

PHYSICS

Paper 0625/11
Multiple Choice (Core)

<i>Question Number</i>	<i>Key</i>	<i>Question Number</i>	<i>Key</i>
1	A	21	D
2	B	22	D
3	C	23	C
4	A	24	A
5	C	25	A
6	C	26	D
7	D	27	D
8	A	28	C
9	D	29	A
10	C	30	B
11	A	31	D
12	D	32	B
13	A	33	C
14	A	34	C
15	A	35	A
16	D	36	D
17	A	37	B
18	D	38	A
19	A	39	D
20	D	40	A

Key Messages

Candidates found the paper quite challenging.

General Comments

Candidates answered questions **3, 9, 12, 27** and **37** well. However they found questions **2, 7, 10, 18, 29, 33** and **40** much more difficult.

Comments on Specific Questions

Question 2

The question was not answered well, with relatively few candidates recognising that the acceleration of free fall does not change as an object falls. The majority of candidates were under the impression that the acceleration would fall to half the value when the ball had fallen through half its initial height.

Question 7

Very few candidates showed a clear understanding of the absence of a resultant force leading to constant motion/velocity.

Question 10

The question was not done well. It is clear that candidates looked at the raw data given in the question without taking into account the units in which they were measured. The masses in the responses **C** and **D** need to be multiplied by g in order to find the force required to lift them.

Question 13

A significant number of candidates thought the syringe contained a liquid only, not recognising that liquids are (virtually) incompressible.

Question 15

The question was not done well. The majority of candidates incorrectly deduced that option **D** showed the position of the bridge at the hottest part of the day. Also there was evidence of a fair amount of guessing.

Question 18

The majority of candidates failed to recognise that copper, as a good conductor, conducts the energy away from the point of heating, thereby keeping the paper cooler. It also suggests that few candidates have seen the experiment carried out.

Question 19

This question also caused problems for a lot of candidates. The concept of a wave passing through a gap causing diffraction and the effect of the width of the gap and the size of the wavelength on the spreading of the wavefronts, did not seem familiar to a significant number of candidates.

Question 29

This question was not done well. Over 50% of candidates applied the formula ($V = IR$) without realising that the resistance used must be the total resistance in the series circuit.

Question 32

Many candidates showed they did not understand the principles of the potentiometer.

Question 33

Many candidates did not appear to be familiar with the properties of the light dependent resistor.

Question 36

Very few candidates knew the use of a relay and there was evidence of large scale guessing.

Question 40

The understanding of the randomness of radioactive decay is not easy and this was confirmed by the range of responses shown.

PHYSICS

Paper 0625/12
Multiple Choice (Core)

<i>Question Number</i>	<i>Key</i>	<i>Question Number</i>	<i>Key</i>
1	C	21	A
2	B	22	D
3	C	23	C
4	D	24	A
5	B	25	A
6	B	26	C
7	C	27	A
8	A	28	A
9	B	29	C
10	D	30	C
11	D	31	C
12	C	32	B
13	A	33	B
14	B	34	C
15	B	35	D
16	D	36	D
17	D	37	B
18	C	38	B
19	C	39	A
20	D	40	C

Key Messages

Candidates found the paper quite challenging.

General Comments

Candidates answered questions **1, 3, 14, and 28** well. However, they found questions **4, 8, 12, 17, 32, 35, 36 and 39** much more difficult.

Comments on Specific Questions

Question 4

This question caused major problems with candidates showing little understanding. There was also evidence that the manipulation of the formula $\text{weight} = \text{mass} \times g$ was too difficult for most candidates.

Question 6

Although nearly half the candidates got the correct answer, it is disappointing that over thirty percent forgot to subtract the mass of the measuring cylinder from the total mass in order to find the mass of liquid.

Question 7

Some candidates did not read the question carefully. The backward arrow was clearly longer than the forward arrow meaning that the car must be slowing down.

Question 8

This is the hardest question on the paper. The majority of candidates either thought that F must be equal to the downward force at the 70 cm mark (3.0 N) or they multiplied the 70 cm by 3.0 N and divided by 80 cm.

Question 11

It is point **Q** that moves towards the surface, thus the pressure decreases as it moves upwards.

Question 12

The question was not done well. Nearly eighty per cent of candidates failed to recognise that if one column falls by 40 mm and the other column rises by 40 mm then the difference in heights would be 80 mm.

Question 15

The question was not done well. The majority of candidates incorrectly deduced that option **D** showed the position of the bridge at the hottest part of the day.

Question 17

The question was not done well. The majority of candidates failed to recognise that copper, as a good conductor, conducts the energy away from the point of heating, thereby keeping the paper cooler. It also suggests that few candidates have seen the experiment carried out.

Question 27

Candidates should understand that to magnetise the bar it must be in a strong magnetic field and this can be supplied by a current carrying coil surrounding the bar.

Question 32

A large majority showed they did not understand the principles of the variable potentiometer.

Question 36

A few candidates showed an understanding of the workings of an electric motor.

Question 39

Very few candidates understood this question.

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Paper 0625/13
Multiple choice (Core)

<i>Question Number</i>	<i>Key</i>	<i>Question Number</i>	<i>Key</i>
1	C	21	A
2	C	22	D
3	C	23	A
4	D	24	C
5	A	25	A
6	C	26	A
7	B	27	B
8	B	28	A
9	C	29	D
10	D	30	B
11	D	31	A
12	C	32	B
13	D	33	A
14	A	34	C
15	C	35	B
16	D	36	D
17	C	37	A
18	D	38	B
19	A	39	A
20	D	40	C

Key Messages

Candidates found the paper quite challenging.

General Comments

Candidates answered questions **3, 4, 9, 10, 13** and **28** well. However they found questions **5, 12, 18, 29, 31, 32, 33, 36** and **39** much more difficult.

Comments on Specific Questions

Question 7

There was a significant minority of candidates who simply added the magnitudes of the two forces, without recognising that they acted in opposite directions to each other.

Question 12

This question was not done well with the majority of candidates not recognising that pressure is force divided by area not mass divided by area.

Question 18

The question was not done well. The majority of candidates failed to recognise that copper, as a good conductor, conducts the energy away from the point of heating, thereby keeping the paper cooler. It also suggests that few candidates have seen the experiment carried out.

Question 27

This question was not done well. Candidates did not seem to have a great knowledge of the similarities/differences between the properties of permanent and electro-magnets and there was evidence of a fair amount of guessing.

Question 29

This proved to be the most difficult question on the paper. Candidates need to recognise that the current in a series circuit is found by dividing the e.m.f. of the source by the total resistance in the circuit. From that the potential difference across each component can be found by multiplying that current by the resistance of each component.

Question 31

Many candidates showed their lack of understanding of parallel circuits by thinking that more power would be produced when only one of the switches is closed. The concept that each pathway is unaffected by the other pathways means that the more pathways that are available means that there is most current (and therefore power) when all the pathways are available.

Question 32

A large majority of candidates showed they did not understand the principles of the potentiometer.

Question 36

Very few candidates knew the use of a relay.

Question 39

The question caused some difficulty. The question tested candidates' knowledge of safety when using radioactive isotopes. The key points are the thickness of a dense material between the source and the staff and the distance between the staff and the source and their effect on the dose received by the staff.

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Paper 0625/21
Multiple Choice (Extended)

<i>Question Number</i>	<i>Key</i>	<i>Question Number</i>	<i>Key</i>
1	A	21	D
2	B	22	A
3	B	23	A
4	C	24	D
5	C	25	A
6	D	26	C
7	C	27	C
8	B	28	A
9	A	29	D
10	A	30	C
11	C	31	B
12	C	32	B
13	C	33	C
14	A	34	D
15	B	35	C
16	D	36	D
17	C	37	B
18	D	38	B
19	B	39	A
20	D	40	B

Key Messages

Many candidates attempted the questions on this paper successfully.

General Comments

There were some outstanding papers where candidates showed knowledge and understanding across the whole range of the syllabus. Candidates answered questions **1, 4, 5, 13, 14, 27, 28** and **37** well. However, they found questions **7, 8, 9, 18** and **29**, much more difficult.

Comments on Specific Questions

Question 7

The question really tested candidates' depth of understanding of dynamics. The ball was described as falling at its terminal velocity, thus it had zero resultant force acting in a vertical direction. Consequently the resultant force acting on the ball when the wind blew was this horizontal force. Very few candidates showed this depth of understanding.

Question 8

This question, despite appearing relatively straightforward caused a great deal of difficulty. The distractors were evenly chosen across the range.

Question 9

This was another question which was not answered well with many candidates failing to include the momentum of the embedded bullet in their reasoning.

Question 18

The question was not done well. The majority of candidates failed to recognise that copper, as a good conductor, conducts the energy away from the point of heating, thereby keeping the paper cooler. It also suggests that few candidates have seen the experiment carried out.

Question 19

This question was challenging for a lot of candidates. Many did not fully understand the dependence of the spreading of the wavefronts on the narrowness of the gap and the wavelength of a wave.

Question 29

The question was very demanding. Candidates did not recognise that doubling the diameter increases the cross sectional area, hence decrease the resistance by a factor of 4. This increase in area will cause the length, to also decrease by a factor of 4, giving an overall decrease in resistance of $4 \times 4 = 16$.

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Paper 0625/22
Multiple Choice (Extended)

<i>Question Number</i>	<i>Key</i>	<i>Question Number</i>	<i>Key</i>
1	A	21	D
2	B	22	A
3	C	23	A
4	B	24	B
5	B	25	C
6	B	26	C
7	C	27	A
8	A	28	B
9	C	29	D
10	A	30	D
11	B	31	A
12	D	32	B
13	C	33	B
14	A	34	B
15	D	35	D
16	A	36	A
17	D	37	B
18	D	38	C
19	B	39	A
20	C	40	C

Key Messages

Many candidates attempted the questions on this paper successfully.

General Comments

There were many truly outstanding papers where candidates showed knowledge and understanding across the whole range of the syllabus. Candidates answered questions **1, 2, 3, 4, 5, 12, 13, 14, 27, 28, 34** and **37** really well. There were only a few questions which caused difficulties for more than a minority, these included questions **9, 18, 19, 29, 32** and **36**.

Comments on Specific Questions

Question 9

Although the majority of the candidates did correctly answer this there was a considerable minority who had problems. The variety of responses given by the unsuccessful candidates suggests that there was a significant amount of guessing.

Question 18

The ideas in this experiment are not easy and the majority of candidates failed to recognise that copper, as a good conductor, conducts the energy away from the point of heating, thereby keeping the paper cooler.

