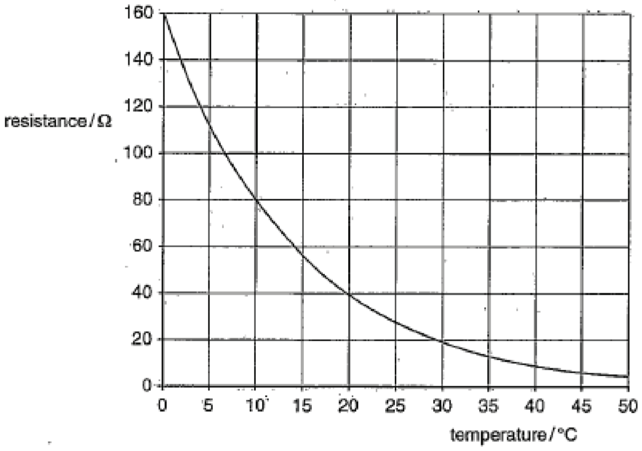


Fig. 10.2

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

As the resistance of y decreases the temperature of y increases.

...[2]

(ii) The temperature of Y is 10 °C. The resistance of X is 20 Ω.

Calculate the combined resistance of Y and X.

$r = y \times X\,\Omega$

$r = 80\,\Omega \times 20\,\Omega = 1600\,\Omega$

resistance = ...1600... Ω [3]

(iii) Calculate the current in the circuit.

$\text{Current} = \frac{r}{V} = \frac{1600\,\Omega}{12\,V} = 133.3\,A$

current = ...133.3... A [3]

[Total: 10]

Examiner comments

① The candidate is unclear about series and parallel circuits.

② The candidate identifies X rather than Y.

Mark awarded for (a) = 0 out of 2

③ A partially correct response is given that gains 1 mark.

④ The candidate correctly uses the graph to obtain a resistance value for Y of 80 Ω, obtaining 1 mark. The calculation is incorrect, the candidate multiplies the rather than adding them together.

⑤ The question requires the use of V=IR. The candidate uses an incorrect equation and therefore reaches an incorrect value.

Mark awarded for (b) = 2 out of 8

Total mark awarded = 2 out of 10

How the candidate could have improved the answer

(a) (i) The candidate did not understand the difference between a series and a parallel circuit.

(a) (ii) The candidate needed to identify Y (thermistor) rather than X.

(b) (i) The candidate should have linked the curve to explain the rate of change.

(b) (ii) To calculate the combined resistance, the candidate should have added two resistances to each other rather than multiply them together.

(b) (iii) The candidate should have used the correct formula: V= IR. The equation was incorrectly stated and an incorrect value was obtained.

Common mistakes candidates made in this question

(b) (ii) A common misconception was a value for the combined resistance of 30 ohm.

(b) (iii) There were the full range of incorrect variations of the V = IR equation.

Question 11

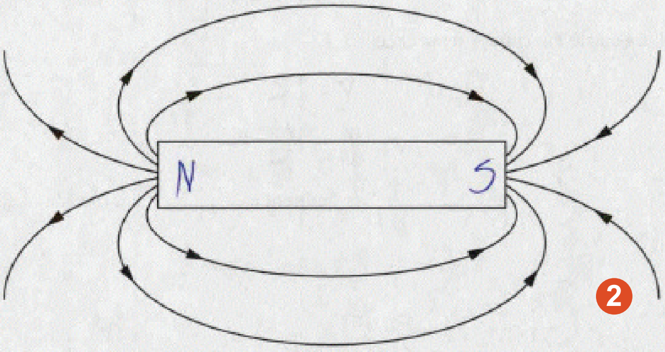
Example Candidate Response – middle

11 **(a)** Put a ring around the names of the metals which are attracted to magnets.

aluminium [✓ copper] [✓ iron] mercury magnesium [✓ steel] tin ①

(b) Fig. 11.1 and Fig. 11.2 show magnetic field patterns for bar magnets.

On each diagram, correctly label the poles. Write **N** or **S**.



②

Fig. 11.1

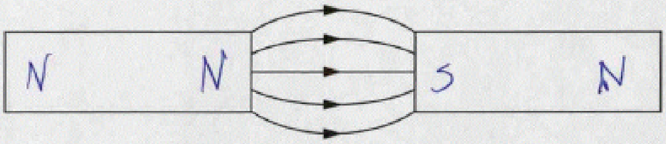
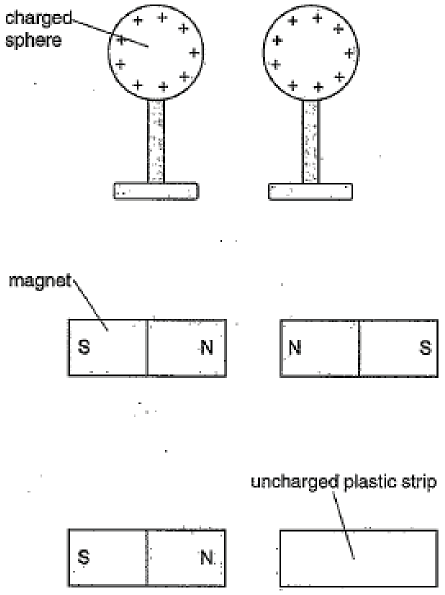


Fig. 11.2

(c) For each diagram in Fig. 11.3, describe the force acting, if any. Use the words *attraction*, *repulsion*, or *no force*.



Repultion
~~no force~~ ③

Repulsion

no force

Fig. 11.3

[3]

Examiner comments

① Three metals ringed. Two are correct and one (copper) is incorrect.

Mark awarded for (a) = 1 out of 2

② The candidate gives correct responses but on the bottom diagram includes a contradiction with the magnet being labelled with two north poles.

Mark awarded for (b) = 1 out of 2

③ Correct responses.

Mark awarded for (c) = 3 out of 3

Total mark awarded = 5 out of 7

How the candidate could have improved the answer

(a) The candidate should have ringed two correct answers and not three.

(b) The candidate should have labelled the magnet with one South and one North pole to gain full marks.

Example Candidate Response – low

11 (a) Put a ring around the names of the metals which are attracted to magnets.

aluminium [✓ copper] [✓ iron] [✓ mercury] magnesium [✓ steel] tin ①

(b) Fig. 11.1 and Fig. 11.2 show magnetic field patterns for bar magnets.

On each diagram, correctly label the poles. Write **N** or **S**.

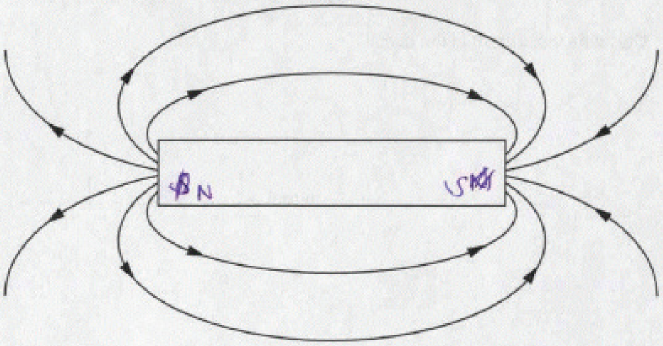


Fig. 11.1

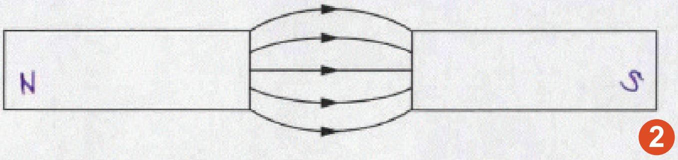
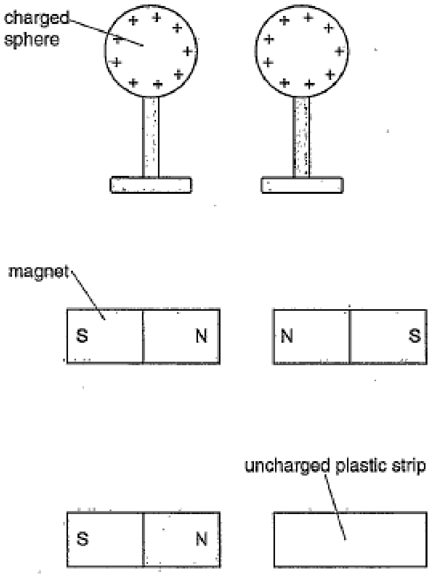


Fig. 11.2 ②

(c) For each diagram in Fig. 11.3, describe the force acting, if any. Use the words *attraction*, *repulsion*, or *no force*.



Attraction.

Repulsion.

no force. ③

Fig. 11.3

[3]

Examiner comments

① Two marks available for two metals correctly identified. The candidate has ringed four metals two are correct and two are incorrect. No credit is given.

Mark awarded for (a) = 0 out of 2

② The candidate identifies the poles correctly in the top diagram 1 mark. However on the figures 11.2 the poles are incorrectly marked.

Mark awarded for (b) = 1 out of 2

③ The first answer is incorrect.

Mark awarded for (c) = 2 out of 3

Total mark awarded = 3 out of 7

How the candidate could have improved the answer

(a) The candidate should have ringed two correct answers and not four.

(b) The candidate should have identified the poles correctly in the bottom diagram to gain full credit.

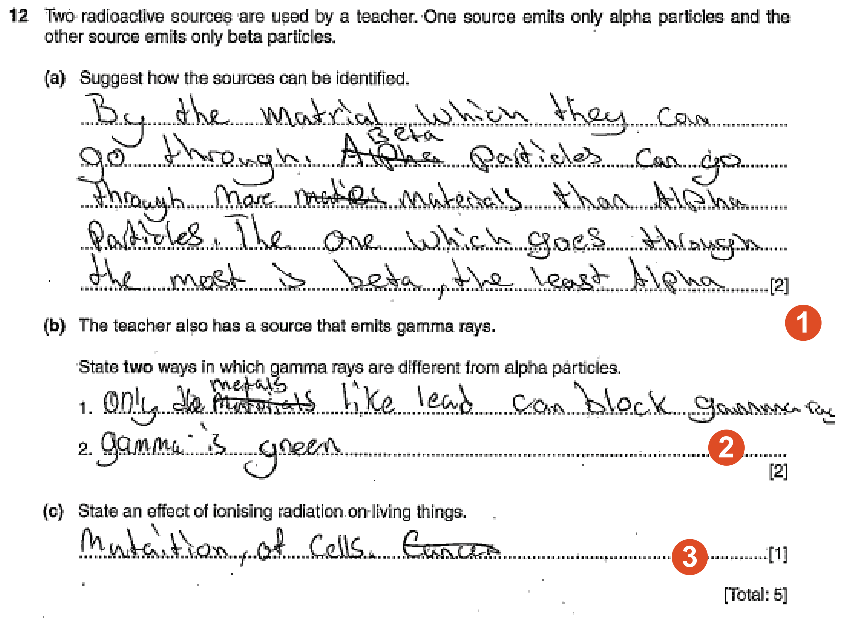
(c) To gain full marks the candidate should have stated ‘repulsion’ for the first answer.

Common mistakes candidates made in this question

(a) Many candidates put a ring around more than two metals. Copper was a frequent incorrect response.

Question 12

Example Candidate Response – middle



12 Two radioactive sources are used by a teacher. One source emits only alpha particles and the other source emits only beta particles.

(a) Suggest how the sources can be identified.

By the matrial which they can go through. ~~Alpha~~ Beta particles can go through more ~~metles~~ materials than Alpha particles. The one which goes through the most is beta, the least Alpha [2]

(b) The teacher also has a source that emits gamma rays.

State **two** ways in which gamma rays are different from alpha particles.

1. Only ~~the~~ ~~materials~~ metals like lead can block gamma ray

2. gamma is green

[2]

①

②

(c) State an effect of ionising radiation on living things.

Mutaition, of Cells. ~~Cancer~~ ③ [1]

[Total: 5]

Examiner comments

① The candidate identifies the differing penetrating properties of alpha and beta particles but the response is too vague to be given any credit.

Mark awarded for (a) = 0 out of 2

② The difference in the penetrating properties gains 1 of the two available marks.

Mark awarded for (b) = 1 out of 2

③ Correct response is given.

Mark awarded for (c) = 1 out of 1

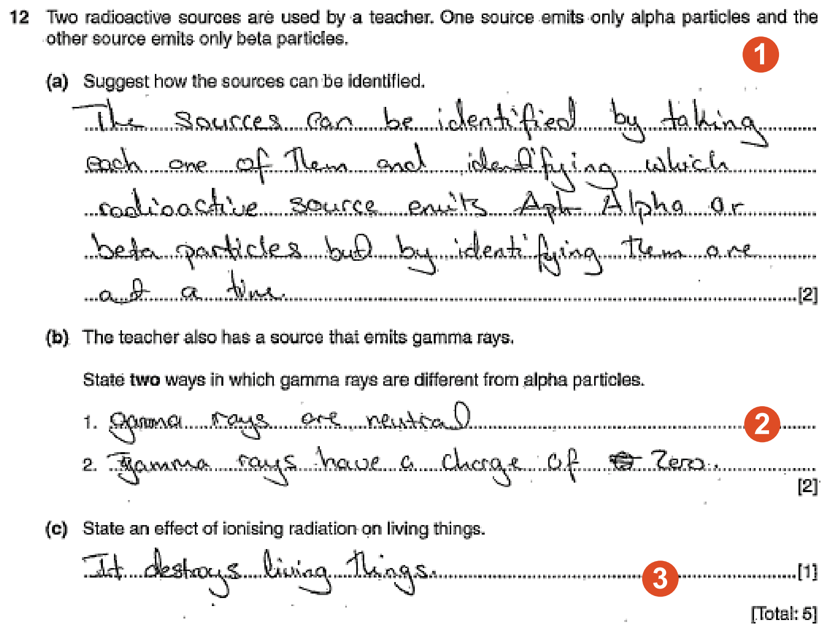
Total mark awarded = 2 out of 5

How the candidate could have improved the answer

(a) The candidate identifies the differing penetrating properties of alpha and beta particles but the response is too vague to gain any credit. The candidate should have included the materials used for determining the sources.

(b) The difference in the penetrating properties gains 1 of the two available marks. Other acceptable responses that could have been given included speed of travel and levels of ionisation.

Example Candidate Response – low



12 Two radioactive sources are used by a teacher. One source emits only alpha particles and the other source emits only beta particles.

①

(a) Suggest how the sources can be identified.

The sources can be identified by taking each one of Them and identifying which radioactive source emits ~~Alph~~ Alpha or beta particles but by identifying Them one at a time. [2]

(b) The teacher also has a source that emits gamma rays.

State **two** ways in which gamma rays are different from alpha particles.

1. Gamma rays are neutral ②
2. Gamma rays have a charge of Zero.

[2]

(c) State an effect of ionising radiation on living things.

It destroys living Things. ③ [1]

[Total: 5]

Examiner comments

① The candidate responds by repeating the question. No credit is given.

Mark awarded for (a) = 0 out of 2

② Both responses are the same indicating that gamma rays do not have a charge.

Mark awarded for (b) = 1 out of 2

③ A vague response that is not credit worthy.

Mark awarded for (c) = 0 out of 1

Total mark awarded = 1 out of 5

How the candidate could have improved the answer

(a) The candidate should have identified a particular method such as 'idea of paper between source and detector'.

(b) Both responses are the same indicating that gamma rays do not have a charge. The candidate should have given two ways in which gamma rays are different from alpha.

(c) 'Damages cells' or 'tissues' would have gained credit.

Common mistakes candidates made in this question

(a) Many candidates gained partial credit giving details about alpha being stopped by paper but did not include the use of a detector to gain full credit.

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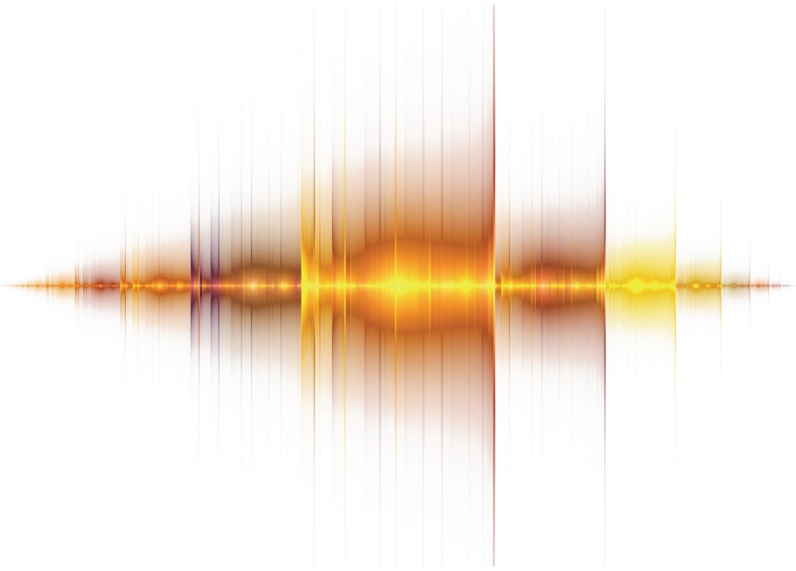
Example Candidate Responses

Paper 4

Cambridge IGCSE™ Physics 0625



Version 2.0

In order to help us develop the highest quality Curriculum Support resources, we are undertaking a continuous programme of review; not only to measure the success of our resources but also to highlight areas for improvement and to identify new development needs.

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Contents

Introduction

The main aim of this booklet is to exemplify standards for those teaching IGCSE Physics (0625), and to show how different levels of candidates' performance (high, middle and low) relate to the subject's curriculum and assessment objectives.

In this booklet candidate responses have been chosen to exemplify a range of answers. Each response is accompanied by a brief commentary explaining the strengths and weaknesses of the answers.

For each question, response is annotated with clear explanation of where and why marks were awarded or omitted. This, in turn, followed by examiner comments on how the answer could have been improved. In this way it is possible for you to understand what candidates have done to gain their marks and what they will have to do to improve their marks. At the end there is a list of common mistakes candidates made in their answers for each question.

This document provides illustrative examples of candidate work. These help teachers to assess the standard required to achieve marks, beyond the guidance of the mark scheme. Some question types where the answer is clear from the mark scheme, such as short answers and multiple choice, have therefore been omitted.

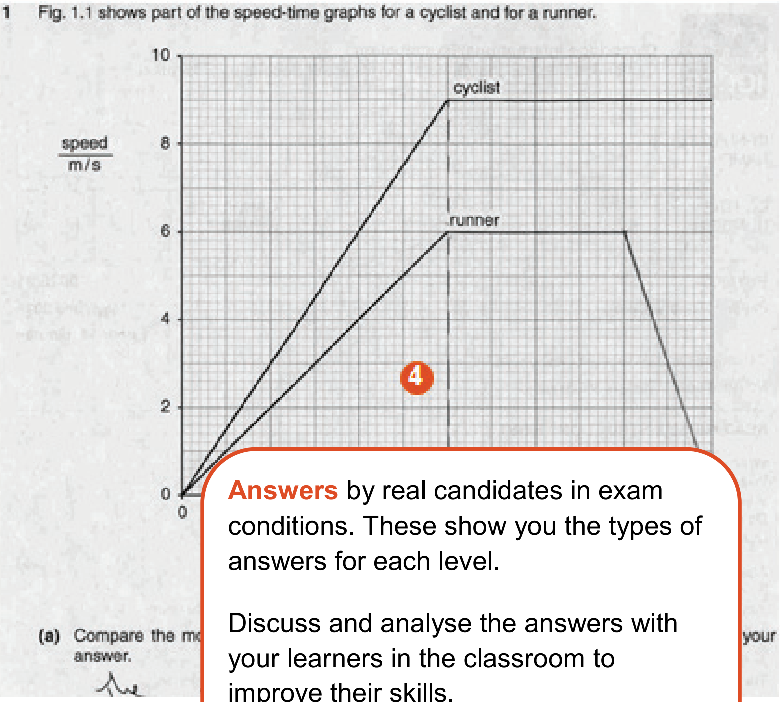
The questions, mark schemes and pre-release material used here are available from the School Support Hub. These files are:

Question Paper 31, June 2016	
Question paper	0620_s16_qp_31.pdf
Mark scheme	0620_s16_ms_31.pdf
Question Paper 42, March 2016	
Question paper	0620_m16_qp_42.pdf
Mark scheme	0620_m16_ms_42.pdf
Question Paper 61, June 2016	
Question paper	0620_s16_qp_61.pdf
Mark scheme	0620_s16_ms_61.pdf

Other past papers, Examiner Reports and other teacher support materials are available on the School Support Hub at www.cambridgeinternational.org/support

How to use this booklet

Example Candidate Response – middle	**Examiner comments**



1 Fig. 1.1 shows part of the speed-time graphs for a cyclist and for a runner.

(a) Compare the mo

your

answer.

Answers by real candidates in exam conditions. These show you the types of answers for each level.

Discuss and analyse the answers with your learners in the classroom to improve their skills.

Examiner annotations: Each response is annotated with clear explanation of where and why marks were awarded or omitted. In this way it is possible for you to understand what candidates have done to gain their marks.

① This response indicates that the cyclist is gaining speed but does not give details of the motion of the runner. A mark is scored for identifying correctly the faster speed of the cyclist.

Mark awarded for (a) = 1 out of 3

How the candidate could have improved the answer

(a) To achieve full marks candidate should have

(c) The candidate should have calculated the are

81m having to gain full marks.

Examiner comments This explains how the candidate could have improved the answer. This helps you to interpret the standard of Cambridge exams and helps your learners to refine exam technique.

Common mistakes candidates made in this question

(b) A common misconception was that the cycli

(c) A common incorrect value was 108m. Candid

the maximum speed by the total time. They did n

Common mistakes a list of common mistakes candidates made in their answers for each question.

Assessment at a glance

All candidates take must enter for three papers.

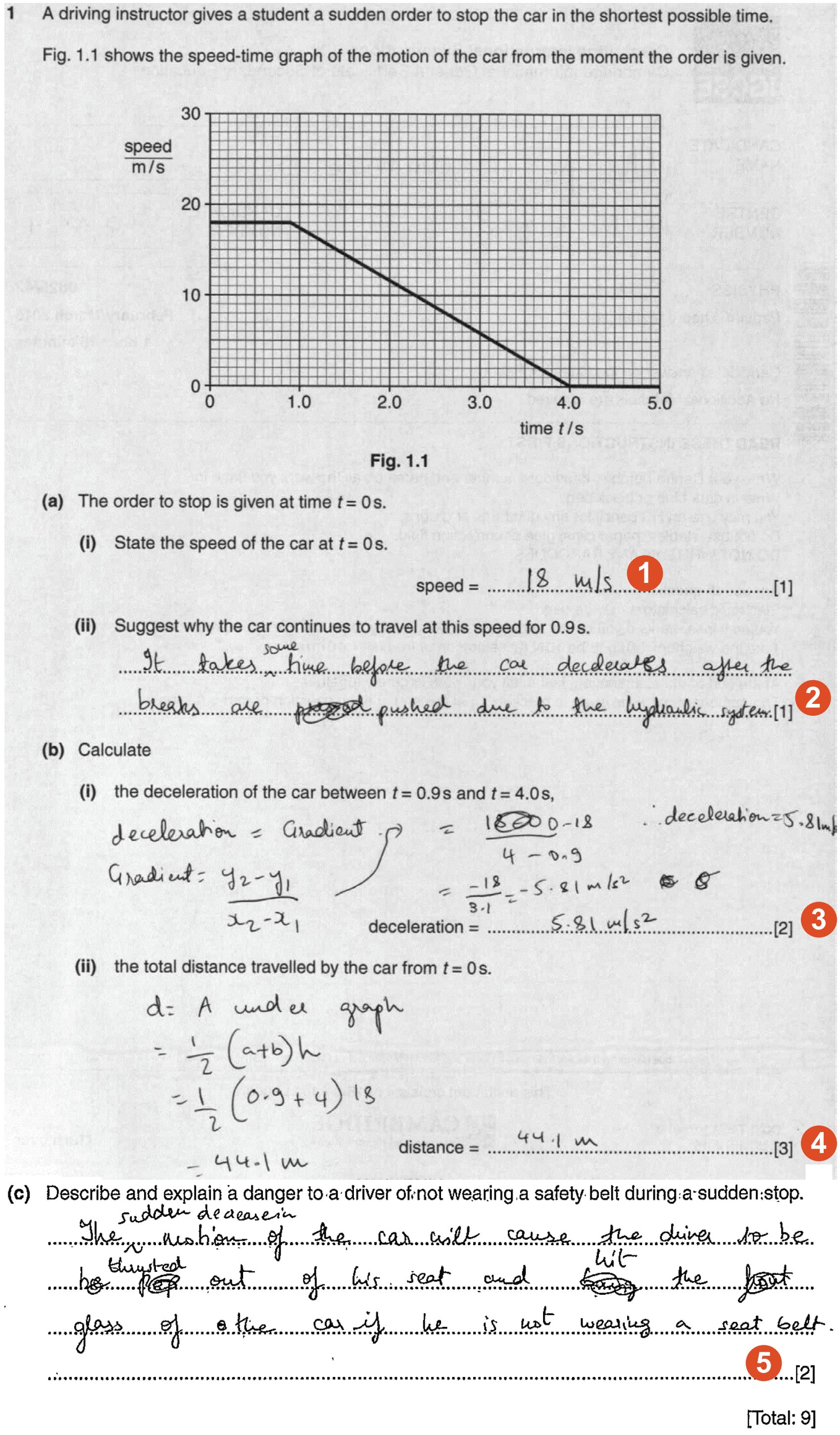
Core candidates take:	**Extended candidates take:**
Paper 1 45 minutes	**Paper 2** 45 minutes
Multiple Choice 30%	Multiple Choice 30%
40 marks	40 marks
40 four-choice multiple-choice questions	40 four-choice multiple-choice questions
Questions will be based on the Core subject content	Questions will be based on the Extended subject content (Core and Supplement)
Assessing grades C–G	Assessing grades A*–G
Externally assessed	Externally assessed
and:	**and:**
Paper 3 1 hour 15 minutes	**Paper 4** 1 hour 15 minutes
Theory 50%	Theory 50%
80 marks	80 marks
Short-answer and structured questions	Short-answer and structured questions
Questions will be based on the Core subject content	Questions will be based on the Extended subject content (Core and Supplement)
Assessing grades C–G	Assessing grades A*–G
Externally assessed	Externally assessed
All candidates take either:	**or:**
Paper 5 1 hour 15 minutes	**Paper 6** 1 hour
Practical Test 20%	Alternative to Practical 20%
40 marks	40 marks
Questions will be based on the experimental skills in Section 4	Questions will be based on the experimental skills in Section 4
Assessing grades A*–G	Assessing grades A*–G
Externally assessed	Externally assessed

Teachers are reminded that the latest syllabus is available on our public website at www.cambridgeinternational.org and the School Support Hub at www.cambridgeinternational.org/support

Paper 4 – Theory (Extended)

Question 1

Example Candidate Response – high



1 A driving instructor gives a student a sudden order to stop the car in the shortest possible time.

Fig. 1.1 shows the speed-time graph of the motion of the car from the moment the order is given.

Fig. 1.1

(a) The order to stop is given at time $t = 0$ s.

(i) State the speed of the car at $t = 0$ s.

speed = 18 m/s ① [1]

(ii) Suggest why the car continues to travel at this speed for 0.9 s.

It takes some time before the car decelerates after the breaks are pushed due to the hydraulic system. [1] ②

(b) Calculate

(i) the deceleration of the car between $t = 0.9$ s and $t = 4.0$ s,

$$\text{deceleration} = \text{Gradient} \qquad = \frac{0-18}{4-0.9}$$

$$\text{Gradient} = \frac{y_2-y_1}{x_2-x_1} \qquad = \frac{-18}{3.1} = -5.81 \text{ m/s}^2$$

∴ deceleration = 5.81 m/s

deceleration = 5.81 m/s² [2] ③

(ii) the total distance travelled by the car from $t = 0$ s.

$$d = A \text{ under graph}$$

$$= \frac{1}{2}(a+b)h$$

$$= \frac{1}{2}(0.9+4)\,18$$

$$= 44.1 \text{ m}$$

distance = 44.1 m [3] ④

(c) Describe and explain a danger to a driver of not wearing a safety belt during a sudden stop.

The sudden decrease in motion of the car will cause the driver to be ~~he~~ thrusted out of his seat and hit the glass of the car if he is not wearing a seat belt.

[2] ⑤

[Total: 9]

Examiner comments

① The graph was read correctly and the correct speed stated.

② The continuity of the initial speed was wrongly attributed to the hydraulic system of the car rather than to the reaction time of the driver.

Mark awarded for (a) = 1 out of 2

③ The formula was stated and the deceleration correctly calculated.

④ The distance required was recognised as being given by the area under the graph. The formula for the area of a trapezium was quoted, correct substitutions were made and the answer calculated correctly.

Mark awarded for (b) = 5 out of 5

⑤ The danger to the driver (hitting the windscreen) was described, but the suggestion that this was due to the driver being thrust forward, rather than continuing at the pre-braking speed of the car, was wrong.

Mark awarded for (c) = 1 out of 2

Total mark awarded = 7 out of 9

How the candidate could have improved the answer

(a) (ii) Reference should have been made to the reaction time of the driver rather than to a mechanical feature of the braking system.

(c) An explanation in terms of the driver continuing to move forwards with the previous speed of the car was needed to gain full credit.

Example Candidate Response – middle

1 A driving instructor gives a student a sudden order to stop the car in the shortest possible time.

Fig. 1.1 shows the speed-time graph of the motion of the car from the moment the order is given.

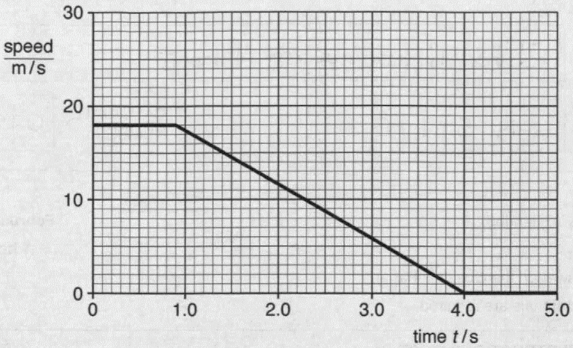


Fig. 1.1

(a) The order to stop is given at time $t = 0$ s.

(i) State the speed of the car at $t = 0$ s.

speed = 18m/s ① [1]

(ii) Suggest why the car continues to travel at this speed for 0.9 s.

Due to a sudden break, the car travelled for more ~~9~~ 0.9 seconds ~~becau~~ then ~~as the~~ its stopped ~~speed~~ ~~was~~ accelerating ② [1]

(b) Calculate

(i) the deceleration of the car between $t = 0.9$ s and $t = 4.0$ s,

gradient = deceleration

$\frac{Y_2 - Y_1}{X_2 - X_1} = x$

$\frac{0 - 18}{4 - 0.9} = x$

$\frac{-18}{3.1} = x$

$-5.806 = x$

$-5.81 = x$

deceleration = -5.81 m/s^2 ③ [2]

(ii) the total distance travelled by the car from $t = 0$ s.

distance = A under graph.

$\therefore \frac{1}{2} \times (a+b) \times h = A$

$\frac{1}{2} \times (1+4) \times 18 = A$

$45 = A$

distance = 45m ④ [3]

(c) Describe and explain a danger to a driver of not wearing a safety belt during a sudden stop.

The sudden stop caused the drivers body to lean forward. If no belt is worn, driver can crash its forehead on the steering. ⑤

[2]

[Total: 9]

Examiner comments

① The graph was read correctly and the correct speed was stated.

② The answer given, suggesting that the car travelled for more than 0.9 s and stopped accelerating, bore no relation to the required response.

Mark awarded for (a) = 1 out of 2

③ The formula was stated and the deceleration correctly calculated.

④ The distance required was recognised as being given by the area under the graph. However, the substitution of 1 rather than 0.9 in the trapezium formula resulted in the wrong numerical answer.

Mark awarded for (b) = 3 out of 5

⑤ The danger to the driver (hitting the windscreen) was described correctly. The explanation, that the driver's body would lean forward, was vague and unacceptable.

Mark awarded for (c) = 1 out of 2

Total mark awarded = 5 out of 9

How the candidate could have improved the answer

(a) (ii) The driver's time to react should have been referred to.

(b) (ii) Correct numbers needed to be substituted into the correct formula that the candidate wrote down.

(c) The cause of the danger to the driver was also required.

Example Candidate Response – low

1 A driving instructor gives a student a sudden order to stop the car in the shortest possible time.

Fig. 1.1 shows the speed-time graph of the motion of the car from the moment the order is given.

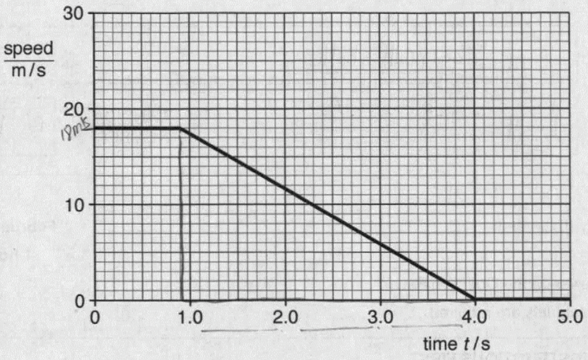


Fig. 1.1

(a) The order to stop is given at time $t = 0$ s.

(i) State the speed of the car at $t = 0$ s.

speed = 18m/s ① [1]

(ii) Suggest why the car continues to travel at this speed for 0.9 s.

The car travels at the constant speed. ② [1]

(b) Calculate

(i) the deceleration of the car between $t = 0.9$ s and $t = 4.0$ s,

$$\text{deceleration} = \frac{(v-u)}{t} = \frac{20}{-3.1}$$

~~[illegible]~~ $= \frac{20-0}{0.9-4.0}$ $= -6.45$

deceleration = −6.45. ③ [2]

(ii) the total distance travelled by the car from $t = 0$ s.

① $18 \times 0.9 = 16.2$.

② $18 \times 3.1 = 55.8$

$16.2 + 55.8.$

$= 72.$

distance = 72m ④ [3]

(c) Describe and explain a danger to a driver of not wearing a safety belt during a sudden stop.

The driver may injour himself because he is not wearing a ~~the~~ safetybelt. When the car suddenly stop, ~~the~~ driver may get a jerk or the body may come forward very rapidly and hit the stering. As the break is ⑤ [2] Pressed hardly so the car has to stop immedicitely.

[Total: 9]

Examiner comments

① The graph was read correctly and the correct speed stated.

② The statement that the car travels at constant speed, suggested failure to grasp the requirements of the question.

Mark awarded for (a) = 1 out of 2

③ The formula quoted for calculating the deceleration was rewarded. The subsequent substitution into the formula was wrong.

④ The candidate's work involved the calculation of the area of two rectangles rather than a rectangle and a triangle. This produced a wrong numerical answer. With no statement that the area under the graph was needed, no compensation marks were possible.

Mark awarded for (b) = 1 out of 5

⑤ The danger to the driver was described correctly. The explanation failed to make any reference to the driver continuing to move forward with the speed of the car.

Mark awarded for (c) = 1 out of 2

Total mark awarded = 3 out of 9

How the candidate could have improved the answer

(a) (ii) A reason for the delay in applying the brakes was needed.

(b) (i) Correct numbers needed to be substituted into the formula that the candidate wrote down.

(b) (ii) Numbers obtained from the graph were written down, but it needed to be clear from these that the area under the graph was being deduced.

(c) The cause of the danger to the driver was also required.

Common mistakes candidates made in this question

(a) (i) Failure to recognise the significance of the reaction time the driver was a common feature.

(b) (i) Many candidates failed to quote an acceptable formula. Others succeeded in this aspect, but then substituted wrong data from the graph.

(b) (ii) The relevance of finding the area under the graph was usually known, but incorrect substitutions or wrong arithmetic frequency followed.

(c) Having correctly describing the danger to the driver, many answers suggested that the driver experienced a force from the seat causing forward motion, rather than continuing to move forwards with previous speed of the car.

Question 2

Example Candidate Response – high

2 Fig. 2.1 shows a hammer being used to drive a nail into a piece of wood.

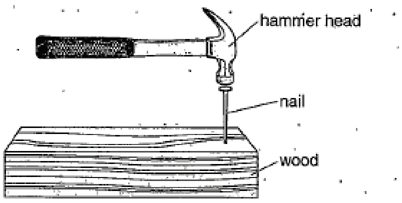


Fig. 2.1

The mass of the hammer head is 0.15 kg.
The speed of the hammer head when it hits the nail is 8.0 m/s.
The time for which the hammer head is in contact with the nail is 0.0015 s.

The hammer head stops after hitting the nail.

(a) Calculate the change in momentum of the hammer head.

momentum = v x m

8m/s x 0.15

change in momentum = 1.2 Kgm/s [2] ①

(b) State the impulse given to the nail.

$\frac{1.2}{0.0015} = 800$ 800 x 0.0015

Force = $\frac{\text{MomNs}}{\text{Time.}}$ Force x Time.

impulse = 1.2 Ns [1]

(c) Calculate the average force between the hammer and the nail. ②

F= $\frac{\text{change in momentum}}{\text{time.}}$

$\frac{1.2 \text{ Kg m/s}}{0.0015 \text{ s}}$

average force = 800N [2]

[Total: 5]

③

Examiner comments

① The formula for momentum change was correctly stated, as were the numbers substituted and the ensuing calculation.

Mark awarded for (a) = 2 out of 2

② The candidate correctly stated the impulse.

Mark awarded for (b) = 1 out of 1

③ The formula written as force = change in momentum / time was correctly stated as were the numbers substituted ensuring the correct response.

Mark awarded for (c) = 2 out of 2

Total mark awarded = 5 out of 5

How the candidate could have improved the answer

Candidate was awarded full marks.