Question 19

This question was challenging for a lot of candidates. Many did not fully understand the dependence of the spreading of the wavefronts on the narrowness of the gap and the wavelength of the wave.

Question 29

This was a challenging question. Candidates are expected to know that it is the movement of electrons (negative charges) which causes the charging of a body. The common error in this example was to forget this fact and think that both the negative and positive charges move.

Question 32

There was some confusion here and although the majority correctly identified response **B**, a significant number thought that the p.d. across the voltmeter was 12 V wherever the flying lead was connected. Others thought that the p.d. was 12 V when connected to point R and 0 V when connected to point **S**.

Question 36

This question proved challenging for many candidates with option D understandably proving to be the most popular distractor.

Question 39

Many candidates showed an incomplete understanding of the random nature of the radioactive decay of atoms.

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Paper 0625/23
Multiple Choice (Extended)

<i>Question Number</i>	<i>Key</i>	<i>Question Number</i>	<i>Key</i>
1	A	21	D
2	C	22	A
3	C	23	A
4	B	24	B
5	C	25	C
6	B	26	D
7	B	27	A
8	D	28	A
9	C	29	A
10	C	30	C
11	B	31	B
12	D	32	B
13	C	33	A
14	A	34	D
15	A	35	C
16	D	36	D
17	C	37	A
18	D	38	A
19	B	39	A
20	A	40	B

Key Messages

Many candidates attempted the questions on this paper successfully.

General Comments

There were some outstanding papers where candidates showed knowledge and understanding across the whole range of the syllabus. Candidates answered questions **1, 4, 6, 9, 12, 13, 14, 27, 33** and **38** well. However, they found questions **3, 8, 10, 18, 32, 35** and **40** much more difficult.

Comments on Specific Questions

Question 3

Many candidates did not think this through properly. The starting point was to recognise that the speed of an object is given by the gradient of the speed – time graph. Once this is established then all that needs to be done is to look for a graph whose gradient decreases as time goes by.

Question 8

This question was challenging for many candidates. The majority thought that response **A** was correct. However, using this method of adding vectors, the component vectors must go round the triangle in the same sense, whereas the resultant vector, which closes the triangle, has the opposite sense.

Question 9

The question is not easy, nevertheless a large majority of candidates recognised that the largest resultant force (when all the resultant forces move the same distance) will do the most work and hence give that body the most kinetic energy.

Question 10

The question proved more difficult than expected. Candidates did not recognise that a body with an initial velocity $2v$ will have four times the kinetic energy of the same body when it has a velocity v . If this kinetic energy is converted into gravitational potential energy then it will reach a height of four times the height of the original ball.

Question 18

The question was not done well. The majority of candidates failed to recognise that copper, as a good conductor, conducts the energy away from the point of heating, thereby keeping the paper cooler. It also suggests that few candidates have seen the experiment carried out.

Question 19

This question was challenging for a lot of candidates. Many did not fully understand the dependence of the spreading of the wavefronts on the narrowness of the gap and the wavelength of the wave.

Question 32

There was some confusion here and although a third correctly identified response **B**, marginally more thought that the p.d. across the voltmeter was 12 V wherever the flying lead was connected. Others thought that the p.d. was 12 V when connected to point R and 0 V when connected to point **S**.

Question 35

The majority of candidates appeared to be under the misconception that a split ring commutator is used in an a.c. generator.

Question 40

This question was made more challenging by the introduction of the background count rate. A large majority of candidates totally ignored this information, whereas, they should have subtracted the background count from both the initial measured count rate and the measured count rate when a half-life has been reached.

PHYSICS

Paper 0625/31 Core Theory
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Key messages

The question paper's layout was the same as that used in previous years. The candidates generally appeared to have been prepared well for the examination. Many of the higher scoring candidates demonstrated well their ability to apply their knowledge and understanding of physics to a variety of contexts across the Core syllabus. There was no evidence of candidates having insufficient time to complete the questions. However, there were a higher proportion of questions that had no response, particularly from candidates who were less well prepared. There was also a significant number of cases where candidates gave responses that may have been rote learned but did not address the question asked. These candidates would benefit from further opportunities to apply their knowledge and understanding to a wider variety of contexts and to develop their skills in responding to examination questions.

When completing questions requiring calculations, candidates should be encouraged to set out and explain the stages in their working clearly. Examiners will often be able to give partial credit to candidates who clearly show the stages in their working even if the final answer is incorrect. The adoption of this routine will help candidates achieve higher marks. Candidates who give only the answer risk the loss of all marks allocated to the question if their answer is incorrect.

General comments

A high proportion of candidates scored well on all questions demonstrating that teachers have a sound appreciation of the syllabus requirements and that candidates had been taught and prepared well for this paper. There were a small but significant number of candidates who scored over 90 per cent of the available marks. In some cases, entry decisions should be reviewed as the very highest scoring candidates may have benefitted from being prepared and entered for the Extended Theory paper.

All but the lowest scoring candidates used and applied standard equations well, such as those used for pressure and speed. Clearly candidates are being given opportunities to practice answering numerical questions and are well prepared for examination questions of this type. However, in some cases candidates lost marks for providing a value that was incorrect without showing the stages in their solution or more commonly for omitting or using an incorrect unit. All candidates should be encouraged to show the equation they are using and the calculation they are going to undertake to ensure that they gain partial credit for any incorrect values. They should also check to ensure that a sensible unit is stated.

In a small number of cases candidates left parts of a question unanswered, suggesting that topics had not been covered well or that candidate's knowledge and understanding was less than secure. Rather surprisingly **Question 11(b)(ii)** that required candidates to add a voltmeter symbol to a circuit was often not attempted.

In very few cases were candidate's responses to parts of a question illegible so that credit could not be given.

Teachers are reminded that the information included in published mark schemes is not intended to act as model answers to the questions asked.

Comments on specific questions

Question 1

- (a) Many correct responses. A common incorrect response was measuring cylinder instead of ruler
- (b) Answered well by better prepared candidates. Most candidates scored at least two marks. Common errors were incorrect units, for example, depth being measured in cm^3 . Marks were also lost for labelled axes in the wrong place.
- (c) Answered well by better prepared candidates. A common incorrect response was 0.025 m.

Question 2

- (a) Answered well by almost all candidates. A small but significant number of candidates lost the mark for not including a unit.
- (b) The majority of candidates scored at least two marks. A very common incorrect response that gained partial credit was 375 m.
- (c) Many candidates gained full credit for this question.

Question 3

- (a) Many correct responses. A common incorrect response was 37.5 N.
- (b) (i), (ii) Higher scoring candidates gained full credit. There were many partially correct responses to the calculation. A common error was the incorrect unit N/m.
- (iii) Many correct responses.

Question 4

- (a) Middle and higher scoring candidates gave a correct response. Common incorrect responses included chemical energy and renewable energy.
- (b) Full credit was obtained by middle and higher scoring candidates. Lower scoring candidates often described the diagram.
- (c) Many partially correct responses indicating thermal or sound energy. Few scored the second mark. Common misconceptions included answers in terms of renewable energy or the energy had 'evaporated'.
- (d) Many correct responses.

Question 5

- (a) Many correct responses.
- (b) This question was well answered by many middle and higher scoring candidates. Many candidates gained partial credit having applied the correct equation using incorrect values. **Part (ii)** was well answered by nearly all candidates.

Question 6

- (a) Well answered by all but the least well-prepared candidates. This is an area of the syllabus that is understood well by candidates.
- (b) Well answered by all but the least well-prepared candidates. Condensation was a common error.

Question 7

- (a) Correct responses from nearly all candidates.
- (b) Many correct responses.
- (c) Few correct responses. Very common incorrect responses were cancer and cell mutation.

Question 8

- (a) Many correct responses.
- (b) There were few credit worthy responses. Many candidates gave vague responses that repeated the question, for example 'radiations that cause ionization'.
- (c) Many correct responses.
- (d) Well answered by only the best prepared candidates. Common incorrect responses were 30 and 60 hours.

Question 9

- (a) Well answered by nearly all candidates.
- (b)(i) Well answered by nearly all candidates.
- (b)(ii) Many candidates scored one of the available marks. A common misconception was that the speed of sound changed when reflecting off an object.
- (c) This question was well answered by only the better prepared candidates. Many candidates gained partial credit for showing their approach.

Question 10

- (a) Middle and higher scoring candidates gained at least partial credit for recognising the attraction between the two magnets in **part (i)**. Very few gained full credit for **part (ii)**. A common misconception was that the magnets would attract.
- (b)(i) Many partially correct responses. A significant number of candidates confused magnetism with electrostatics gaining no credit.
- (b)(ii) Many responses that gained partial credit.

Question 11

- (a) Very few credit worthy responses. Most answers were in terms of chemical to electrical energy.
- (b)(i) Many correct responses. A common incorrect response was voltmeter.
- (b)(ii) A high proportion of candidates did not respond to this question. Rather surprisingly, few gave an answer that gained full credit.
- (b)(iii) Many correct responses.

Question 12

- (a) Well answered by the better prepared candidates. A common error by less well-prepared candidates was the inclusion of a power supply in their diagrams.
- (b) Many candidates gained at least one mark for increasing the number of coils.

PHYSICS

Paper 0625/32 Core Theory
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Key messages

Apart from normal aspects of learning, there were three further aspects where candidates could have improved their performance.

- In calculations, candidates must set out and explain their working correctly. If poor or no working is shown by the candidate and it leads to the correct answer, the examiner may be able to give credit due to the merit of the work. However, when a candidate gives a wrong final answer and no working is shown, it is often impossible for the examiner to give due reward for those parts that are correct.
- Greater clarity and precision when answering questions requiring a description or explanation.
- It is important that candidates read the questions carefully in order to understand exactly what is being asked.
- In order to improve their performance candidates should practise applying their knowledge to new situations by attempting questions in support materials or exam papers from previous sessions.

General comments

A high proportion of candidates were well prepared for this paper. Equations were generally well known by better and by slightly below average candidates but a significant number struggled to even recall the equations.

Often candidates had been well taught how to apply their knowledge and understanding to fairly standard situations. On occasions, when asked to apply their knowledge to a new situation, they could become confused and display a lack of breadth of understanding. More successful candidates were willing to think through the possibilities and apply their knowledge when the question asked for suggestions to explain new situations. Less successful candidates found difficulty in applying their knowledge to new situations; they did not show the stages in their working and did not think through their answers before writing.