Example Candidate Response – middle

2 Fig. 2.1 shows a hammer being used to drive a nail into a piece of wood.

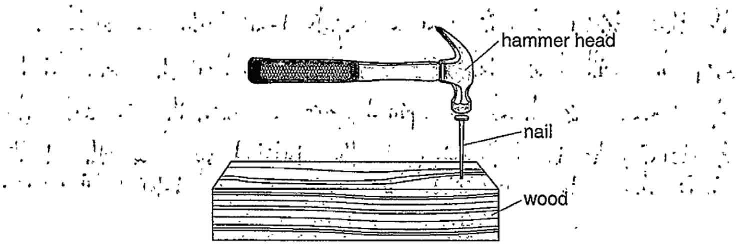


Fig. 2.1

The mass of the hammer head is 0.15 kg.
The speed of the hammer head when it hits the nail is 8.0 m/s.
The time for which the hammer head is in contact with the nail is 0.0015 s.

The hammer head stops after hitting the nail.

(a) Calculate the change in momentum of the hammer head.

mass x velocity – mass x velocity
0.15 x 8 0.15 x 0
1.2 kg m/s 0 kg m/s
1.2 - 0 = 1.2 kg m/s

change in momentum = 1.2 kg m/s ① [2]

(b) State the impulse given to the nail.

impulse = 1.2 Ns ② [1]

(c) Calculate the average force between the hammer and the nail.

$$\text{average force} = \frac{2 \times \text{mass} \times \text{speed}}{\text{time}} = \frac{2 \times 0.15 \times 8}{0.0015}$$

$$= \frac{2.4}{0.0015} = 1600\text{N}$$

average force = 1600 N ③ [2]

[Total: 5]

Examiner comments

① The formula for momentum change was correctly stated, as were the numbers substituted and the ensuing calculation.

Mark awarded for (a) = 2 out of 2

② The candidate correctly stated the impulse as being equal to the momentum change in **(a)**, albeit with the alternative acceptable unit.

Mark awarded for (b) = 1 out of 1

③ In this calculation, the formula 2*mv*/*t* was used rather than the correct *mv*/*t*.

Mark awarded for (c) = 0 out of 2

Total mark awarded = 3 out of 5

How the candidate could have improved the answer

(c) The formula *mv/t*, written as symbols or words, should have been used. The candidate used 2 x mass x speed / time. (Use of the word 'speed' rather than the correct word 'velocity' was condoned in this answer.)

Example Candidate Response – low

2 Fig. 2.1 shows a hammer being used to drive a nail into a piece of wood.

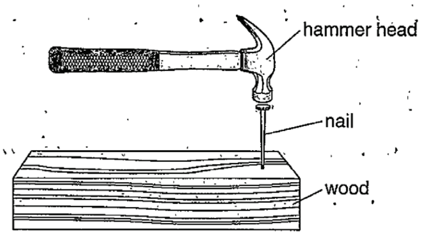


Fig. 2.1

The mass of the hammer head is 0.15 kg.
The speed of the hammer head when it hits the nail is 8.0 m/s.
The time for which the hammer head is in contact with the nail is 0.0015 s.

The hammer head stops after hitting the nail.

(a) Calculate the change in momentum of the hammer head.

Momentum = Mass x Velocity.
= 0·15 x 8·0
= 1·2

change in momentum = 1.2 ① [2]

(b) State the impulse given to the nail.

impulse = 0·0018. ② [1]

(c) Calculate the average force between the hammer and the nail.

Force = Mass x acceleration.

average force = ③ [2]

[Total: 5]

Examiner comments

① The correct numerical value was calculated using the acceptable formula mass x velocity. Omission of the unit resulted in a 1 mark penalty.

Mark awarded for (a) = 1 out of 2

② For no apparent reason, the impulse was stated as 0.0018 s.

Mark awarded for (b) = 0 out of 1

③ The formula written as force = mass x acceleration was rewarded. No substitutions into this formula followed.

Mark awarded for (c) = 1 out of 2

Total mark awarded = 2 out of 5

How the candidate could have improved the answer

(a) For both marks the candidate was required to write the correct unit with the numerical value that was calculated.

(b) The requirement was to recall that impulse = change of momentum and thus to repeat the answer to (a).

(c) The answer began correctly with F = mass x acceleration. No further work was shown. Data from the question should then have been used to evaluate the acceleration.

Common mistakes candidates made in this question

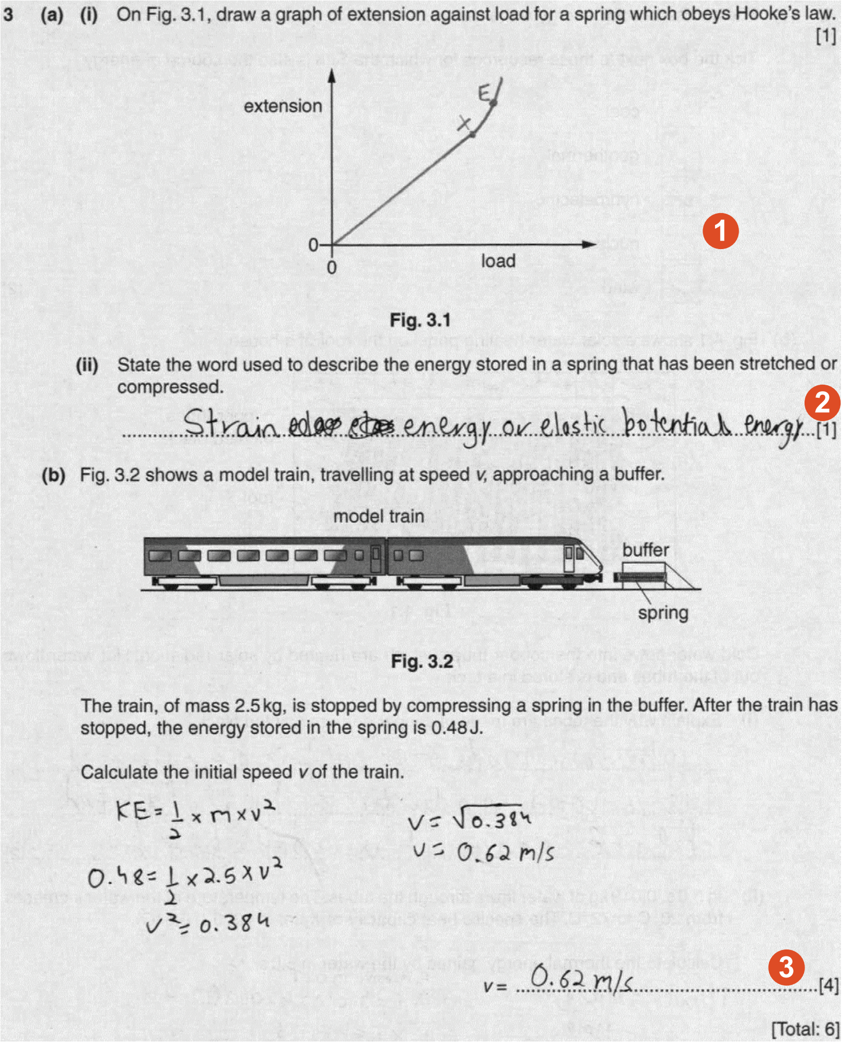
(a) The common error was to quote a wrong unit, e.g. kg / ms instead of kg m/s, or to omit a unit.

(b) Errors were made by candidates who failed to recall that change of momentum, (the answer to (a)), is equal to impulse.

(c) Failure to make progress after quoting *F = ma or F = m(v – u)/t* was a frequent mistake.

Question 3

Example Candidate Response – high



3 (a) (i) On Fig. 3.1, draw a graph of extension against load for a spring which obeys Hooke's law. [1]

Fig. 3.1

(ii) State the word used to describe the energy stored in a spring that has been stretched or compressed.

Strain ~~elas~~ ~~elas~~ energy or elastic potential energy [1]

(b) Fig. 3.2 shows a model train, travelling at speed v, approaching a buffer.

Fig. 3.2

The train, of mass 2.5 kg, is stopped by compressing a spring in the buffer. After the train has stopped, the energy stored in the spring is 0.48 J.

Calculate the initial speed v of the train.

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

$0.48 = \frac{1}{2} \times 2.5 \times v^2$

$v^2 = 0.384$

$v = \sqrt{0.384}$

$v = 0.62$ m/s

$v =$ 0.62 m/s [4]

[Total: 6]

Examiner comments

① The drawing showed a straight line through the origin that became a curve at its upper end. The end of the straight line section was labelled X with a further label Y on the curve. With an appropriate key for point X, e.g. limit of proportionality, a mark would have been possible.

② The candidate wrote 'strain energy or elastic potential energy'. Either of these alternatives is acceptable.

Mark awarded for (a) = 1 out of 2

③ For a successful calculation, candidates needed to assume that all the energy stored in the spring transfers to the train as kinetic energy. The candidate made this assumption and successfully carried out the calculation of the speed of the train.

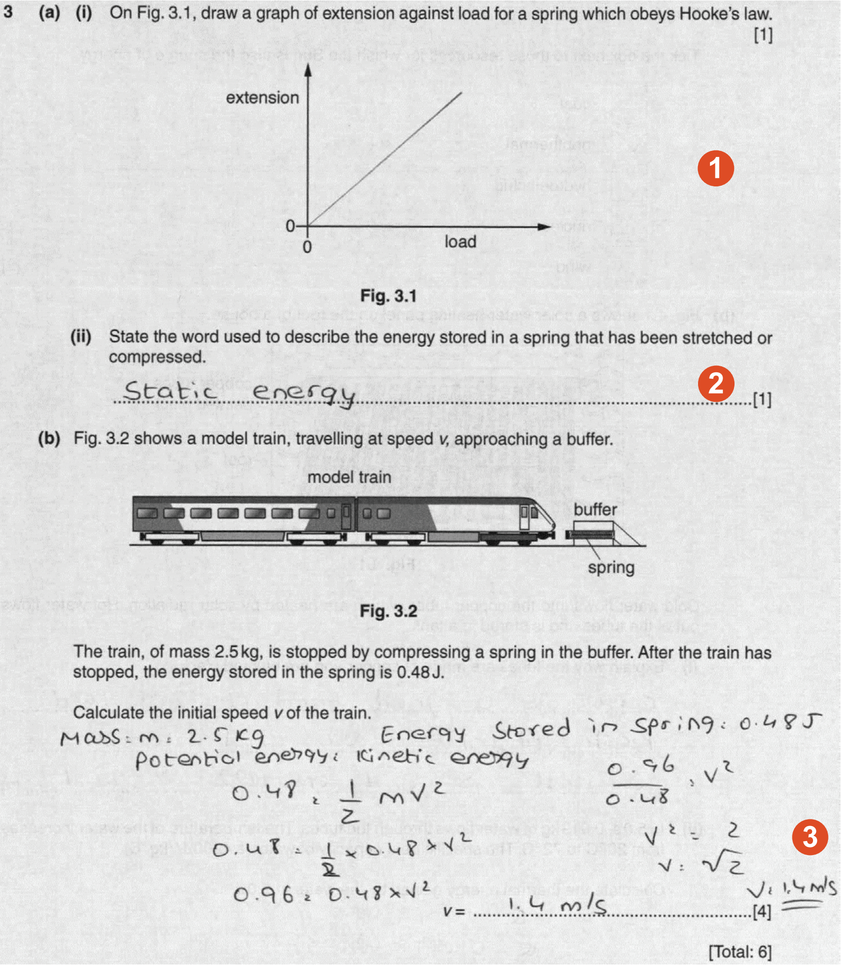
Mark awarded for (b) = 4 out of 4

Total mark awarded = 5 out of 6

How the candidate could have improved the answer

(a) (i) The candidate's graph should have terminated at point X. Alternatively, the point X could have been identified as the limit of proportionality, inferring that Hooke's was applicable up to this point.

Example Candidate Response – middle



3 (a) (i) On Fig. 3.1, draw a graph of extension against load for a spring which obeys Hooke's law. [1]

①

Fig. 3.1

(ii) State the word used to describe the energy stored in a spring that has been stretched or compressed.

Static energy ② [1]

(b) Fig. 3.2 shows a model train, travelling at speed *v*, approaching a buffer.

Fig. 3.2

The train, of mass 2.5 kg, is stopped by compressing a spring in the buffer. After the train has stopped, the energy stored in the spring is 0.48 J.

Calculate the initial speed *v* of the train.

Mass = m = 2.5 Kg

Energy Stored in Spring: 0.48 J

Potential energy = Kinetic energy

$0.48 = \frac{1}{2} mv^2$

$0.48 = \frac{1}{2} \times 0.48 \times v^2$

$0.96 = 0.48 \times v^2$

$\frac{0.96}{0.48} = v^2$

$v^2 = 2$

$v = \sqrt{2}$

$v = 1.4$ m/s

③

v = 1.4 m/s [4]

[Total: 6]

Examiner comments

① The straight-line graph drawn through the origin fulfilled the requirement for the mark.

② 'Static' energy was not an acceptable statement of the type of energy stored in a spring.

Mark awarded for (a) = 1 out of 2

③ The 2 marks awarded were for the use of $1/2mv^2$ and for equating this to the energy stored in the spring. An incorrect substitution of the value of *m* meant that no further marks could be allowed.

Mark awarded for (b) = 2 out of 4

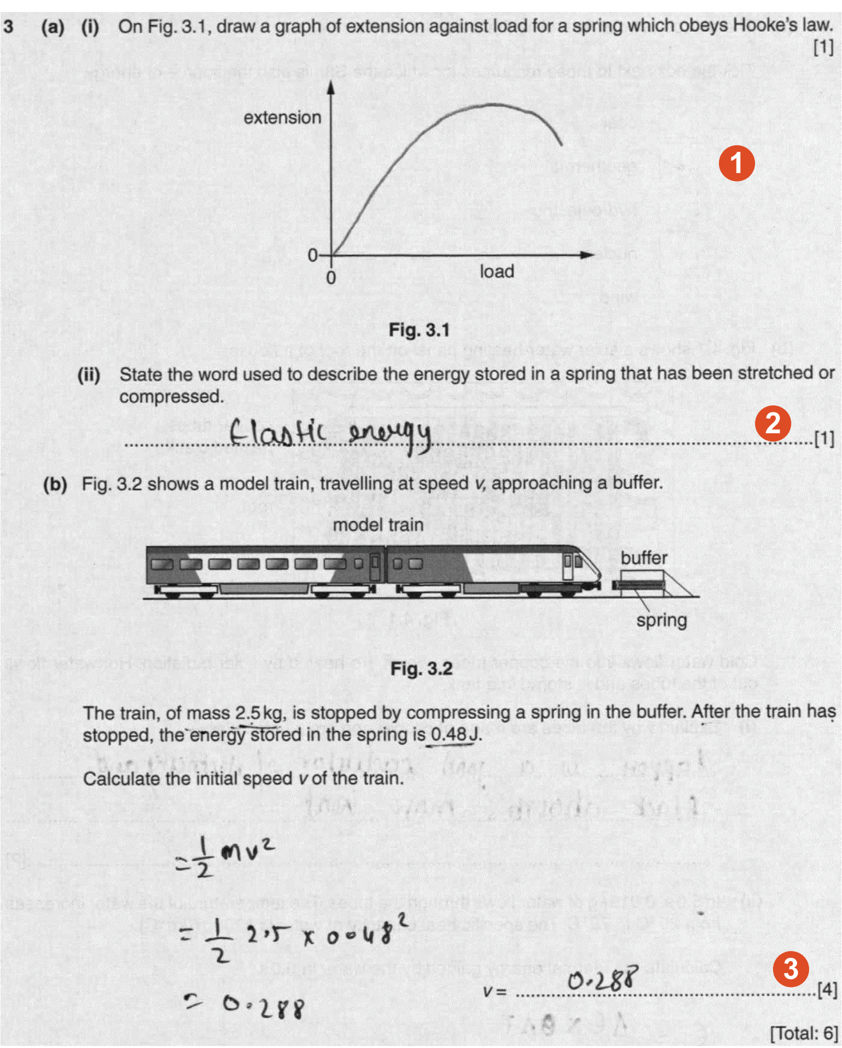
Total mark awarded = 3 out of 6

How the candidate could have improved the answer

(a) (ii) The type of energy should have been identified as 'strain' or 'elastic' rather 'static'.

(b) The correct formula was stated. The mass of the train should have been substituted for the mass in that formula rather than the energy stored in the spring.

Example Candidate Response – low



3 (a) (i) On Fig. 3.1, draw a graph of extension against load for a spring which obeys Hooke's law. [1]

Fig. 3.1

(ii) State the word used to describe the energy stored in a spring that has been stretched or compressed.

Elastic energy ② [1]

(b) Fig. 3.2 shows a model train, travelling at speed *v*, approaching a buffer.

Fig. 3.2

The train, of mass 2.5 kg, is stopped by compressing a spring in the buffer. After the train has stopped, the energy stored in the spring is 0.48 J.

Calculate the initial speed *v* of the train.

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

$= \frac{1}{2}\ 2.5 \times 0.48^2$

$= 0.288$

③

v = 0.288 [4]

[Total: 6]

Examiner comments

① A curved graph drawn from the origin was unacceptable.

② The reference to elastic energy gained the mark.

Mark awarded for (a) = 1 out of 2

③ 1/2mv^2 was seen and rewarded with a mark. No correct work followed.

Mark awarded for (b) = 1 out 4

Total mark awarded = 2 out of 6

How the candidate could have improved the answer

(a) (i) The graph required was a straight line starting at the origin, not a curve.

(b) The candidate wrote down the correct formula for kinetic energy, but failed to equate this with the given quantity of energy stored in the spring.

Common mistakes candidates made in this question

(a) (i) Failure to draw a straight line starting at the origin.

(a) (ii) Wrong identification of the type of energy stored in a spring.

(b) After a correct statement of the formula for kinetic energy, failing to equate this to the given quantity of energy stored in the spring, or, having done this correctly, making mistakes with the ensuing calculation.

Question 4

Example Candidate Response – High

4 **(a)** The source of solar energy is the Sun.

Tick the box next to those resources for which the Sun is also the source of energy.

☑ coal
☐ geothermal
☑ hydroelectric
☐ nuclear
☑ wind ① [2]

(b) Fig. 4.1 shows a solar water-heating panel on the roof of a house.

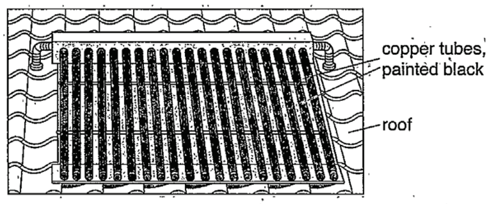


Fig. 4.1

Cold water flows into the copper tubes, which are heated by solar radiation. Hot water flows out of the tubes and is stored in a tank.

(i) Explain why the tubes are made of copper and are painted black.

The tubes are made of copper because copper is a good conductor of heat, so it will be heated easily. It is painted black because black objects are good absorbers of heat. ② [2]

(ii) In 5.0 s, 0.019 kg of water flows through the tubes. The temperature of the water increases from 20 °C to 72 °C. The specific heat capacity of water is 4200 J/(kg °C).

Calculate the thermal energy gained by the water in 5.0 s.

$$energy = mc\Delta T$$
$$energy = 0.019 \times 4200 \times (72^\circ - 20^\circ)$$
$$= 79.8 \times 52$$
$$= 4149.6 J$$

thermal energy = 4149.6 J ③ [3]

(iii) The efficiency of the solar panel is 70%.

Calculate the power of the solar radiation incident on the panel.

$$70\% \rightarrow 4149.6$$
$$100\% \rightarrow \frac{4149.6}{70} \times 100 = 5928$$

power = 5928 W ④ [2]

[Total: 9]

Examiner comments

① The 3 correct boxes, coal, hydroelectric and wind, were ticked.

Mark awarded for (a) = 2 out of 2

② A correct explanation for the use of copper tubes was given. The explanation for the tubes being painted black required a reference to their good absorption of radiation or infra-red, not simply 'heat' as suggested by the candidate.

③ The thermal energy was correctly calculated, correct substitutions having been made into the recalled formula.

④ Having written an acceptable definition of efficiency, the candidate calculated the energy incident on the panel in the stated time rather than the power.

Mark warded for (b) = 5 out of 7

Total mark awarded = 7 out of 9

How the candidate could have improved the answer

(b) (i) The second part required 'tubes painted black because black is a good absorber of radiation', not simply 'heat'.

(b) (iii) In order to calculate the power input, the thermal energy calculated in (b) (ii) needed to be divided by 5 before the subsequent calculation. The candidate's answer was the energy input.

Example Candidate Response – middle

4 **(a)** The source of solar energy is the Sun.

Tick the box next to those resources for which the Sun is also the source of energy.

☐ coal
☐ geothermal
☑ hydroelectric
☐ nuclear
☑ wind ①

[2]

(b) Fig. 4.1 shows a solar water-heating panel on the roof of a house.

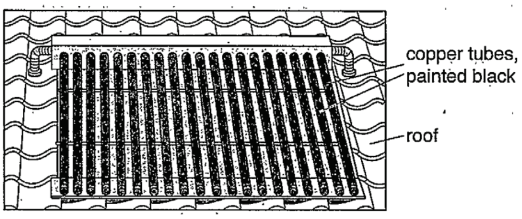


Fig. 4.1

Cold water flows into the copper tubes, which are heated by solar radiation. Hot water flows out of the tubes and is stored in a tank.

(i) Explain why the tubes are made of copper and are painted black.

• Copper tubes conduct heat and can easily pass heat to the water flowing.
• Black painted tube ②

[2]

(ii) In 5.0 s, 0.019 kg of water flows through the tubes. The temperature of the water increases from 20 °C to 72 °C. The specific heat capacity of water is 4200 J/(kg °C).

Calculate the thermal energy gained by the water in 5.0 s.

$H = mc\Delta t$

$H = 0.019 \times 4200 \times 52 = 4149.6 \times 5 = 20748$

thermal energy = 20748 J ③ [3]

(iii) The efficiency of the solar panel is 70%.

Calculate the power of the solar radiation incident on the panel.

$$\frac{4149.6 \times 100}{1 \times 70} = 5928$$

power = 5928 W/s ④ [2]

[Total: 9]

Examiner comments

① The hydroelectric and wind boxes only were ticked, the candidate presumably not realising that coal is derived from wood, for which the growth requires sunlight.

Mark awarded for (a) = 1 out of 2

② The candidate wrote that copper conducts heat, as do all metals, rather than that copper is a good conductor of heat.
No explanation as to why the tubes are painted black was offered.

③ The correct formula was used, correct substitutions were made, and the thermal energy correctly calculated. This thermal energy was then inexplicably multiplied by the time of heating, resulting in the loss of a mark.

④ Having made correct substitution into an energy formula (not written down), the energy incident on the panel was calculated, rather than the power.

Mark awarded for (b) = 3 out of 7

Total mark awarded = 4 out of 9

How the candidate could have improved the answer

(a) A tick was also required in the box for ‘coal’.

(b) (i) An explanation for the tubes being painted black was also required. None was offered.

(b) (ii) The candidate should not have multiplied the value of the energy that had been correctly calculated, by the time of heating.

(b) (iii) In order to calculate the power input, the thermal energy calculated in (b) (ii) needed to be divided by 5 before the subsequent calculation. The candidate’s answer was the energy input.

Example Candidate Response – low

4 **(a)** The source of solar energy is the Sun.

Tick the box next to those resources for which the Sun is also the source of energy.

☐ coal
☑ geothermal
☐ hydroelectric
☑ nuclear
☐ wind ①

[2]

(b) Fig. 4.1 shows a solar water-heating panel on the roof of a house.

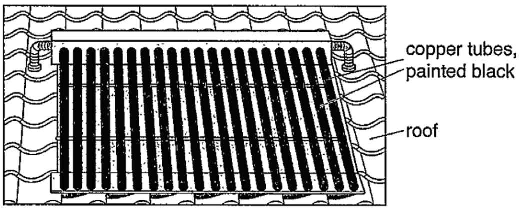


Fig. 4.1

Cold water flows into the copper tubes, which are heated by solar radiation. Hot water flows out of the tubes and is stored in a tank.

(i) Explain why the tubes are made of copper and are painted black.

Copper is a good conductor of heat and colour black is a good absorber of heat. ②

[2]

(ii) In 5.0 s, 0.019 kg of water flows through the tubes. The temperature of the water increases from 20 °C to 72 °C. The specific heat capacity of water is 4200 J/(kg °C).

Calculate the thermal energy gained by the water in 5.0 s.

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

$Q = 0.019 \times 52 \times 4200 \text{ J/kg°C}$

$= 4149.6 \text{ J} \times 5 \quad = 20748 \text{ J}$

thermal energy = ~~4149.6 J~~ 20748 J ③ [3]

(iii) The efficiency of the solar panel is 70%.

Calculate the power of the solar radiation incident on the panel.

$\frac{x}{4149.6} \times 100 = 70 \quad = 2904.72 \text{ J}$

power = 2904.72 J ④ [2]

[Total: 9]

Examiner comments

① It is possible that the candidate had misread the question. The 2 boxes ticked were those not associated with energy derived from the Sun.

Mark awarded for (a) = 0 out of 2

② A correct explanation for the use of copper tubes was given. As with many answers to this question about the reason for using tubes painted black, the candidate referred to their good absorption of heat, not thermal energy or infra-red, as required.

③ The correct formula was used, correct substitutions were made, and the thermal energy correctly calculated. This thermal energy was then multiplied by the time of heating, resulting in a mark deduction.

④ A formula defining energy was not written down. The use of data did not suggest that a correct formula had been recalled.

Mark awarded for (b) = 3 out of 7

Total mark awarded = 4 out of 9

How the candidate could have improved the answer

(a) The candidate left unticked the 3 boxes that should have been ticked, instead ticking the other 2 wrong boxes. It is possible that the question had been misinterpreted.

(b) (i) The second part required ‘tubes painted black because black is a good absorber of <u>radiation</u>’, not simply ‘heat’.

(b) (ii) The candidate should not have multiplied the value of the correctly calculated energy by the time of heating.

(b) (iii) The formula relating efficiency to energy input and output, or power input and output, should have been written down, which if correct would have gained a mark.

Common mistakes candidates made in this question

(a) Possible misreading of the question may have led to some of the wrong responses. In general, awareness that the Sun is not the origin of nuclear and geothermal energy is not a well-known idea.

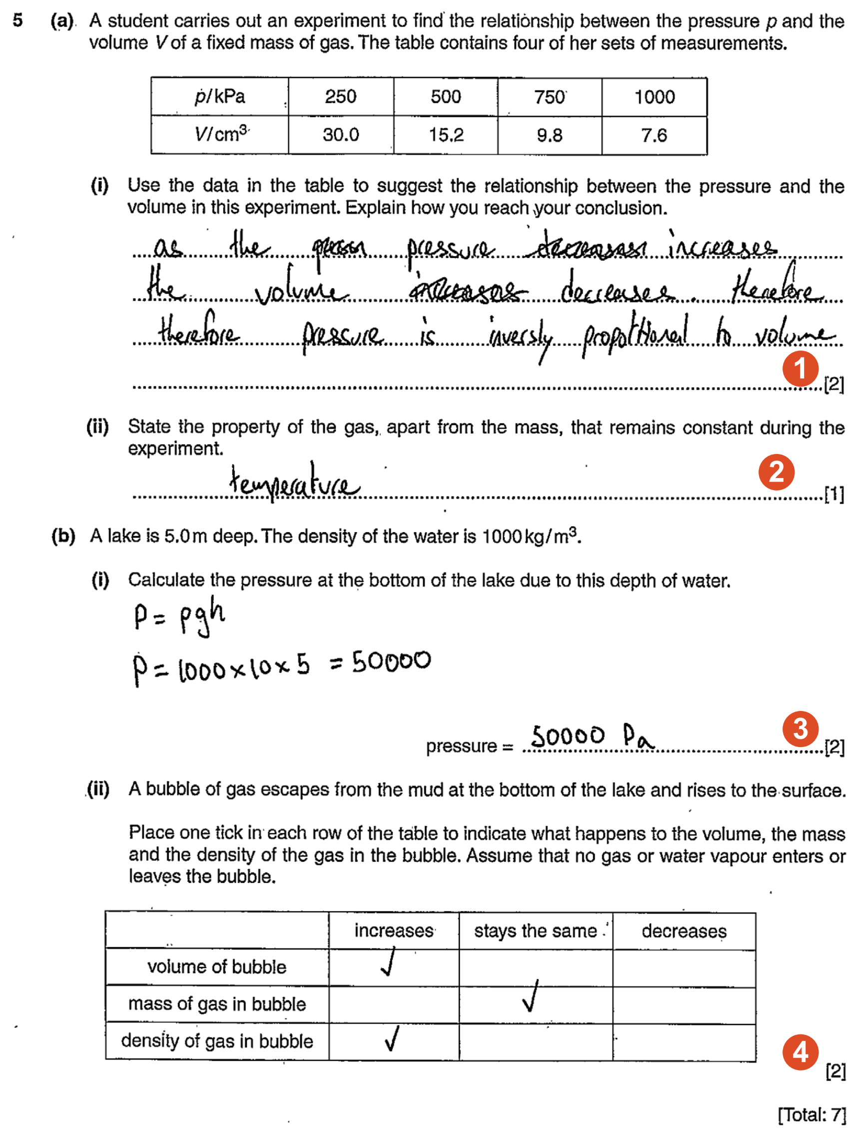
(b) (i) Many answers referred to the good absorption of <u>heat</u> radiation by a black-painted surface rather than the correct good absorption of <u>radiation</u>.

(b) (ii) It was not uncommon for answers to show a correct value for the thermal energy gained subsequently multiplied by the time.

(b) (iii) Failure to write down a formula before attempting to use the numbers deprived many of a possible mark. Many answers failed to address the power aspect, working entirely with energy instead.

Question 5

Example Candidate Response – high



5 (a) A student carries out an experiment to find the relationship between the pressure *p* and the volume *V* of a fixed mass of gas. The table contains four of her sets of measurements.

p/kPa	250	500	750	1000
V/cm^3	30.0	15.2	9.8	7.6

(i) Use the data in the table to suggest the relationship between the pressure and the volume in this experiment. Explain how you reach your conclusion.

as the ~~[illegible]~~ pressure ~~decreases~~ increases the volume ~~increases~~ decreases therefore therefore pressure is inversly propotional to volume

① [2]

(ii) State the property of the gas, apart from the mass, that remains constant during the experiment.

temperature ② [1]

(b) A lake is 5.0 m deep. The density of the water is 1000 kg/m^3.

(i) Calculate the pressure at the bottom of the lake due to this depth of water.

$P = \rho g h$

$P = 1000 \times 10 \times 5 = 50000$

pressure = 50000 Pa ③ [2]

(ii) A bubble of gas escapes from the mud at the bottom of the lake and rises to the surface.

Place one tick in each row of the table to indicate what happens to the volume, the mass and the density of the gas in the bubble. Assume that no gas or water vapour enters or leaves the bubble.

	increases	stays the same	decreases
volume of bubble	✓		
mass of gas in bubble		✓	
density of gas in bubble	✓		

④ [2]

[Total: 7]

Examiner comments

① The statement that pressure and volume are inversely proportional to each other was correct and probably based on recall of Boyle's law. However, the explanation that this is simply because as the volume decreases the pressure increases is insufficient to explain the inverse relationship.

② The temperature was correctly identified as being the quantity that stays constant, this being a conditional factor in the statement of Boyle's law.

Mark awarded for (a) = 2 out of 3

③ The formula $P = h\rho g$ was stated was used to obtain the correct pressure.

④ The boxes for 'volume increases' and 'mass stays the same' were ticked as required. Correctly using the recall of density = mass/volume would have directed the candidate to tick 'density decreases' rather than increases.

Mark awarded for (b) = 3 out of 4

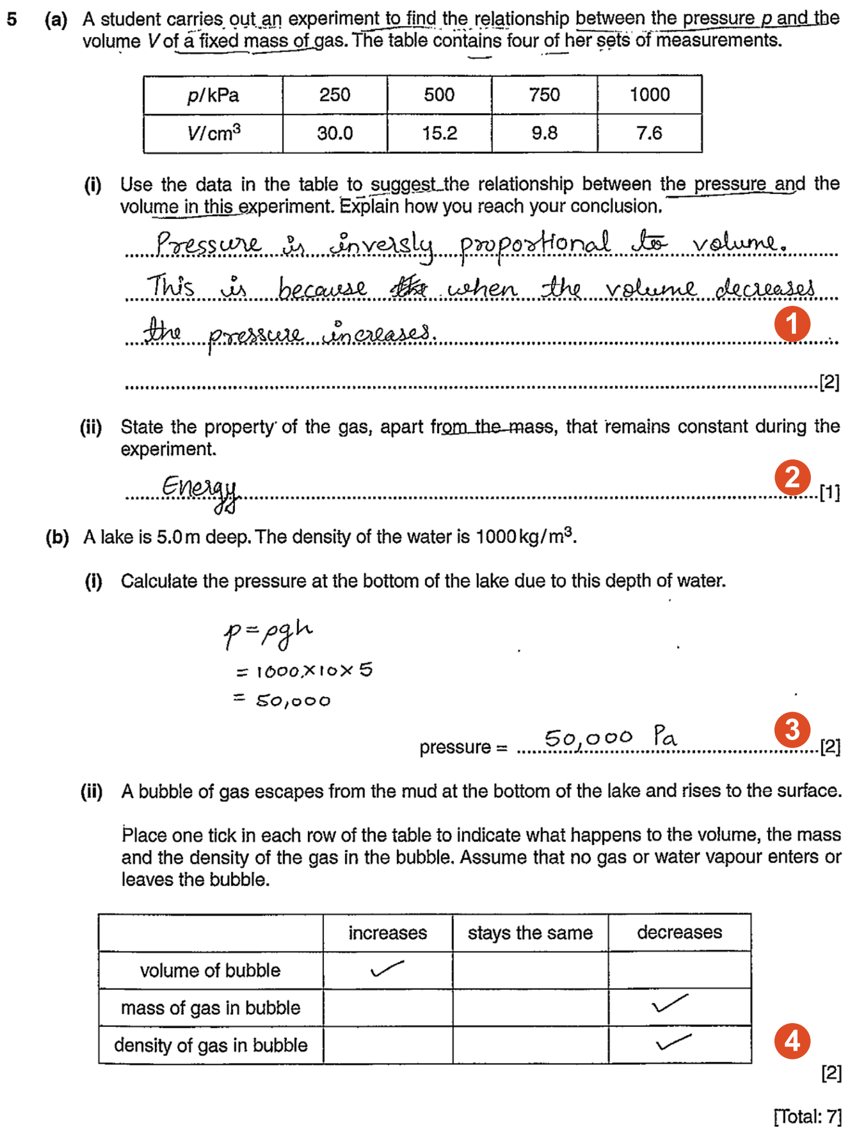
Total mark awarded = 5 out of 7

How the candidate could have improved the answer

(a) (i) A complete answer required a reference as to how the data confirmed the relationship between the pressure and volume. The answer only stated the relationship.

(b) (ii) The answer should have shown that the density of the gas decreases.

Example Candidate Response – middle



5 **(a)** A student carries out an experiment to find the relationship between the pressure *p* and the volume *V* of a fixed mass of gas. The table contains four of her sets of measurements.

p/kPa	250	500	750	1000
V/cm^3	30.0	15.2	9.8	7.6

(i) Use the data in the table to suggest the relationship between the pressure and the volume in this experiment. Explain how you reach your conclusion.

Pressure is inversly proportional to volume.
This is because ~~the~~ when the volume decreases
the pressure increases. ①

[2]

(ii) State the property of the gas, apart from the mass, that remains constant during the experiment.

Energy ② [1]

(b) A lake is 5.0 m deep. The density of the water is 1000 kg/m^3.

(i) Calculate the pressure at the bottom of the lake due to this depth of water.

$p = \rho g h$

$= 1000 \times 10 \times 5$

$= 50{,}000$

pressure = 50,000 Pa ③ [2]

(ii) A bubble of gas escapes from the mud at the bottom of the lake and rises to the surface.

Place one tick in each row of the table to indicate what happens to the volume, the mass and the density of the gas in the bubble. Assume that no gas or water vapour enters or leaves the bubble.

	increases	stays the same	decreases
volume of bubble	✓		
mass of gas in bubble			✓
density of gas in bubble			✓

④ [2]

[Total: 7]

Examiner comments

① The correct statement that pressure and volume are inversely proportional to each other was probably based on recall of an aspect of Boyle's law. The explanation that this is because as the volume decreases the pressure increases is insufficient to explain this relationship.

② 'Energy' was chosen as being the quantity that stays constant rather than the correct 'temperature'. It appears that the candidate's recall of Boyle's law was incomplete.

Mark awarded for (a) = 1 out of 3

③ The formula P = hρg was stated was used to obtain the correct pressure.

④ To have ticked the boxes volume increases (correct), mass decreases (wrong) and density decreases (correct), suggests that the candidate did not consider the validity of the formula density = mass/volume in the approach to these responses.

Mark awarded for (b) = 3 out of 4

Total mark awarded = 4 out of 7

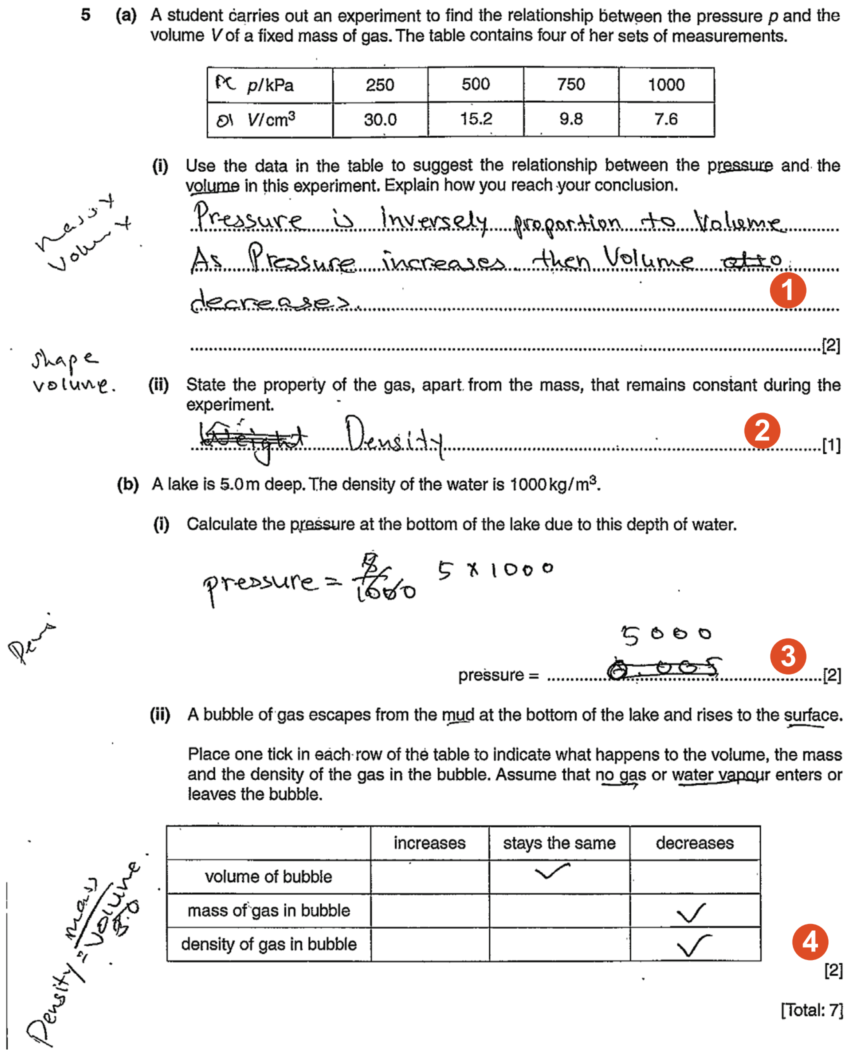
How the candidate could have improved the answer

(a) (i) A complete answer required a reference as to how the data confirmed the relationship between the pressure and volume. The answer only stated the relationship.

(a) (ii) Temperature should have been stated as the property of the gas that remained constant, not energy.

(b) (ii) The answer should have shown that the mass of the gas stays the same.

Example Candidate Response – low



5 (a) A student carries out an experiment to find the relationship between the pressure p and the volume V of a fixed mass of gas. The table contains four of her sets of measurements.

p/kPa	250	500	750	1000
V/cm^3	30.0	15.2	9.8	7.6

(i) Use the data in the table to suggest the relationship between the pressure and the volume in this experiment. Explain how you reach your conclusion.

mass + volume +

Pressure is Inversely proportion to Voleme As Pressure increases then Volume ~~atto~~ decreases. ①

[2]

Shape volume.

(ii) State the property of the gas, apart from the mass, that remains constant during the experiment.

~~Weight~~ Density ② [1]

(b) A lake is 5.0 m deep. The density of the water is 1000 kg/m^3.

(i) Calculate the pressure at the bottom of the lake due to this depth of water.

pressure = ~~5/1000~~ 5 × 1000

Den

pressure = ~~0.005~~ 5000 ③ [2]

(ii) A bubble of gas escapes from the mud at the bottom of the lake and rises to the surface.

Place one tick in each row of the table to indicate what happens to the volume, the mass and the density of the gas in the bubble. Assume that no gas or water vapour enters or leaves the bubble.

	increases	stays the same	decreases
volume of bubble		✓	
mass of gas in bubble			✓
density of gas in bubble			✓

Density = mass / volume 3.0

④ [2]

[Total: 7]

Examiner comments

① The relationship between pressure and volume was correctly stated. From the explanation given it is apparent that there is a general belief that an inversely proportional relationship is confirmed if one quantity increases and the other one decreases.

② To answer this correctly, there needs to be a thorough knowledge of a complete statement of Boyle's law and the relationship between density, mass and volume. The statement that density stays constant suggests a lack of this knowledge.

Mark awarded for (a) = 1 out of 3

③ The depth of the lake and density of the water were multiplied together. No recall of $P = h\rho g$ was apparent.

④ The candidate ticked the boxes for volume stays the same and mass decreases, both wrong. Although density = mass/volume had been written down, the box for density decreases was ticked correctly, although it did not follow from the previous wrong ticks, gaining a mark.

Mark awarded for (b) = 1 out of 4

Total mark awarded = 2 out of 7

How the candidate could have improved the answer

(a) (i) A complete answer required a reference as to how the data confirmed the relationship between pressure and volume. The answer only stated the relationship.

(a) (ii) Temperature should have been stated as the property of the gas that remained constant, not mass.

(b) (i) Candidates should always state a relevant formula, which if correct, gains a mark. In this case no formula was stated and the use of numbers in the calculation was totally incorrect.

(b) (ii) The answer should have shown that the volume of the gas increases and the mass of the gas stays the same.

Common mistakes candidates made in this question

(a) (i) The requirement to use the data in the table was infrequently complied with. Candidates could either state that the products of *P* and *V* were all about 7500 or show that if pressure doubles the volume halves, or vice versa.

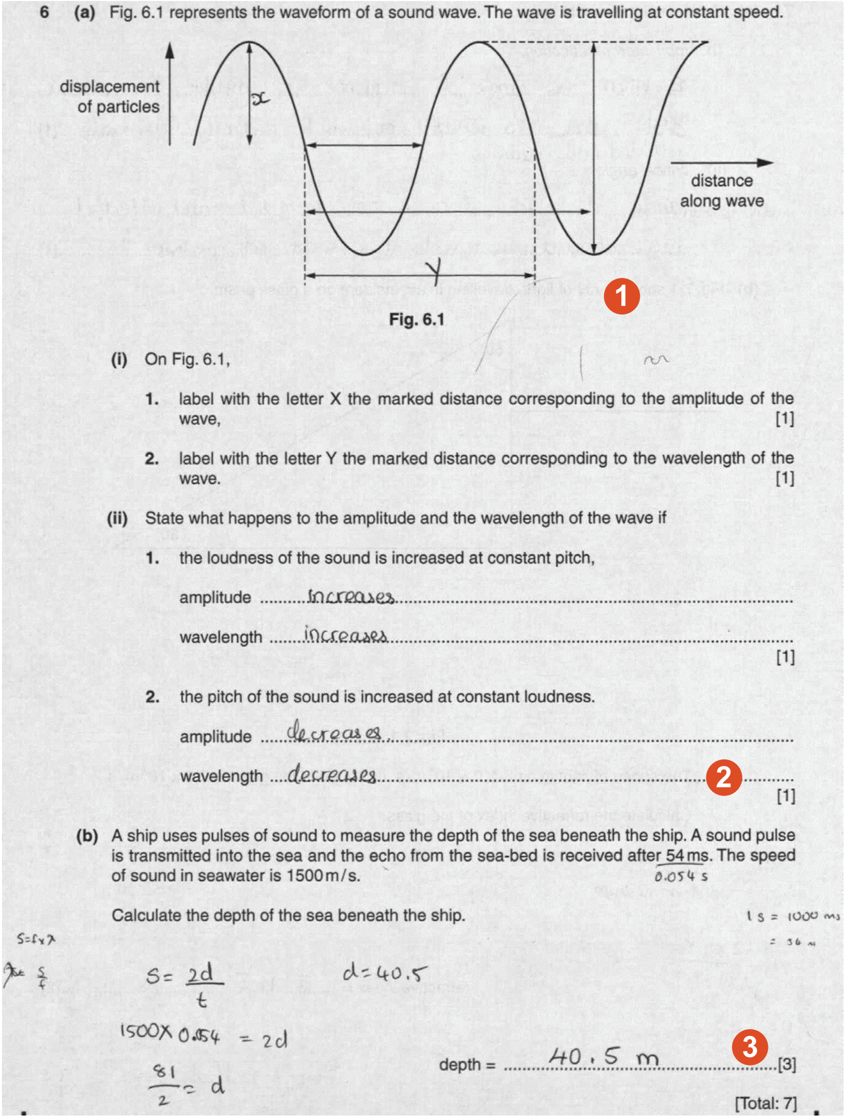
(a) (ii) Many instances of candidates stating the wrong property as constant were seen.

(b) (i) Most mistakes that were made were due to failure to recall the required formula.

(b) (ii) One, or less frequently two, wrongly placed ticks were in seen in a significant number of answers. It was particularly disappointing to see a response suggesting that the mass of the bubble changes.

Question 6

Example Candidate Response – high



6 **(a)** Fig. 6.1 represents the waveform of a sound wave. The wave is travelling at constant speed.

Fig. 6.1

(i) On Fig. 6.1,

1. label with the letter X the marked distance corresponding to the amplitude of the wave, [1]

2. label with the letter Y the marked distance corresponding to the wavelength of the wave. [1]

(ii) State what happens to the amplitude and the wavelength of the wave if

1. the loudness of the sound is increased at constant pitch,

amplitude ....increases..........

wavelength ....increases.......... [1]

2. the pitch of the sound is increased at constant loudness.

amplitude ....decreases..........

wavelength ....decreases.......... ② [1]

(b) A ship uses pulses of sound to measure the depth of the sea beneath the ship. A sound pulse is transmitted into the sea and the echo from the sea-bed is received after 54 ms. The speed of sound in seawater is 1500 m/s.

0.054 s

Calculate the depth of the sea beneath the ship.

1 s = 1000 ms

= 56 ms

$S = f \times \lambda$

$S = \frac{2d}{t}$ $d = 40.5$

$1500 \times 0.054 = 2d$

$\frac{81}{2} = d$

depth = ...40.5 m.......... ③ [3]

[Total: 7]

Examiner comments

① The candidate is clearly aware of the required definitions.
1. The amplitude was correctly labelled.
2. The wavelength was correctly labelled.

② There is evidence of some confusion in the answers here. Neither mark could be awarded.
1. The amplitude and wavelength were both described as increasing. The former only was correct.
2. The amplitude and wavelength were both described as decreasing. The latter only was correct.

Mark awarded for (a) = 2 out of 4

③ Substitutions were made into the correct formula. With correct manipulation of the numbers, the depth of water was accurately calculated.

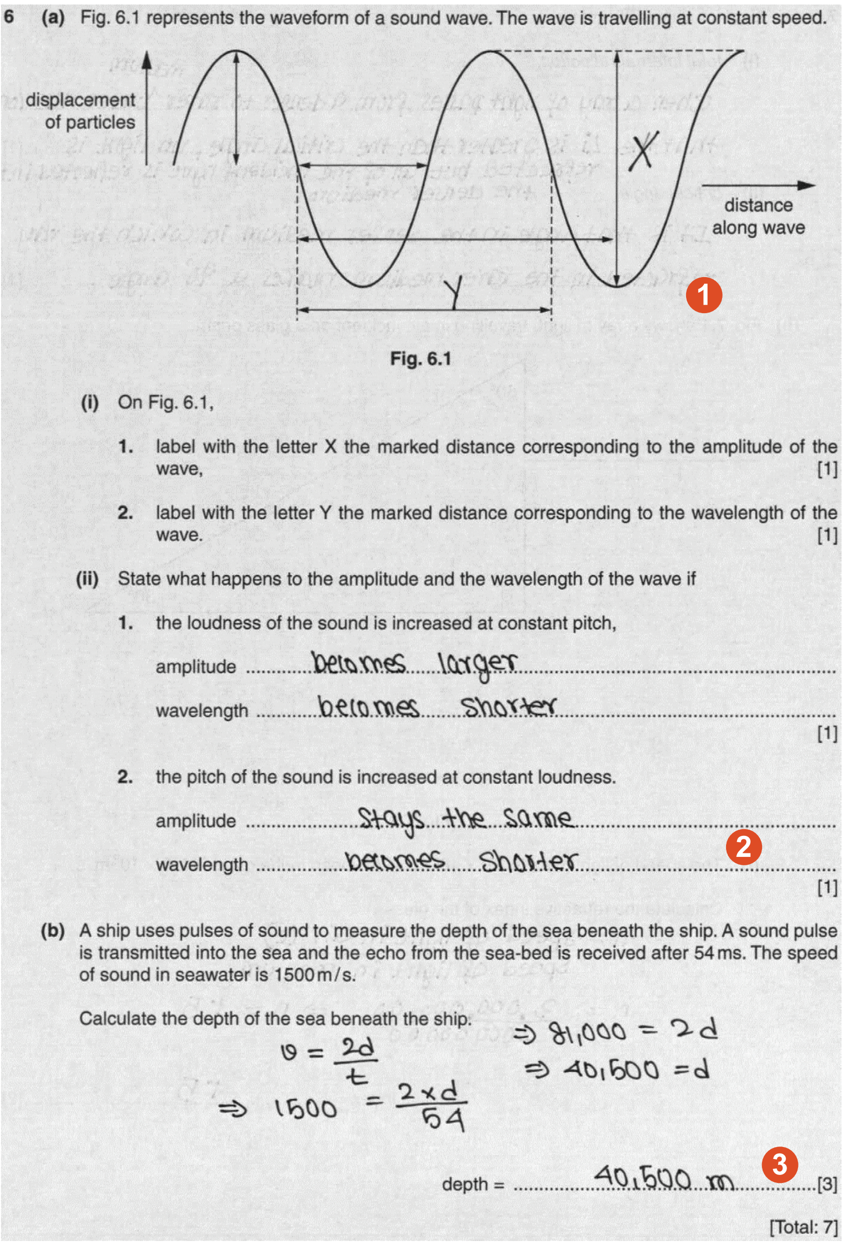
Mark awarded for (b) = 3 out of 3

Total mark awarded = 5 out of 7

How the candidate could have improved the answer

(a) (ii) The candidate needed to have learnt thoroughly the links between amplitude and loudness, and between pitch, frequency and wavelength.

Example Candidate Response – middle



6 **(a)** Fig. 6.1 represents the waveform of a sound wave. The wave is travelling at constant speed.

Fig. 6.1

(i) On Fig. 6.1,

1. label with the letter X the marked distance corresponding to the amplitude of the wave, [1]

2. label with the letter Y the marked distance corresponding to the wavelength of the wave. [1]

(ii) State what happens to the amplitude and the wavelength of the wave if

1. the loudness of the sound is increased at constant pitch,

amplitude ......becomes larger......

wavelength ......becomes Shorter...... [1]

2. the pitch of the sound is increased at constant loudness.

amplitude ......Stays the same......

wavelength ......becomes Shorter...... ② [1]

(b) A ship uses pulses of sound to measure the depth of the sea beneath the ship. A sound pulse is transmitted into the sea and the echo from the sea-bed is received after 54 ms. The speed of sound in seawater is 1500 m/s.

Calculate the depth of the sea beneath the ship.

$$v = \frac{2d}{t}$$

$$\Rightarrow 1500 = \frac{2 \times d}{54}$$

$$\Rightarrow 81{,}000 = 2d$$

$$\Rightarrow 40{,}500 = d$$

depth = ...40,500 m...... ③ [3]

[Total: 7]

Examiner comments

① The candidate's recall of the definition of amplitude was unsound.
1. The labelling of the amplitude was incorrect.
2. The labelling of the wavelength was correct.

② The candidate was aware of the connection between loudness and amplitude. The knowledge of relationship between pitch and wavelength is less certain.
1. The amplitude was correctly described as larger. The wavelength was incorrectly described as shorter.
2. The amplitude was correctly described as the same. The wavelength was correctly described as shorter.

Mark awarded for (a) = 2 out of 4

③ The formula was stated correctly. 54 milliseconds was not converted to seconds before substitution, so there was a power of 10 error in the depth, resulting in a 1 mark penalty.

Mark awarded for (b) = 2 out of 3

Total mark awarded = 4 out of 7

How the candidate could have improved the answer

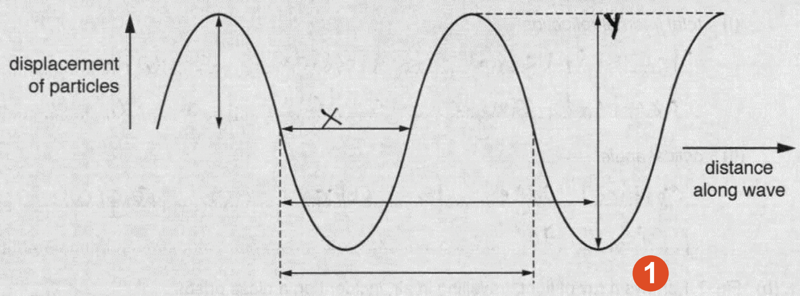
(a) (i) The candidate needed to have learnt and recalled the definition of amplitude as the maximum displacement.

(a) (ii) Recall of the link between amplitude and loudness was shown, but a mistake was made in recalling the link between pitch and wavelength.

(b) More care in reading the question may have avoided the mistake of using 54 s in the calculation instead of 54 *ms*.

Example Candidate Response – low

6 **(a)** Fig. 6.1 represents the waveform of a sound wave. The wave is travelling at constant speed.



①

Fig. 6.1

(i) On Fig. 6.1,

1. label with the letter X the marked distance corresponding to the amplitude of the wave, [1]

2. label with the letter Y the marked distance corresponding to the wavelength of the wave. [1]

(ii) State what happens to the amplitude and the wavelength of the wave if

1. the loudness of the sound is increased at constant pitch,

amplitude Stays the Same.

wavelength increase.

[1]

2. the pitch of the sound is increased at constant loudness.

amplitude the decrease.

wavelength St Increase.

②

[1]

(b) A ship uses pulses of sound to measure the depth of the sea beneath the ship. A sound pulse is transmitted into the sea and the echo from the sea-bed is received after 54 ms. The speed of sound in seawater is 1500 m/s.

Calculate the depth of the sea beneath the ship.

$S = \frac{D}{t}$ $\frac{54}{60} = 0.93333$ S

$= 1500 = \frac{D}{\cancel{0.54} \; 0.93}$ | $D = 1500 \times 0.93$

$= \frac{1395m}{2}$

$= D = 697.5m$

depth = 697.5m ③ [3]

[Total: 7]

Examiner comments

① The candidate showed no appreciation of the definition of amplitude.
1. The labelling of the amplitude was incorrect.
2. The labelling of the wavelength was correct.

② Knowledge of the relationships between loudness and amplitude, and between wavelength and pitch was not in evidence.
1. The amplitude was incorrectly described as staying the same. The wavelength was incorrectly described as increased.
2. The amplitude was incorrectly described as decreased. The wavelength was incorrectly described as increased.

Mark awarded for (a) = 2 out of 4

③ The mark awarded was for stating speed s = *d/t*.
The conversion of 54 milliseconds to seconds was made by dividing 54 by 60. Inevitably the calculation of the depth was wrong.

Mark awarded for (b) = 1 out of 3

Total mark awarded = 4 out of 7

How the candidate could have improved the answer

(a) (i) The candidate needed to have learnt and recalled the definition of amplitude as the maximum displacement.

(a) (ii) The relationships between loudness and amplitude, and between pitch, frequency and wavelength need to have been learnt thoroughly.

6 (b) The method of conversion of milliseconds to seconds must be learnt. The formula relating the time for an echo to return to a source of sound, the speed of the sound, and the distance from a reflecting surface needed to be recalled.

Common mistakes candidates made in this question

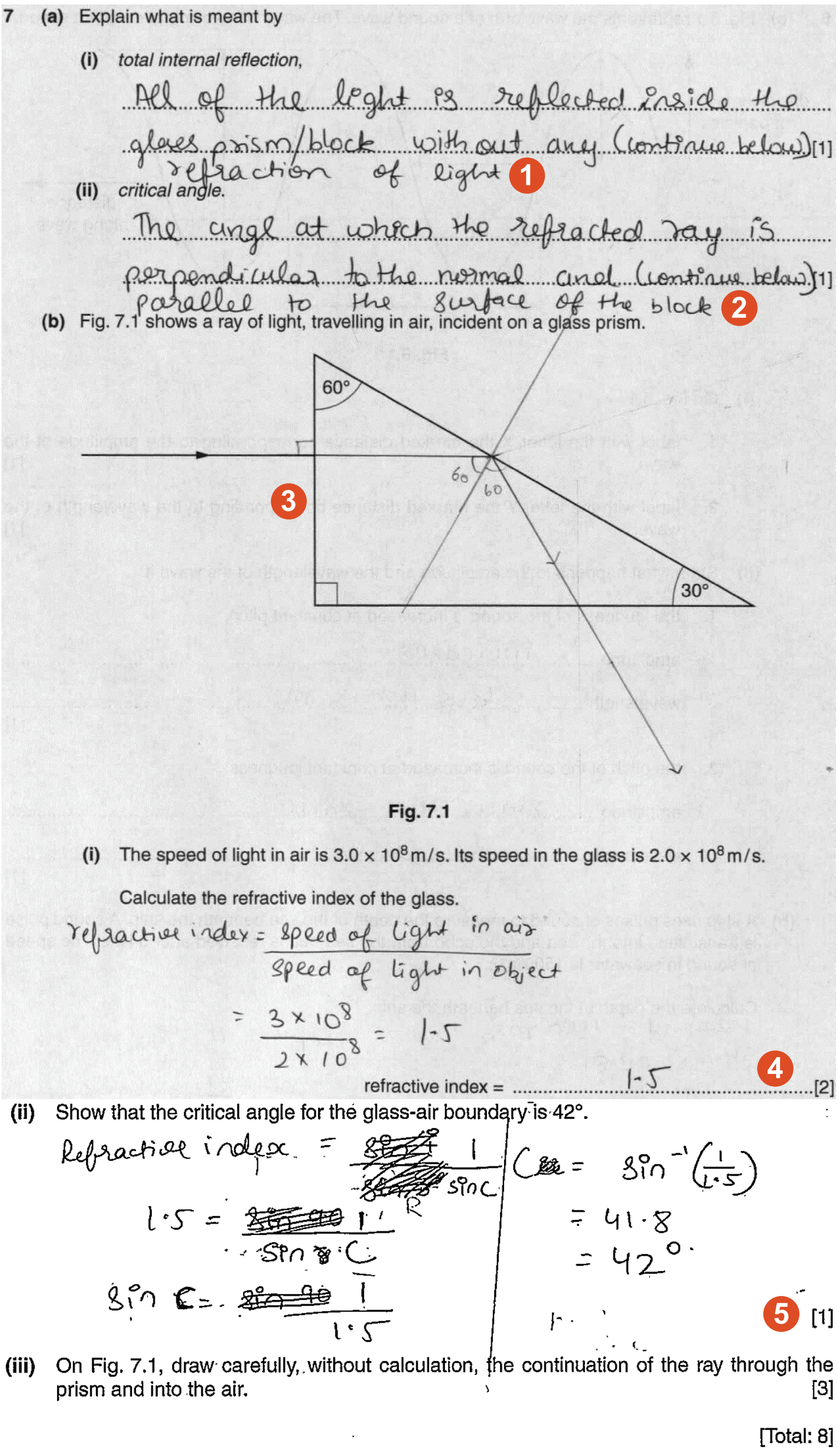
(a) (i) Mistakes due to lack of or poor recall of the definitions of amplitude, and less frequently, wavelength.

(a) (ii) Mistakes due to lack of knowledge of the relationships between loudness and amplitude, and between pitch, frequency and wavelength.

(b) Failure to the conversion of milliseconds to seconds. Using $v = d/t$ without noting the fact that d is twice the distance from the source of sound to the reflecting surface.

Question 7

Example Candidate Response – high



7 (a) Explain what is meant by

(i) *total internal reflection,*

All of the light is reflected inside the glass prism/block without any (continue below) [1]
refraction of light ①

(ii) *critical angle.*

The angl at which the refracted ray is perpendicular to the normal and (continue below) [1]
parallel to the surface of the block ②

(b) Fig. 7.1 shows a ray of light, travelling in air, incident on a glass prism.

Fig. 7.1

(i) The speed of light in air is 3.0 × 10^8 m/s. Its speed in the glass is 2.0 × 10^8 m/s.

Calculate the refractive index of the glass.

refractive index = $\frac{\text{speed of light in air}}{\text{speed of light in object}}$

$= \frac{3 \times 10^8}{2 \times 10^8} = 1.5$

refractive index = 1.5 ④ [2]

(ii) Show that the critical angle for the glass-air boundary is 42°.

Refractive index = $\frac{1}{\sin C}$

$1.5 = \frac{~~\sin 90~~ \; 1}{\sin C}$

$\sin C = \frac{~~\sin 90~~ \; 1}{1.5}$

$C = \sin^{-1}\left(\frac{1}{1.5}\right)$

$= 41.8$

$= 42°.$

⑤ [1]

(iii) On Fig. 7.1, draw carefully, without calculation, the continuation of the ray through the prism and into the air. [3]

[Total: 8]

Examiner comments

① Reference to a glass prism is accepted as a more dense medium, so the detail given was correct.

② The candidate needed to say that the angle of incidence, not just the angle, at which the refracted ray is perpendicular to the normal.

Mark awarded for (a) = 1 out of 2

③ The ray diagram fails to show the refraction of the ray away from the normal at the lower face of the prism.

④ The formula stated the substitutions and the calculation are correct.

⑤ The formula stated the substitutions and the calculation are correct.

Mark awarded for (b) = 5 out of 6

Total mark awarded = 6 out of 8

How the candidate could have improved the answer

(a) (ii) The angle referred to must be the angle of incidence.

(b) (iii) The ray emerging from the lower face needed to be shown bending away from the normal.

Example Candidate Response – middle

7 **(a)** Explain what is meant by

(i) *total internal reflection,*

~~when angle~~ Angle of incident more than critical angle. ①

..........[1]

(ii) *critical angle.*

~~Refraction~~ Angle of refraction equal to 90°. ②

..........[1]

(b) Fig. 7.1 shows a ray of light, travelling in air, incident on a glass prism.

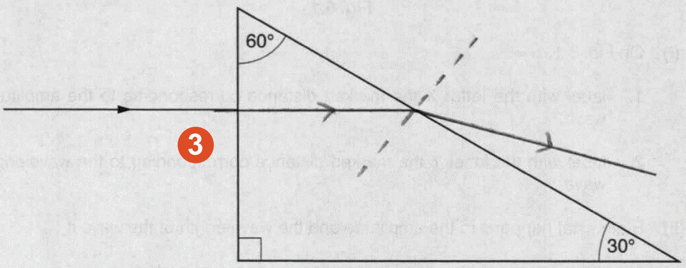


Fig. 7.1

(i) The speed of light in air is 3.0 × 10^8 m/s. Its speed in the glass is 2.0 × 10^8 m/s.

Calculate the refractive index of the glass.

$n = \frac{3\times10^8}{2\times10^8}$

$= 1.5$

refractive index = 1.5 ④ ....[2]

(ii) Show that the critical angle for the glass-air boundary is 42°.

$\sin c = \frac{1}{1.5}$

$c = 41.8$

$c = 42°.$ ⑤

[1]

(iii) On Fig. 7.1, draw carefully, without calculation, the continuation of the ray through the prism and into the air. [3]

[Total: 8]

Examiner comments

① The answer omits the point that the angle of incidence is in a more dense medium or e.g. glass.

② The critical angle is an angle of incidence and this aspect is not addressed in the answer.

Mark awarded for (a) = 0 out of 2

③ The only possible credit is for showing that the ray undergoes no change of direction at the vertical face of the prism. The ray is shown as passing out of the prism at the sloping face, not undergoing total internal reflection.

④ The formula is not stated, but the data is used to calculate the correct value of the refractive index.

⑤ As in **(i)**, no formula is stated, but a correct calculation is carried out.

Mark awarded for (b) = 4 out of 6

Total mark awarded = 4 out of 8

How the candidate could have improved the answer

(a) (i) The response needed to refer to reflection in a more dense material and state that there is no refracted ray.

(a) (ii) The response needed to state that the critical angle is an angle of incidence and also that it is the angle for which the refracted ray travels along the boundary, or the angle above which total internal reflection occurs.

(b) (iii) The completed diagram needed to show total internal reflection at the sloping face of the prism followed by bending away from the normal.at the lower face.

Example Candidate Response – low

7 **(a)** Explain what is meant by

(i) *total internal reflection,*

When the incident ray from a denser medium reflects back into the medium itself ① [1]

(ii) *critical angle.*

When the incident ray travels exactly below the surface of the medium ② [1]

(b) Fig. 7.1 shows a ray of light, travelling in air, incident on a glass prism.

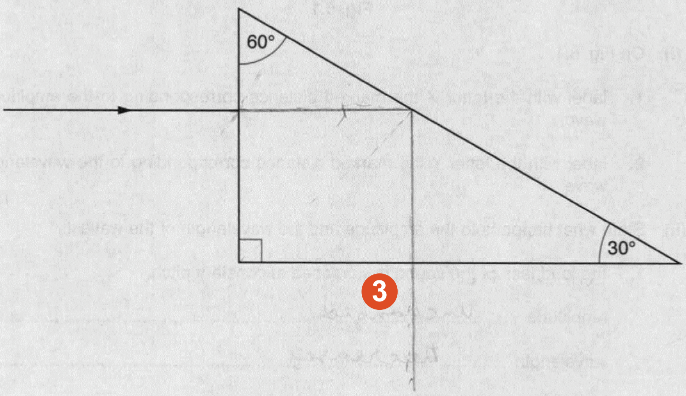


Fig. 7.1

(i) The speed of light in air is 3.0×10^8 m/s. Its speed in the glass is 2.0×10^8 m/s.

Calculate the refractive index of the glass.

$n_1 \sin I = n_2 \sin R$

refractive index = $\frac{3}{2}$ ④ [2]

(ii) Show that the critical angle for the glass-air boundary is 42°.

⑤

[1]

(iii) On Fig. 7.1, draw carefully, without calculation, the continuation of the ray through the prism and into the air. [3]

[Total: 8]

Examiner comments

① The meaning of total internal reflection is satisfactorily explained.

② In common with many answers to this question, there is no reference to the critical angle being an angle of incidence.

Mark rewarded for (a) = 1 out of 2

③ The ray was correctly shown as passing through the first face undeflected. Total internal reflection at the sloping face was shown but would only have been correct for a 45°, 90°, 45° prism.

④ The formula stated is not relevant to the data provided. The answer stated as 3/2, that should have been written as 1.5, does not follow from the preceding work and could simply be a recall of the value of the refractive index of glass.

⑤ No attempt at calculating the critical angle was made.

Mark awarded for (b) = 0 out of 6

Total mark awarded = 2 out of 8

How the candidate could have improved the answer

(a) (ii) The response needed to state that the critical angle is an angle of incidence and also that it is the angle for which the refracted ray travels along the boundary' or the angle above which total internal reflection occurs.

(b) (i) The formula needed was the one relating the refractive index of the glass to the speeds of light in air and in glass, with substitutions into this formula. The numerical answer needed to follow from this working.

(b) (ii) No response was offered.

(b) (iii) The completed diagram was required to show total internal reflection with reasonable accuracy occurring at the sloping face of the prism. This accuracy was not achieved in the answer. The ray needed to be shown bending away from the normal.at the lower face.

Common mistakes candidates made in this question

(a) (i) Failure to refer to the reflection taking place in a more dense material.

(a) (ii) Failure to state that the critical angle is an angle of incidence.

(b) (i) In the context of the data given in the question, use of the wrong formula for refractive index.

(b) (ii) Lack of recall of the relevant formula relating the critical angle to the refractive index of the denser material.

(b) (iii) Insufficient accuracy in drawing the totally reflected ray at the sloping face of the prism. Not showing the ray refracting away from the normal at the lower face of the prism.

Question 8

Example Candidate Response – high

8 **(a)** Fig. 8.1 shows 3 lamps and a fuse connected to a power supply.

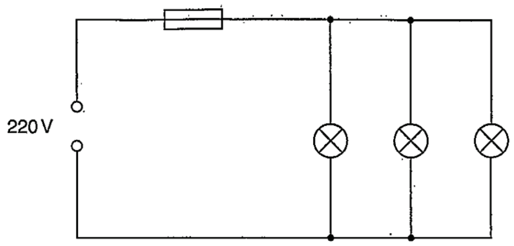


Fig. 8.1

The e.m.f. of the supply is 220V. Each lamp is labelled 220V, 40W. The rating of the fuse is 2.0A.

Calculate

(i) the current in each lamp,

Current = Power / Voltage

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

$= \frac{40}{220}$

$= 0.18$

current = 0.18A ① [2]

(ii) the current in the fuse,

~~Total current in circuit: 120 / 220 = 0.55A~~

~~Fuse current = total / lamps~~

~~= 0.55 − (3×0.18)~~

~~= 0.55 − 0.54~~

~~= 0.01~~

current = ~~0.01A~~ 2A ② [1]

(iii) the total number of lamps, all in parallel, that could be connected without blowing the fuse.

Total number of lamps = Current in fuse / current of lamp

$= \frac{2}{0.18} = 11.11$

number = 11 ③ [2]

(b) After a very long period of use, the wire filament of one of the lamps becomes thinner.

(i) Underline the effect of this change on the resistance of the filament.

resistance increases   resistance remains the same   resistance decreases ④ [1]

(ii) State and explain the effect of this change on the power of the lamp.

The power of the lamp would decrease. This is due to decrease in current. The current is decreased due to the increase in resistance. ⑤ [2]

[Total: 8]

Examiner comments

① With the correct formula and substitution, the correct current was calculated.

② After an inconclusive attempt at a calculation, the candidate wrote down the rating of the fuse as the total current. The current in a single lamp had to be multiplied by 3.

③ The fuse rating was correctly divided by the value calculated in (a) (i).

Mark awarded for (a) = 4 out of 5

④ The candidate had recalled correctly that a thinner wire has a larger resistance.

⑤ The statement that the power would be reduced was rewarded. The explanation was incomplete. It was correct to write that the current would be reduced, but a reference to $P = IV$ with V having a constant value also had to be made.

Mark awarded for (b) = 2 out of 3

Total mark awarded = 6 out of 8

How the candidate could have improved the answer

(a) (ii) The answer to (i) needed to be multiplied by 3.

(b) (ii) The answer required a reference to a relevant formula; either $P = IV$ or $P = V^2/R$.

Example Candidate Response – middle

8 **(a)** Fig. 8.1 shows 3 lamps and a fuse connected to a power supply.

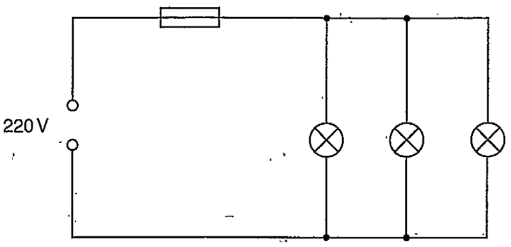


Fig. 8.1

The e.m.f. of the supply is 220 V. Each lamp is labelled 220 V, 40 W. The rating of the fuse is 2.0 A.

Calculate

(i) the current in each lamp,

$P = VI.$

$\frac{P}{V} = I.$

$\frac{40}{220} = 0.18$

current = 0.18 A ① [2]

(ii) the current in the fuse,

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

$I = \frac{440.}{40} = 11$

current = 11 A ② [1]

(iii) the total number of lamps, all in parallel, that could be connected without blowing the fuse.

number = 61 ③ [2]

(b) After a very long period of use, the wire filament of one of the lamps becomes thinner.

(i) Underline the effect of this change on the resistance of the filament.

<u>resistance increases</u>   resistance remains the same   resistance decreases ④ [1]

(ii) State and explain the effect of this change on the power of the lamp.

$P = \frac{V^2}{R}.$ This formula determines that resistance is inversly proportional to power so therefore if ~~PR~~ power is doubled than ~~R ceo~~ Resistance is halved. [2] ⑤

[Total: 8]

Examiner comments

① Using the correct formula and substitution, the candidate calculated the correct current.

② The answer suggested that the candidate had no idea as to how to cope with issues concerning lamps, and by implication, resistors, in parallel. For no apparent reason, the formula $P = IV$ was quoted and spurious substitutions made.

③ A numerical answer of no relevance was written in the answer space.

Mark awarded for (a) = 2 out of 5

④ The candidate had recalled correctly that a thinner wire has a larger resistance.

⑤ The formula $P = V^2/R$ was quoted and power stated as being inversely proportional to resistance. Together, these aspects allowed a mark. There was no follow-up to complete an explanation.

Mark awarded for (b) = 2 out of 3

Total mark awarded = 4 out of 8

How the candidate could have improved the answer

(a) (ii) The answer to (i) needed to be multiplied by 3.

(a) (iii) The fuse value of 2 *A* should have been divided by the answer to (a) (i).

(b) (ii) A relevant formula was written down, but the candidate's use of the formula needed to be applicable to the particular details of the question.

Example Candidate Response – low

8 **(a)** Fig. 8.1 shows 3 lamps and a fuse connected to a power supply.

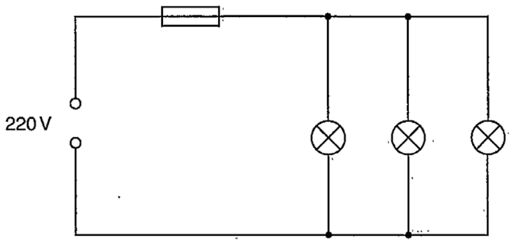


Fig. 8.1

The e.m.f. of the supply is 220 V. Each lamp is labelled 220 V, 40 W. The rating of the fuse is 2.0 A.

Calculate

(i) the current in each lamp,

$P = IV$

$40 = I \times 220$

$\therefore \frac{220}{40} = 5.5$

current = 5.5 ① [2]

(ii) the current in the fuse,

279

current = 110 ② [1]

(iii) the total number of lamps, all in parallel, that could be connected without blowing the fuse.

number = ~~2~~ ③ [2]

(b) After a very long period of use, the wire filament of one of the lamps becomes thinner.

(i) Underline the effect of this change on the resistance of the filament.

<u>resistance increases</u>   resistance remains the same   resistance decreases ④ [1]

(ii) State and explain the effect of this change on the power of the lamp.

The resistence increases ~~tot~~ so the power of the lamp will decrease. ⑤

[2]

[Total: 8]

Examiner comments

① The stated formula was correct and gained a mark. Wrong substitutions followed.

② No working was shown, just a wrong numerical answer with no unit.

③ Again there was no working. A wrong numerical answer was written in the answer space, but was crossed out.

Mark awarded for (a) = 1 out of 5

④ The candidate had recalled correctly that a thinner wire has a larger resistance.

⑤ The statement that power decreases with an increase in resistance was rewarded, but there was no subsequent explanation.

Mark awarded for (b) = 2 out of 3

Total mark awarded = 3 out of 8

How the candidate could have improved the answer

(a) (i) Correct substitutions were made into the correct formula but the arithmetic that followed should have calculated 40/220 rather than 220/40.