The questions on centre of timing, convection, gas pressure and circuit diagrams were generally not well answered by candidates. There were a significant number of candidates who either did not read the questions carefully, or gave answers that were related to the topic being tested, but did not answer the question.

The English language ability of the majority of the candidates was adequate for the demands of this paper. There were a very small number of candidates, who struggled to express themselves adequately.

Comments on specific questions

Question 1

- (a) The vast majority of candidates scored this mark. Weaker candidates gave vague responses such as ruler or tape.
- (b)(i) A surprising number of candidates merely copied the image instead of giving the correct answer of 58.75 seconds.
- (ii) With the error carried forward in the mark scheme, the vast majority of candidates scored both marks. Weaker candidates used $\text{speed} = \text{time} \div \text{distance}$.

- (iii) A surprising number of candidates failed to study the diagram carefully, and failed to convert minutes to seconds.

Question 2

- (a) (i) The majority of candidates scored this mark. However, a surprising number tried to use $\text{density} = \text{mass} \div \text{volume}$ rather than subtracting masses.
- (ii) With ecf from part (i) the majority of candidates scored two or three marks. Common errors were using $\text{density} = \text{volume} \times \text{mass}$, and either omitting or inserting an incorrect unit.
- (b) The majority of candidates gave sensible answers relating to the density of the brush and the paint. Weaker candidates suggested that the brush was lighter than the paint.

Question 3

- (a) The vast majority of candidates scored this mark. A number of candidates still used $g = 9.81 \text{ N / kg}$. A common error was to state $\text{weight} = \text{mass} \div g$.
- (b) (i) Most candidates correctly calculated the moment of the sunshade about the pivot. A common error was to divide the force by the distance, or to convert the force to kilograms.
- (ii) The vast majority of candidates scored this mark.

Question 4

- (a) (i) The vast majority of candidates answered this question correctly. Only the weakest candidates gave answers such as sunlight.
- (ii) Most candidates scored full marks on this question. Weaker candidates thought that the higher temperature was due to black being a better conductor of thermal energy.
- (b) Most candidates gave clear explanations for the movement of air around the room, with many candidates scoring full marks. Weaker candidates gave statements such as colder, less dense air falls, or warm air rises because it is more dense.

Question 5

- (a) Many candidates found this question difficult. A lack of clarity in responses meant scores were very low. Many candidates talked about collisions, but failed to qualify this with detail about collisions on the inside of the packet.
- (b) Many candidates scored one or both marks. Weaker candidates thought the factors were force and area.
- (c) (i) The majority of candidates recognised the barometer.
- (ii) The vast majority of candidates scored one or two marks, but only the most able correctly calculated the pressure of the gas supply.

Question 6

- (a)(i),(ii) The majority of candidates scored one or two marks, and it was pleasing to see that most candidates used a ruler in their ray diagram.
- (iii) Many candidates failed to score through simply giving the name of the law rather than stating it in full.
- (iv) Many candidates lost marks through giving explanations that were too vague, such as the mirror reflects the light.

- (b)(i),(ii)** Many candidates scored full marks. Common mistakes were to have a refracted ray in glass away from the normal, or to merely draw a reflected ray.

Question 7

- (a)(i)** The majority of candidates scored both marks, but a surprising number merely repeated some of the regions already labelled in the diagram.
- (ii)** Most candidates scored both marks, and a significant number scored one mark through having the correct terms interchanged.
- (b)** Many candidates scored this mark. A common error was to state that sound waves are transverse waves.
- (c)** Many students scored three or four marks for this question. Weaker candidates lost marks by failing to give enough detail in their descriptions.

Question 8

- (a)** Most candidates were able to draw the shape of the magnetic field around the bar magnet, but a significant number failed to give the correct direction of the field or had contradictory arrows on their lines of force.
- (b)** Many candidates gave clear descriptions, but a significant number attempted to describe electromagnetic induction.
- (c)** The majority of candidates correctly selected steel, with many others selecting soft iron, and a few selecting copper.

Question 9

- (a)** The majority of candidates scored both marks. It is important that candidates follow instructions on labelling given in the question.
- (b)** Most candidates gave two clear methods of increasing the forces on the sides of the coil. Weaker candidates gave vague responses such as use a bigger battery.
- (c)(i)** Most candidates scored this mark, but a significant number of candidates gave answers such as protons, alpha particles, and copper was another common response.
- (ii)** Many candidates scored both marks. A significant number stated that the current would decrease, but failed to give a correct explanation for this. Another group of candidates thought that the current would increase due to a decrease in resistance.

Question 10

- (a)** Many candidates scored two or three marks, but significant numbers failed to score through vague and unclear descriptions of the errors in the student's circuits.
- (b)(i)** Most candidates were able to describe how the brightness of light in the room affected the resistance of the LDR. Weaker candidates failed to mention resistance, with statements such as the more light in the room, the lower the LDR.
- (ii)** Many candidates scored full marks, but a significant number failed to select a resistance from the graph. Others used $R = I \div V$.

Question 11

- (a) The majority of candidates gave a clear explanation of the purpose of a fuse. Weaker candidates appeared to confuse a fuse with a variable resistor, with statements such as it controls the amount of current reaching the television.
- (b) (i) Most candidates scored this mark. A common error was to state the metal was soft iron.
- (ii) The majority of candidates scored full marks. Most candidates who wrote down the correct equation often went on to score full marks. Candidates who tried some form of cross multiplication often failed to score any marks.

Question 12

- (a) (i),(ii) The majority of candidates identified the name of and the charge on the particle. A common error was to call particle X an electron, and a few gave the name alpha particle.
- (iii) Many candidates correctly identified the isotope of lithium.
- (b) The vast majority of candidates scored either one or two marks for this question. Weaker candidates thought that the mass would either double or quadruple.

PHYSICS

Paper 0625/33 Core Theory
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Key messages

Apart from normal aspects of learning, there were three further aspects where candidates could have improved their performance.

- Practise applying their knowledge to new situations by attempting questions in support materials or exam papers from previous sessions.
- In calculations, candidates must show clear working to support their answers. If unclear or no working is shown by the candidate and it leads to the correct answer, due credit may be given for the numerical answer. However, when a candidate makes an error that leads to an incorrect numerical answer and no working is shown, marks for the method may not be awarded.
- Greater care and accuracy when drawing diagrams. In all instances ray diagrams must be drawn using a rule or straight edge.

General comments

A high proportion of candidates had clearly been well taught and prepared for this paper. Equations were generally well known by better and by slightly below average candidates but many struggled when required to rearrange the equations.

The questions on the waves, electrostatics and radioactivity topics were generally not well answered by candidates. There were a significant number of candidates who either did not read the questions carefully, or gave answers that were related to the topic being tested, but did not answer the question.

Often candidates had been well taught how to apply their knowledge and understanding to fairly standard situations. On occasions, when asked to apply their knowledge to a new situation, they could become confused and display a lack of breadth of understanding. More successful candidates were willing to think through the possibilities and apply their knowledge when the question asked for suggestions to explain new situations.

The English language ability of the vast majority of the candidates was adequate for the demands of this paper. However, there was a small minority who struggled to express themselves adequately.

Comments on specific questions

Question 1

- (a) The majority of candidates described two ways of improving the accuracy of the measurement. However, a significant number lost marks through vague and inaccurate statements.
- (b) The majority of candidates were able to describe a method of calculating the thickness of a sheet of paper. Weaker candidates gave confused statements such as dividing the number of pages by the thickness of the book.
- (c) The majority of candidates scored three or four marks. Common errors were to divide mass by 10, failing to convert grams to kilograms, and the omission or use of an incorrect unit.

Question 2

- (a) Many candidates scored this mark. The most common error was electrical closely followed by potential energy.
- (b)(i) The majority of candidates scored full marks. The most common error was to divide the distance from the pivot by the force.
- (ii) Many candidates struggled with this question. Only the most able linked ideas such as chemical energy transferred from the student is stored as gravitational potential energy in the lid of the laptop.
- (c) The majority of candidates gave two advantages of the solar panel over the mains electrical supply. Weaker candidates gave vague descriptions for renewal energy sources such as eco-friendly or better for the environment; these did not score.
- (d) Many candidates realised that the solar panel would take longer to recharge the battery.

Question 3

- (a) (i),(ii),(iii) The majority of candidates scored these marks.
- (iv) Most candidates were able to calculate the average speed of the car. Weaker candidates attempted to calculate the area under the graph, with little success.
- (b) The majority of candidates scored both marks. Weaker candidates described the difference in speed but failed to go on to explain how the graph showed the difference in speed.

Question 4

- (a) Many candidates correctly calculated the force on the road from the tyre. The most common error was to use $\text{force} = \text{pressure} \div \text{area}$.
- (b) Many candidates scored marks by referring to collisions between molecules, but only the most able referred to collisions with the walls of the tyre.

Question 5

- (a) The majority of candidates were able to complete the flow chart. A common mistake was to reverse the positions of statements A and F.
- (b) Many candidates scored both marks, but a disappointing number gave vague or unclear statements which failed to score.
- (c) Candidates found this surprisingly difficult, with many giving vague statements such as “it explains how well it works”.

Question 6

- (a) The majority of candidates scored two or three marks. A surprising number of candidates failed to use the three terms given to label the three diagrams.
- (b)(i),(ii) Many candidates scored both marks, but a significant number lost marks through failing to indicate distances accurately.
- (c) Many candidates scored both marks. It was pleasing to see most candidates showing a correct refraction at the centre of the lens. Unfortunately there are still some candidates who attempt to complete a ray diagram without the use of a ruler.

Question 7

- (a) The majority of candidates correctly indicated the directions of vibrations. Only a small minority gave directions at right angles to the direction of wave travel.
- (b) The majority of candidates scored this mark. The most common errors were water and steel.
- (c) (i) Many candidates gave a suitable value for frequency, but failed to give the correct unit.
(ii) Most candidates gave a correct meaning for ultrasound.

Question 8

- (a) The majority of candidates scored two marks, with lamps correctly connected in parallel, and correct symbols for switches drawn. Very few candidates added variable resistors to the circuit.
- (b) The majority of candidates gave good descriptions of the purpose of switch X.
- (c) A surprisingly large number of candidates could not identify component Y as a fuse, and even fewer gave adequate descriptions of how the fuse works.

Question 9

- (a) A surprisingly large number of candidates thought that tin would be attracted to the magnet, and that a magnet would have no effect on a bar of unmagnetised iron.
- (b) Many candidates gave good descriptions of the differences in magnetic properties of soft iron and steel.