(a) (ii) The answer to (i) needed to be multiplied by 3.

(a) (iii) The fuse value of 2 A should have been divided by the answer to (a)(i).

(b) (ii) The answer required a reference to a relevant formula; either $P = IV$ or $P = V^2/R$.

Common mistakes candidates made in this question

(a) (i) Wrong use of the data, sometimes after correct substitution into a relevant formula.

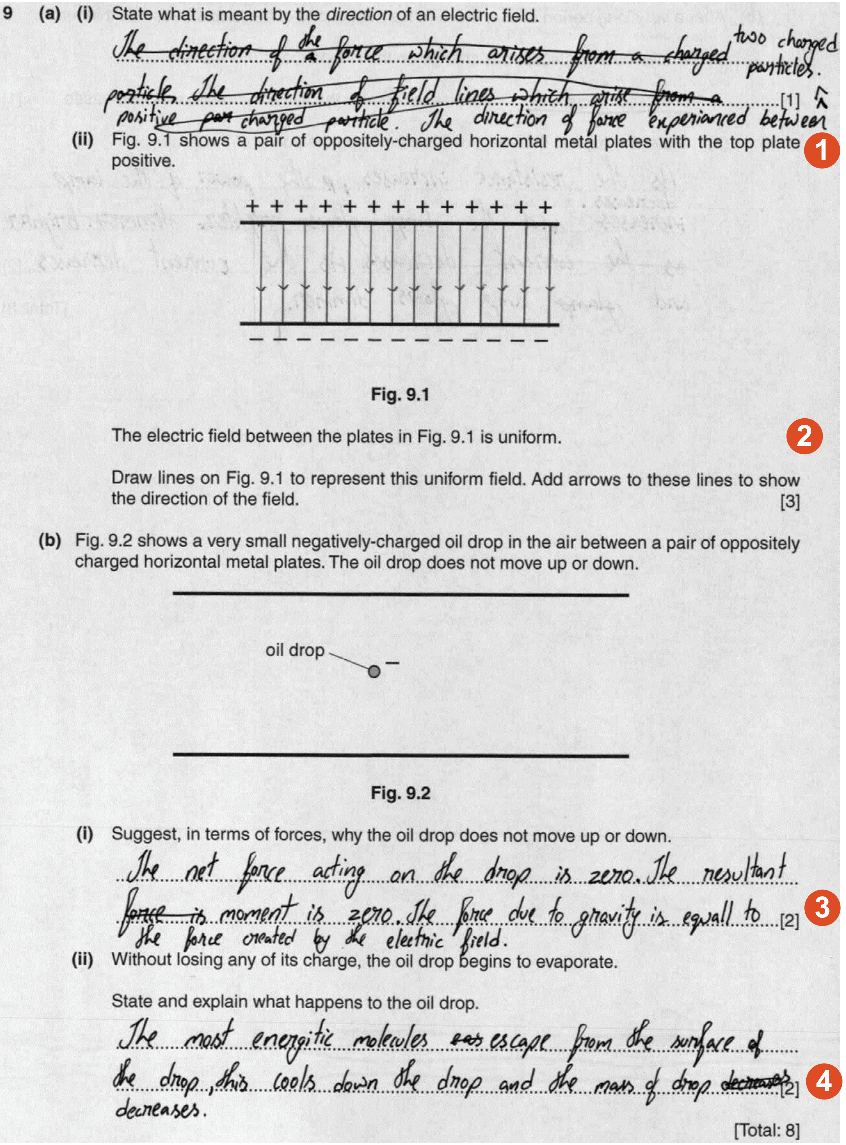
(a) (ii) A wrong arithmetic approach, usually arising from the fact that some candidates do not appreciate that in the parallel circuit, the total current is the sum of the currents in the individual lamps.

(a) (iii) Using a recalled formula unnecessarily. This mistake arises from the point made in (a)(ii) above.
(b) (i) Failure to recall the relationship between the resistance of a wire and the area of cross-section of the wire.

(b) (ii) After stating correctly that the current in the lamp decreases, not following this with a deduction based upon using $P = IV$ or $\mathrm{P} = V^2/R$.

Question 9

Example Candidate Response – high



9 (a) (i) State what is meant by the *direction* of an electric field.

~~The direction of the a force which arises from a charged particle. The direction of field lines which arise from a positive par charged particle.~~ The direction of force experianced between two charged particles. [1]

(ii) Fig. 9.1 shows a pair of oppositely-charged horizontal metal plates with the top plate positive. ①

Fig. 9.1

The electric field between the plates in Fig. 9.1 is uniform. ②

Draw lines on Fig. 9.1 to represent this uniform field. Add arrows to these lines to show the direction of the field. [3]

(b) Fig. 9.2 shows a very small negatively-charged oil drop in the air between a pair of oppositely charged horizontal metal plates. The oil drop does not move up or down.

Fig. 9.2

(i) Suggest, in terms of forces, why the oil drop does not move up or down.

The net force acting on the drop is zero. The resultant ~~force is~~ moment is zero. The force due to gravity is equall to the force created by the electric field. [2] ③

(ii) Without losing any of its charge, the oil drop begins to evaporate.

State and explain what happens to the oil drop.

The most energitic molecules ~~eas~~ escape from the surface of the drop, this cools down the drop and the mass of drop ~~decreases~~ decreases. [2] ④

[Total: 8]

Examiner comments

① The candidate could not recall what is meant by the direction of an electric field.

② The field lines and the direction of the field limes were accurately drawn.

Mark awarded for (a) = 3 out of 4

③ The statement that the force due to gravity acting on the oil drop and the force created by the electric field was acceptable

④ The candidate correctly stated that the mass of the oil drop decreases due to evaporation, but made no suggestion about the consequent movement of the drop.

Mark awarded for (b) = 3 out of 4

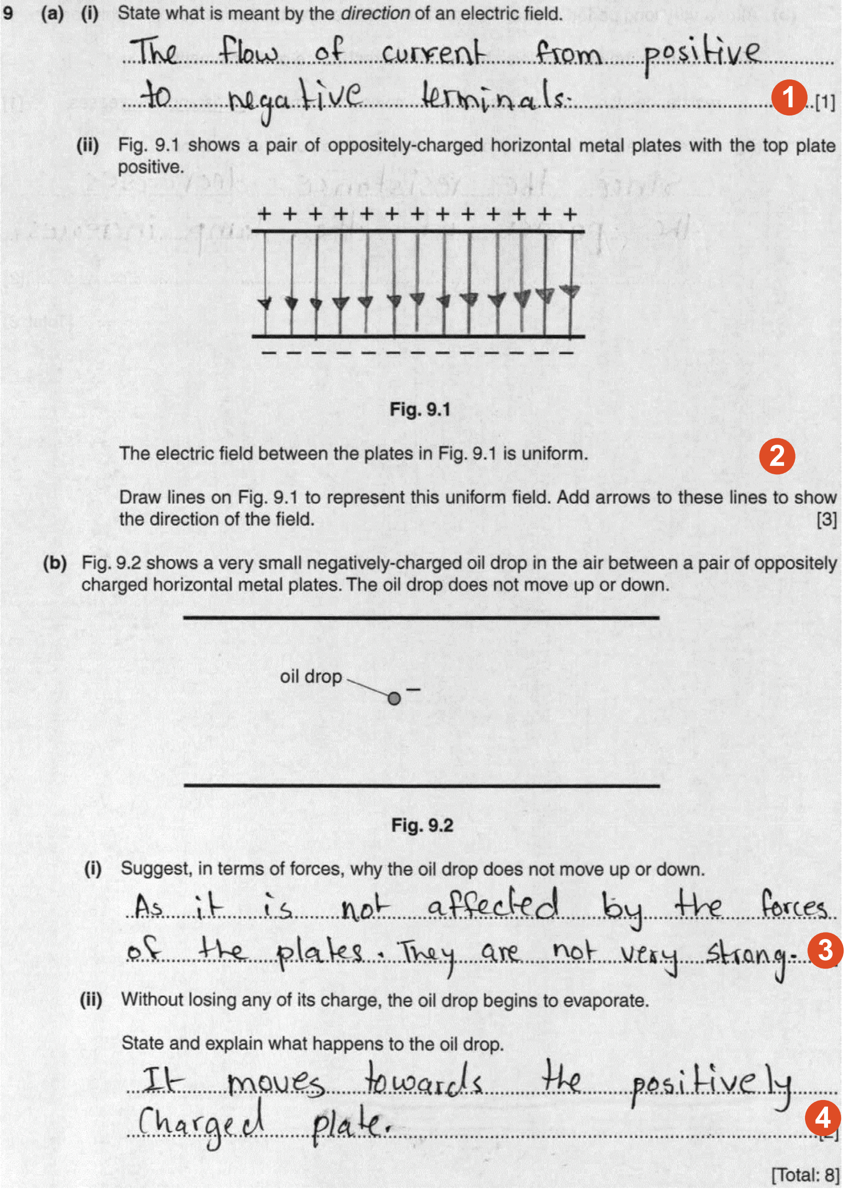
Total mark awarded = 6 out of 8

How the candidate could have improved the answer

(a) (i) By stating that the direction of the of the field is the direction of the force acting on a positive charge.

(b) (ii) As well as stating that the mass of the drop decreases, the answer needed to include the point that the drop moves upwards.

Example Candidate Response – middle



9 **(a)** **(i)** State what is meant by the *direction* of an electric field.

The flow of current from positive to negative terminals. ① [1]

(ii) Fig. 9.1 shows a pair of oppositely-charged horizontal metal plates with the top plate positive.

Fig. 9.1

The electric field between the plates in Fig. 9.1 is uniform. ②

Draw lines on Fig. 9.1 to represent this uniform field. Add arrows to these lines to show the direction of the field. [3]

(b) Fig. 9.2 shows a very small negatively-charged oil drop in the air between a pair of oppositely charged horizontal metal plates. The oil drop does not move up or down.

Fig. 9.2

(i) Suggest, in terms of forces, why the oil drop does not move up or down.

As it is not affected by the forces of the plates. They are not very strong. ③

(ii) Without losing any of its charge, the oil drop begins to evaporate.

State and explain what happens to the oil drop.

It moves towards the positively charged plate. ④

[Total: 8]

Examiner comments

① The direction of an electric field, stated as the direction of the flow of current from positive to negative terminals, was wrong.

② The field lines and the direction of the field arrows were accurately drawn.

Mark awarded for (a) = 3 out of 4

③ The suggestion that the oil drop was not affected by forces due to the plates was entirely wrong.

④ Exceptionally for this question, the candidate's statement that the oil drop moves towards the positively charged plate was rewarded. Unfortunately, no explanation was offered.

Mark awarded for (b) = 1 out of 4

Total mark awarded = 4 out of 8

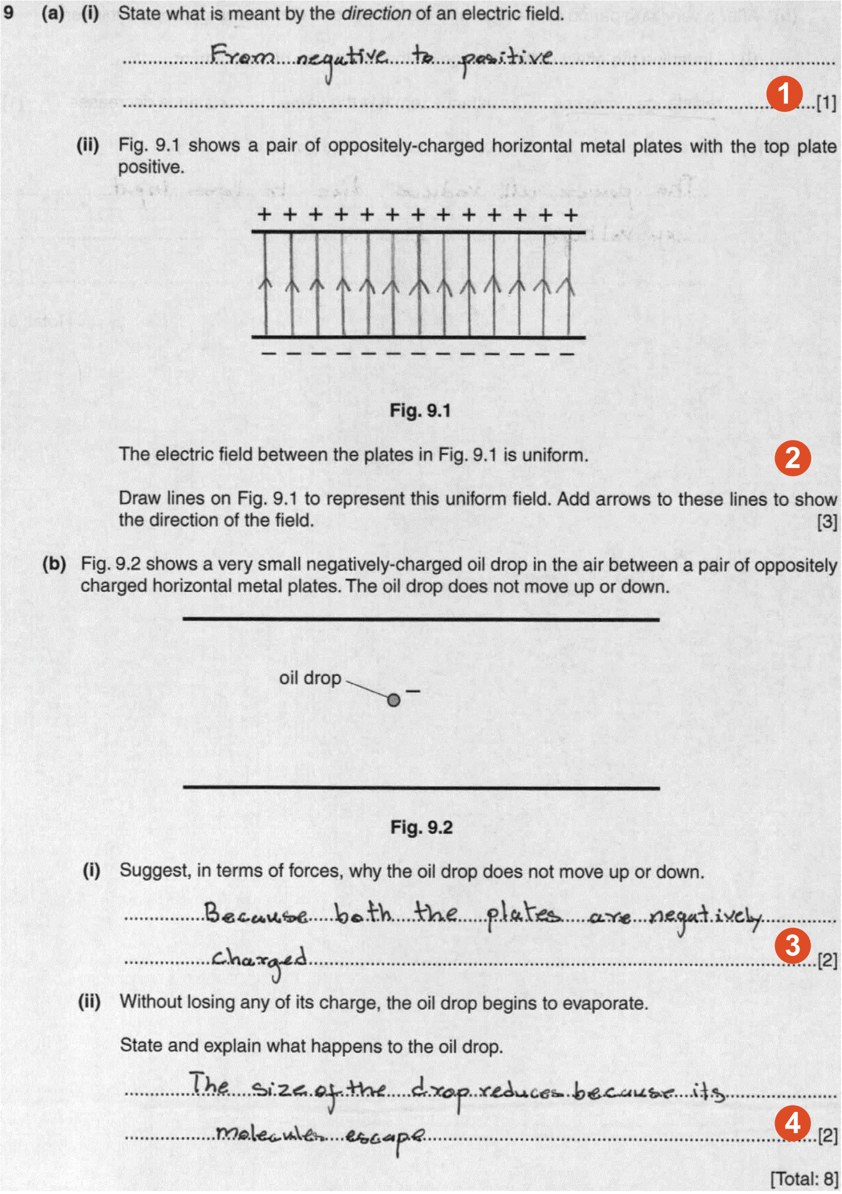
How the candidate could have improved the answer

(a) (i) By stating that the direction of the of the field is the direction of the force acting on a positive charge.

(b) (i) By stating that the upward force on the drop due to the electric field (1 mark) equals the weight of the drop or the downward force on the drop.(1 mark)

(b) (ii) The answer needed to include the point that the mass or weight of the drop decreases.

Example Candidate Response – low



9 **(a)** **(i)** State what is meant by the *direction* of an electric field.

From negative to positive

① [1]

(ii) Fig. 9.1 shows a pair of oppositely-charged horizontal metal plates with the top plate positive.

Fig. 9.1

The electric field between the plates in Fig. 9.1 is uniform. ②

Draw lines on Fig. 9.1 to represent this uniform field. Add arrows to these lines to show the direction of the field. [3]

(b) Fig. 9.2 shows a very small negatively-charged oil drop in the air between a pair of oppositely charged horizontal metal plates. The oil drop does not move up or down.

Fig. 9.2

(i) Suggest, in terms of forces, why the oil drop does not move up or down.

Because both the plates are negatively charged ③ [2]

(ii) Without losing any of its charge, the oil drop begins to evaporate.

State and explain what happens to the oil drop.

The size of the drop reduces because its molecules escape ④ [2]

[Total: 8]

Examiner comments

① ‘From negative to positive’, for the suggested meaning of the direction of the electric field, was wrong.

② The field lines between the plates were accurately drawn as parallel and equally spaces. The arrows indicating the direction of the field pointed upwards rather than downwards.

Mark awarded for (a) = 2 out of 4

③ No marks could be awarded for the statement that both plates are negatively charged.

④ The candidate stated correctly that the size of the drop reduces as a result of evaporation. However, a reduction in the mass of the drop is the issue in the context of this question. No explanation followed.

Mark awarded for (b) = 0 out of 4

Total mark awarded = 2 out of 8

How the candidate could have improved the answer

(a) (i) By stating that the direction of the of the field is the direction of the force acting on a positive charge.

(a) (ii) The field direction arrows needed to be point in in the downward direction.

(b) (i) The candidate needed to have noted that the question specified that the plates are oppositely charged.

(b) (ii) By stating that the mass or weight of the drop, not the size, decreases, and that the drop moves upwards.

Common mistakes candidates made in this question

(a) (i) Failure to recall the syllabus statement defining the direction of an electric field.

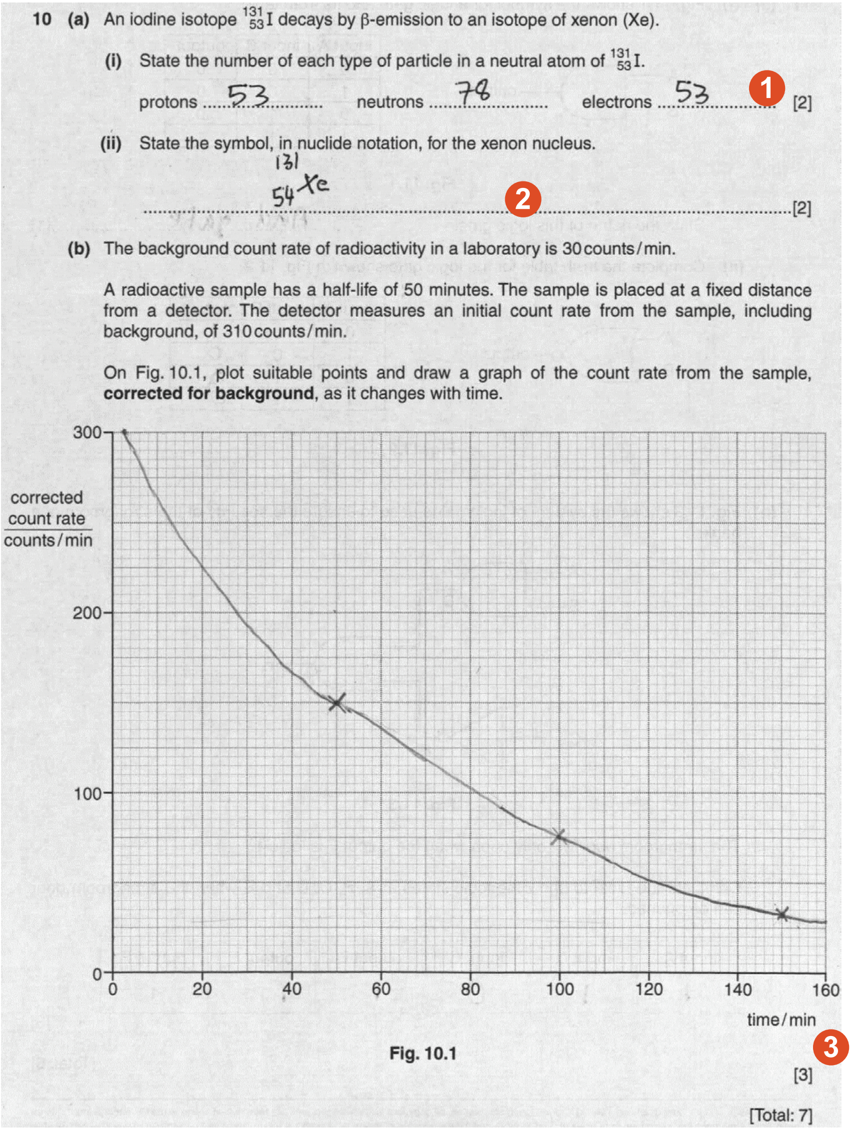
(a) (ii) Uneven spacing of field lines. Direction arrows on field line pointing in the wrong direction.

(b) (i) Making vague statements about the forces acting on the drop rather than referring to the equilibrium of the forces, i.e. the upward force on the drop due to the electric field is equal to the downward force on the drop or the weight of the drop.

(b) (ii) Not stating that the mass or weight of the drop decreases (due to evaporation), and that the drop moves upwards.

Question 10

Example Candidate Response – high



10 **(a)** An iodine isotope $^{131}_{53}\text{I}$ decays by β-emission to an isotope of xenon (Xe).

(i) State the number of each type of particle in a neutral atom of $^{131}_{53}\text{I}$.

protons ......53...... neutrons ......78...... electrons ......53...... ① [2]

(ii) State the symbol, in nuclide notation, for the xenon nucleus.

......$^{131}_{54}Xe$...... ② ......[2]

(b) The background count rate of radioactivity in a laboratory is 30 counts/min.

A radioactive sample has a half-life of 50 minutes. The sample is placed at a fixed distance from a detector. The detector measures an initial count rate from the sample, including background, of 310 counts/min.

On Fig. 10.1, plot suitable points and draw a graph of the count rate from the sample, **corrected for background**, as it changes with time.

Fig. 10.1

③

[3]

[Total: 7]

Examiner comments

① The particle numbers stated were all correct.

② The symbol for the xenon nucleus was correct.

Mark awarded for (a) = 4 out of 4

③ Points were plotted at 3 out of 4 correct times, allowing a mark. The background count rate was not subtracted from the count rates listed, so there was no further credit.

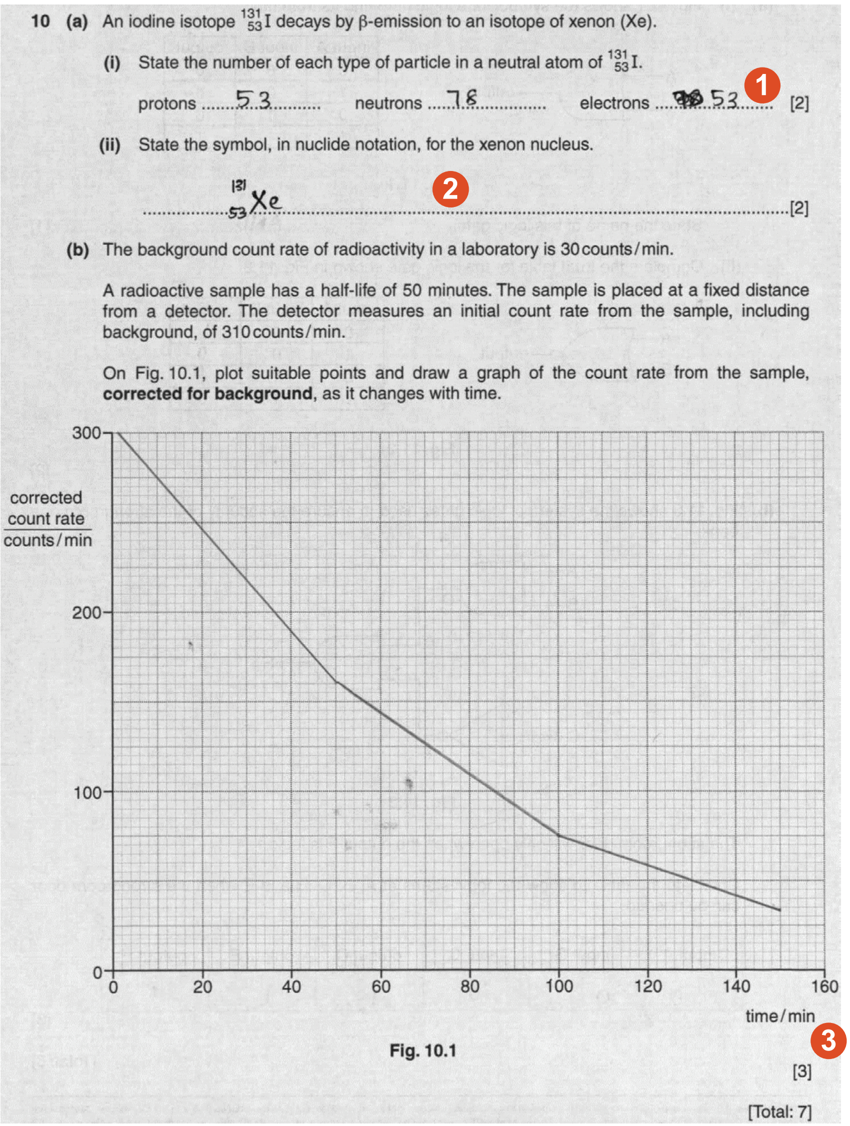
Mark awarded for (b) = 1 out of 3

Total mark awarded = 5 out of 7

How the candidate could have improved the answer

(b) The points were plotted at suitable times, but the count rates plotted did not take account of the background count rate.

Example Candidate Response – middle



10 (a) An iodine isotope $^{131}_{53}\text{I}$ decays by β-emission to an isotope of xenon (Xe).

(i) State the number of each type of particle in a neutral atom of $^{131}_{53}\text{I}$.

protons ....53.......... neutrons ......78.............. electrons ...~~78~~ 53........ [2]

①

(ii) State the symbol, in nuclide notation, for the xenon nucleus.

$^{131}_{53}\text{Xe}$ ② ....[2]

(b) The background count rate of radioactivity in a laboratory is 30 counts/min.

A radioactive sample has a half-life of 50 minutes. The sample is placed at a fixed distance from a detector. The detector measures an initial count rate from the sample, including background, of 310 counts/min.

On Fig. 10.1, plot suitable points and draw a graph of the count rate from the sample, **corrected for background**, as it changes with time.

Fig. 10.1

③

[3]

[Total: 7]

Examiner comments

① The particle numbers stated were all correct.

② The subscript number, for the number of protons in the xenon nucleus, was wrong.

Mark awarded for (a) = 3 out of 4

③ Points were plotted at 3 out of 4 correct times, allowing a mark. The background count rate was not subtracted from the initial count rates listed, so the plotting of the points was wrong, as was the graph.

Mark awarded for (b) = 1 out of 3

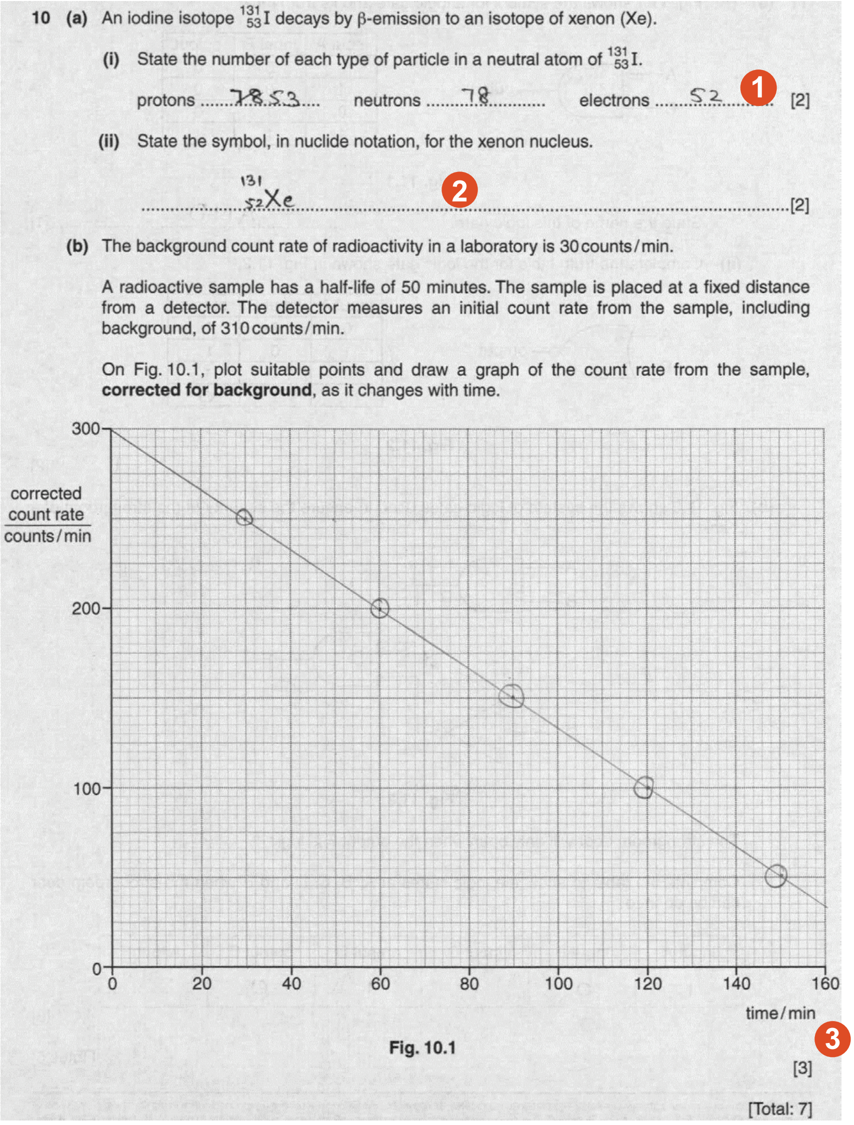
Total mark awarded = 4 out of 7

How the candidate could have improved the answer

(a) (ii) By writing the subscript number as 54, i.e. the proton number increases by one for a β-decay.

(b) The points were plotted at suitable times, but the count rates plotted did not take account of the background count rate.

Example Candidate Response – low



10 **(a)** An iodine isotope $^{131}_{53}\mathrm{I}$ decays by β-emission to an isotope of xenon (Xe).

(i) State the number of each type of particle in a neutral atom of $^{131}_{53}\mathrm{I}$.

protons ....~~78~~ 53.... neutrons ....78.... electrons ....52.... ① [2]

(ii) State the symbol, in nuclide notation, for the xenon nucleus.

....$^{131}_{52}Xe$.... ② ....[2]

(b) The background count rate of radioactivity in a laboratory is 30 counts/min.

A radioactive sample has a half-life of 50 minutes. The sample is placed at a fixed distance from a detector. The detector measures an initial count rate from the sample, including background, of 310 counts/min.

On Fig. 10.1, plot suitable points and draw a graph of the count rate from the sample, **corrected for background**, as it changes with time.

Fig. 10.1

③

[3]

[Total: 7]

Examiner comments

① The electron number given in the answer was wrong. Candidates usually know that the proton number and the electron number are the same, but not in this case.

② The subscript number, for the number of protons in the xenon nucleus, was wrong.

Mark awarded for (a) = 2 out of 4

③ The candidate clearly had no idea how to handle the given data. Points were plotted at times not suggested by the data, and such that the graph through these points lay in the straight line that was drawn.

Mark awarded for (b) = 0 out of 3

Total mark awarded = 2 out of 7

How the candidate could have improved the answer

(a) (i) The candidate should have recalled that for a neutral atom, the electron number is the same as the proton number.

(a) (ii) By writing the subscript number as 54, i.e. the proton number increases by one for a β-decay.

(b) First, by subtracting the background count rate from the initial count rate. Then dividing this corrected initial count rate successively by 2. Finally, plotting these values at 50 s intervals and drawing a curve through these points.

Common mistakes candidates made in this question

(a) (i) No particularly common mistakes, but those made tended to be random ones, mostly in either the neutron number or the electron number.

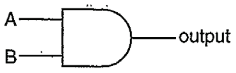
(a) (ii) Of the mistakes made, most were in the subscript, the number of protons. Fewer were in the superscript, the nucleon number.

(b) The most frequent mistake was in failing to subtract the background count rate. Some of the responses in which this aspect was correct, were followed by curves not sufficiently smooth or straight lines joining successive points.

Question 11

Example Candidate Response – high

11 **(a)** **(i)** Fig. 11.1 shows the symbol for a logic gate and its truth table.

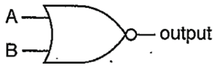


input A	input B	output
0	0	0
1	0	0
0	1	0
1	1	1

Fig. 11.1

State the name of this logic gate. ....AND Gate.......... ① [1]

(ii) Complete the truth table for the logic gate shown in Fig. 11.2.



input A	input B	output
0	0	1
1	0	0
0	1	0
1	1	0

Fig. 11.2

② [2]

(b) Fig. 11.3 shows the system of logic gates used to ensure the security of the strongroom of a bank.

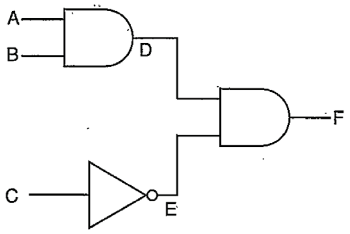


Fig. 11.3

The strongroom door will only open when the output F is logic 1.

Complete the table to show the logic states at A, B, C, D and E when the strongroom door can be opened.

input A	input B	input C	output D	output E	output F
1	1	1	1	1	1

③ [3]

[Total: 6]

Examiner comments

① The logic gate was correctly identified from its symbol or its truth table, or both of these.

② The table for the unidentified logic gate was successfully completed.

Mark awarded for (a) = 3 out of 3

③ There was an error in the entry in the C column of the table.

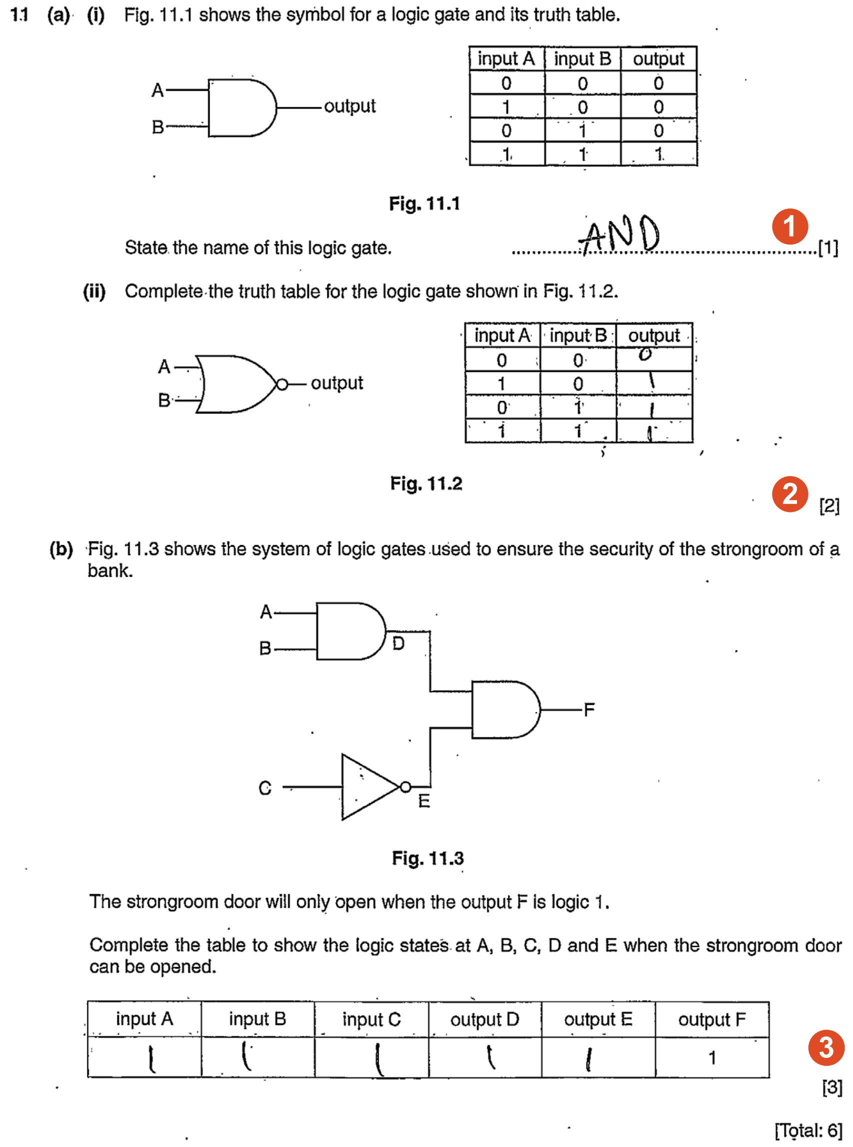
Mark awarded for (b) = 2 out of 3

Total mark awarded = 5 out of 6

How the candidate could have improved the answer

(c) The entry in the C column should be zero.

Example Candidate Response – middle



11 (a) (i) Fig. 11.1 shows the symbol for a logic gate and its truth table.

input A	input B	output
0	0	0
1	0	0
0	1	0
1	1	1

Fig. 11.1

State the name of this logic gate. ....AND.......... ① [1]

(ii) Complete the truth table for the logic gate shown in Fig. 11.2.

input A	input B	output
0	0	0
1	0	1
0	1	1
1	1	1

Fig. 11.2

② [2]

(b) Fig. 11.3 shows the system of logic gates used to ensure the security of the strongroom of a bank.

Fig. 11.3

The strongroom door will only open when the output F is logic 1.

Complete the table to show the logic states at A, B, C, D and E when the strongroom door can be opened.

input A	input B	input C	output D	output E	output F
1	1	1	1	1	1

③ [3]

[Total: 6]

Examiner comments

① The logic gate was correctly identified as an AND gate.

② The candidate either failed to recognise that the given gate as a NOR gate or could not recall the output of a NOR gate.

Mark awarded for (a) = 1 out of 3

③ There was an error in the entry in the C column of the table, the candidate having entered 1 rather than 0.

Mark awarded for (b) = 2 out of 3

Total mark awarded = 3 out of 6

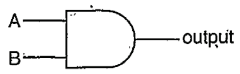
How the candidate could have improved the answer

(b) The output column numbers should be for a NOR gate, not an OR gate.

(c) The entry in the C column should be zero.

Example Candidate Response – low

11 **(a)** **(i)** Fig. 11.1 shows the symbol for a logic gate and its truth table.

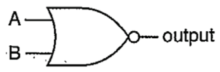


input A	input B	output
0	0	0
1	0	0
0	1	0
1	1	1

Fig. 11.1

State the name of this logic gate. ....AND........ ① [1]

(ii) Complete the truth table for the logic gate shown in Fig. 11.2.



input A	input B	output
0	0	1
1	0	1
0	1	1
1	1	0

②

Fig. 11.2

[2]

(b) Fig. 11.3 shows the system of logic gates used to ensure the security of the strongroom of a bank.

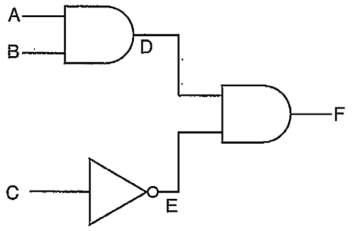


Fig. 11.3

The strongroom door will only open when the output F is logic 1.

Complete the table to show the logic states at A, B, C, D and E when the strongroom door can be opened.

input A	input B	input C	output D	output E	output F
1	1	1	0	0	1

③

[3]

[Total: 6]

Examiner comments

① There was a correct identification as the gate as an AND gate

② Two of the entries in the output column were wrong.

Mark awarded for (a) = 1 out of 3

③ The entries in the A and B columns only were correct.
The candidate clearly has poor recall of the symbols and properties of logic gates.

Mark awarded for (b) = 1 out of 3

Total mark awarded = 2 out of 6

How the candidate could have improved the answer

(b) The output column numbers should be for a NOR gate, not a NAND gate.

(c) The numbers in the C, D and E columns should be 0,1 and 1 respectively.

Common mistakes candidates made in this question

(b) Failure to identify the given gate as a NOR gate.

(c) Mistakes were fairly uncommon, but those made were most frequently made in the C column.

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Example Candidate Responses

Paper 5

Cambridge IGCSE™

Physics 0625

Version 2.0

In order to help us develop the highest quality Curriculum Support resources, we are undertaking a continuous programme of review; not only to measure the success of our resources but also to highlight areas for improvement and to identify new development needs.

We invite you to complete our survey by visiting the website below. Your comments on the quality and relevance of Cambridge Curriculum Support resources are very important to us.

https://surveymonkey.co.uk/r/GL6ZNJB

Do you want to become a Cambridge consultant and help us develop support materials?

Please follow the link below to register your interest.

http://cie.org.uk/cambridge-for/teachers/teacherconsultants/

Contents

Introduction

The main aim of this booklet is to exemplify standards for those teaching IGCSE Physics (0625), and to show how different levels of candidates' performance (high, middle and low) relate to the subject's curriculum and assessment objectives.

In this booklet candidate responses have been chosen to exemplify a range of answers. Each response is accompanied by a brief commentary explaining the strengths and weaknesses of the answers.

For each question, response is annotated with clear explanation of where and why marks were awarded or omitted. This, in turn, followed by examiner comments on how the answer could have been improved. In this way it is possible for you to understand what candidates have done to gain their marks and what they will have to do to improve their marks. At the end there is a list of common mistakes candidates made in their answers for each question.

This document provides illustrative examples of candidate work. These help teachers to assess the standard required to achieve marks, beyond the guidance of the mark scheme. Some question types where the answer is clear from the mark scheme, such as short answers and multiple choice, have therefore been omitted.

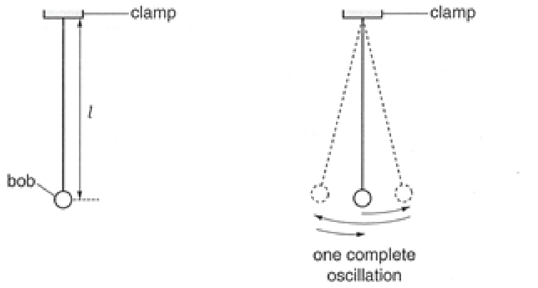
The questions, mark schemes and pre-release material used here are available to download from the School Support Hub. These files are:

Question Paper 3, June 2016	
Question paper	0625_s16_qp_31.pdf
Mark scheme	0620_s16_ms_31.pdf
Question Paper 4, June 2016	
Question paper	0620_s16_qp_41.pdf
Mark scheme	0620_s16_ms_41.pdf
Question Paper 5, November 2016	
Question paper	0620_w16_qp_52.pdf
Mark scheme	0620_w16_ms_52.pdf
Question Paper 6, June 2016	
Question paper	0620_s16_qp_61.pdf
Mark scheme	0620_s16_ms_61.pdf

Other past papers, Examiner Reports and other teacher support materials are available on the School Support Hub at www.cambridgeinternational.org/support

How to use this booklet

Example Candidate Response – high	Examiner comments
1 In this experiment, you will use a pendulum to determine a value for the acceleration of free fall *g*. Carry out the following instructions, referring to Figs. 1.1 and 1.2.	



Answers by real candidates in exam conditions. These show you the types of answers for each level.

Discuss and analyse the answers with your learners in the classroom to improve their skills.

measured to the centre of the

hen measuring the length *l*.

along the

el eye

Examiner annotations: Each response is annotated with clear explanation of where and why marks were awarded or omitted. In this way it is possible for you to understand what candidates have done to gain their marks.

① The candidate shows understanding of perpendicular viewing of the scale on the metre rule.

How the candidate could have improved the answer

(d) (ii) The candidate could have suggested two

experiment using different lengths, repeating the

repeating the timing of the 20 oscillations several

that merely suggesting repeats, without specifyin

Examiner comments This explains how the candidate could have improved the answer. This helps you to interpret the standard of Cambridge exams and helps your learners to refine exam technique.

Common mistakes candidates made in this question

The most common mistakes were to miss the unit

equation in part **(c) (ii)** and not to be able to sugges

Common mistakes a list of common mistakes candidates made in their answers for each question.

Assessment at a glance

All candidates take three papers.

Candidates who have studied the Core subject content, or who are expected to achieve a grade D or below, should be entered for Paper 1, Paper 3 and either Paper 5 or Paper 6. These candidates will be eligible for grades C to G.

Candidates who have studied the Extended subject content (Core and Supplement), and who are expected to achieve a grade C or above, should be entered for Paper 2, Paper 4 and either Paper 5 or Paper 6. These candidates will be eligible for grades A* to G.

Core candidates take:	**Extended candidates take:**
Paper 1 45 minutes	**Paper 2** 45 minutes
Multiple Choice 30%	Multiple Choice 30%
40 marks	40 marks
40 four-choice multiple-choice questions	40 four-choice multiple-choice questions
Questions will be based on the Core subject content	Questions will be based on the Extended subject content (Core and Supplement)
Assessing grades C–G	Assessing grades A*–G
Externally assessed	Externally assessed

and Core candidates take:	**and Extended candidates take:**
Paper 3 1 hour 15 minutes	**Paper 4** 1 hour 15 minutes
Theory 50%	Theory 50%
80 marks	80 marks
Short-answer and structured questions	Short-answer and structured questions
Questions will be based on the Core subject content	Questions will be based on the Extended subject content (Core and Supplement)
Assessing grades C–G	Assessing grades A*–G
Externally assessed	Externally assessed

All candidates take either:	**or:**
Paper 5 1 hour 15 minutes	**Paper 6** 1 hour
Practical Test 20%	Alternative to Practical 20%
40 marks	40 marks
Questions will be based on the experimental skills in Section 4	Questions will be based on the experimental skills in Section 4
Assessing grades A*–G	Assessing grades A*–G
Externally assessed	Externally assessed

Teachers are reminded that the latest syllabus is available on our public website at www.cambridgeinternational.org and the School Support Hub at www.cambridgeinternational.org/support

Paper 5 – Practical Test

Question 1

Example candidate response – high

1 In this experiment, you will use a pendulum to determine a value for the acceleration of free fall *g*.

Carry out the following instructions, referring to Figs. 1.1 and 1.2.

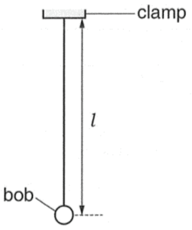


Fig. 1.1

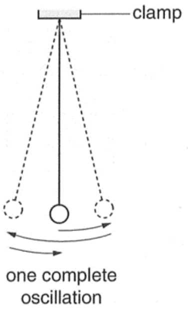


Fig. 1.2

A pendulum has been set up for you as shown in Fig. 1.1.

(a) Adjust the pendulum until its length $l = 50.0$ cm. The length l is measured to the centre of the bob.

Explain briefly how you avoided a parallax (line of sight) error when measuring the length l.

Place the meter rule vertically along the pendelum and horizontally level eye with the 50 cm mark and 0cm mark when measuring length of L. ① [1]

(b) Displace the pendulum bob slightly and release it so that it swings. Fig. 1.2 shows one complete oscillation of the pendulum.

(i) Measure the time t for 20 complete oscillations.

$t =$ 28.3 s ② [1]

(ii) Calculate the period T of the pendulum. The period is the time for one complete oscillation.

$\frac{28.3}{20} = 1.415$

$= 1.42$s

$T =$ 1.42 s ③ [2]

Examiner comments

① The candidate shows understanding of perpendicular viewing of the scale on the metre rule.

Mark awarded for (a) = 1 out of 1

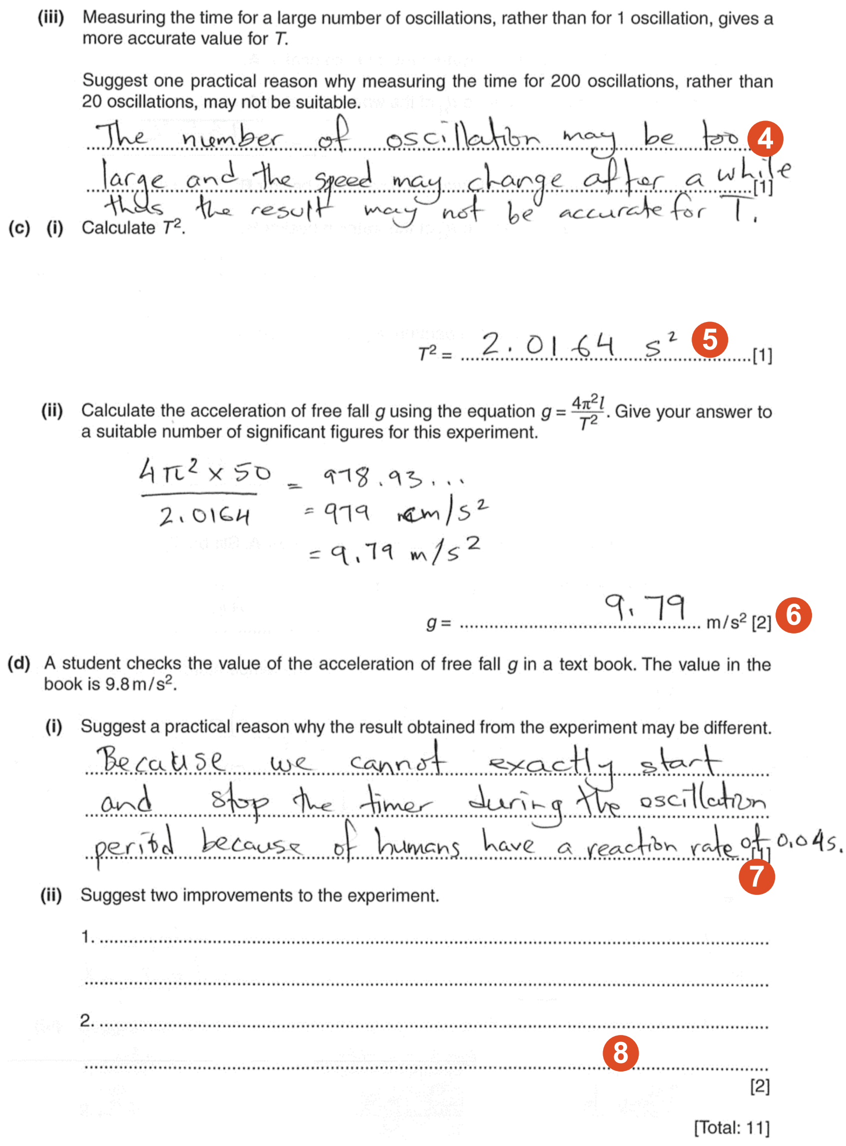
② The time *t* is within the tolerance allowed, showing that the candidate has followed the instructions carefully, adjusting the pendulum to the required length and counting the correct number of oscillations.

Mark awarded for (b) (i) = 1 out of 1

③ The calculation is correct and the unit *s* is used.

Mark awarded for (b) (ii) = 2 out of 2

Example candidate response – high, continued



(iii) Measuring the time for a large number of oscillations, rather than for 1 oscillation, gives a more accurate value for *T*.

Suggest one practical reason why measuring the time for 200 oscillations, rather than 20 oscillations, may not be suitable.

The number of oscillation may be too large and the speed may change after a while thus the result may not be accurate for T. ④ [1]

(c) **(i)** Calculate T^2.

T^2 = 2.0164 s^2 ⑤ [1]

(ii) Calculate the acceleration of free fall *g* using the equation $g = \frac{4\pi^2 l}{T^2}$. Give your answer to a suitable number of significant figures for this experiment.

$\frac{4\pi^2 \times 50}{2.0164} = 978.93...$

$= 979$ ~~cm~~ m/s^2

$= 9.79\ m/s^2$

g = 9.79 m/s² [2] ⑥

(d) A student checks the value of the acceleration of free fall *g* in a text book. The value in the book is 9.8 m/s².

(i) Suggest a practical reason why the result obtained from the experiment may be different.

Because we cannot exactly start and stop the timer during the oscillation period because of humans have a reaction rate of 0.04s. [1] ⑦

(ii) Suggest two improvements to the experiment.

1. ....

2. .... ⑧

[2]

[Total: 11]

Examiner comments

④ The candidate makes a sensible suggestion. Note that the suggestion in this case does not necessarily have to be theoretically correct since that would require knowledge beyond the core curriculum.

Mark awarded for (b) (iii) = 1 out of 1

⑤ The candidate shows attention to detail and good understanding of units, giving *s*² for the unit of *T*².

Mark awarded for (c) (i) = 1 out of 1

⑥ The candidate shows good attention to detail, converting from *cm*/s² to *m*/s² to arrive at a value, given to three significant figures, within the tolerance allowed.

Mark awarded for (c) (ii) = 2 out of 2

⑦ The candidate correctly identifies a possible reason related to reaction time.

Mark awarded for (d) (i) = 1 out of 1

⑧ The candidate does not suggest any improvements.

Mark awarded for (d) (ii) = 0 out of 2

Total mark awarded = 9 out of 11

How the candidate could have improved the answer

(d) (ii) The candidate could have suggested two possible improvements. For example, repeating the experiment using different lengths, repeating the experiment using an increased number of oscillations, repeating the timing of the 20 oscillations several times and taking an average, using a fiducial marker. No credit is given for simply suggesting repeats without specifying details.

Example candidate response – middle

1 In this experiment, you will use a pendulum to determine a value for the acceleration of free fall *g*.

Carry out the following instructions, referring to Figs. 1.1 and 1.2.

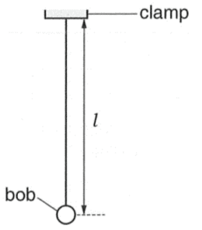


Fig. 1.1

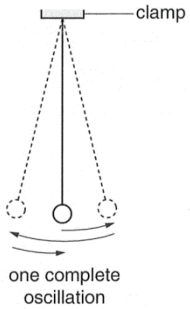


Fig. 1.2

A pendulum has been set up for you as shown in Fig. 1.1.

(a) Adjust the pendulum until its length l = 50.0 cm. The length l is measured to the centre of the bob.

Explain briefly how you avoided a parallax (line of sight) error when measuring the length l.

View the ruler at right angles ① [1]

(b) Displace the pendulum bob slightly and release it so that it swings. Fig. 1.2 shows one complete oscillation of the pendulum.

(i) Measure the time *t* for 20 complete oscillations.

② *t* = 28 ~~15~~ seconds [1]

(ii) Calculate the period *T* of the pendulum. The period is the time for one complete oscillation.

$\cancel{\frac{20}{15}} = \cancel{1.333...}$

$\frac{28}{20} = 1.4$

③ *T* = 1.4 ~~1.33~~ seconds [2]

Examiner comments

① The candidate shows understanding of perpendicular viewing of the scale on the metre rule.

Mark awarded for (a) = 1 out of 1

② The time *t* is within the tolerance allowed. This shows the candidate has followed the instructions carefully, adjusting the pendulum to the required length and counting the correct number of oscillations.

Mark awarded for (b) (i) = 1 out of 1

③ The calculation is correct and the unit *s* is used.

Mark awarded for (b) (ii) = 2 out of 2

Example candidate response – middle, continued	Examiner comments
(iii) Measuring the time for a large number of oscillations, rather than for 1 oscillation, gives a more accurate value for *T*. Suggest one practical reason why measuring the time for 200 oscillations, rather than 20 oscillations, may not be suitable. It will take too long ~~and~~ to measure the time for 200 oscillations ④ [1]	④ This is too vague to score a mark. Mark awarded for (b) (iii) = 0 out of 1
(c) (i) Calculate T^2. 1.777. . . . T^2 = 1.96 ~~1.78 seconds~~ ⑤ [1]	⑤ The candidate does not give the unit s^2. Mark awarded for (c) (i) = 0 out of 1
(ii) Calculate the acceleration of free fall *g* using the equation $g = \frac{4\pi^2 l}{T^2}$. Give your answer to a suitable number of significant figures for this experiment. $\frac{4 \times \pi^2 \times \overset{0.5}{\cancel{50}}}{1.78^2}$ = ~~110.336~~ ~~84.5~~ ~~11.10386~~ ~~108.944515~~ = 10.07 *g* = 10.1 ~~1109~~ ~~11.1~~ m/s² ⑥ [2]	⑥ The candidate shows good attention to detail using 0.5 *m* rather than 50 *cm* to arrive at a value, given to three significant figures, within the tolerance allowed. Mark awarded for (c) (ii) = 2 out of 2
(d) A student checks the value of the acceleration of free fall *g* in a text book. The value in the book is 9.8 m/s². **(i)** Suggest a practical reason why the result obtained from the experiment may be different. There was no air resistance accounted for in my results ⑦ [1]	⑦ The candidate does not identify a good practical reason. Mark awarded for (d) (i) = 0 out of 1
(ii) Suggest two improvements to the experiment. 1. Repeat the experiment to get the average 2. Measure the length from centre of bob ⑧ [2] [Total: 11]	⑧ The candidate does not suggest suitable improvements. Mark awarded for (d) (ii) = 0 out of 2 **Total mark awarded = 6 out of 11**

How the candidate could have improved the answer

(c) (i) The candidate should have included a unit and worked out that since the unit of time is *s*, the unit of a time squared must be s^2.

(b) (iii) and **(d) (i)** and **(ii)** The candidate could have used the experience of practical work gained during the IGCSE course to carefully consider the experiment and suggest suitable practical reasons for the difficulty in recording a very large number of oscillations, the experimental result being different to the accepted value and improvements to the experiment.

Example candidate response – low

1 In this experiment, you will use a pendulum to determine a value for the acceleration of free fall *g*.

Carry out the following instructions, referring to Figs. 1.1 and 1.2.

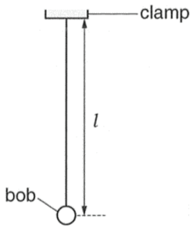


Fig. 1.1

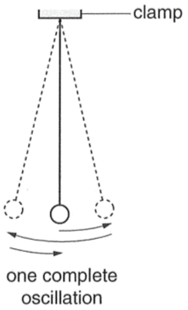


Fig. 1.2

A pendulum has been set up for you as shown in Fig. 1.1.

(a) Adjust the pendulum until its length l = 50.0 cm. The length l is measured to the centre of the bob.

Explain briefly how you avoided a parallax (line of sight) error when measuring the length l.

I used a ruler to align the middle of the bob to the rule of measurement as this would avoid error. ① [1]

(b) Displace the pendulum bob slightly and release it so that it swings. Fig. 1.2 shows one complete oscillation of the pendulum.

(i) Measure the time *t* for 20 complete oscillations.

② t = 37.0 seconds. [1]

(ii) Calculate the period T of the pendulum. The period is the time for one complete oscillation.

$$\frac{37.0\text{ se}}{20}$$

③ T = 1.85 [2]

Examiner comments

① The candidate writes just enough to convey the idea of using a horizontal straight edge.

Mark awarded for (a) (i) = 1 out of 1

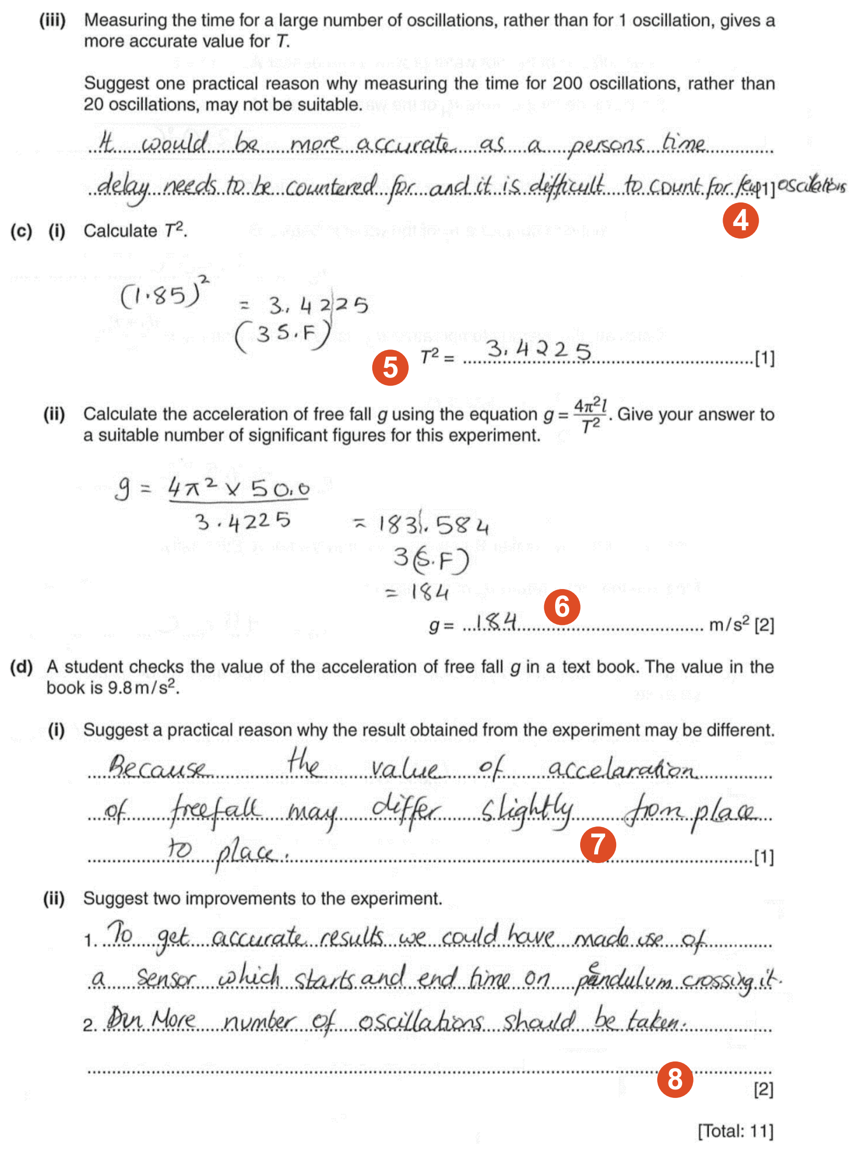
② The time *t* is beyond the tolerance allowed, showing that the candidate has either adjusted the pendulum to the wrong length or counted the wrong number of oscillations.

Mark awarded for (b) (i) = 0 out of 1

③ The calculation is correct but the unit *s* is missing.

Mark awarded for (b) (ii) = 1 out of 2

Example candidate response – low, continued



(iii) Measuring the time for a large number of oscillations, rather than for 1 oscillation, gives a more accurate value for *T*.

Suggest one practical reason why measuring the time for 200 oscillations, rather than 20 oscillations, may not be suitable.

It would be more accurate as a persons time delay needs to be countered for and it is difficult to count for few oscillations [1]

④

(c) (i) Calculate T^2.

$(1{\cdot}85)^2 = 3.4225$ (3 S.F)

⑤ $T^2 =$ 3.4225 [1]

(ii) Calculate the acceleration of free fall *g* using the equation $g = \frac{4\pi^2 l}{T^2}$. Give your answer to a suitable number of significant figures for this experiment.

$$g = \frac{4\pi^2 \times 50.0}{3.4225} = 183.584$$

3(S.F)

= 184

$g =$ 184 ⑥ m/s^2 [2]

(d) A student checks the value of the acceleration of free fall *g* in a text book. The value in the book is $9.8\,m/s^2$.

(i) Suggest a practical reason why the result obtained from the experiment may be different.

Because the value of accelaration of freefall may differ slightly from place to place. ⑦ [1]

(ii) Suggest two improvements to the experiment.

1. To get accurate results we could have made use of a sensor which starts and end time on pendulum crossing it.
2. Dn More number of oscillations should be taken.

⑧ [2]

[Total: 11]

Examiner comments

④ The candidate does not give a valid practical reason.

Mark awarded for (b) (iii) = 0 out of 1

⑤ The unit s^2 is missing.

Mark awarded for (c) (i) = 0 out of 1

⑥ The value is outside the tolerance allowed but it is given to a sensible three significant figures.

Mark awarded for (c) (ii) = 1 out of 2

⑦ The candidate does not give a valid practical reason.

Mark awarded for (d) (i) = 0 out of 1

⑧ The candidate gives one suitable suggestion.

Mark awarded for (d) (ii) = 1 out of 2

Total mark awarded = 4 out of 11

How the candidate could have improved the answer

The candidate could have paid more attention to the details of the experiment in order to obtain a value of *t* within tolerance and to use correct units throughout.

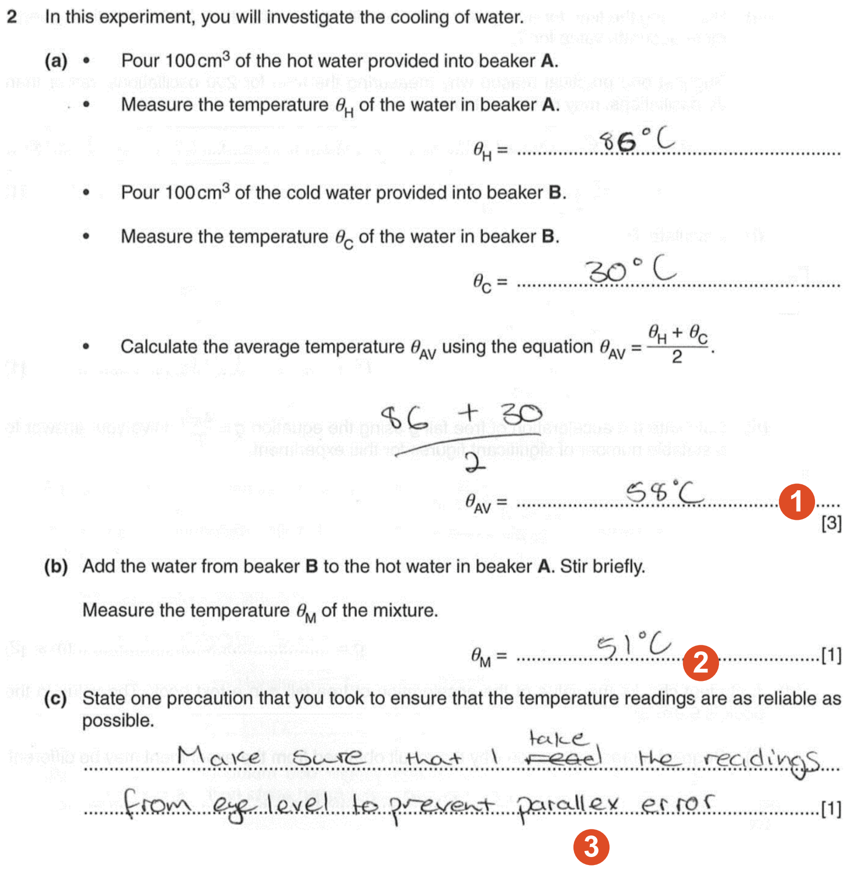
(b) (iii) and **(d) (i)** and **(ii)** The candidate could have used the experience of practical work gained during the IGCSE course to carefully consider the experiment and suggest suitable practical reasons for the difficulty in recording a very large number of oscillations, the experimental result being different to the accepted value.

Common mistakes candidates made in this question

- Missing the unit s^2 for T^2 (or using s).
- **(c) (ii)**.Using 50 cm instead of 0.5 *m* in the equation.
- **(d) (ii)** Being unable to suggest suitable improvements to the experiment.

Question 2

Example candidate response – high	Examiner comments



2 In this experiment, you will investigate the cooling of water.

(a)
- Pour 100 cm^3 of the hot water provided into beaker **A**.
- Measure the temperature θ_H of the water in beaker **A**.

θ_H = 86°C

- Pour 100 cm^3 of the cold water provided into beaker **B**.
- Measure the temperature θ_C of the water in beaker **B**.

θ_C = 30°C

- Calculate the average temperature θ_{AV} using the equation $\theta_{AV} = \frac{\theta_H + \theta_C}{2}$.

$$\frac{86 + 30}{2}$$

θ_{AV} = 58°C ① [3]

(b) Add the water from beaker **B** to the hot water in beaker **A**. Stir briefly.

Measure the temperature θ_M of the mixture.

θ_M = 51°C ② [1]

(c) State one precaution that you took to ensure that the temperature readings are as reliable as possible.

Make sure that I ~~feel~~ take the recidings from eye level to prevent parallex error [1]

③

Examiner comments

① The candidate records temperature values within tolerance and correctly calculates the average temperature. The correct unit °C is used throughout.

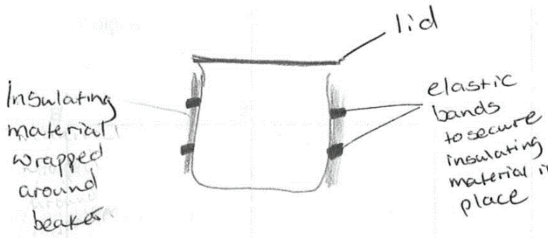
Mark awarded for (a) = 3 out of 3

② The candidate records a temperature for the mixture that is within tolerance.

Mark awarded for (b) = 1 out of 1

③ The candidate's wording is just sufficient to convey the idea of perpendicular viewing of the thermometer scale.

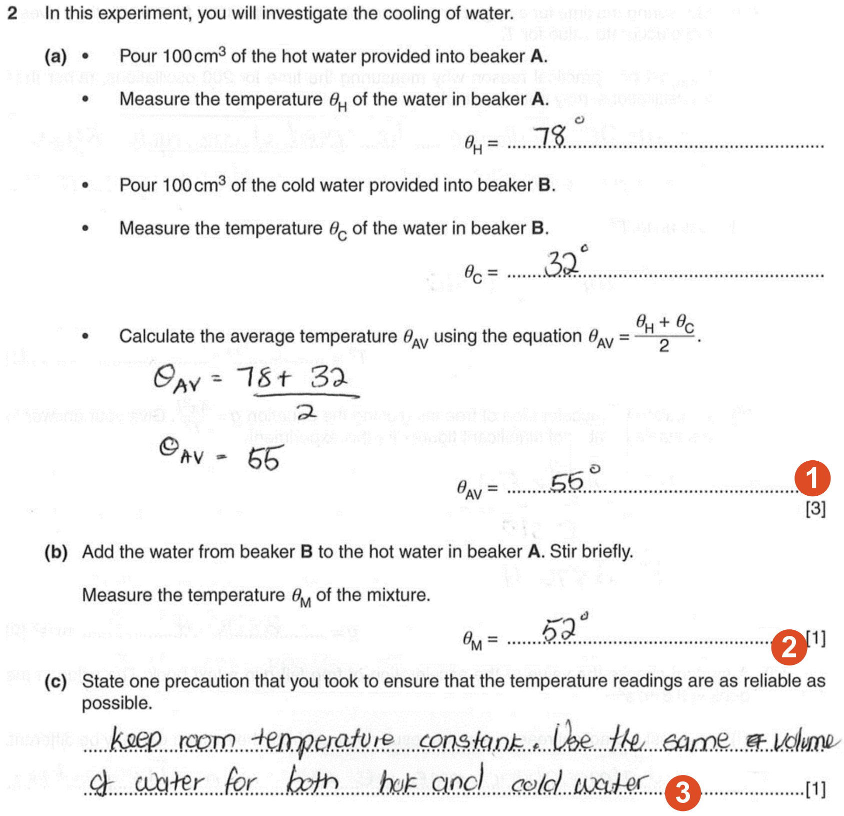
Mark awarded for (c) = 1 out of 1

Example candidate response – high, continued	Examiner comments
(d) Empty both beakers. You are provided with • a lid, with a hole for the thermometer, • some insulating material, • two elastic bands. **(i)** In the space below, draw a labelled diagram to show how you will use these items to reduce the loss of thermal energy when the procedure is repeated.  ④ [2]	④ The diagram is clear. Mark awarded for (d) (i) = 2 out of 2
(ii) Using the improvements shown in your diagram, repeat the procedure in parts **(a)** and **(b)**. θ_H = ~~62~~° 73°C θ_C = 31°C θ_{AV} = 52°C θ_M = 50°C ⑤ [1]	⑤ The candidate records a realistic set of readings. Mark awarded for (d) (ii) = 1 out of 1
(iii) Comment on whether the improvements made to the apparatus have significantly changed the value of the temperature θ_M. Use your results to justify your answer. ~~No~~ The value of θM has not significantly changed, because there is only a 1°C difference between both experiments ⑥ [1]	⑥ The candidate makes a clear statement and justifies it by reference to the results, correctly quoting the difference in the two values for θ_M. Mark awarded for (d) (iii) = 1 out of 1
(iv) Suggest two conditions that should be kept constant for all parts of this experiment. 1. The amount of water used 2. The ~~external~~ room ~~environment~~ temperature must be maintained [2] ⑦ [Total: 11]	⑦ The candidate gives two conditions that should be kept constant. Mark awarded for (d) (iv) = 2 out of 2 **Total mark awarded = 11 out of 11**

How the candidate could have improved the answer

This answer gained full marks. However, the answer to **(c)** includes the rather vague phrase ‘from eye level’. This would be more clearly expressed as ‘view the thermometer scale perpendicularly’ or similar wording.

Example candidate response – middle



2 In this experiment, you will investigate the cooling of water.

(a) • Pour 100 cm^3 of the hot water provided into beaker **A**.

• Measure the temperature θ_H of the water in beaker **A**.

θ_H = 78°

• Pour 100 cm^3 of the cold water provided into beaker **B**.

• Measure the temperature θ_C of the water in beaker **B**.

θ_C = 32°

• Calculate the average temperature θ_{AV} using the equation $\theta_{AV} = \frac{\theta_H + \theta_C}{2}$.

$$\theta_{AV} = \frac{78 + 32}{2}$$

$$\theta_{AV} = 55$$

θ_{AV} = 55° ① [3]

(b) Add the water from beaker **B** to the hot water in beaker **A**. Stir briefly.

Measure the temperature θ_M of the mixture.

θ_M = 52° ② [1]

(c) State one precaution that you took to ensure that the temperature readings are as reliable as possible.

keep room temperature constant. Use the same volume of water for both hot and cold water ③ [1]

Examiner comments

① The candidate records temperature values within tolerance and correctly calculates the average temperature. An incorrect unit ° is used throughout.

Mark awarded for (a) = 2 out of 3

② The candidate records a temperature for the mixture that is within tolerance.

Mark awarded for (b) = 1 out of 1

③ The candidate does not answer the question. (This answer would have scored both marks if given for d (iv)).

Mark awarded for (c) = 0 out of 1

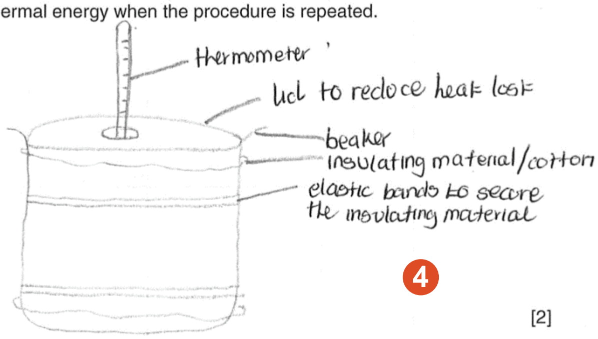
Example candidate response –middle, continued

(d) Empty both beakers.

You are provided with

- a lid, with a hole for the thermometer,
- some insulating material,
- two elastic bands.

(i) In the space below, draw a labelled diagram to show how you will use these items to reduce the loss of thermal energy when the procedure is repeated.



[2]

(ii) Using the improvements shown in your diagram, repeat the procedure in parts **(a)** and **(b)**.

θ_H = 77°

θ_C = 32°

θ_{AV} = 54.5°

θ_M = 56° ⑤

[1]

(iii) Comment on whether the improvements made to the apparatus have significantly changed the value of the temperature θ_M. Use your results to justify your answer.

$\frac{56-52}{56} \times 100 = 7.14\%$, ~~Yes it has~~ ~~No it has~~

Yes it has changed the value, because it ~~it chang~~ increased by 4° from 52° to 56° ⑥ [1]

(iv) Suggest two conditions that should be kept constant for all parts of this experiment.

1. Initial temperature

2. room temperature ⑦

[2]

[Total: 11]

Examiner comments

④ The diagram is clear.

Mark awarded for (d) (i) = 2 out of 2

⑤ The candidate records a realistic set of readings.

Mark awarded for (d) (ii) = 1 out of 1

⑥ The candidate identifies the change in value but does not state whether or not the change is significant.

Mark awarded for (d) (iii) = 0 out of 1

⑦ The candidate gives one condition that should be kept constant.

Mark awarded for (d) (iv) = 1 out of 2

Total mark awarded = 7 out of 11

How the candidate could have improved the answer

The candidate needed to use the correct temperature unit, °C, not simply ° which is the unit of angle.

(c) The candidate should have read the question more carefully. The response given would have scored two marks had it been given as the answer to **(d) (iv)**.

(d) (iii) The candidate should have stated that the change is significant, not merely stating that there is a change.

(d) (iv) The candidate should have specified that the initial temperature referred to is of either the hot water or the cold water (or both).

Common mistakes candidates made in this question

- **(d) (iii)** and **(iv)** Giving vague answers.

Question 3

Example candidate response – high	Examiner comments
3 In this experiment, you will investigate refraction using a transparent block. Carry out the following instructions, using the separate ray-trace sheet provided. You may refer to Fig. 3.1 for guidance.	