Question 10

- (a) Most candidates gave correct names for the two coils. Only the weakest candidates referred to them as top and bottom coils.
- (b) The majority of candidates correctly determined the output voltage of the transformer. These candidates usually started by writing down the transformer equation. Candidates who tried to use some form of cross multiplication met with little success.

Question 11

- (a) Many candidates produced good representations of the magnetic field in and around the coil. Many candidates, however, gave the wrong or contradictory directions of the magnetic field.
- (b) (i),(ii) The majority of candidates recognised the electromagnet, and most of these went on to give a correct use of electromagnets.

Question 12

- (a) Many candidates gave clear descriptions of how to identify alpha and beta particles, but a significant number lost marks through vague or unclear statements in their descriptions.
- (b) Many candidates scored full marks on this question. Weaker candidates tended to confuse the location of the electron and the neutron, and the charge on the neutron and the proton. There were very few candidates who failed to answer this question, indicating that the time for the paper was adequate.

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Key messages

Candidates are advised to make sure that they read the questions thoroughly before beginning their answers and to be aware of the different meanings and what is required in the answer by terms such as state, explain and calculate, as indicated in the syllabus.

They should also check that they have included a unit where needed in numerical answers and that it is the correct unit.

General comments

There was no evidence that the time allowed to complete the paper was insufficient. Most candidates omitted very few, if any, questions.

On the whole the standard of handwriting was higher than it had been in previous years and candidates wrote numbers clearly.

The numerical work was generally good but the answers to non-numerical questions were more varied.

Some candidates struggled with giving an appropriate answer when they were asked to 'explain what is meant by...' often just stating a formula in symbols or words. They should be encouraged to describe the concepts rather than write down a mathematical expression. This applied particularly in **Question 1(a)**, **3(a)(i)** and **7(a)**.

Comments on specific questions

Section A

Question 1

This question enabled most candidates to make a good start on the paper.

- (a) Many candidates were successful with the idea of 'rate of decrease of speed/velocity' or 'negative acceleration'. Some candidates, in an attempt to answer more fully, confused their answer by referring to 'decreasing acceleration'.
- (b)(i) Many candidates were able to correctly calculate the area under the graph or at least part of the area. Some mistakes in reading the scale of the graph or making errors in calculation of the area were made. Candidates are advised to write down 'distance = area under graph' instead of going straight to inserting numerical values. By doing that they are assured of at least the first mark.
- (ii) Even more candidates were awarded both marks for this question. Again, candidates should be advised to write down an equation before substituting numbers.
- (c) In both **Parts (i)** and **(ii)** a one word answer was all that was required. Sometimes candidates went on to give more information which meant the mark wasn't awarded, for example stating that deceleration decreases until the body has a constant speed. Many candidates gave the answer to **(ii)** as increases, assuming that it would be the opposite of **(i)** instead of appreciating that $F = ma$.

Question 2

- (a) (i) Some candidates could correctly calculate the impulse and use correct units. The concept of impulse was not generally well understood, with many candidates just equating it to change of momentum, which generally led nowhere as the mass wasn't given in the stem of the question. A common mistake in unit was N/s instead of the correct N s.
- (ii) Some candidates unable to answer (i) could answer this part as now the equation to use was impulse = change in momentum. Some candidates were successful using $F = ma$ and $a = (v-u)/t$. A common error was to attempt to use just $F = ma$ with a value of 10 m/s^2 .
- (iii) This part of the question proved to be more testing. If candidates recognised that they needed to use KE lost = PE gained they were often successful in obtaining both marks though there were some errors in use of the formulae: failing to square the speed was one error. Candidates who attempted to use distance = average speed $\times$ time often used the time taken to kick the ball instead of the time to reach its highest point. Some candidates used equations of motion such as $v^2 = u^2 + 2as$ and had varying degrees of success.
- (b) Correct answers of strain or elastic energy were often seen. Many other candidates gave answers of potential energy or kinetic energy and other forms of energy.

Question 3

- (a) (i) To gain both marks for this question candidates needed to refer to force (or pull) and gravity. Many omitted any mention of gravity or simply wrote down the mathematical equation $W = mg$ in symbols or words. This is an example of where candidates need to be encouraged to understand the concept and to appreciate that the question is asking for a description not an equation.
- (ii) The formula $W = mg$ was needed now and many candidates were awarded the first mark. Answers using g as 10 N/kg instead of 7.5 N/kg , or incorrect or missing unit, lost some candidates the second mark.
- (b) This question was well answered and many candidates realised that, in order to make a prediction about the balloon, they needed to calculate the density of the inflated balloon. A common mistake was to not give a unit for the density or to give a wrong unit for it. Candidates who converted the mass from g to kg before calculating the density were the most successful in giving a correct unit. Many candidates who slipped up on giving a correct density unit did successfully explain their prediction in terms of the density of the balloon and the density of the planet's atmosphere. A minority of candidates lost a mark for comparing the balloon's density with the density of the planet or the surface of the planet. Those candidates who made no attempt at a density calculation usually scored no marks at all.

Question 4

- (a) (i) Most candidates appreciated that the rate of transfer of energy was the same as the power of the lamp and that it did not require a change of unit – the W being a perfectly satisfactory unit. J/s are also acceptable. Candidates should be aware that when a question says 'State...' no calculation is needed.
- (ii) Some candidates successfully gave the names of two processes including radiation. Candidates are advised to note that when a question asks them to name the processes involved, then that implies that more than one process is needed. Many just gave the answer 'radiation'. A minority of candidates clearly did not know what was meant by 'processes' and described various energy changes.
- (b) (i) Most candidates could successfully predict which thermometer would show the higher temperature. Many were also able to give a reason relating to the emission of radiation, though few mentioned the word radiation and hence could not be awarded all the marks for this question. Answers which did not gain any credit for the explanation usually referred to absorption properties instead of emission properties. Candidates need to be clear about whether surfaces are emitting or absorbing radiation.

- (ii) More candidates gained both the marks here by comparing absorption properties of the two surfaces. The most common errors included not being clear that it was experiment 1 that they were comparing with experiment 2, rather than the individual thermometers again and/or not giving a comparison of absorption or reflection properties since they did not qualify their answer with 'good' or 'better' or 'poor' or 'worse' and just stated that dull black absorbs or shiny silver reflects.
- (c) This is an example of a question where candidates should have read the question carefully and answered the question asked. Most candidates, even those who achieved high marks overall, often just stated that shiny is a good reflector of radiation. They had already been awarded a mark for that in (b)(ii) and in this part a benefit to the firefighter was required.

Question 5

- (a) Most candidates gained at least two marks on this question as they were able to state that the pressure increased and that the molecules moved faster or had greater KE. Some weaker candidates only referred to the energy of the molecules increasing and did not specify that it was their KE that increased. Many candidates were also awarded the mark for more frequent collisions of the molecules with the walls. There were more candidates correctly stating that the collisions were more frequent rather than just more of them. The most able candidates could also state that the force increased or that the molecules hit harder.
- (b) Good answers to this question showed that candidates had read the question carefully and answered both parts of it – stating what happened to the pressure and volume and explaining why the piston moved and eventually stopped. However there were relatively few answers that gained both marks. Some candidates were confused about the concept of volume and stated that the molecules had more room to move around and that the volume remained the same.

Question 6

- (a) The answers to both parts of this question should have been straightforward. There were a significant number of answers that showed confusion between critical angle, refraction and total internal reflection. Candidates who did not use the terminology 'total internal reflection' needed to refer both to the idea of all the light being reflected and back (into the glass).
- (b)(i) Despite many candidates giving the correct answers in (a) relatively few gained both marks here. The most common answer was to draw a refracted ray at the first surface. As there were 2 marks for this question this should suggest to candidates that they would need to draw 2 rays. Apparently candidates did not realise that the angle marked was not the angle of incidence. Some candidates who correctly drew total internal reflection at the first surface did not draw a refracted ray at the second surface or showed refraction in the wrong direction.
- (ii) Candidates who realised that they needed to use the equation $n = 1 / \sin c$ were usually successful in obtaining 2 marks unless they gave a unit for refractive index. Those who tried to use $n = \sin i / \sin r$ were usually unsuccessful unless they realised that i was 90° .

Question 7

- (a) Many correct answers here. Those who did not get credit here were those who gave an equation involving frequency or referred to number of wavefronts in a given time or per minute. This was another question where candidates needed to describe a concept rather than give a formula.
- (b)(i) Good answers referred to an area of high pressure or high density/the molecules being close together. Others mistakenly referred to the waves being closer together.
- (ii) The best answers here were those where candidates used a ruler and a compass to ensure that they drew diffracted waves correctly and with the same wavelength as the incident wave. Freehand sketches often failed to achieve both marks as the wavelength was not clear.
- (iii) Many candidates were able to explain that there was less diffraction by expressing the idea as less spreading or less curvature. Some candidates then went on to say that the wavelength changed, which meant that they could not be awarded this mark.

- (c) (i) There were many correct answers here. Candidates are advised to write down the equation $v = f\lambda$ rather than mentally rearranging the equation and just writing down numbers. There were no marks for 6800/340. A unit error was often made here with candidates giving the unit as λ .
- (ii) About half of the candidates answered this question correctly. Those who did not do so usually gave answers that there were too high, the speed of sound in air or the speed of light. Occasionally the unit was missing.

Question 8

- (a) About half the candidates gave the answer 'iron' here or some other inappropriate material, sometimes copper.
- (b) (i) Most candidates gained at least one mark here for a mention of magnetic field or magnetic flux and many were able to refer to induction rather than just the current being produced. The idea of magnetic flux cutting or the field being cut by the coil was better known than in previous years, though some candidates were confused and stated that the magnet cut the coil.
- (ii) A good proportion of candidates could state the direction of movement of the magnet, or the pole which entered the magnet first determined the direction of the reading of the galvanometer, but few could explain the physics behind it. To achieve the second mark candidates needed to recognise that the coil behaved like a magnet that repelled the magnet moving in, or that the direction of the e.m.f. opposes the change producing it.
- (c) Good answers here gave an acceptable method and an additional piece of information for the second mark. Others referred to the magnet being connected to an a.c. supply rather than passing the magnet through a coil carrying an alternating current.

Question 9

- (a) In most cases candidates could recall that the component required was an LDR and could draw an acceptable circuit symbol. Candidates are advised to use the circuit symbols specified in the syllabus. A few LEDs, variable resistors or thermistors lost candidates both marks.
- (b) (i) There were a good number of completely correct responses and most candidates gained at least one mark for their knowledge of the formula relating voltage, current and resistance but, in many answers, the resistance used was not the total resistance. Candidates using the potential divider formula or simple proportion, tended to be more successful than those who calculated the current first and then multiplied by resistance to obtain the voltmeter reading.
- (ii) There were few correct answers to this question. Some referred to the battery running down or the voltmeter moving position in the circuit. Vague answers about increasing the resistance could not be awarded the mark as there was no indication of which component the increase applied to. Some candidates stated that the temperature of the thermistor should decrease.