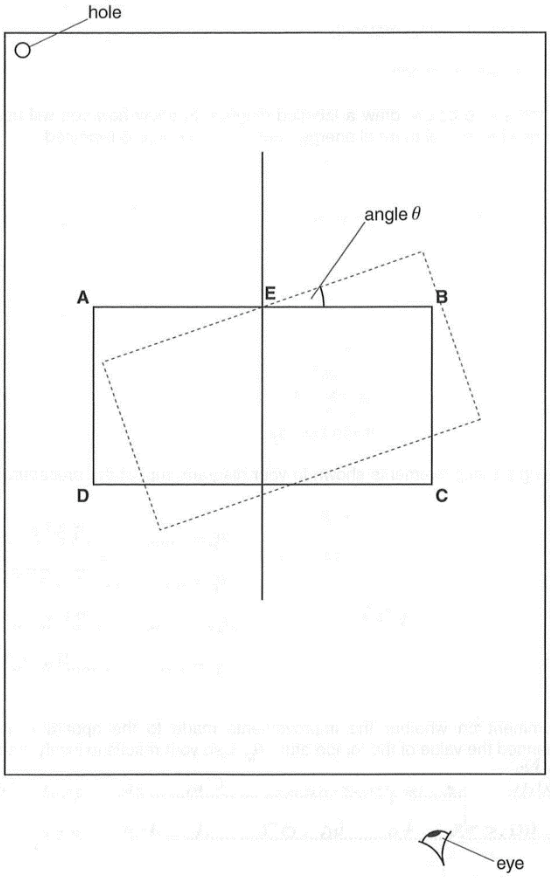
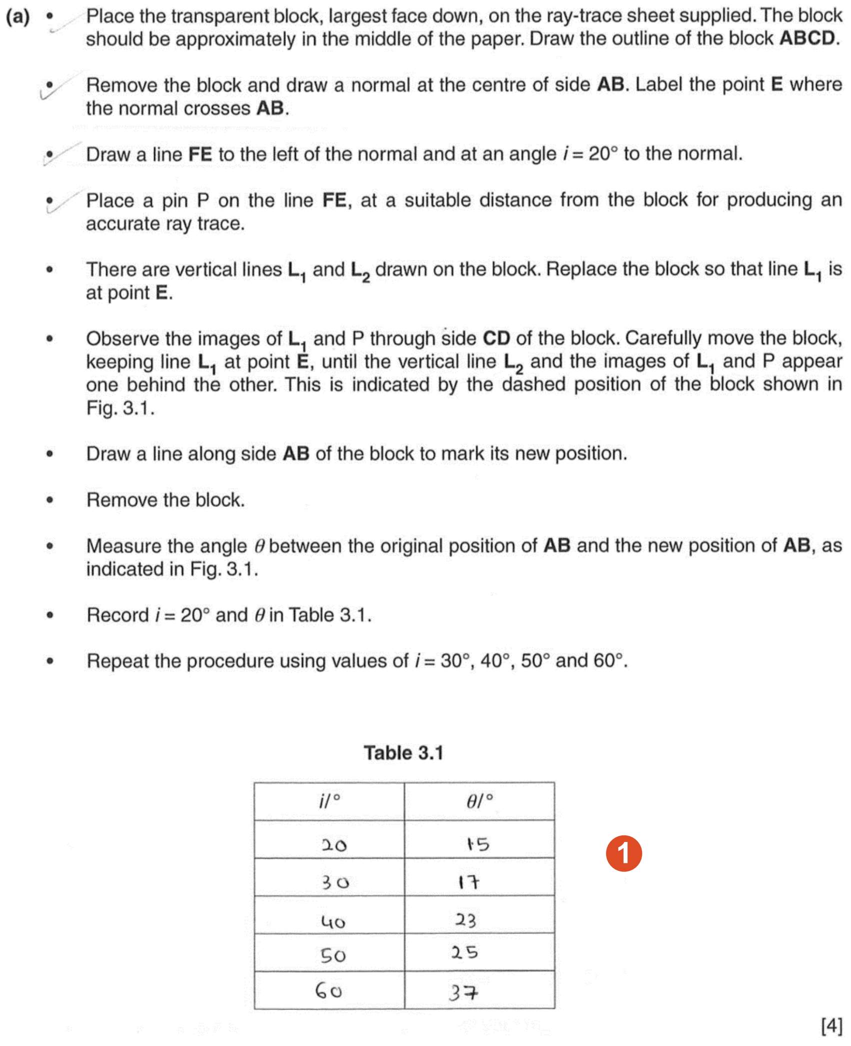


Fig. 3.1

Example candidate response – high, continued



(a)
- Place the transparent block, largest face down, on the ray-trace sheet supplied. The block should be approximately in the middle of the paper. Draw the outline of the block **ABCD**.
- Remove the block and draw a normal at the centre of side **AB**. Label the point **E** where the normal crosses **AB**.
- Draw a line **FE** to the left of the normal and at an angle i = 20° to the normal.
- Place a pin P on the line **FE**, at a suitable distance from the block for producing an accurate ray trace.
- There are vertical lines $\mathbf{L_1}$ and $\mathbf{L_2}$ drawn on the block. Replace the block so that line $\mathbf{L_1}$ is at point **E**.
- Observe the images of $\mathbf{L_1}$ and P through side **CD** of the block. Carefully move the block, keeping line $\mathbf{L_1}$ at point **E**, until the vertical line $\mathbf{L_2}$ and the images of $\mathbf{L_1}$ and P appear one behind the other. This is indicated by the dashed position of the block shown in Fig. 3.1.
- Draw a line along side **AB** of the block to mark its new position.
- Remove the block.
- Measure the angle θ between the original position of **AB** and the new position of **AB**, as indicated in Fig. 3.1.
- Record i = 20° and θ in Table 3.1.
- Repeat the procedure using values of i = 30°, 40°, 50° and 60°.

Table 3.1

i/°	θ/°
20	15
30	17
40	23
50	25
60	37

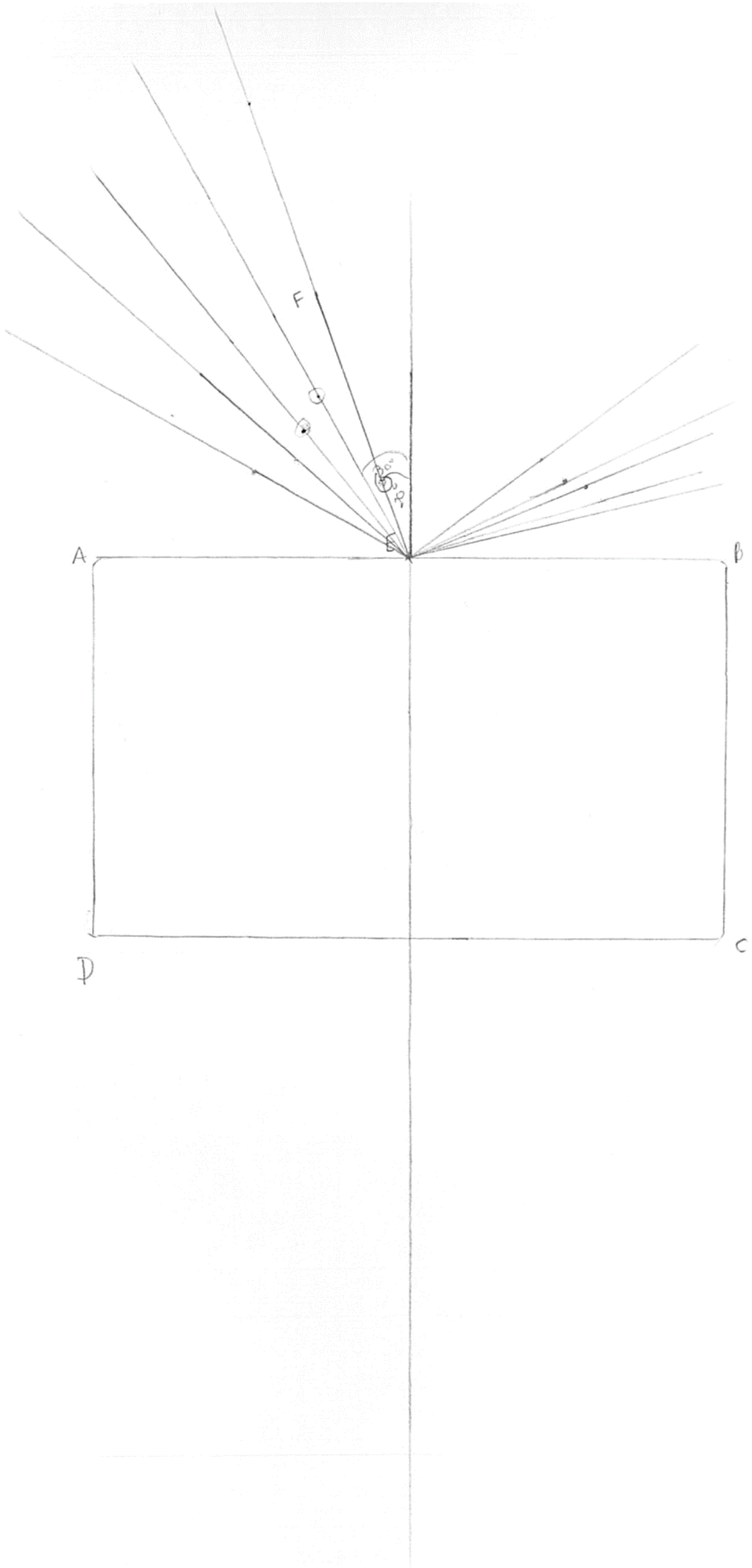
①

[4]

Examiner comments

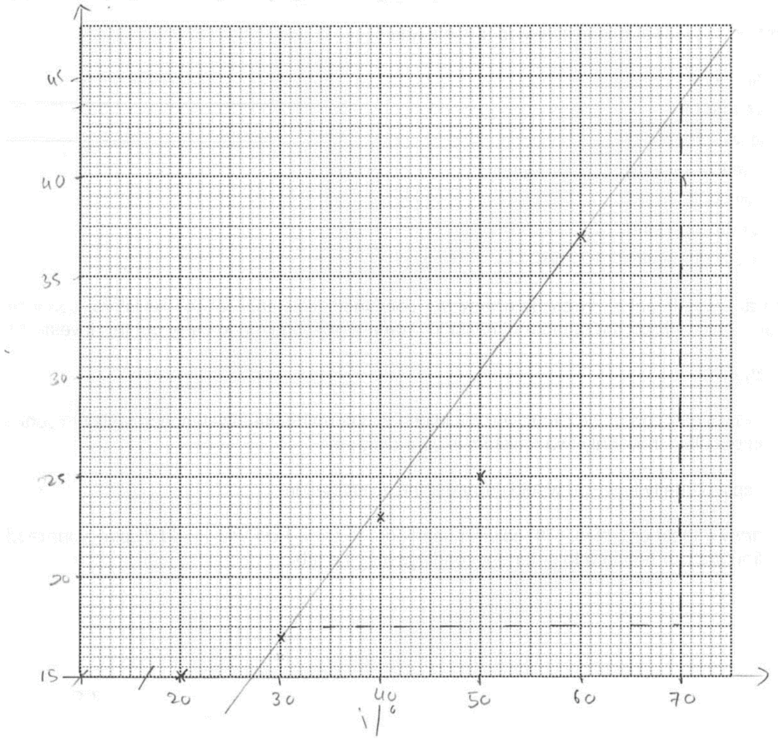
① The ray-trace is carefully drawn and shows the rays correctly positioned with the first position for pin P about 8 cm from **E**. The candidate has sensibly placed the pin a large distance from the block. The angles recorded are within the tolerance allowed, showing that the candidate has used the protractor correctly. Some of the values show that the candidate has not carried out the experiment quite as accurately as required.

Mark awarded for (a) = 3 out of 4

Example candidate response – high, continued	Examiner comments
	

Example candidate response – high, continued

(b) Plot a graph of *θ*/° (*y*-axis) against *i*/° (*x*-axis).



②

[4]

(c) Determine the gradient *G* of the graph. Show clearly on the graph how you obtained the necessary information.

$g = \frac{v}{h}$ $= 0.6666..7..$

$= \frac{43.5 - 17.5}{70 - 31}$

G = 0.667 ③ [2]

(d) Referring to your graph, comment on the quality of your measurements.

The measurements are not very accurate because they is no equal distribution of point on line of best fit. [1]

Tie your ray-trace sheet into this Booklet between pages 8 and 9. ④

[Total: 11]

Examiner comments

② The graph axes are correctly set up with suitable scales and labelling. The plots are correctly positioned. The mark for the best-fit line is awarded because the candidate draws a sensible line although the results have produced a large scatter.

Mark awarded for (b) = 4 out of 4

③ The candidate draws a large triangle but the value obtained for the gradient is outside the tolerance allowed.

Mark awarded for (c) = 1 out of 2

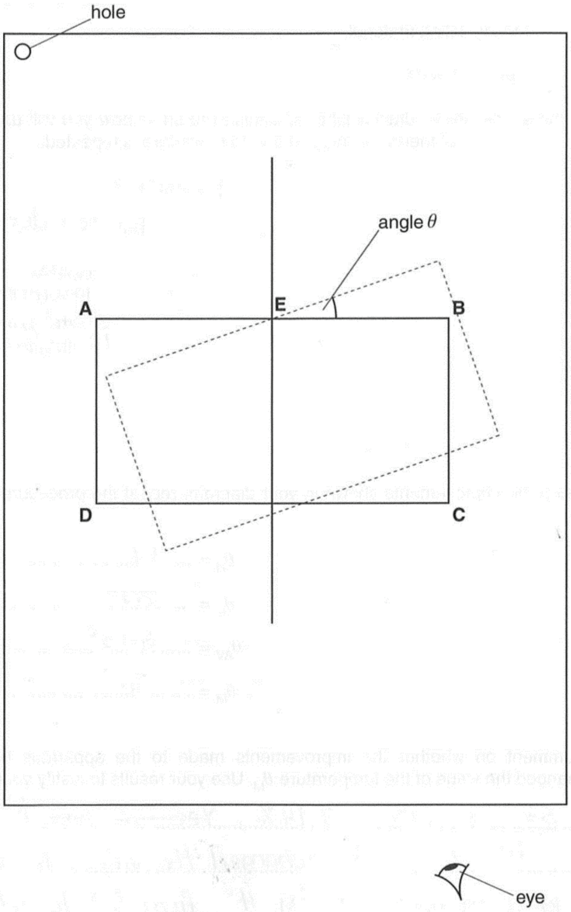
④ The candidate successfully conveys the idea of the large scatter of plots around the best-fit line indicating the poor quality of the measurements.

Mark awarded for (d) = 1 out of 1

Total mark awarded = 9 out of 11

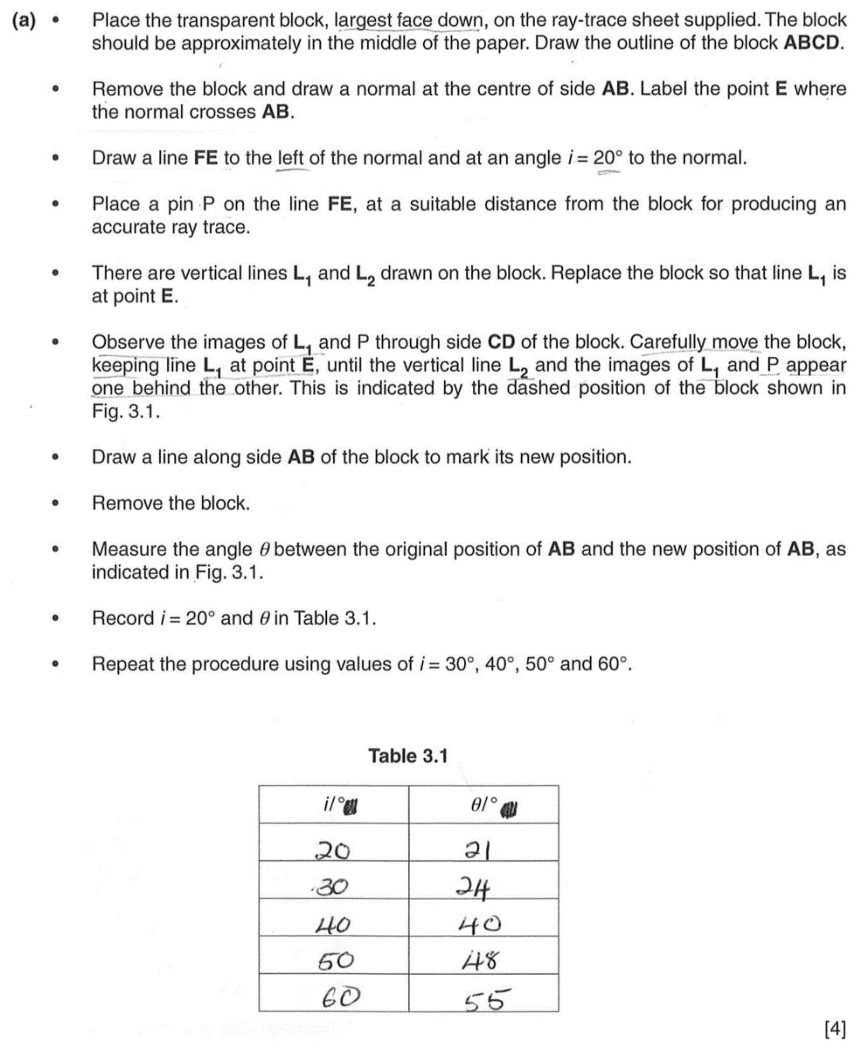
How the candidate could have improved the answer

The candidate needed to take more care lining up the pin and the lines on the block and keeping the block in the correct position in order to obtain accurate values for the angle *θ*.

Example candidate response – middle	Examiner comments
3 In this experiment, you will investigate refraction using a transparent block. Carry out the following instructions, using the separate ray-trace sheet provided. You may refer to Fig. 3.1 for guidance.  **Fig. 3.1**	

Example candidate response – middle, continued

Examiner comments

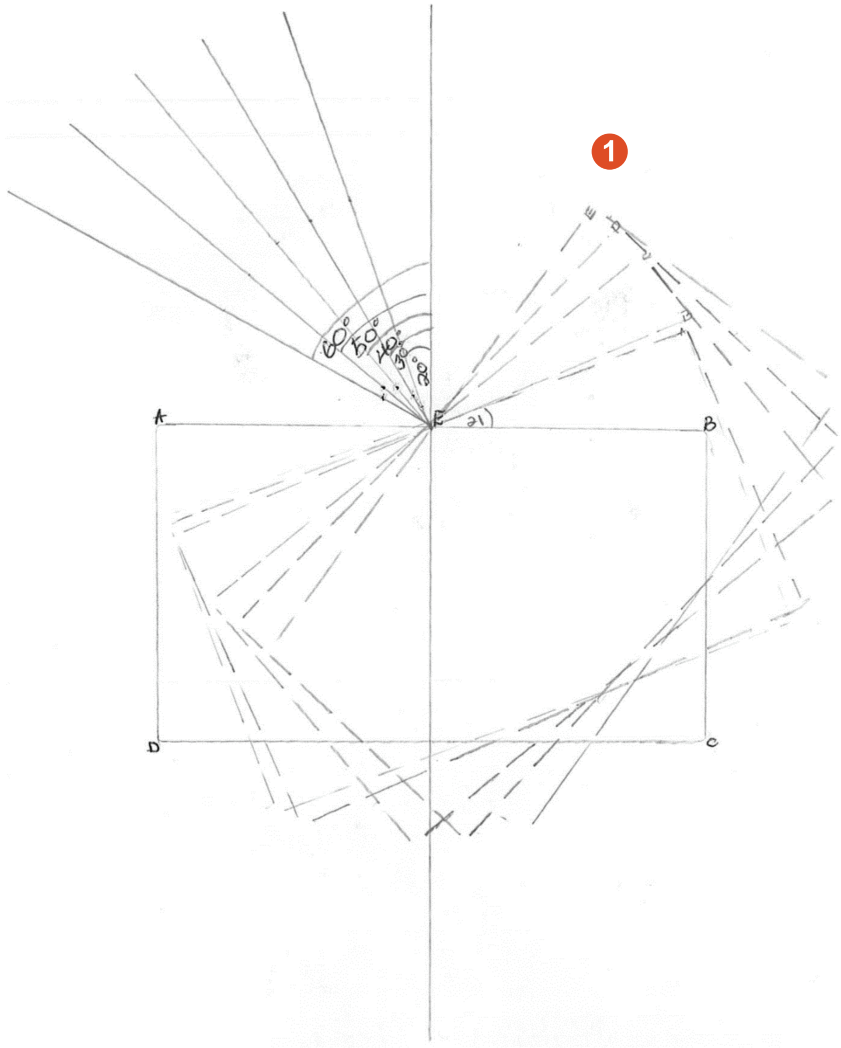


(a)
- Place the transparent block, largest face down, on the ray-trace sheet supplied. The block should be approximately in the middle of the paper. Draw the outline of the block **ABCD**.
- Remove the block and draw a normal at the centre of side **AB**. Label the point **E** where the normal crosses **AB**.
- Draw a line **FE** to the left of the normal and at an angle $i = 20°$ to the normal.
- Place a pin P on the line **FE**, at a suitable distance from the block for producing an accurate ray trace.
- There are vertical lines $\mathbf{L_1}$ and $\mathbf{L_2}$ drawn on the block. Replace the block so that line $\mathbf{L_1}$ is at point **E**.
- Observe the images of $\mathbf{L_1}$ and P through side **CD** of the block. Carefully move the block, keeping line $\mathbf{L_1}$ at point **E**, until the vertical line $\mathbf{L_2}$ and the images of $\mathbf{L_1}$ and P appear one behind the other. This is indicated by the dashed position of the block shown in Fig. 3.1.
- Draw a line along side **AB** of the block to mark its new position.
- Remove the block.
- Measure the angle θ between the original position of **AB** and the new position of **AB**, as indicated in Fig. 3.1.
- Record $i = 20°$ and θ in Table 3.1.
- Repeat the procedure using values of $i = 30°$, 40°, 50° and 60°.

Table 3.1

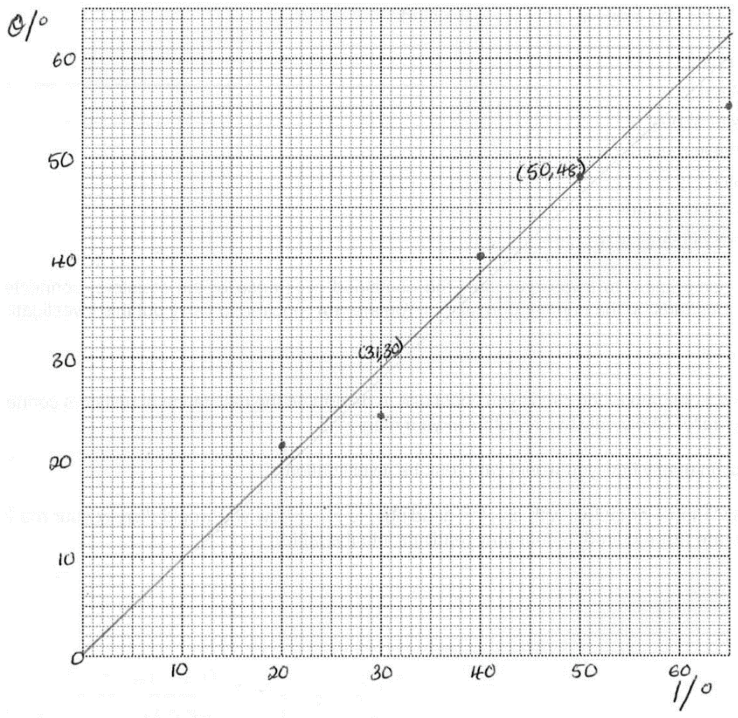
i/°	θ/°
20	21
30	24
40	40
50	48
60	55

[4]

Example candidate response – middle, continued	Examiner comments
	1 The ray-trace is carefully drawn and shows the rays correctly positioned with the first position for pin P at least 5 cm from **E**. The angles recorded are within the tolerance allowed, showing that the candidate has used the protractor correctly. Some of the values show that the candidate has not carried out the experiment quite as accurately as required. Mark awarded for (a) = 3 out of 4

Example candidate response – middle, continued

(b) Plot a graph of θ/° (y-axis) against i/° (x-axis).



②

[4]

(c) Determine the gradient G of the graph. Show clearly on the graph how you obtained the necessary information.

$(31, 30)$ $(50, 48)$

x_1 y_1 x_2 y_2

$$G = \frac{x_2 - x_1}{y_2 - y_1} = \frac{50-31}{48-30} = 1.0555$$

$G =$ 1.06 ③ [2]

(d) Referring to your graph, comment on the quality of your measurements.

Accurate, as they have a large difference in between ~~them~~ each other ④ [1]

Tie your ray-trace sheet into this Booklet between pages 8 and 9.

[Total: 11]

Examiner comments

② The graph axes are correctly set up with suitable scales and labelling. The plots are correctly positioned. The plots are larger than they should be and this is penalised by not awarding the final graph mark.

Mark awarded for (b) = 3 out of 4

③ A triangle is indicated on the graph but it uses less than half of the candidate's line. The value for G is within the tolerance allowed.

Mark awarded for (c) = 1 out of 2

④ The candidate writes a vague statement and does not comment on the line or the plots.

Mark awarded for (d) (i) = 0 out of 1

Total mark awarded = 7 out of 11

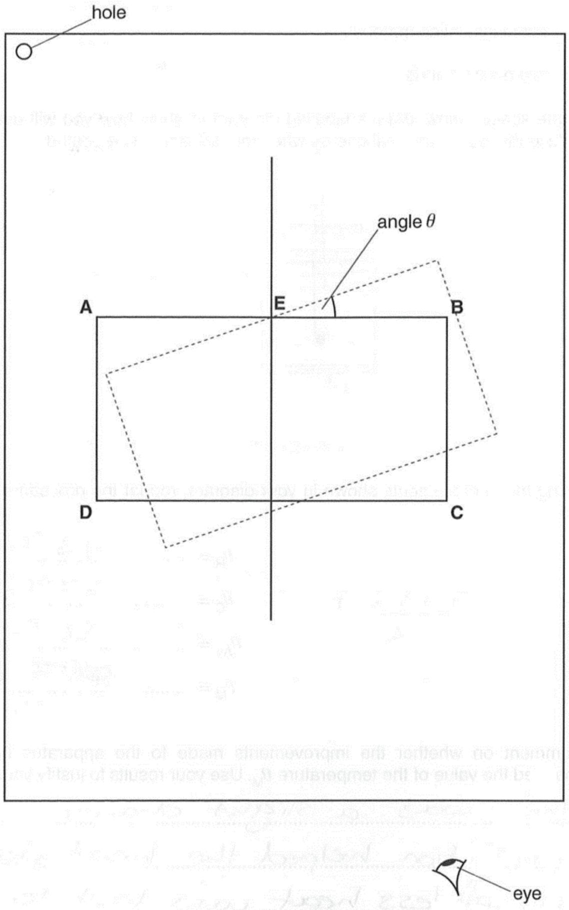
How the candidate could have improved the answer

The candidate needed to take more care lining up the pin and the lines on the block and keeping the block in the correct position in order to obtain accurate values for the angle θ.

The candidate should have used neat crosses instead of 'blobs' to plot the points on the graph.

A large triangle using at least half of the line should have been used for determining the gradient.

(d) The candidate needed to refer clearly to the scatter of points around the best-fit line, stating that the number of points not close to the line suggests poor quality measurements.

Example candidate response – low	Examiner comments
3 In this experiment, you will investigate refraction using a transparent block. Carry out the following instructions, using the separate ray-trace sheet provided. You may refer to Fig. 3.1 for guidance.  **Fig. 3.1**	

Example candidate response – low, continued

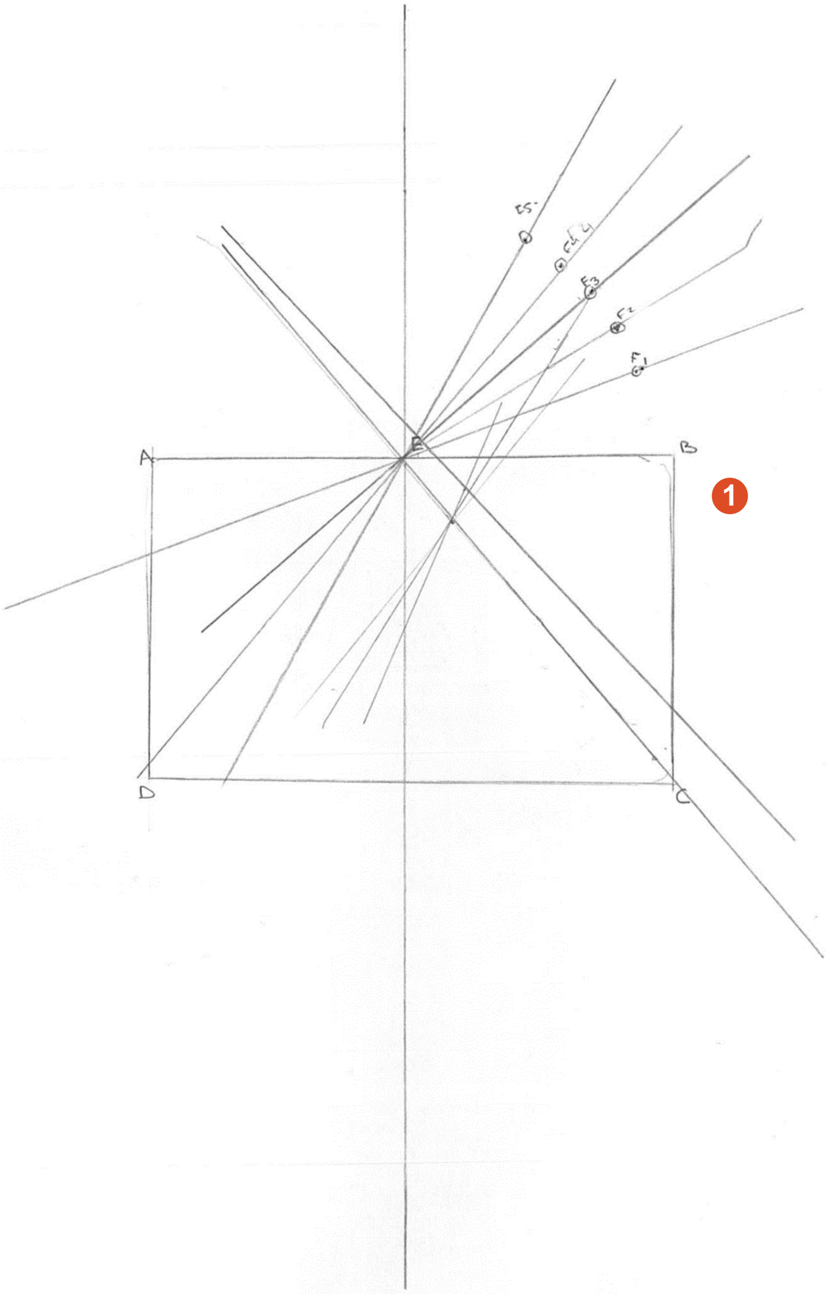
Examiner comments

(a)
- Place the transparent block, largest face down, on the ray-trace sheet supplied. The block should be approximately in the middle of the paper. Draw the outline of the block **ABCD**.
- Remove the block and draw a normal at the centre of side **AB**. Label the point **E** where the normal crosses **AB**.
- Draw a line **FE** to the left of the normal and at an angle $i = 20°$ to the normal.
- Place a pin P on the line **FE**, at a suitable distance from the block for producing an accurate ray trace.
- There are vertical lines $\mathbf{L_1}$ and $\mathbf{L_2}$ drawn on the block. Replace the block so that line $\mathbf{L_1}$ is at point **E**.
- Observe the images of $\mathbf{L_1}$ and P through side **CD** of the block. Carefully move the block, keeping line $\mathbf{L_1}$ at point **E**, until the vertical line $\mathbf{L_2}$ and the images of $\mathbf{L_1}$ and P appear one behind the other. This is indicated by the dashed position of the block shown in Fig. 3.1.
- Draw a line along side **AB** of the block to mark its new position.
- Remove the block.
- Measure the angle θ between the original position of **AB** and the new position of **AB**, as indicated in Fig. 3.1.
- Record $i = 20°$ and θ in Table 3.1.
- Repeat the procedure using values of $i = 30°, 40°, 50°$ and $60°$.

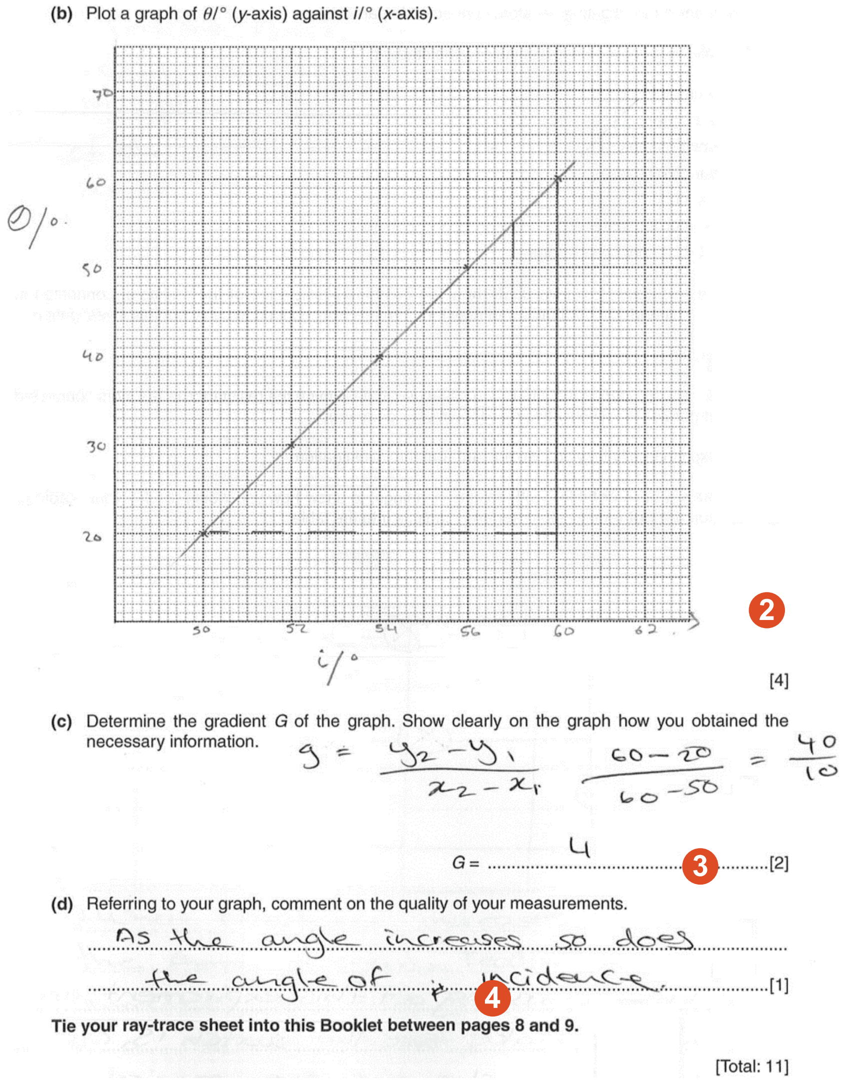
Table 3.1

$i/°$	$\theta/°$
20	50
30	52
40	54
50	36
60	60

[4]

Example candidate response – low, continued	Examiner comments
 ①	① The ray-trace shows that the candidate has not followed the instructions with care. The incident rays are on the wrong side of the normal and lines showing the new positions of the block are inconsistent. The distance between the first position for pin P and the point **E** is just within the tolerance allowed. Mark awarded for (a) = 1 out of 4

Example candidate response – low, continued



(b) Plot a graph of θ/° (y-axis) against i/° (x-axis).

[4]

(c) Determine the gradient G of the graph. Show clearly on the graph how you obtained the necessary information.

$$g = \frac{y_2 - y_1}{x_2 - x_1} \quad \frac{60 - 20}{60 - 50} = \frac{40}{10}$$

G = 4 ③ [2]

(d) Referring to your graph, comment on the quality of your measurements.

As the angle increases so does the angle of incidence ④ [1]

Tie your ray-trace sheet into this Booklet between pages 8 and 9.

[Total: 11]

Examiner comments

② The graph axes are the wrong way round and the scale on the x-axis is inconsistent.
The *i* readings are equally spaced along the x-axis. This results in the candidate not being able to demonstrate plotting skills or judgement of the best-fit straight line.

Mark awarded for (b) = 0 out of 4

③ A large triangle is drawn but the value for *G* is outside the tolerance allowed.

Mark awarded for (c) = 1 out of 2

④ The candidate writes a vague statement and does not comment on the line or the plots.

Mark awarded for (d) = 0 out of 1

Total mark awarded = 2 out of 11

How the candidate could have improved the answer

The candidate needed to follow the instructions step-by-step and with care.

The graph should have been plotted with the *θ* and *i* values on the correct axes and the scale on the *i* axis should have been continuous.

(d) The candidate needed to refer clearly to the scatter of points around the best-fit line.

Common mistakes candidates made in this question

- Taking insufficient care to keep the centre of the side **AB** of the block at point **E** and to line up the pin and lines on the block to obtain accurate readings.
- **(d)** Giving vague answers instead of referring clearly to the scatter of points around the best-fit line.

Question 4

Example candidate response – high

4 A student is investigating resistors connected in parallel.

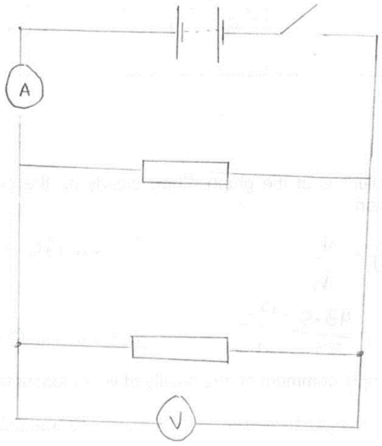
The following apparatus is available to the student:

ammeter
voltmeter
power supply
variable resistor
switch
connecting leads
a box of identical resistors.

Plan an experiment to investigate how the combined resistance of the resistors, connected in parallel, depends on the number of resistors. You are **not** required to carry out this investigation.

You should:

- draw a diagram of the circuit you could use to determine the resistance of resistors connected in parallel (show only two resistors in your diagram)
- explain briefly how you would carry out the investigation
- draw a table or tables, with column headings, to show how you would display your readings. You are **not** required to enter any readings into the table.