Question 10

- (a) Answers suggesting the removal or loss of electrons or negative charges were acceptable. Most candidates appreciated that there was a movement of charge but were not specific enough in their answer. A minority tried to describe induction.
- (b) (i) Most candidates appreciated that the top of the sphere would become positively charged. Candidates who only placed a few charges in the top half of the sphere were more successful in placing the same number of negative charges in the bottom half of the sphere. In some instances it looked as though they thought that there should be more positive charges than negative ones.
- (b) (ii) Most candidates could refer to earthing the sphere but few explained that the earthing wire needed to be removed and then the rod.

Question 11

- (a) Most candidates gained at least one mark – either for stating a suitable value for the background count or for halving one of the readings. Many were thus awarded 2 marks and good candidates could usually arrive at the correct answer for the half-life, thus being awarded all 4 marks.
- (b) There were many completely correct answers. Where there was a mistake, it was usually in giving incorrect values to the beta particle. Most candidates gained at least one mark as they realised that they needed to balance the equation.
- (c) There were many good answers showing that candidates understood that the nucleus would repel the alpha particle. The third mark for the undeflected alpha particle proved the easiest one to obtain. For the first mark, candidates who showed the particle retracing its original path needed to either extend the path beyond the original line or place an arrow on the line.

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Key messages

Apart from normal aspects of learning, there were three further aspects where candidates could have improved their performance.

- It is essential that candidates show their working and write down the equations. The comments about **Question 8(b)(ii)** explain how credit was often lost due to inadequate working but similar shortcomings were seen in other questions. In particular, candidates sometimes remember the symbols for three quantities of an equation as a triangle. Such symbol triangles are not acceptable as evidence of the correct equation in working and are ignored by examiners.
- Sometimes it appears that candidates had tried to remember facts by rote without the supporting understanding of the Physics. Without proper understanding candidates are invariably going to misapply learned data and fail to gain credit
- All but the very strongest candidates would benefit from more practice in applying their knowledge in unfamiliar situations. This would deepen candidates' understanding and improve their performance in the examination. Many candidates, when asked to apply their knowledge to a new situation, lose confidence and are unable to use what knowledge they do have. This was most evident in responses to **Questions 5(b)** and **10(c)**.

General comments

A high proportion of candidates had clearly been well taught and prepared for this paper. Equations were generally well known but the use of equations and the quantities represented were not always understood. There were frequent examples where candidates substituted numbers from the question in the wrong place in equations. This applied particularly to **Question 5(a)(i)** where candidates needed to remember and apply two equations correctly.

Generally candidates followed the rubric of the questions. However, candidates must not try to maximise their chances by giving more than one answer to a question or choosing an answer that might cover two situations. Similarly candidates in nearly all situations must commit to an answer. Saying for example in **Question 11(c)** that the gloves might stop α -particles is insufficient.

Often candidates simply did not read the questions carefully enough and wrote known standard facts when, in fact, the question required the application of these facts. In **Question 10(c)** a significant proportion of candidates failed to follow the rubric of the question.

The use of units by most candidates was good.

Physics is a practical subject and candidates are encouraged to gain wide practical experience. This is not only helpful as preparation for the practical based Papers 5 and 6 but also to deepen their understanding for the Theory Papers. For example, candidates with good practical experience of using logic gates in a variety of digital circuits were in a much better position to gain credit in the design aspect of **Question 10(c)**.

Overall the English language ability of the vast majority of candidates was adequate for the demands of this paper. Examiners are well aware that English is not the first language for many candidates and are as flexible as possible in accepting answers where the use of English is not perfect. However, poor use of English cannot be accepted where it makes the Physics of an answer confusing.

On this paper there were specific situations where many candidates appeared to lose credit because of inadequate understanding and use of English.

In **Question 2(a)** candidates were instructed to place one tick in each column of the table. A significant minority of candidates confused rows and columns and placed one tick in each row.

Examiners are aware that in the first language of many candidates the comparative is treated differently from English and where possible make allowances. In **Question 6(c)(i)** the expected answer was a diagram showing straight lines with curved ends. So in **6(c)(ii)2** the answer given by many candidates that the wave crests are curved does not describe a change. The candidate should have made it clear that the wave crests become more curved.

Comments on specific questions

Question 1

- (a) (i) Almost all candidates knew the distinction between scalar and vector quantities.
- (ii) This was generally well answered.
- (b) This was generally well answered but a small number of candidates drew a horizontal line or mistook the graph for a speed-time graph.
- (c) Many candidates were able to produce a suitable scale diagram and give an appropriate scale. Most were then able to give a correct size for the resultant velocity. However, many candidates did not read the instruction to draw a scale diagram or did not use it to reach their answer, simply calculating using Pythagoras theorem. The biggest difficulty was with the direction of the resultant, which was very often either missing or too vague (SW, etc.).

Many weaker candidates did attempt a scale diagram but made a whole range of errors usually in the directions of the vectors or how to find the resultant.

[Correct answers 7.4 m/s and bearing 240° (other correct and clear references for direction were acceptable)]

Question 2

- (a) Most candidates were aware that the mass of the vehicle would be the same on the Moon as on Earth and many, but a smaller proportion, gave the correct answer about the weight of the vehicle on the Moon. Only the stronger candidates gained credit for their answer about the deceleration of the vehicle on the Moon.

This was the case where many candidates confused the instruction only to put one tick in each column. This may have been due to confusion in the use of the English language but these candidates clearly did not think through that it would inevitably lead to contradictory responses.

- (b) This was generally well answered especially for the calculation of the force on the piston where the majority gained full credit. A small proportion used the incorrect equation $F = P/A$.

A significant minority, however, successfully completed the calculation and gained full credit. The large majority set out their work clearly so it was easy to follow what they had done and, in case of error, it was possible for examiners to see what was correct in candidates' answers and award part credit.

Weaker candidates, however, often did not realise that a calculation of moments was also required or substituted the wrong distances from the pivot. The most frequent error was to use

(24 – 7 =) 17 cm as the larger distance instead of the full distance from the pedal to the pivot.

Question 3

- (a) This was generally well answered.
- (b)(i)1 This was generally well answered but there were a significant number of unit errors.
- 2 Conservation of momentum was widely known and almost all tried to use it with varying degrees of success. The most common mistake was to substitute the wrong mass to the blocks after the collision, even substituting weight in a momentum equation
- 3 Most candidates knew that they should use change of momentum but failed to apply it correctly, or made substitution errors, including again using weight rather than mass.
- (ii) Only a small minority gained credit here. Many did not seem to understand the point of the question. A significant number made no response and many others merely mentioned friction, which was much too vague a response.

Question 4

- (a) Almost all candidates realised that the collision between the particles and the balloon was key to there being a pressure, but very few considered the change of momentum that occurs when the direction of motion changes. A small proportion of really strong candidates did show excellent understanding, mentioning impulse and change of momentum; many others thought that simply stating that the particles have momentum was all that was required. Many did not read the question carefully enough and did not mention momentum in their answer at all.
- (b) Many candidates mentioned an increased rate of collision between molecules and walls. But little else was mentioned and many only talked about collisions between the particles. A very small number lost credit by claiming that the speed of the molecules changed.
- (c) This calculation was usually well done. The majority of candidates correctly substituted into the equation $P_1 V_1 = P_2 V_2$ and successfully calculated the final pressure of the gas. However, a minority started with the incorrect equation $P_1/V_1 = P_2/V_2$.

Question 5

- (a)(i) This was usually well done with most candidates gaining some credit and many gaining full credit. The majority knew that they needed to equate electrical energy to the energy gained by the water and many did so successfully. The equations $E = mc \Delta T$ and $E = VIt$ were well known but the mistakes of mass quoted in grams or wrong temperature difference were frequently seen.
- A considerable number of candidates seemed to confuse the symbols used for various quantities. In the past Q has been used as the symbol for thermal energy and was used as such by a significant minority of candidates e.g. writing $Q = mc T$. This 0625 syllabus only uses the symbol Q for charge (see the Syllabus Appendix showing the symbols used) and candidates should be taught not to use Q for thermal energy. On this occasion candidates were not penalised for the use of Q as the symbol thermal energy as long as their working was clear. However, candidates went on to confuse themselves by trying to equate thermal energy to electrical energy using the equation $Q = It$. A further point of confusion for weaker candidates was T for temperature and t for time.
- (ii) This was generally well answered.
- (b) This proved to be difficult for many candidates to answer well. Many candidates made things harder for themselves by choosing not to draw a simple diagram. It could have helped in clarifying many issues in their descriptions of the experiment. Candidates should practice and be encouraged to add clear labelled diagrams that assist with their answers.

A common problem was answers that did not always make it clear where the thermometers were placed and many candidates felt the need to divide the container using the ruler, which is not the function of a measuring instrument. The ruler was also used to measure the length on the thermometer.

A number of candidates, who wrote very detailed, sensible and clear methods, then lost credit for failing to include the expected results.

Question 6

(a) and (b) The majority of candidates gained full credit on these parts. Weaker candidates often confused amplitude and frequency and misapplied the wave velocity equation. There were also a significant number of unit errors including muddling metres and centimetres.

(c) (i) The strongest candidates drew excellent diagrams with regular, straight wave crests diffracting round at the ends. Often little care seemed to have been taken in drawing a precise diagram so examiners could not distinguish between poor knowledge of Physics and poor presentation and were not able to give credit. A significant minority of candidates drew semi-circular wave crests, which would have only been correct emerging from a small gap.

(ii) 1 Many candidates gave the correct statement that wavelength increases but the question also required an explanation, which was not always given.

2 If candidates drew wave crest with curved ends in **(c)(i)**, stating in this part of the question that the ends were now curved does not make a comparison, or indicate that a change has taken place. Strong candidates made comparative statements such as more curved or diffracted more.

Question 7

(a) (i) Generally this was well answered.

(ii) Generally this was well answered but a minority of weaker candidates applied the Snell's law equation upside down and calculated an angle of 75° .

(b) Stronger candidates answered this well and many gained full credit. However, many other candidates lost credit by failing to read the instructions in the question. Often only one ray was drawn, or the ray or rays were not extended back to locate the image.

Question 8

(a) (i) This was well answered by almost all candidates but some tried unsuccessfully to use $V = IR$.

(ii) This was also well answered by almost all candidates, but a common error was to use the p.d. of 12 V for the whole circuit as the p.d. across the lamp.

(b) (i) Candidates need to be aware of the need to be specific when referring to the change of various quantities in a circuit. Strong candidates wrote clear specific reference to the resistance of the wire increasing or the current in the circuit being less. There are several resistances that could be referred to in this circuit and weaker candidates lost credit due to vague statements about an unspecified resistance.

(ii) Very few candidates showed any meaningful working. If this led to the correct answer then full credit could be gained. However, it was possible that many candidates, who were on the right lines but had an incorrect final answer, lost all credit due to insufficient working. Examiners can only give partial credit when the candidate has made it clear that some correct and relevant Physics has been used.

Question 9

- (a) The line of the arrow for magnetic field was usually drawn correctly but often the direction arrow was wrong. Generally the force arrow was drawn consistently with the magnetic field but weaker candidates were often confused.
- (b) Many candidates failed to read the question carefully and wrote about the field or current direction not the direction of the force.
- (c) (i) Many strong candidates gained full credit for accurate drawings giving full detail correctly. Less strong candidates lost credit for a variety of inaccuracies.
(ii) This was generally well answered.
- (d) The many incorrect answers included every conceivable direction. This suggested that only stronger candidates were aware of the definition of a magnetic field.

Question 10

- (a) The standard symbol for an LED did not seem to be very well known. Even when the correct symbol for a diode was used the arrows were often omitted or pointing inwards.
- (b) This was generally well answered.
- (c) Both parts of this question proved challenging to all candidates. The main issues were failure carefully to read and follow the instructions in the question. It should be noted that the fourth point in the extension syllabus part 4.4, states that candidates need to be able to design a simple digital circuit. Few candidates seemed to have the breadth of knowledge and practice to tackle the design aspect.
(i) Only a small minority of candidates gained credit here. Many did not read the question carefully and did not 'use 2 or more of the gates in (b)' or have a circuit with '2 inputs and 1 output' to make up a circuit using only NOR gates. Most candidates did not take the hint offered in the question about connecting together the inputs of a NOR gate.
(ii) Many candidates gained some credit for drawing a NOR gate followed by a NOT gate. But often credit was lost by inappropriate or missing labelling of the point X.

Question 11

- (a) This was well answered by most strong candidates who gained full credit. Common errors by weaker candidates were to show the middle path stopping at the nucleus or passing straight through the nucleus and the bottom path deflected up.
- (b) Only a small number of candidates produced clear, concise answers. Many candidates, even those who were strong on most questions, failed to appreciate the random nature of radioactive decay. Vague answers were frequently given, with candidates simply stating that there was a variation in the numbers, and not writing anything about the source of the radiation.
- (c) This was generally well answered with many candidates gaining full credit. Some lost credit by giving general descriptions of the material that absorbs each particle rather than engaging with the question that was asked. This was a situation described in the **General comments** where some candidates were writing ambiguous statements such as 'The gloves might stop the α -particles.'

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Key messages

This paper assesses a wide range of topics which are drawn from all parts of the syllabus. Candidates must be confident that the entire syllabus has been revised and that the fundamental ideas of the subject at this level are understood. There are many techniques that occur on all Physics papers and candidates must be familiar with them. Candidates must be able to rearrange algebraic formulae and must do so accurately and quickly if they are not to be at a disadvantage. Similarly, answers given to two or three significant figures must be correctly rounded and this is not always done correctly. Answers given to one significant figure are rarely accepted and even when the second significant figure is a zero, it should be quoted. Units are required for nearly all the numerical answers and credit is forfeited when this is not done. Conversely, the two quantities refractive index and efficiency (when expressed as a decimal fraction) should not be given a unit as they are both defined from the ratio of identical quantities.

When diagrams or sketches are drawn or figures are added to, it is always worthwhile to spend just a few extra seconds making sure that the diagram neatly shows what it is intended to. Scrappy or carelessly drawn diagrams can be difficult to interpret.

Where an answer is replaced with a second version, candidates should avoid writing the replacement on top of the version already present or even in the small gap between the lines of writing. It is nearly always possible to find a blank space somewhere on the paper and to write a clear second version. In the original answer space, however, reference should be made to the location of the replacement answer.

General comments

The standards achieved by different candidates vary widely and usually reflect the understanding of the subject the candidate has achieved. It is important, however, to ensure that the answers given are an accurate indicator of the candidate's understanding. This is best done by ensuring that the answer supplied does answer the question asked and gives an appropriate response to it. Where a question begins *State and explain...* full credit can only be awarded for an answer that correctly states what has been asked for and then continues to offer a correct explanation. The sort of answer expected, can usually be deduced from the number of marks allocated to the question and from the wording used. There is no need to give answers in complete sentences; bullet points which deal exactly with what has been asked for can be clearer, especially for candidates whose first language is not English.

Comments on specific questions

Question 1

- (a) The majority of candidates identified the two vectors and answered this question correctly. Those candidates who did not do so, very commonly underlined *force* but then indicated a quantity other than impulse; *frequency* and *energy* were often selected by these candidates.
- (b)(i) This part was well answered and many candidates obtained full credit. The unit of acceleration is not always known and whilst other erroneous forms were occasionally supplied, the unit m/s^{-2} was the most common error.
- (ii) This was almost always correct. A small minority of candidates multiplied the distance by the time.

- (iii) Many candidates were awarded full credit here even though few candidates sketched a line where the initial gradient was zero. The most common inaccuracy was to sketch a straight line from the origin to the point (3.0, 9.9). The lines sketched by a small minority of candidates were very poorly drawn and obtained very little credit; it is not always clear whether a very thick line is starting at the origin or not.

Question 2

- (a) Many candidates gave a correct definition in the form of a word equation. This, however, is a question where some candidates did not answer the question in the terms in which it asked. The simply answer mv is neither an equation nor a word.
- (b) (i) The correct numerical answer with the correct unit was given by a large number of candidates.
- (ii) Many candidates achieved full credit for determining the velocity of B but others made some progress or revealed some understanding of the approach needed but did not obtain the correct final answer. A common source of error was to ignore the final momentum of block A and to assume that the final momentum of B was equal to the initial momentum of A.
- (c) Many candidates struggled here and were unclear of the approach to take. One frequently adopted approach was to calculate the acceleration of B and then to determine the force. The most direct approach of dividing the change in momentum by the time of collision was only occasionally followed.
- (d) Many answers explained why the kinetic energy of block A was less than its original value; this was a question that needed to be read carefully.

Question 3

- (a) This part of the question was very frequently correctly answered with only a small minority of candidates not achieving full credit. There were, however, a small number of candidates who calculated the reciprocal of the density or who supplied an incorrect unit.
- (b) There were a very large number of good answers here although a small number stated that the block would float because its density was greater than that of the liquid. The liquid was occasionally referred to as *water*.

Question 4

There were four marks allocated to this question and this, along with the size of the answer space on the paper, might have suggested that this question was not completely straightforward. Many candidates simply ignored the effect of the lever and calculated the pressure using the force of 200 N. Of those candidates who did attempt to apply the principle of moments first, there was some uncertainty concerning the distances to be used. A perpendicular distance of 14 cm (i.e. 22–8.0) was not infrequently used in the calculation.

Question 5

- (a) This section of the question was normally well answered with many candidates realising that the white shirt would be cooler than the black one. The simple statement that a white surface is a poor absorber was not credited but candidates found many different ways of suggesting that it is a poor absorber of infra-red radiation. A relatively common explanation was the statement that a white surface is a poor emitter and a poor absorber of infra-red radiation. This was not credited as in this situation, it is the absorption property of the surfaces that are significant.

- (b)(i) There were many good answers here, in which the effect of two changes in the weather were described. One source of error was to be not sufficiently specific when describing the effect. The question asks for the effect on the rate at which the puddle dries and so an answer such as *An increase in temperature causes more evaporation* does not quite answer the question asked. The candidates who referred to an increase (or decrease) in the humidity of the surrounding air, were divided as to the effect on the rate at which the puddle dries.
- (ii) This part was well answered; many candidates referred to the molecules needing energy in order for them to break the intermolecular bonds in the liquid.

Question 6

- (a) The majority of answers accurately described the motion of the molecules and their colliding with the inner surface of the balloon. Very few, however, made any reference to the change of momentum or the way in which it led to a pressure.
- (b)(i) Some candidates supplied an appropriate equation but others did not. Equations that suggested that the pressure of a gas is directly proportional to its volume were not uncommon.
- (ii)1. This was often answered correctly with only the occasional candidate supplying a unit that did not correspond to the numerical value of the pressure.
- (ii)2. This part produced a variety of responses. Some candidates deduced the appropriate pressure and read the correct answer from the graph with very little working shown. A very similar number were clearly uncertain of the approach to be taken and either left the question out or wrote down an answer which did not seem to have been obtained by any obvious route.

Question 7

- (a)(i) Many calculations led to the correct answer but a similar number were obtained from a formula that had been misremembered. The usual formula is $v = f \lambda$ but other versions are used by some candidates and it is not, under these circumstances, always clear what the different terms represent. A fairly common version is $s = wf$ but this can be confused as candidates are prone to interpret both s and w as the speed.
- (ii) Only a minority of candidates quoted an acceptable value here. There were several variations on the value $3.0 \times 10^8 \text{ m/s}$ none of which gained any credit.
- (iii) Many candidates gave an answer that was consistent with the values quoted in (a)(i) and (a)(ii) but very few explanations were sufficiently detailed. A calculation using the formula $v = f \lambda$ was the most common explanation that was credited.
- (b) Only a minority of candidates obtained full credit. A frequently stated definition suggests that it is the movement of the wave, rather than the vibration, of the particles that is parallel to the energy transfer direction. This is inevitably the case and does not gain any credit.
- (c)(i) Many candidates were aware of this inverse relationship and gained credit here.
- (ii) The direct relationship here was supplied by only a minority of candidates with rather more suggesting that a greater wavelength produced a smaller diffraction.

Question 8

- (a) The most frequently occurring answer was that the refractive index of the glass and of the air were equal in value or that refraction does not occur at curved surfaces.
- (b)(i) This calculation was often performed correctly although the answer 19° was also commonly given. This comes from confusing the direction in which the refraction takes place when leaving a denser medium.
- (ii) The direction of the refraction was more commonly towards the normal than it was correct. This part was omitted by a significant minority of candidates.