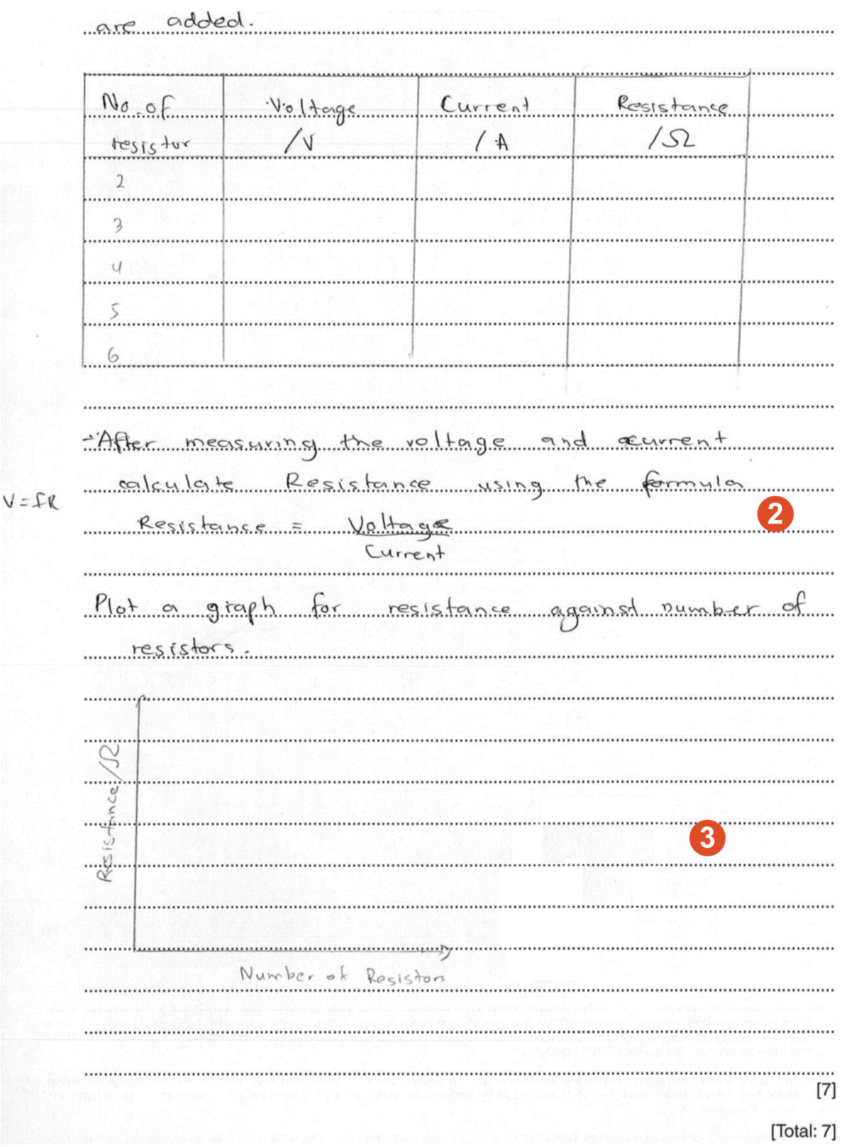


Set the ~~s~~ circuit as above, with ~~one~~ two resistors.
Close the switch and measure the current ①
and voltage. Repeat experiment by adding
~~an~~ a resistor every time. Until a total of 6 resistors

Examiner comments

① The circuit diagram is well drawn and correct in all respects. The concise method includes use of two resistors and measurement of current and voltage followed by repeats using an additional resistor each time.

Example candidate response – high, continued



are added.

No. of resistor	Voltage /V	Current /A	Resistance /Ω
2			
3			
4			
5			
6			

-After measuring the voltage and current calculate Resistance using the formula

$V=IR$

$$\text{Resistance} = \frac{\text{Voltage}}{\text{Current}}$$ ②

Plot a graph for resistance against number of resistors.

③

[7]

[Total: 7]

Examiner comments

② The table shows all the required elements – columns for the number of resistors, voltage and current with correct units. The candidate shows in the table and writes clearly that the resistance is calculated from the voltage and current readings.

③ The candidate uses five combinations of resistors and suggests a suitable graph that could be plotted.

Total mark awarded = 7 out of 7

How the candidate could have improved the answer

This answer gained full marks. The candidate understood the task and wrote a very clear and concise plan.

Example candidate response – middle

4 A student is investigating resistors connected in parallel.

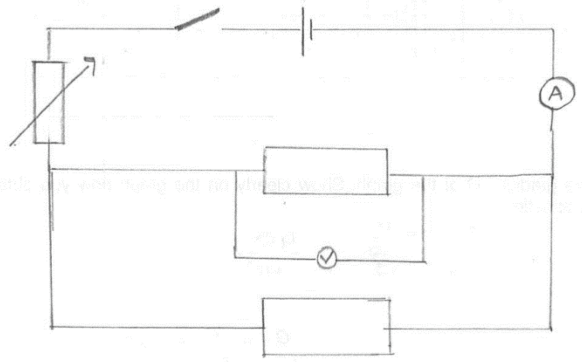
The following apparatus is available to the student:

ammeter ✓
voltmeter ✓
power supply ✓
variable resistor
switch
connecting leads
a box of identical resistors.

Plan an experiment to investigate how the combined resistance of the resistors, connected in parallel, depends on the number of resistors. You are **not** required to carry out this investigation.

You should:

- draw a diagram of the circuit you could use to determine the resistance of resistors connected in parallel (show only two resistors in your diagram)
- explain briefly how you would carry out the investigation
- draw a table or tables, with column headings, to show how you would display your readings. You are **not** required to enter any readings into the table.



①

Set up the apparatus as Shown

Method

1) ~~S~~ Use the variable resistor to

control the amount of current

Examiner comments

① The circuit diagram is well drawn and correct in all respects. The method includes reference to repeating the measurements with different numbers of resistors.

Example candidate response – middle, continued

(unknown given)

2) Use a voltmeter to measure voltage (V)

3) ~~Switch on~~ Use 2 resistors

4) Switch on

5) Measure the current using the ammeter and voltage using voltmeter. Record these values

6) Repeat steps (3 – 5) using 3, 4, 5 and 5 resistors respectively

7) ~~M.~~ Record your values and use the equation $R = \frac{V}{I}$ to measure the resistance.

Plot a graph of voltage, V(x-axis) and current, A (y-axis).

V/V	I/A	R/Ω

← Table ②

Conclusion

The highest resistance will have the lowest current. ~~The~~ and the highest voltage.

[7]

[Total: 7]

Examiner comments

② The table does not include a column for the number of resistors used. The candidate clearly states that the readings are used to calculate the combined resistance of the resistors. The candidate does not make any other points about the investigation to gain further credit.

Total mark awarded = 5 out of 7

How the candidate could have improved the answer

The table required a column for the number of resistors used.

The candidate needed to make one more valid suggestion relating to precautions (e.g. using a low current to prevent resistors becoming too hot) or an aspect of good practice (e.g. using at least five different resistor combinations).

Example candidate response – low

4 A student is investigating resistors connected in parallel.

The following apparatus is available to the student:

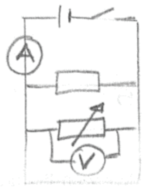
ammeter
voltmeter
power supply
variable resistor
switch
connecting leads
a box of identical resistors.

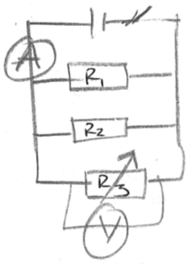
Plan an experiment to investigate how the combined resistance of the resistors, connected in parallel, depends on the number of resistors. You are **not** required to carry out this investigation.

You should:

- draw a diagram of the circuit you could use to determine the resistance of resistors connected in parallel (show only two resistors in your diagram)
- explain briefly how you would carry out the investigation
- draw a table or tables, with column headings, to show how you would display your readings. You are **not** required to enter any readings into the table.

Fig 1





①

~~We connect the apparatus as shown above~~
~~Fig 1, We switch on the power,~~
We connect a resistor (with known Resistence)
then we connect ~~and~~ a variable resistor

Examiner comments

① The circuit diagram shows a voltmeter in parallel with a component. A variable resistor is wrongly shown in parallel with the fixed resistors. The voltmeter and ammeter symbols are not correct because they have lines through the middle. The method includes reference to repeating the measurements with different numbers of resistors.

Example candidate response – low

in parallel and connect a voltmeter in parallel as shown by Fig 1. We record the ~~A~~ readings on the ammeter and voltmeter in the table below and calculate resistence.

A Ammeter	Voltmeter (V)	Resistence (Ω)

Then we calculate the combined resistence using the formula

$$\frac{\text{Product of both } \cancel{\text{resters}} \text{ Resistors}}{\text{Sum of both Resistors}}$$

Then we repeat the experiment by ~~Varying~~ ~~the~~ Adding another resistor in parallel as shown by ~~figure~~ Fig. 2. Then we record the readings in the Table and ~~record~~ ~~the~~ calculate the combined resistence by formula

$$\frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$$

②

Examiner comments

② The table does not include a column for the number of resistors used. The candidate shows that the readings are used to calculate the combined resistance of the resistors. The candidate does not make any other points about the investigation to gain further credit.

Total mark awarded = 2 out of 11

How the candidate could have improved the answer

The candidate needed to take more care drawing the circuit diagram so that the voltmeter and ammeter did not have lines through the middle. Also the position of the variable resistor should not have been part of the parallel combination.

The table required a column for the number of resistors used and the current column should have been headed I/A.

The candidate needed to make one more valid suggestion relating to precautions (e.g. using a low current to prevent resistors becoming too hot) or an aspect of good practice (e.g. using at least five different resistor combinations).

Common mistakes candidates made in this question

- Describing a standard experiment to investigate the resistance of a resistor using a variable resistor to give a range of potential difference and current readings.
- Describing a combination of this type of standard experiment with the investigation stated in the question which resulted in a confusing account.

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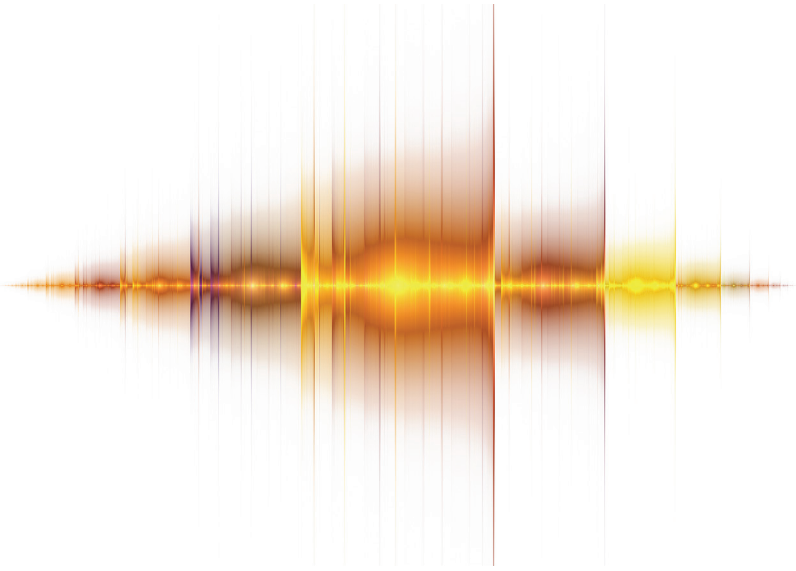
Cambridge Assessment
International Education

Example Candidate Responses

Paper 6

Cambridge IGCSE™
Physics 0625



Version 2.0

Cambridge
Pathway

In order to help us develop the highest quality Curriculum Support resources, we are undertaking a continuous programme of review; not only to measure the success of our resources but also to highlight areas for improvement and to identify new development needs.

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https://surveymonkey.co.uk/r/GL6ZNJB

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http://cie.org.uk/cambridge-for/teachers/teacherconsultants/

Contents

Introduction

The main aim of this booklet is to exemplify standards for those teaching IGCSE Physics (0625), and to show how different levels of candidates' performance (high, middle and low) relate to the subject's curriculum and assessment objectives.

In this booklet candidate responses have been chosen to exemplify a range of answers. Each response is accompanied by a brief commentary explaining the strengths and weaknesses of the answers.

For each question, response is annotated with clear explanation of where and why marks were awarded or omitted. This, in turn, followed by examiner comments on how the answer could have been improved. In this way it is possible for you to understand what candidates have done to gain their marks and what they will have to do to improve their marks. At the end there is a list of common mistakes candidates made in their answers for each question.

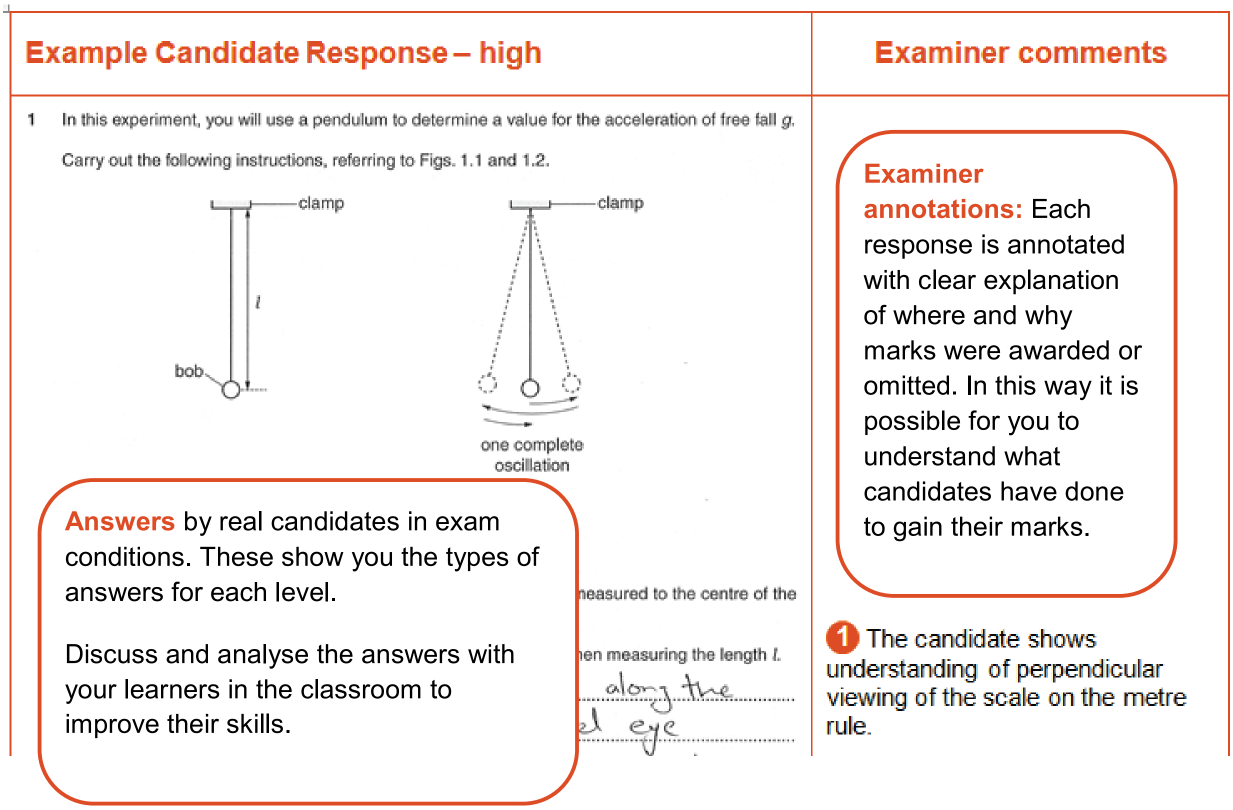
This document provides illustrative examples of candidate work. These help teachers to assess the standard required to achieve marks, beyond the guidance of the mark scheme. Some question types where the answer is clear from the mark scheme, such as short answers and multiple choice, have therefore been omitted.

The questions, mark schemes and pre-release material used here are available to download from the School Support Hub. These files are:

Question Paper 3, June 2016	
Question paper	0625_s16_qp_31.pdf
Mark scheme	0620_s16_ms_31.pdf
Question Paper 4, June 2016	
Question paper	0620_s16_qp_41.pdf
Mark scheme	0620_s16_ms_41.pdf
Question Paper 5, November 2016	
Question paper	0620_w16_qp_52.pdf
Mark scheme	0620_w16_ms_52.pdf
Question Paper 6, June 2016	
Question paper	0620_s16_qp_62.pdf
Mark scheme	0620_s16_ms_62.pdf

Other past papers, Examiner Reports and other teacher support materials are available on the School Support Hub at www.cambridgeinternational.org/support

How to use this booklet



Example Candidate Response – high	**Examiner comments**
1 In this experiment, you will use a pendulum to determine a value for the acceleration of free fall *g*. Carry out the following instructions, referring to Figs. 1.1 and 1.2.	

neasured to the centre of the

hen measuring the length *l*.

along the

el eye

Answers by real candidates in exam conditions. These show you the types of answers for each level.

Discuss and analyse the answers with your learners in the classroom to improve their skills.

Examiner annotations: Each response is annotated with clear explanation of where and why marks were awarded or omitted. In this way it is possible for you to understand what candidates have done to gain their marks.

① The candidate shows understanding of perpendicular viewing of the scale on the metre rule.

How the candidate could have improved the answer

(d) (ii) The candidate could have suggested
experiment using different lengths, repeating
repeating the timing of the 20 oscillations sev
that merely suggesting repeats, without spec

Examiner comments This explains how the candidate could have improved the answer. This helps you to interpret the standard of Cambridge exams and helps your learners to refine exam technique.

Common mistakes

The most common error for this question was the mistake
constitutes an Alphabet Agency. Many responses incorre
reforms, all legislation passed by the Roosevelt administr
Commonplace was the inclusion of the Emergency Banki

Common mistakes a list of common mistakes candidates made in their answers for each question.

Assessment at a glance

All candidates take three papers.

Candidates who have studied the Core subject content, or who are expected to achieve a grade D or below, should be entered for Paper 1, Paper 3 and either Paper 5 or Paper 6. These candidates will be eligible for grades C to G.

Candidates who have studied the Extended subject content (Core and Supplement), and who are expected to achieve a grade C or above, should be entered for Paper 2, Paper 4 and either Paper 5 or Paper 6. These candidates will be eligible for grades A* to G.

Core candidates take:	**Extended candidates take:**
Paper 1 45 minutes Multiple Choice 30% 40 marks 40 four-choice multiple-choice questions Questions will be based on the Core subject content Assessing grades C–G Externally assessed	**Paper 2** 45 minutes Multiple Choice 30% 40 marks 40 four-choice multiple-choice questions Questions will be based on the Extended subject content (Core and Supplement) Assessing grades A*–G Externally assessed
and Core candidates take:	**and Extended candidates take:**
Paper 3 1 hour 15 minutes Theory 50% 80 marks Short-answer and structured questions Questions will be based on the Core subject content Assessing grades C–G Externally assessed	**Paper 4** 1 hour 15 minutes Theory 50% 80 marks Short-answer and structured questions Questions will be based on the Extended subject content (Core and Supplement) Assessing grades A*–G Externally assessed
All candidates take either:	**or:**
Paper 5 1 hour 15 minutes Practical Test 20% 40 marks Questions will be based on the experimental skills in Section 4 Assessing grades A*–G Externally assessed	**Paper 6** 1 hour Alternative to Practical 20% 40 marks Questions will be based on the experimental skills in Section 4 Assessing grades A*–G Externally assessed

Teachers are reminded that the latest syllabus is available on our public website at www.cambridgeinternational.org and the School Support Hub at www.cambridgeinternational.org/support

Paper 6 – Alternative to Practical

Question 1

Example candidate response – high

1 A student is investigating the stretching of a spring.

The apparatus is shown in Fig. 1.1.

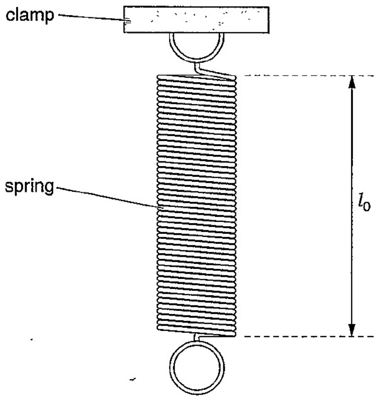


Fig. 1.1

(a) On Fig. 1.1, measure the unstretched length l_0 of the spring. Record l_0 in the first row of Table 1.1. [1]

(b) The student hangs a load L of 1.0 N on the spring and measures the new length l of the spring. She repeats the measurements using loads of 2.0 N, 3.0 N, 4.0 N and 5.0 N. The readings are shown in Table 1.1.

(i) For each set of readings, calculate the extension e of the spring using the equation $e = (l - l_0)$. Record the values of e in the table.

Table 1.1

L/N	l/mm	e/mm
0.0	55	0 ①
1.0	59	4
2.0	64	9
3.0	69	14
4.0	74	19
5.0	78	23 ②

[1]

(ii) Explain briefly one precaution that you would take in order to obtain reliable readings.

Wait for the spring to go back to it's original length before taking the next reading. ③ [1]

Examiner comments

① The candidate measures and records the length correctly.

Mark awarded for (a) = 1 out of 1

② The values of extension have been successfully calculated.

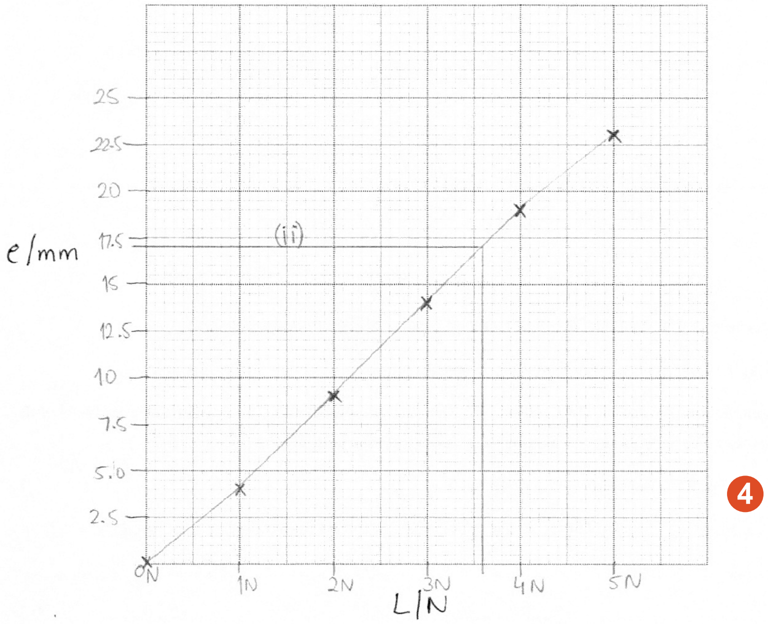
Mark awarded for (b) (i) = 1 out of 1

③ The suggested procedure contradicts the description of the experiment.

Mark awarded for (b) (ii) = 0 out of 1

Example candidate response – high, continued

(c) Plot a graph of *e*/mm (*y*-axis) against *L*/N (*x*-axis).



[4]

(d) The student removes the load from the spring and hangs an unknown load **X** on the spring. She measures the length *l* of the spring.

l = 72 mm

(i) Calculate the extension *e* of the spring.

$e = l - l_0$

$e = 72 - 55 = 17$

e = 17 mm ⑤ [1]

(ii) Use the graph to determine the weight *W* of the load **X**. Show clearly on the graph how you obtained the necessary information.

W = 3.6N ⑥ [2]

[Total: 10]

Examiner comments

④ The candidate draws a graph with the axes the right way round and correctly labels with a suitable scale. The plotting is accurate but a best-fit straight line has not been drawn. A line joins each point to the next.

Mark awarded for (c) = 3 out of 4

⑤ This is correct.

Mark awarded for (d) (i) = 1 out of 1

⑥ The method is clearly shown on the graph and obtains a value for *W* that is within the tolerance allowed and gives the correct unit *N*.

Mark awarded for (d) (ii) = 2 out of 2

Total mark awarded = 8 out of 10

How the candidate could have improved the answer

The candidate needed to write a relevant precaution describing how to read the rule to obtain a reliable reading.

The graph line should have been a best-fit straight line.

Example candidate response – middle

1 A student is investigating the stretching of a spring.

The apparatus is shown in Fig. 1.1.

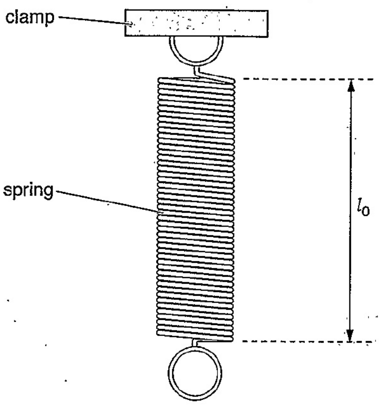


Fig. 1.1

(a) On Fig. 1.1, measure the unstretched length l_0 of the spring. Record l_0 in the first row of Table 1.1. [1]

(b) The student hangs a load L of 1.0 N on the spring and measures the new length l of the spring. She repeats the measurements using loads of 2.0 N, 3.0 N, 4.0 N and 5.0 N. The readings are shown in Table 1.1.

(i) For each set of readings, calculate the extension e of the spring using the equation $e = (l - l_0)$. Record the values of e in the table.

Table 1.1

L/N	l/mm	e/mm
0.0	55	0
1.0	59	4
2.0	64	9
3.0	69	14
4.0	74	19
5.0	78	23

①

②

[1]

(ii) Explain briefly one precaution that you would take in order to obtain reliable readings.

I won't put any external force on the load as the length of the spring will change. ③ [1]

Examiner comments

① The candidate measures and records the length correctly.

Mark awarded for (a) = 1 out of 1

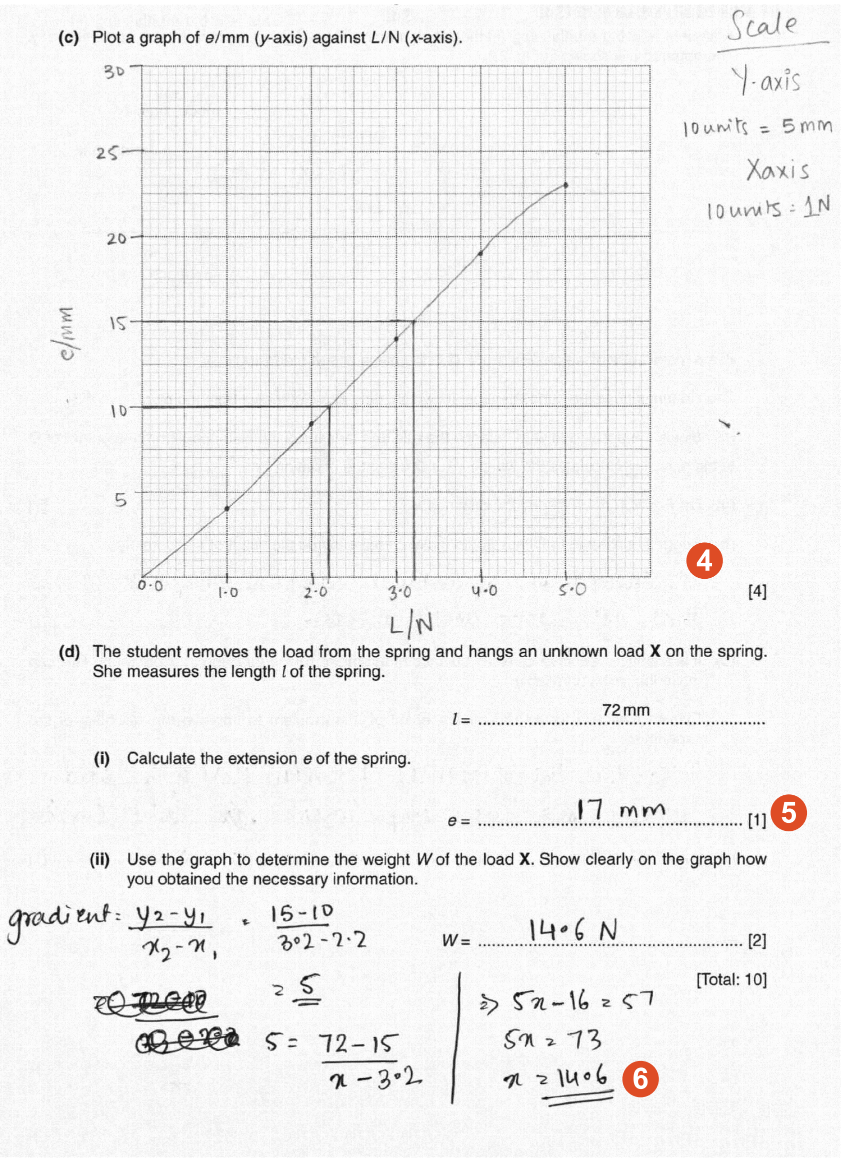
② The values of extension have been correctly calculated.

Mark awarded for (b) (i) = 1 out of 1

③ The candidate's suggestion is not a relevant precaution but a vague statement about avoiding carelessness.

Mark awarded for (b) (ii) = 0 out of 1

Example candidate response – middle, continued	Examiner comments



(c) Plot a graph of *e*/mm (*y*-axis) against *L*/N (*x*-axis).

[4]

(d) The student removes the load from the spring and hangs an unknown load **X** on the spring. She measures the length *l* of the spring.

l = 72 mm

(i) Calculate the extension *e* of the spring.

e = 17 mm [1] ⑤

(ii) Use the graph to determine the weight *W* of the load **X**. Show clearly on the graph how you obtained the necessary information.

gradient: $\frac{y_2 - y_1}{x_2 - x_1} = \frac{15-10}{3.2-2.2}$

$= 5$

$5 = \frac{72-15}{x-3.2}$

$\Rightarrow 5x - 16 = 57$

$5x = 73$

$x = 14.6$ ⑥

W = 14.6 N [2]

[Total: 10]

④ The candidate draws a graph with the axes the right way round and correctly labels with a suitable scale. The plotting is accurate but the candidate does not draw a best-fit straight line. The candidate draws a line that joins each point to the next.

Mark awarded for (c) = 3 out of 4

⑤ Extension has been calculated correctly.

Mark awarded for (d) (i) = 1 out of 1

⑥ The candidate does not take a reading of *W* at the point on the graph where the extension *e* = 17mm, but calculates the gradient and then goes on to some further calculations.

Mark awarded for (d) (ii) = 0 out of 2

Total mark awarded = 6 out of 10

How the candidate could have improved the answer

The candidate needed to write a relevant precaution describing how to read the rule to obtain a reliable reading.

The graph line should have been a best-fit straight line.

The candidate needed to read the load from the graph at the point where the extension is 17 mm.

Example candidate response – low

1 A student is investigating the stretching of a spring.

The apparatus is shown in Fig. 1.1.

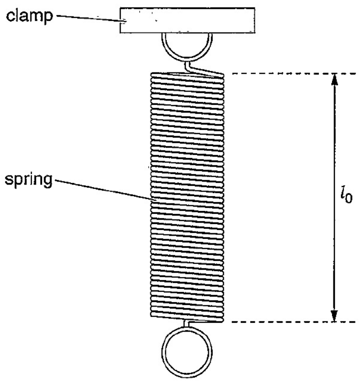


Fig. 1.1

(a) On Fig. 1.1, measure the unstretched length l_0 of the spring. Record l_0 in the first row of Table 1.1. [1]

(b) The student hangs a load L of 1.0 N on the spring and measures the new length l of the spring. She repeats the measurements using loads of 2.0 N, 3.0 N, 4.0 N and 5.0 N. The readings are shown in Table 1.1.

(i) For each set of readings, calculate the extension e of the spring using the equation $e = (l - l_0)$. Record the values of e in the table.

Table 1.1

L/N	l/mm	e/mm
0.0	55	0
1.0	59	4
2.0	64	5
3.0	69	5
4.0	74	5
5.0	78	4

①

②

[1]

(ii) Explain briefly one precaution that you would take in order to obtain reliable readings.

~~it was a spring law~~ the spring law could happen in this progress, when the weight was increase [1]

maybe the spring just decreasing itrange from original leaght when put on weight

③

Examiner comments

① This is correct.

Mark awarded for (a) (i) = 1 out of 1

② The candidate does not calculate the extension for each value of the load but calculates the change in extension for each value of load.

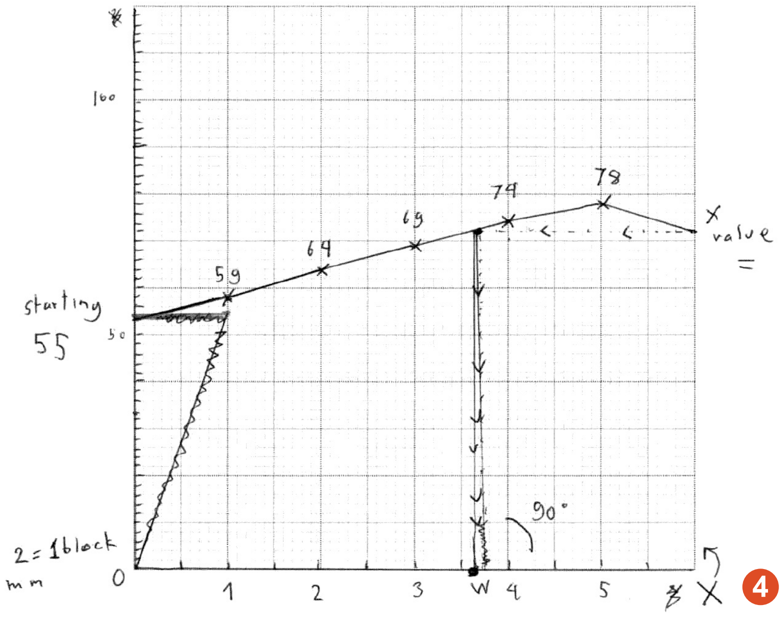
Mark awarded for (b) (i) = 0 out of 1

③ The candidate makes a comment about ‘the spring law’ instead of writing a precaution.

Mark awarded for (b) (ii) = 0 out of 1

Example candidate response – low, continued

(c) Plot a graph of *e*/mm (*y*-axis) against *L*/N (*x*-axis).



④ [4]

(d) The student removes the load from the spring and hangs an unknown load **X** on the spring. She measures the length *l* of the spring.

l = 72 mm

(i) Calculate the extension *e* of the spring.

e = 17 mm ⑤ [1]

(ii) Use the graph to determine the weight *W* of the load **X**. Show clearly on the graph how you obtained the necessary information.

W = ⑥ 3.7 N [2]

[Total: 10]

Examiner comments

④ The candidate plots *l*/mm against *L*/N instead of *e*/mm against *L*/N as instructed in the question. The axes are not labelled. The first plot is missing and the line is not a best-fit straight line.

Mark awarded for (c) = 0 out of 4

⑤ The extension is calculated correctly.

Mark awarded for (d) (i) = 1 out of 1

⑥ In spite of plotting the wrong graph, the candidate is able to use the graph correctly to obtain a value for *W* that is within the tolerance allowed and gives the correct unit, *N*.

Mark awarded for (d) (ii) = 2 out of 2

Total mark awarded = 4 out of 10

How the candidate could have improved the answer

The candidate should have understood what was meant by the extension of a spring to calculate the values correctly.

A relevant precaution describing how to read the rule should have been used to obtain a reliable reading.

The candidate should have plotted extension on the *y*-axis of the graph and then plot all the points accurately and draw a best-fit straight line.

Common mistakes candidates made in this question

- Writing a vague statement rather than a relevant precaution describing how to read the rule to obtain a reliable reading.
- Making a poor judgement of the best-fit straight line on the graph.

Question 2

Example candidate response – high

2 A student is using a balancing method to determine the weight of a piece of soft modelling clay. The apparatus is shown in Fig. 2.1.

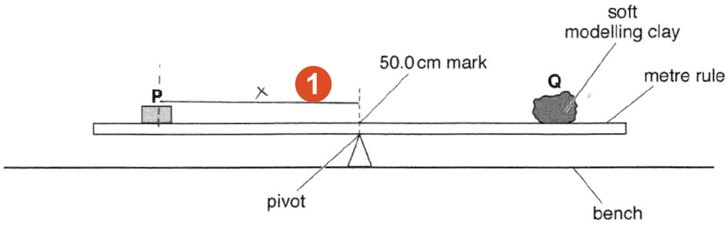


Fig. 2.1

P is a metal cube of weight P = 1.0 N. **Q** is the piece of soft modelling clay.

The student places the cube **P** so that its weight acts at a distance x from the pivot.

He adjusts the position of **Q** to balance the rule and measures the distance y from the centre of **Q** to the pivot. He calculates the weight W of **Q** using the equation $W = \frac{Px}{y}$.

(a) **On Fig. 2.1**, mark clearly the distance x. [1]

(b) Suggest a change to **Q** that would make it easier to find the value of y accurately.

+Make the shape ~~to~~ more defined, e.g: Square. So you can find the center of the object. ② [1]

(c) It is difficult to achieve an exact balance of the metre rule in this type of experiment. This can make the result unreliable.

Explain how you would reduce the effect of this problem to improve the reliability of the experiment.

+ Use a solid object instead of a modelling clay.
+ Make sure object P and Q don't cover the lines and numbers of the ruler. ③ [1]

Examiner comments

① The candidate correctly marks the distance x on Fig. 2.1.