- (c) Many candidates find descriptive questions such as this quite testing and this is reflected in the significant number of candidates who omitted this part. There were several relevant points being made by the candidates and many obtained at least some credit. Only a small number of candidates obtained full credit here.

Question 9

- (a) This was generally well answered and full credit was obtained by many candidates.
- (b) (i) Many candidates were able to supply the correct potential difference. There were also answers such as 12V which is the electromotive force of the battery.
- (ii) Some candidates realised that this combined resistance was equal to that calculated in (a) but others tried a second calculation which often involved the formula for a parallel pair of resistors.
- (iii) It was in this part, that the formula for a parallel pair of resistors could have been used to show that the resistance of each of the individual resistors was equal to twice the resistance of the pair. Many candidates knew that a factor of two was relevant but, more often than not, the value given here was not twice the value of the resistance in (b)(ii) but half of it.
- (c) There were several good explanations here but some candidates gave answers in terms of the resistance and made no reference to the current or to the potential difference across the lamp.

Question 10

- (a) (i) Few candidates gave a completely correct explanation here and the common belief that there is a current in the core of the transformer was quite commonly stated. Answers that made no mention of any magnetic field rarely obtained any credit. The terms *induce* or *induction* was very commonly misapplied to the production of the magnetic field in the primary coil.
- (ii) The suggestion that the electrical conduction property of the iron is important is a consequence of the erroneous belief that there is a current in the core. Many candidates gave this as the answer here.
- (b) (i) This calculation was frequently correct although occasionally the inverse of the correct turns ratio was used.
- (ii) More often than not, the current was calculated assuming that it increased by the same ratio as the electromotive force did. It was only a minority of candidates who were awarded full credit.
- (c) Although many candidates stated an economic benefit of high-voltage transmission, few explanations were offered.

Question 11

- (a) (i) Some candidate gave an explanation that related to the collimation of the beam but other answers were more common.
- (ii) Most candidates were clear that the reading on the detector would not change and the explanations offered were commonly correct; even so full credit was obtained only rarely.
- (b) Many answers did not make any reference to the ionising effects of these particles and rays at all but simply stated some information that related to the way in which they are emitted. Few candidates were awarded full credit here.

PHYSICS

Paper 0625/51 Practical Test

Key messages

- Candidates will need to have had a thorough grounding in practical work during the course, including reflection and discussion on the precautions taken to improve reliability and control of variables.
- Candidates should be aware that, as this paper tests an understanding of experimental work, explanations and justifications will need to be based on practical rather than theoretical considerations.
- Numerical answers should be expressed clearly, to the appropriate number of significant figures and with a correct unit, where applicable. Candidates should know that these techniques will be tested at some point in the paper.
- Candidates should be ready to apply their practical knowledge to different situations. Questions should be read carefully to ensure that they are answered appropriately.

General comments

The aim of the examination is to enable candidates to display their knowledge and understanding of practical physics techniques, including the following:

- plotting graphs
- tabulating readings
- manipulating data to obtain results
- drawing conclusions
- dealing with possible sources of error
- controlling variables
- handling practical apparatus and making accurate measurements
- choosing the most suitable apparatus

It is assumed that, as far as possible, the IGCSE course will be taught so that candidates undertake regular practical work as an integral part of their study of physics.

Questions on experimental techniques were answered much more effectively by candidates who clearly had regular experience of similar practical work and much less successfully by those who, apparently, had not.

The practical nature of the examination should be borne in mind when explanations or justifications are required, for example in **Questions 2(c)(ii), 2(d) and 3(d)**.

It is expected that numerical answers will be expressed to a number of significant figures which is appropriate to the data given in the question or a measurement carried out by the candidate.

Comments on specific questions

Question 1

- (a) The majority of candidates successfully recorded the length in mm but some gave their answer in cm. Many candidates, however, did not show the length on the diagram as requested in the question.
- (b) Most candidates recorded realistic readings in the table.

- (c) One of a number of suitable precautions could be used here. Most candidates chose to describe perpendicular viewing of the scale. This needed to be clearly expressed to gain the mark. Vague references to vertical, horizontal, parallel or eye-level must be avoided so that answers are clear.
- (d) Most candidates labelled the graph axes correctly and drew them the right way round, choosing a suitable scale. Plotting was generally accurate. Many candidates drew a well-judged straight line although some lost the mark by drawing a 'dot-to-dot' line whilst others drew a straight line that did not match the plots. Some candidates lost the final mark because their line was too thick or the plots too large.
- (e) Candidates needed to realise that the line does not pass through the origin so the length is not proportional to the load.
- (f) Candidates were expected to use the graph line to find the load value requested. Those who did were often successful but those who attempted some form of calculation often produced a confused answer.

Question 2

- (a) Most candidates recorded a realistic value for room temperature with the correct unit.
- (b) Most candidates recorded suitable values that showed the experiment being carried out according to the instructions.
- (c) (i) Some candidates recorded the total temperature drop for the second response.
(ii) Candidates who wrote a theoretical description of evaporation did not score this mark. Candidates needed to write a practical reason for the difference such as the rate of cooling decreasing as the temperature becomes closer to room temperature.
- (d) Candidates needed to write from their experience of similar experiments carried out during the course to suggest practical changes such as longer time gaps or a higher initial water temperature.
- (e) Candidates were expected to observe that B should be used because the line of sight is perpendicular to the scale and in line with the bottom of the meniscus. Whilst many candidates knew the word 'meniscus' there is evidence of confusion about the meaning. The meniscus is the curved surface of the liquid. Some candidates seemed to be writing that the top or bottom of the meniscus is called the meniscus and this led to confusing answers. The word 'meniscus' was not required so those candidates who wrote a clear description were able to score the mark.

Question 3

- (a) Most candidates drew a carefully constructed ray-trace showing familiarity with this type of experiment and the ability to follow the instructions in a logical manner. A minority of candidates confused the angle of incidence with the glancing angle.
- (b)&(c) Measurement of angles and distances was done with care by the majority of candidates.
- (d) Here candidates were required to make a judgement based on their own results. The statement needed to be clear, saying that either the results support the suggestion or they do not. The justification then needed to match the statement with wording that showed a clear understanding of the concept of results being within, or beyond, the limits of experimental accuracy.
- (e) Successful candidates made a relevant suggestion from their experience. Others made vague suggestions that only amounted to writing that they would follow the instructions carefully. This did not score the available marks. Some candidates appeared to be relying on answers they had learned from past papers that were not appropriate for this experiment (for example, using a darkened room so that the rays can be easily seen).

Question 4

Many candidates coped well with the challenge of this planning question. Those who followed the guidance in the question were able to write concisely and address all the necessary points. Many candidates drew a correct diagram. Some positioned the voltmeter wrongly, either in series with the other components or across a variable resistor instead of the test wire. Circuit symbols were usually correct but the variable resistor symbol (if used) was often confused with the thermistor. Construction of a table of readings helps candidates to organise their thoughts and write clearly about how to carry out the investigation. The table needed to include columns for type of wire, voltage, current and resistance with correct units for the quantities.

In the description, readings of voltage and current followed by reference to the calculation of resistance were required. Candidates then needed to state clearly that the process was repeated with wires of different materials. Some candidates were not clear about whether they meant different materials or different lengths or diameters of wires of the same material.

The key variables here are the length and diameter of the wires. A significant number of candidates knew that the micrometer should be used to check the diameter of the wires.

PHYSICS

Paper 0625/52 Practical Test

Key messages

To achieve well in this examination, candidates need to have a thorough grounding in practical work during the course. Candidates should have as much personal experience of carrying out experiments themselves as possible. The practical work should include reflection and discussion of the significance of results, precautions taken to improve reliability and control of variables.

Centres are provided with a list of required apparatus well in advance of the examination date. Where Centres wish to substitute apparatus, it is essential to contact Cambridge to check that the change is appropriate and that candidates will not be disadvantaged. Any changes must be recorded in the Supervisor's report.

General comments

The aim of the examination is to enable candidates to display their knowledge and understanding of practical physics techniques. These include:

- handling practical apparatus and making accurate measurements
- tabulating of readings
- graph plotting and interpretation
- manipulating data to obtain results
- drawing conclusions
- understanding the concepts of results being equal within the limits of experimental accuracy
- dealing with possible sources of inaccuracy
- control of variables
- choosing the most effective way to use the equipment provided

The majority of candidates entering this paper were well prepared and able to demonstrate some ability and understanding across the whole of the range of practical skills being tested. All parts of every practical test were attempted and there was no evidence of candidates running short of time. The majority of candidates were able to follow instructions correctly, record observations clearly and perform calculations accurately and correctly. Units were well known and were almost always included, writing was neat and legible and ideas were expressed logically. However many candidates seemed less able to derive conclusions backed up by evidence, or to present well thought-out conclusions.

All questions provided opportunities for differentiation, but particularly good, was **Question 1(d)**, where only the more able candidates were able to suggest valid reasons why different students carrying out the experiment with care, and using the same apparatus, may not obtain identical results.

The gathering and recording of data presented few problems for any candidates. There was evidence of some candidates not having the use of a calculator.

The ability to record readings to an appropriate precision, usually reflecting the measuring instrument being used, or to quote a derived result to an appropriate number of significant places, still causes difficulty for many candidates. There were also many examples of instances where a candidate had repeated a measurement and had overwritten their first answer. This often made it difficult for the Examiner to see what the reading was, and sometimes the Examiner was unable to award the mark. Candidates should be encouraged to cross out completely and to re-write their answers so that there is no ambiguity. Some candidates still find difficulty in choosing an appropriate scale to plot their graphs and in drawing a best-fit line to display their data.

There were instances this year of Centres disadvantaging their candidates by not supplying the correct apparatus. Where this was not mentioned in the report from the Supervisor, it was difficult to award credit. It is important to provide details of changes made to the specified apparatus, and possibly specimen results if appropriate, so that Examiners can give full credit to candidates' results that lie outside the expected tolerance values. Cambridge should agree major changes to apparatus in advance of the examination date.

Comments on specific questions

Question 1

- (a) Values of potential difference and current were almost always recorded to a suitable number of decimal places. The resistances of the different lengths of resistance wire were usually calculated correctly, but the values were not always recorded to a consistent number of significant figures. Candidates were also penalised if they rounded their answers incorrectly. Despite the instruction to include units in the column headings of the table, units were often missing.
- (b) Most candidates connected the wandering lead to the correct point in the circuit and recorded values of potential difference and current, but the value obtained for the potential difference across the longer length of resistance wire was in some cases less than previously obtained. Where a value obtained is obviously incorrect, candidates should be encouraged to go back and repeat their measurements.