Mark awarded for (a) = 1 out of 1

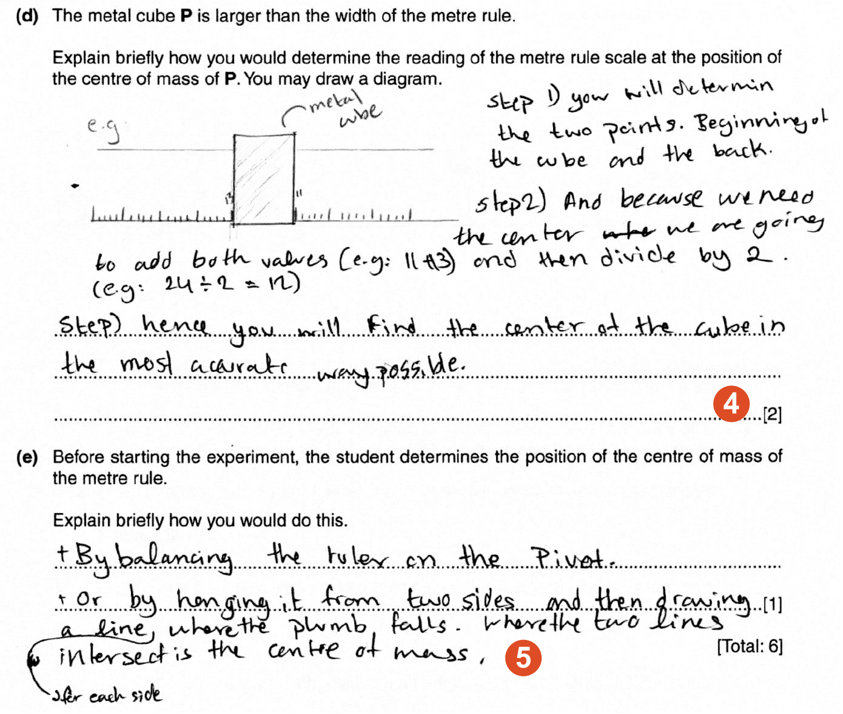
② This is a good suggestion for the change to **Q**.

Mark awarded for (b) = 1 out of 1

③ Exact balance has not been addressed but the candidate writes about precautions that are taken to obtain accurate distance readings.

Mark awarded for (c) = 0 out of 1

Example candidate response – high, continued



(d) The metal cube **P** is larger than the width of the metre rule.

Explain briefly how you would determine the reading of the metre rule scale at the position of the centre of mass of **P**. You may draw a diagram.

step 1) you will determin the two points. Beginning of the cube and the back.

step2) And because we need the center ~~whe~~ we are going to add both values (e.g: 11+13) and then divide by 2. (e.g: 24÷2 = 12)

Step) hence you will find the center of the cube in the most accurate way possible.

④ [2]

(e) Before starting the experiment, the student determines the position of the centre of mass of the metre rule.

Explain briefly how you would do this.

+By balancing the ruler on the Pivot.

+ Or by hanging it from two sides and then drawing [1]
a line, where the plumb falls. where the two lines
intersect is the centre of mass, ⑤
after each side

[Total: 6]

Examiner comments

④ Clear diagram has been drawn which explains the procedure well.

Mark awarded for (d) =
2 out of 2

⑤ Balancing the rule on the pivot has been written correctly. The alternative method, added unnecessarily, is too complex and not very practical but has not been penalised.

Mark awarded for (e) =
1 out of 1

Total mark awarded =
5 out of 6

How the candidate could have improved the answer

(c) The candidate should have used the experience gained during the course to describe what was done in this type of experiment. For example moving **Q** slowly one way until the rule just tips, then moving **Q** the other way until the rule tips back and taking the reading between these two positions of **Q**.

(e) Although the candidate was awarded the mark, it would have been better to have written only about balancing the rule on the pivot and not to add a second, rather impractical method.

Example candidate response – middle

2 A student is using a balancing method to determine the weight of a piece of soft modelling clay. The apparatus is shown in Fig. 2.1.

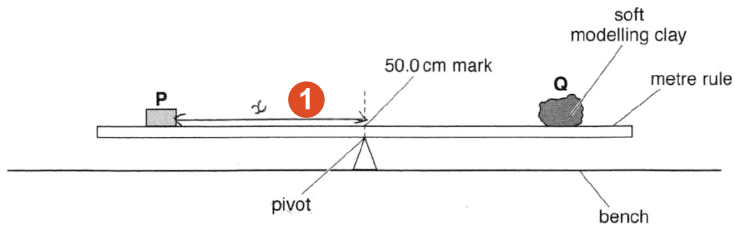


Fig. 2.1

P is a metal cube of weight $P = 1.0\,\text{N}$. **Q** is the piece of soft modelling clay.

The student places the cube **P** so that its weight acts at a distance x from the pivot.

He adjusts the position of **Q** to balance the rule and measures the distance y from the centre of **Q** to the pivot. He calculates the weight W of **Q** using the equation $W = \frac{Px}{y}$.

(a) **On Fig. 2.1**, mark clearly the distance x. [1]

(b) Suggest a change to **Q** that would make it easier to find the value of y accurately.

Give an ~~apprets~~ appropriate measured shape to the modelling clay ② [1]

(c) It is difficult to achieve an exact balance of the metre rule in this type of experiment. This can make the result unreliable.

Explain how you would reduce the effect of this problem to improve the reliability of the experiment.

~~Repeating~~ By repeating the experiment several times and taking average. ③ [1]

Examiner comments

① The candidate shows the distance to one edge of the cube, not the centre.

Mark awarded for (a) = 0 out of 1

② This is a vague answer.

Mark awarded for (b) = 0 out of 1

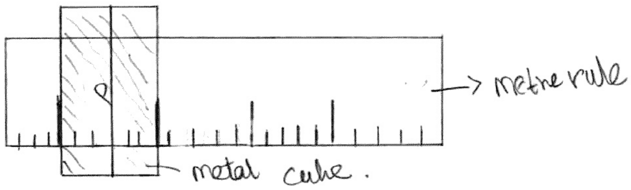
③ The answer suggests repeating the experiment several times and taking the average.

Mark awarded for (c) = 1 out of 1

Example candidate response – middle, continued

(d) The metal cube **P** is larger than the width of the metre rule.

Explain briefly how you would determine the reading of the metre rule scale at the position of the centre of mass of **P**. You may draw a diagram.



By dividing the mass equally on both sides of the required position ④

[2]

(e) Before starting the experiment, the student determines the position of the centre of mass of the metre rule.

Explain briefly how you would do this.

By placing the metre rule on the pivot and [illegible] seeing the point where it balances equally [1]

⑤ [Total: 6]

Examiner comments

④ The candidate indicates a correct method but the response is too vague to gain both marks.

Mark awarded for (d) =
1 out of 2

⑤ This is correct.

Mark awarded for (e) =
1 out of 1

**Total mark awarded =
3 out of 11**

How the candidate could have improved the answer

(a) The distance *x* to the centre of the block should have been shown.

(b) The candidate should have suggested an appropriate shape (e.g. a cube).

(d) Writing should have been clearer that the block width must be measured.

Example Candidate Response – low

2 A student is using a balancing method to determine the weight of a piece of soft modelling clay. The apparatus is shown in Fig. 2.1.

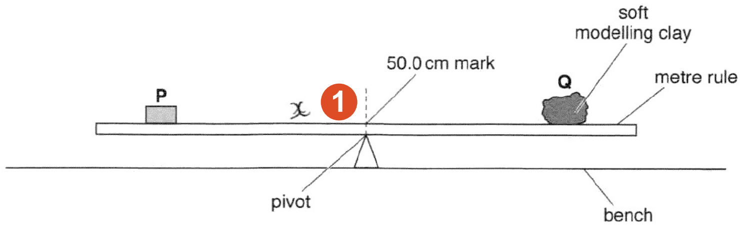


Fig. 2.1

P is a metal cube of weight $P = 1.0\,\text{N}$. **Q** is the piece of soft modelling clay.

The student places the cube **P** so that its weight acts at a distance x from the pivot.

He adjusts the position of **Q** to balance the rule and measures the distance y from the centre of **Q** to the pivot. He calculates the weight W of **Q** using the equation $W = \frac{Px}{y}$.

(a) **On Fig. 2.1**, mark clearly the distance x. [1]

(b) Suggest a change to **Q** that would make it easier to find the value of y accurately.

~~Weigh~~ ~~[illegible]~~ Place it on it's centre of mass. ② [1]

(c) It is difficult to achieve an exact balance of the metre rule in this type of experiment. This can make the result unreliable.

Explain how you would reduce the effect of this problem to improve the reliability of the experiment.

Repeat the experiment and find the average. ③ [1]

Examiner comments

① The candidate does not mark the distance x clearly.

Mark awarded for (a) = 0 out of 1

② This does not answer the question.

Mark awarded for (b) = 0 out of 1

③ The candidate correctly suggests repeating the experiment several times and taking the average.

Mark awarded for (c) = 1 out of 1

Example candidate response – low, continued	Examiner comments
(d) The metal cube **P** is larger than the width of the metre rule. Explain briefly how you would determine the reading of the metre rule scale at the position of the centre of mass of **P**. You may draw a diagram. you would measure the reading and subtract it fron 50.0 cm ④ [2]	④ This does not answer the question. Mark awarded for (d) = 0 out of 2
(e) Before starting the experiment, the student determines the position of the centre of mass of the metre rule. Explain briefly how you would do this. by placing on the pivot so it doesn't tilt ⑤ [1] [Total: 6]	⑤ This is correct. Mark awarded for (e) = 1 out of 1 **Total mark awarded = 2 out of 6**

How the candidate could have improved the answer

(a) The candidate should have shown the distance *x* from the pivot to the centre of the block.

(b) An appropriate shape should have been suggested (e.g. a cube).

(c) The candidate needed to explain that the width of the cube must be measured and then the block positioned so that half the width lays either side of the required position. A diagram makes it much easier for the candidate to describe this.

Common mistakes candidates made in this question

Writing vague responses to parts **(c)** and **(d)**. Candidates should realise that they are being asked to write from their own experience of carrying out similar experiments during their course.

Question 3

Example Candidate Response – high

3 A student is investigating the magnification of images produced by a lens.

The apparatus is shown in Fig. 3.1.

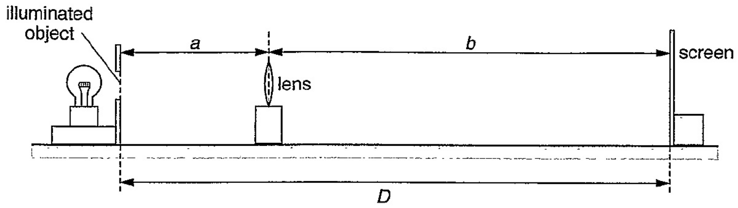


Fig. 3.1

The student places a screen at a distance D = 80.0 cm from an illuminated object. The screen and the illuminated object remain in the same positions throughout the experiment.

(a) She places the lens close to the illuminated object. She moves the lens until she sees a sharply focused, **enlarged** image of the object on the screen.

She measures the distance a from the illuminated object to the centre of the lens.

a = 20.3 cm

She measures the distance b from the centre of the lens to the screen.

b = 59.7 cm

Calculate the magnification m_1 of the image, using the equation $m_1 = \frac{b}{a}$.

m_1 = 2.94 ① [1]

Examiner comments

① The calculation is correct.

Mark awarded for (a) = 1 out of 1

Example Candidate Response – high, continued

(b) The student then moves the lens towards the screen until a **smaller**, sharply focused image of the object is seen on the screen.

She measures the distance x from the illuminated object to the centre of the lens.

x = 60.2 cm

She measures the distance y from the centre of the lens to the screen.

y = 19.8 cm

Calculate the magnification m_2 of the image, using the equation $m_2 = \frac{y}{x}$.

m_2 = 0.329 ② [1]

(c) A student suggests that $m_1 \times m_2$ should equal 1.

State whether the results support this suggestion. Justify your answer by reference to the results.

statement Yes

justification $m_1 \times m_2 = 0.967 < 1$, but ~~the~~ the result is within the limit of experimental accuracy. ③

[2]

(d) State two precautions that you would take in this experiment to obtain reliable results.

1. Keep the object, lens and screen at the same height.

2. Do the experiment in a dark room. ④

[2]

(e) Suggest one reason why it is difficult, in this type of experiment, to decide on the best position of the lens to obtain a sharply focused image on the screen.

~~The~~ It is hard to find the best sharply focused image because of the small difference between images. [1]

⑤ [Total: 7]

Examiner comments

② The calculation is correct.

Mark awarded for (b) = 1 out of 1

③ The statement is correct and the justification is clearly explained.

Mark awarded for (c) = 2 out of 2

④ The candidate suggests two sensible precautions.

Mark awarded for (d) = 2 out of 2

⑤ The candidate does not give a convincing reason, showing a lack of familiarity with this type of experiment.

Mark awarded for (e) = 0 out of 1

Total mark awarded = 6 out of 7

How the candidate could have improved the answer

(e) The candidate should have explained that the image could appear equally well focused over a range of lens positions.

Example candidate response – middle

3 A student is investigating the magnification of images produced by a lens.

The apparatus is shown in Fig. 3.1.

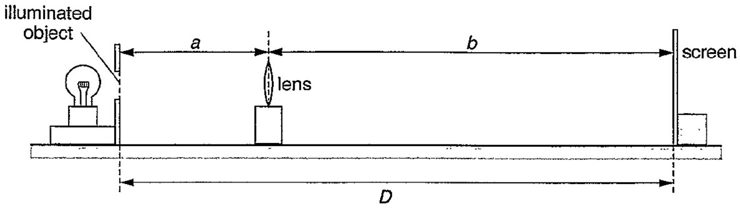


Fig. 3.1

The student places a screen at a distance $D = 80.0$ cm from an illuminated object. The screen and the illuminated object remain in the same positions throughout the experiment.

(a) She places the lens close to the illuminated object. She moves the lens until she sees a sharply focused, **enlarged** image of the object on the screen.

She measures the distance a from the illuminated object to the centre of the lens.

a = 20.3 cm

She measures the distance b from the centre of the lens to the screen.

b = 59.7 cm

Calculate the magnification m_1 of the image, using the equation $m_1 = \frac{b}{a}$.

m_1 = 2.94 ① [1]

Examiner comments

① The calculation is correct.

Mark awarded for (a) = 1 out of 1

Example candidate response – middle, continued	Examiner comments
(b) The student then moves the lens towards the screen until a **smaller**, sharply focused image of the object is seen on the screen. She measures the distance x from the illuminated object to the centre of the lens. x = 60.2 cm She measures the distance y from the centre of the lens to the screen. y = 19.8 cm Calculate the magnification m_2 of the image, using the equation $m_2 = \frac{y}{x}$. m_2 = 0.33 ② [1]	② The calculation is correct. Mark awarded for (b) = 1 out of 1
(c) A student suggests that $m_1 \times m_2$ should equal 1. State whether the results support this suggestion. Justify your answer by reference to the results. statement the magnification of the image is ~~the same~~ not the same justification The magnification wouldn't be the same ~~no matter where the len is placed~~ becaue it can change according to where the lens is placed 2.94 × 0.33 = 0.97 ③ [2]	③ The candidate calculates $m_1 \times m_2$ correctly but does not state that 0.97 is very close to 1 and therefore the results support the suggestion within the limits of experimental accuracy. Mark awarded for (c) = 0 out of 2
(d) State two precautions that you would take in this experiment to obtain reliable results. 1. adjust the lens back and forth until it show clear and sharp imag 2. make the experiment in a dark room ④ [2]	④ Two sensible precautions are suggested. Mark awarded for (d) = 2 out of 2
(e) Suggest one reason why it is difficult, in this type of experiment, to decide on the best position of the lens to obtain a sharply focused image on the screen. Becaue the size of the object also make the experiment difficult ⑤ [1] [Total: 7]	⑤ The candidate does not give a convincing reason, showing a lack of familiarity with this type of experiment. Mark awarded for (e) = 0 out 1 **Total mark awarded = 4 out of 7**

How the candidate could have improved the answer

(c) The candidate should have realised that the results support the suggestion within the limits of experimental accuracy.

(e) The candidate needed to show familiarity with this type of experiment by explaining that the image can appear equally well focused over a range of lens positions.

Example Candidate Response – low

3 A student is investigating the magnification of images produced by a lens.

The apparatus is shown in Fig. 3.1.

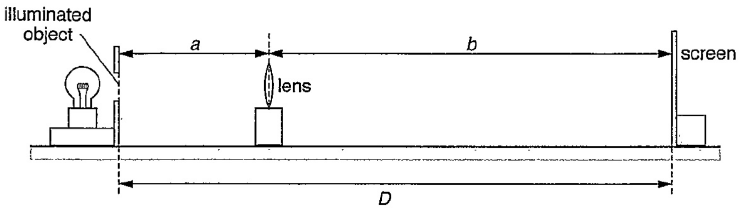


Fig. 3.1

The student places a screen at a distance $D = 80.0\,\text{cm}$ from an illuminated object. The screen and the illuminated object remain in the same positions throughout the experiment.

(a) She places the lens close to the illuminated object. She moves the lens until she sees a sharply focused, **enlarged** image of the object on the screen.

She measures the distance a from the illuminated object to the centre of the lens.

a = 20.3 cm

She measures the distance b from the centre of the lens to the screen.

b = 59.7 cm

Calculate the magnification m_1 of the image, using the equation $m_1 = \frac{b}{a}$.

m_1 = x 2.94 ① [1]

Examiner comments

① The calculation is correct.

Mark awarded for (a) = 1 out of 1

Example candidate response – low, continued

(b) The student then moves the lens towards the screen until a **smaller**, sharply focused image of the object is seen on the screen.

She measures the distance x from the illuminated object to the centre of the lens.

x = 60.2 cm

She measures the distance y from the centre of the lens to the screen.

y = 19.8 cm

Calculate the magnification m_2 of the image, using the equation $m_2 = \frac{y}{x}$.

m_2 = X 0·3 ② [1]

(c) A student suggests that $m_1 \times m_2$ should equal 1.

State whether the results support this suggestion. Justify your answer by reference to the results.

statement NO

justification It is because the distances from the centre of lens and from illuminated object is vice versa in the two experiments therefore magnifications are also different. ③

[2]

(d) State two precautions that you would take in this experiment to obtain reliable results.

1. use a bright light bulb so that image formed can be clearer.

2. carry out this experiment in a dark room with no other light. ④

[2]

(e) Suggest one reason why it is difficult, in this type of experiment, to decide on the best position of the lens to obtain a sharply focused image on the screen.

It is because the lens is adjusted by hand. ⑤

[1]

[Total: 7]

Examiner comments

② The calculation is correct but not given to 2 or 3 significant figures.

Mark awarded for (b) = 0 out of 1

③ The candidate does not state or explain that the results support the suggestion, within the limits of experimental accuracy.

Mark awarded for (c) = 0 out of 2

④ These are alternative answers for one correct response.

Mark awarded for (d) = 1 out of 2

⑤ The candidate does not give a convincing reason, showing a lack of familiarity with this type of experiment.

Mark awarded for (e) = 0 out of 1

Total mark awarded =
2 out of 7

How the candidate could have improved the answer

(b) The answer should have been given to 2 or 3 significant figures.

(c) The candidate should have realised that the results support the suggestion within the limits of experimental accuracy.

(d) A second valid suggestion should have been made.

(e) Familiarity with this type of experiment should have been shown by explaining that the image can appear equally well focused over a range of lens positions.

Common mistakes candidates made in this question

Failure to realise the significance of results being within the limits of experimental accuracy.

Writing vague responses to part **(e)**. Candidates should realise that they are being asked to write from their own experience of carrying out similar experiments during their course.

Question 4

Example candidate response – high

4 A student is investigating how the resistance of a wire depends on the length of the wire. The student aims to plot a graph.

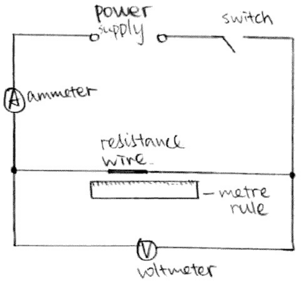
The following apparatus is available to the student:

ammeter
voltmeter
power supply
variable resistor
switch
connecting leads
resistance wires of different lengths
metre rule.

Plan an experiment to investigate how the resistance of a wire depends on the length of the wire.

You should

- draw a diagram of the circuit you could use to determine the resistance of each wire
- explain briefly how you would carry out the investigation
- suggest suitable lengths of wire
- state the key variables that you would control
- draw a table, or tables, with column headings to show how you would display your readings. You are not required to enter any readings in the table.



①

Examiner comments

① The candidate draws a good circuit diagram including the correct circuit symbols.

Example candidate response – high, continued

Steps: ① According to the diagram, connect the circuit with the apparatus, and connect a 10cm resistance wire. (length measured by metre rule)

② close the switch, read the current on the ammeter, I and the potential difference on the voltmeter, V and record them onto the table.

③ Use the formula, resistance $= \frac{p.d}{current}$, calculate the resistance of this wire, as R and record the data

④ repeat the experiment, only change the wires with different lengths, measured by meter rule, they are ~~10cm~~ 15cm, 20cm, 25cm, 30cm, 35cm, 40cm seperately, calculate their resistance and record the data

(Keep the power supply constant.) ②

length of resistance wire/cm	I /A	V / V	R / Ω

③

[7]

[Total: 7]

Examiner comments

② The method includes taking readings of current and potential difference using at least five different lengths.
The range of different lengths is appropriate.

③ The candidate draws a suitable table with headings for length, current, potential difference and resistance, each with the correct unit.

Total mark awarded =
6 out of 7

How the candidate could have improved the answer

The candidate needed to state any key variables to control.

Example candidate response – middle

4 A student is investigating how the resistance of a wire depends on the length of the wire. The student aims to plot a graph.

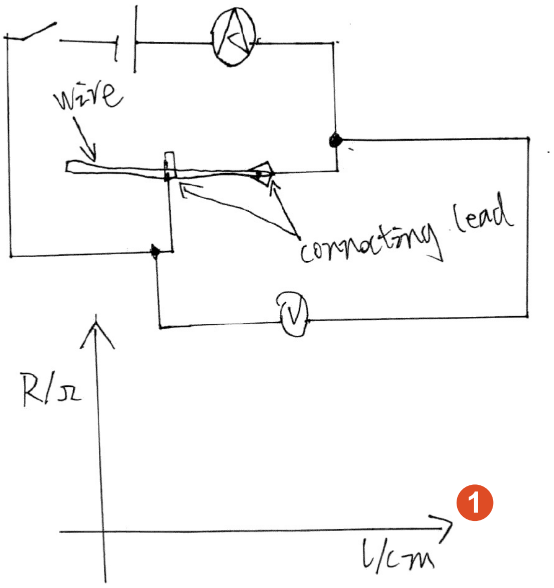
The following apparatus is available to the student:

ammeter
voltmeter
power supply
variable resistor
switch
connecting leads
resistance wires of different lengths
metre rule.

Plan an experiment to investigate how the resistance of a wire depends on the length of the wire.

You should

- draw a diagram of the circuit you could use to determine the resistance of each wire
- explain briefly how you would carry out the investigation
- suggest suitable lengths of wire
- state the key variables that you would control
- draw a table, or tables, with column headings to show how you would display your readings. You are not required to enter any readings in the table.



Examiner comments

① The candidate draws a workable circuit diagram including the correct circuit symbols.

Example candidate response – middle, continued

~~First , connect the circuit~~

The length of wire should be 50 cm long.

First, connect the connecting lead on the wire and connect the circuit. x Record the length of the wire which is connect into the circuit and the voltage and the current. Use $R = \frac{V}{I}$ to get the resistance of the wire.

Then change the position of the connecting lead and repeat the experiment.

In the experiment, you should not change the ~~wire and the~~ sectional area of the wire and the voltage of the battery. ②

[7]

[Total: 7]

Examiner comments

② The method does not include taking readings of current and potential difference using at least five different lengths.

The candidate correctly suggests that the cross-sectional area of the wire is a variable that should be kept constant.

Total mark awarded =
4 out of 7

How the candidate could have improved the answer

The candidate should have written a clear, brief method to include taking readings of current and voltage, using five or more lengths of wire and suggesting a suitable range of different lengths. Also the candidate should have drawn a table as specified in the question.

Example candidate response – low

4 A student is investigating how the resistance of a wire depends on the length of the wire. The student aims to plot a graph.

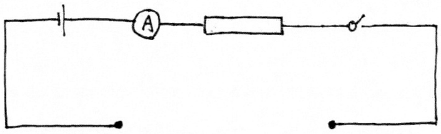
The following apparatus is available to the student:

ammeter
voltmeter
power supply
variable resistor
switch
connecting leads
resistance wires of different lengths
metre rule.

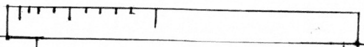
Plan an experiment to investigate how the resistance of a wire depends on the length of the wire.
investigate

You should

- draw a diagram of the circuit you could use to determine the resistance of each wire
- explain briefly how you would carry out the investigation
- suggest suitable lengths of wire
- state the key variables that you would control
- draw a table, or tables, with column headings to show how you would display your readings. You are not required to enter any readings in the table.



1



	Test 1			Test 2		
length/cm	Ammeter (A)	V (V)	R (Ω)	A (A)	V (V)	R (Ω)

Examiner comments

1 The candidate draws an incomplete circuit, but the circuit symbols are correct.

Example Candidate Response – low, continued

Build a circuit like the diagram as shown., place different length of wire at the connecting leads., each one test for twice by change the resistance (variable resistor)., record the ammeter and voltmeter reading., measure its length after testing in the circuit.

During the experiment, make sure each wire only need to test for twice, but different considerable resistance., ~~the~~ other one still need to test at these two resistance.

Then caculate. ②

[7]

[Total: 7]

Examiner comments

② The candidate mentions taking readings of current and voltage but there are no other important aspects of the method given.

The candidate does not state any key variables to control.

Total mark awarded =
2 out of 7

How the candidate could have improved the answer

The candidate should have drawn a complete circuit then written a clear brief method including taking readings of current and voltage, using five or more lengths of wire and suggesting a suitable range of different lengths. Also the candidate should have drawn a table as specified in the question.

Any key variables to control should have been mentioned.

Common mistakes candidates made in this question

Writing a vague method that did not address the task set in the question, drawing an incomplete table (e.g. with units missing) and missing out the description of key variables to control.

Question 5

Example candidate response – high

5 A student is investigating the cooling of water.

Some of the apparatus is shown in Fig. 5.1.

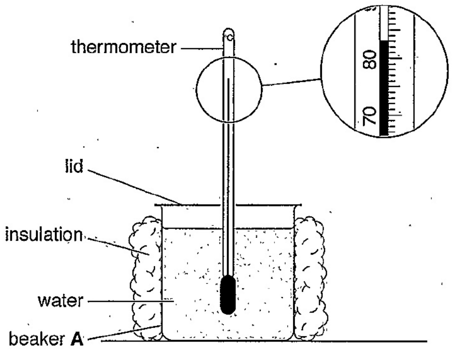


Fig. 5.1

(a) The student pours 200 cm^3 of hot water into a 250 cm^3 insulated beaker labelled **A**. He covers the top of the beaker with a lid.

The student takes a temperature reading every 30 s as the water cools. The readings are shown in Table 5.1.

(i) Complete the column headings in the table. [1]

(ii) The starting temperature θ of the hot water in beaker **A** is shown on Fig. 5.1.

Record this temperature in the table at time t = 0 s. [1]

Table 5.1

	beaker **A** insulation and lid	beaker **B** insulation, no lid	beaker **C** lid, no insulation
t / s	θ / °C	θ / °C	θ / °C ①
0	83 ②	85	78
30	80	79	74
60	77	74	71
90	75	70	68
120	73	67	66
150	71	64	64

Examiner comments

① The column headings are correct.

② The temperature reading is correct.

Mark awarded for (a) (i) = 1 out of 1

Mark awarded for (a) (ii) = 1 out of 1

Example candidate response – high, continued

(b) The student repeats the procedure using a 250 cm^3 beaker labelled **B**. This beaker is insulated but has no lid.

He repeats the procedure again using a 250 cm^3 beaker labelled **C**. This beaker has a lid but no insulation.

All the readings are shown in Table 5.1.

(i) Tick the statement that best describes the results of the investigation.

☐ Removing the lid speeds up the rate of cooling significantly more than removing the insulation.

☐ Removing the insulation speeds up the rate of cooling significantly more than removing the lid.

☑ There is no significant difference between removing the lid and removing the insulation. ③

[1]

(ii) Justify your answer by reference to the readings.

Low difference of changing in temperature

85°C − 79°C = 6°C   78°C − 74°C = 4°C ;   6°C − 4°C = 2°C

④ 74°C − ~~78~~ 70 °C = 4°C   71°C − 68°C = 3°C   4°C − 3°C = 1°C (So the low difference should be include [1]

(c) State two of the conditions that should be kept the same in this experiment in order for the comparison to be fair.

1. Initial ~~Co~~ temperature of hot water

2. ~~Repeat the experiment~~ humidity ⑤

[2]

(d) Suggest a suitable material for the lid. Give a reason for your choice of material.

material wood

reason ~~Because~~ It is a insulator and can keep heat inside the beaker efficiently ⑥

[2]

Examiner comments

③ The candidate has not ticked the first box.

Mark awarded for (b) (i) = 0 out of 1

④ The answer given in part (i) is incorrect so the justification is also incorrect.

Mark awarded for (b) (ii) = 0 out of 1

⑤ Two appropriate conditions that should be kept constant have been suggested.

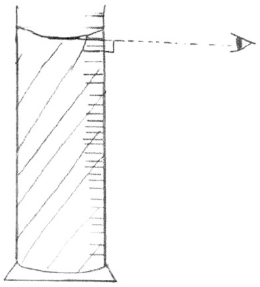
Mark awarded for (c) = 2 out of 2

⑥ The candidate makes a sensible suggestion for the material of the lid and gives a good reason for the choice.

Mark awarded for (d) = 2 out of 2

Example candidate response – high, continued

(e) Describe briefly how a measuring cylinder is read in order to obtain a reliable value for the volume of water. You may draw a diagram.



Eyes should perpendicular to the measuring cylinder's scale of level of water ~~and~~ ⑦

[2]

[Total: 10]

Examiner comments

⑦ The candidate draws a clear and correct diagram giving all the necessary information – measuring to the bottom of the meniscus and viewing the scale at right angles.

Mark awarded for (e) = 2 out of 2

Total mark awarded = 8 out of 10

How the candidate could have improved the answer

(b) The candidate needed to draw the correct conclusion from the results and then justify that conclusion.

Example candidate response – middle

5 A student is investigating the cooling of water.

Some of the apparatus is shown in Fig. 5.1.

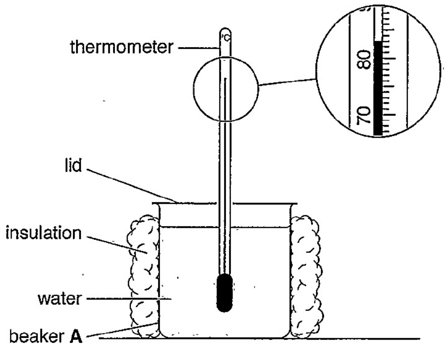


Fig. 5.1

(a) The student pours 200 cm^3 of hot water into a 250 cm^3 insulated beaker labelled **A**. He covers the top of the beaker with a lid.

The student takes a temperature reading every 30 s as the water cools. The readings are shown in Table 5.1.

(i) Complete the column headings in the table. [1]

(ii) The starting temperature θ of the hot water in beaker **A** is shown on Fig. 5.1.

Record this temperature in the table at time t = 0 s. [1]

Table 5.1

	beaker **A** insulation and lid	beaker **B** insulation, no lid	beaker **C** lid, no insulation
t/s	θ/°C	θ/ °C	θ/ °C ①
0	83 ②	85	78
30	80	79	74
60	77	74	71
90	75	70	68
120	73	67	66
150	71	64	64

Examiner comments

① The column headings are correct.

② The temperature reading is correct.

Mark awarded for (a) (i) = 1 out of 1

Mark awarded for (a) (ii) = 1 out of 1

Example candidate response – middle, continued

(b) The student repeats the procedure using a 250 cm^3 beaker labelled **B**. This beaker is insulated but has no lid.

He repeats the procedure again using a 250 cm^3 beaker labelled **C**. This beaker has a lid but no insulation.

All the readings are shown in Table 5.1.

(i) Tick the statement that best describes the results of the investigation.

☐ Removing the lid speeds up the rate of cooling significantly more than removing the insulation.

☐ Removing the insulation speeds up the rate of cooling significantly more than removing the lid.

☑ There is no significant difference between removing the lid and removing the insulation. ③

[1]

(ii) Justify your answer by reference to the readings.

Beaker B and C ~~are~~ have different rates of cooling at the start but then Beaker B's rate gets faster and the become almost same ④ [1]

(c) State two of the conditions that should be kept the same in this experiment in order for the comparison to be fair.

1. Volume of water

2. Initial temperature of water ⑤

[2]

(d) Suggest a suitable material for the lid. Give a reason for your choice of material.

material Rubber

reason Good insulator ⑥

[2]

Examiner comments

③ The first box should have been ticked.

Mark awarded for (b) (i) = 0 out of 1

④ The answer given in part **(i)** is incorrect so the justification is also incorrect.

Mark awarded for (b)(ii) = 0 out of 1

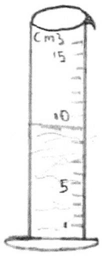
⑤ The candidate suggests one appropriate condition (the initial temperature of the water) that should be kept constant.

Mark awarded for (c) = 1 out of 2

⑥ The candidate makes a sensible suggestion for the material of the lid and gives a good reason for the choice.

Mark awarded for (d) = 2 out of 2

Example candidate response – middle, continued	Examiner comments
(e) Describe briefly how a measuring cylinder is read in order to obtain a reliable value for the volume of water. You may draw a diagram.	



The point at which the top of the water is is read in the scale provided so in this case the volume of the water is 9cm3 ⑦

[2]

[Total: 10]

⑦ The candidate does not show in the diagram or description how to obtain a reliable reading for the volume.

Mark awarded for (e) = 0 out of 2

Total mark awarded = 5 out of 10

How the candidate could have improved the answer

(b) The correct conclusion should have been drawn from the results and then justified that conclusion.

(c) Second valid conclusion should have been stated.

(e) The candidate should have shown in the diagram or description how to obtain a reliable reading for the volume.

Example candidate response – low

5 A student is investigating the cooling of water.

Some of the apparatus is shown in Fig. 5.1.

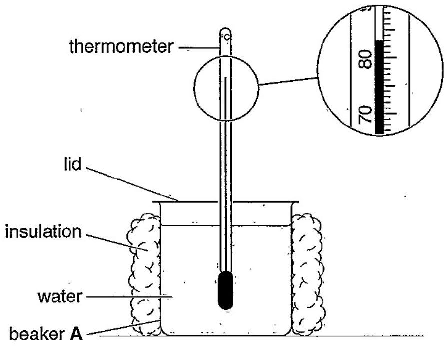


Fig. 5.1

(a) The student pours 200 cm^3 of hot water into a 250 cm^3 insulated beaker labelled **A**. He covers the top of the beaker with a lid.

The student takes a temperature reading every 30 s as the water cools. The readings are shown in Table 5.1.

(i) Complete the column headings in the table. [1]

(ii) The starting temperature θ of the hot water in beaker **A** is shown on Fig. 5.1.

Record this temperature in the table at time t = 0 s. [1]

Table 5.1

	beaker **A** insulation and lid	beaker **B** insulation, no lid	beaker **C** lid, no insulation
t/ S	θ/ cm	θ/ cm	θ/ cm ①
0	83 ②	85	78
30	80	79	74
60	77	74	71
90	75	70	68
120	73	67	66
150	71	64	64

Examiner comments

① The time unit is correct but the candidate writes cm as the unit for temperature.

② The temperature reading is correct.

Mark awarded for (a) (i) = 0 out of 1

Mark awarded for (a) (ii) = 1 out of 1

Example candidate response – low, continued

(b) The student repeats the procedure using a 250 cm^3 beaker labelled **B**. This beaker is insulated but has no lid.

He repeats the procedure again using a 250 cm^3 beaker labelled **C**. This beaker has a lid but no insulation.

All the readings are shown in Table 5.1.

(i) Tick the statement that best describes the results of the investigation.

☐ Removing the lid speeds up the rate of cooling significantly more than removing the insulation.

☑ Removing the insulation speeds up the rate of cooling significantly more than removing the lid.

☐ There is no significant difference between removing the lid and removing the insulation. ③

[1]

(ii) Justify your answer by reference to the readings.

Because in beaker C, ~~w~~ you can see the result and temperature going down much faster than Beaker B. ④ [1]

(c) State two of the conditions that should be kept the same in this experiment in order for the comparison to be fair.

1. ~~I~~ Surrounding temperature should be kept same /normal at all times.

2. Size of the beaker ~~used~~. that is used. ⑤

[2]

(d) Suggest a suitable material for the lid. Give a reason for your choice of material.

material Glass.

reason In-expensive and it also catches water droplets. ⑥

[2]

Examiner comments

③ The candidate has not ticked the correct box.

Mark awarded for (b) (i) = 0 out of 1

④ The answer given in part (i) is incorrect so the justification is also incorrect.

Mark awarded for (b) (ii) = 0 out of 1

⑤ The candidate suggests one appropriate condition (room temperature) that should be kept constant.

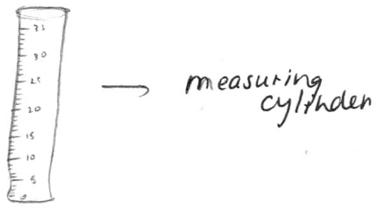
Mark awarded for (c) = 1 out of 2

⑥ The candidate does not suggest a suitable material in the context of the experiment in a school laboratory.

Mark awarded for (d) = 1 out of 2

Example candidate response – low, continued

(e) Describe briefly how a measuring cylinder is read in order to obtain a reliable value for the volume of water. You may draw a diagram.



water is filled inside measuring cylinder. The readings will be given and there are proper divisions in the cylinder you you to obtain a much more accurate reading ⑦ [2]

[Total: 10]

Examiner comments

⑦ The candidate does not show in the diagram or description how to obtain a reliable reading for the volume.

Mark awarded for (e) = 0 out of 2

Total mark awarded = 3 out of 10

How the candidate could have improved the answer

(a) The unit of temperature ºC was required.

(b) The candidate should have arrived at the correct conclusion from the results and then justify that conclusion.

(c) Second valid condition was not stated.

(d) The candidate should have suggested a suitable material and reason, in the context of a school laboratory.

(e) The candidate needed to show in the diagram or description how to obtain a reliable reading for the volume.

Common mistakes candidates made in this question

- Drawing the wrong conclusion in part **(b)**.
- Writing a vague answer for one of the conditions that should be kept the same.

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