When the wires were joined to make a parallel combination, most candidates recorded sensible values of potential difference and current and went on to obtain a value for resistance that was less than their previous answer.

- (c) Most candidates were able to state, whether or not, their results supported the statement given and placed a tick in the correct box. The idea of experimental tolerances and whether two measured quantities are close enough to be considered equal, or not, is beginning to be better understood by candidates.
- (d) Although this was a more demanding final part to the practical exercise, it was surprising that many candidates were not able to give a sensible practical reason as to why the results obtained, if the experiment were repeated, might be different from the values they actually obtained. Only a minority of candidates suggested that the power supply might run down or that a heating effect in the wires would change the resistance.

Having just performed the experiment, it was surprising that comments about the difficulty in placing the sliding contact exactly at the required place on the wire were virtually non-existent.

Question 2

- (a) The distance a between the 5.0 cm mark and the pivot was almost always recorded correctly. The distance b between the centre of load Q and the pivot at balance was usually quoted to the nearest millimetre and was within the tolerance allowed. Occasionally candidates ignored the instruction to measure from the centre of load Q to the pivot, and recorded the distance from Q to the right hand end of the metre rule or gave the reading on the rule where the centre Q was placed.

The instructions given were usually followed correctly and the majority of candidates ended up with a full set of results in the table with the correct values for a , and values of b which were all less than 50.0 cm and decreasing.

- (b) There continues to be an improvement in the standard of graph plotting. Candidates nearly always chose sensible horizontal and vertical scales. The instruction to start both axes at the origin was ignored by some candidates who were penalised for this. There was much less evidence of the use of scales that increased in inconvenient increments, such as 3 or 7. Choosing such scales makes the points much harder to plot by the candidates and more difficult for Examiners to check the candidates' plotted points.

There were many excellent, carefully drawn, best-fit lines produced by candidates. However, there were still too many graphs where the candidate's attempt at a best-fit line was forced through the origin. The resulting line was anything other than best fit.

- (c) Only a small number of the more able candidates stated that the quantities a and b were not directly proportional because although the graph produced was a straight line, it did not pass through the origin. It is to be a very popular misconception by candidates, that a straight-line graph indicates direct proportionality between the two plotted quantities.
- (d) Most candidates wrote down sensible values for the mass of the metre rule and the value of the quantity mX . The calculations of the two moments were usually carried out correctly, but the unit of these quantities was often missing or incorrect despite the unit for moment being given in the previous part of the question.
- (e) This more demanding final part caused problems. The more able candidates realised that the two calculated moments were unequal because the moment of the weight of the rule had not been considered or that the pivot was not placed at the centre of mass of the rule.

Question 3

- (a) The ray traces drawn by candidates were usually neat and accurate. The normal NL was almost invariably drawn in the correct position, the points E and M correctly labelled and the line FE drawn to the left of the normal with an angle of incidence $40^\circ (\pm 1^\circ)$. Candidates did as instructed, and marked in the positions of the pins and labelled them P_1 and P_2 . In the majority of cases, the pins had been placed too close together. In image location using pins, the pins used should be placed at least 5 cm apart.
- (b) P_3 and P_4 were usually correctly placed, the correct construction lines drawn and the values of α and x measured to within the tolerance allowed ($\pm 2^\circ$ and ± 2 mm).
- (c) The experiment was usually repeated successfully with the line FE drawn on the other side of the normal. There was much evidence of accurate drawing and most candidates obtained values for β and y that were within the allowed tolerance.
- (d) Because candidates had two pairs of values to consider here, they found it difficult to decide if their results showed that their pairs of values were equal, or not, when experimental error was considered. For many candidates, the values for α and β were usually very close and could be considered equal, but the values for x and y were too far apart to be considered to be equal, even allowing for experimental error. In this situation, the answer expected was no, α and x were not equal to β and y .

Question 4

This was the second time that a planning exercise has been set on the June paper. The question discriminated well, with the full range of marks being awarded to candidates.

Although it was not a requirement to draw a diagram, many candidates took the hint given, and used a diagram to aid their explanation. Candidates should be made aware that some of the marks available may be awarded from a carefully drawn diagram. It was relatively rare to see a neat, well-labelled diagram – most were rough sketches drawn without the aid of a ruler. Candidates were fortunate that neatness was not being assessed.

Most candidates described a sensible method to investigate the effect of draughts on the rate of cooling of hot water. Investigations were based on temperature measurements of a fixed volume of hot water as the fan cooled it. The occasional candidate did not use all fan speeds available to them but merely measured the time for the water to cool without a fan and then with the fan set on one particular speed.

Most candidates appreciated that to make the investigation a fair test, equal volumes of water should be used in both cases. Other popular key control variables stated were the distance of the fan from the beaker and the room temperature. The idea that the starting temperature of the water in both beakers should be identical was stated far less frequently.

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Despite the instruction given to candidates to draw a table with headings, tables were often missing. The headings in many of the tables given by candidates did not relate to the given investigation. Difficulty was experienced here because candidates needed to show fan speed, temperature and time in their tables and many were unsure how to cope with three variables. Where suitable tables were drawn, credit was often lost because there were no units in the column headings.

Only the more able candidates were successful in explaining how they would use their readings to reach a conclusion. Most candidates knew intuitively that the faster the speed of the fan, the quicker the water would cool, and merely stated so. Good explanations as to how they would use the data generated in their table to reach a conclusion were rare.

PHYSICS

Paper 0625/53 Practical Test

Key messages

- Candidates will need to have had a thorough grounding in practical work during the course, including reflection on the significance of precautions taken to improve reliability and the importance of controlling variables.
- Candidates should be aware that, as this paper tests an understanding of practical work, explanations will need to be based on data from the question or the implications of observations rather than theoretical considerations.
- Numerical answers should be expressed clearly, to the appropriate number of significant figures and with a correct unit, where applicable. Candidates should know that these techniques will be tested at some point in the paper.
- Candidates should be ready to apply their practical knowledge in planning and designing an experiment to investigate a given brief. It is important for candidates to have a wide experience of practical work so that they can include this background knowledge in the design.

General comments

The aim of the examination is to enable candidates to display their knowledge and understanding of practical physics techniques, including the following:

- plotting graphs
- tabulating readings
- manipulating data to obtain results
- drawing and justifying conclusions
- dealing with possible sources of error
- controlling variables
- making accurate measurements and observations.

It is assumed that, as far as possible, the IGCSE course will be taught so that candidates undertake regular practical work as an integral part of their study of physics.

Questions on experimental techniques were answered much more effectively by candidates who clearly had a background of similar practical work and much less successfully by those who, apparently, had not. The breadth of candidates' experience of experimental work was apparent in the quality of the results obtained.

The practical nature of the examination should be borne in mind when explanations or justifications are asked for. This was seen in some of the excellent answers to **Question 3(e)(ii)** which required a reference to results rather than theory and in the clear practical details given by some candidates in **Question 1(d)**, **Question 2(g)** and **Question 3(f)**. Less good responses indicated that candidates had not read the specific requirements of the questions carefully or had little experience of carrying out these types of experiment.

Numerical answers must include a matching unit, where necessary, and be expressed to a number of significant figures which is appropriate to the data given in the question. These points were demonstrated in many of the responses to **Question 1(c)(ii)**, **Question 2(d)** and **Question 3(c)(ii)**.

Candidates need to be mindful that use of a 'recurring' symbol, does not indicate the intended number of significant figures and will lose credit given for this aspect of the answer.

Each Practical Test will include a question in which candidates will be asked to outline a plan for an investigation. These questions will always be able to be answered by careful reading of the brief and the

logical application of sound experimental practice. Many candidates showed good practical knowledge when answering **Question 4** but it was clear that a number had not been prepared for this or had limited experience of basic experimental work.

Comments on specific questions

Question 1

This was a question that was tackled well by many candidates, although a number found difficulty in obtaining the required results. Some power supplies may have had very low internal resistances and, without the use of the suggested series resistance, the required range of potential differences was hard to achieve. However, the marking ensured that candidates were not disadvantaged if this was clearly the case.

(a) Many obtained a set of increasing currents, expressed to at least 2 decimal places.

(b) Some good graphical skills were apparent in many answers.

Many chose a suitable scale and labelled the axes correctly, although a number were reversed, with I/A on the y -axis.

Plotting was generally good. Where unusual scales had been suggested, plotting was often more awkward and mistakes occurred.

Many candidates indicated the plots with fine crosses as advised in previous reports to Centres. Small dots are acceptable but are often obscured when the line is drawn through them, making it more difficult to award the mark for correctly plotted values. A sharp pencil should be used for the plots and for the line so that accurate drawing may be achieved and errors easily corrected.

The common response was an attempt at a best-fit straight line although there were more than the usual number of lines which joined the plots together in an irregular fashion. This is never acceptable for the mark.

(c) Many answers lay within the expected range, with a clear triangle shown on the graph. However, the resistance unit was often omitted or the value expressed to more than 3 significant figures.

(d) Only a few candidates realised from their increasing values of current in the experiment that shorter lengths of resistance wire would produce excessive currents.

(e) Many drew the expected rectangle with strike-through arrow but there were a number who showed thermistor symbols or combinations of thermistor/variable resistor.

Question 2

Good responses to aspects of this question were seen from many candidates, although comments on the practical details proved difficult for a significant number.

(a) Most candidates recorded a sensible value for the weight of the modelling clay.

(b) The volume of water in the measuring cylinder was generally as expected and many described the technique of observing the bottom of the meniscus at right angles to the scale. A number gave one or other of these precautions rather than both.

(c) The majority of candidates recorded the expected lower forcemeter reading and higher measuring cylinder reading.

(d) Most calculated ρ correctly from their readings but fewer gave the appropriate unit of g/cm^3 .

(e) The majority of candidates measured masses which reflected the required volume of water in the measuring cylinder.

- (f) This mark assessed the accuracy of the practical work in both methods, with a range for both calculated values of density. A good number obtained credit, demonstrating the skills that had been applied.
- (g) Many answers referred to inaccurate experimental techniques and did not gain the marks. It was expected that responses should highlight the inherent sources of inaccuracy in the suggested methods, such as measuring the mass of the empty measuring cylinder after it had contained water rather than before. A number of candidates did point this out. Correct reference to the precision of the measuring cylinder scale was also seen.

The second mark, for a suggested improvement, was harder to achieve for most.

Question 3

This question was answered well by many candidates but it was clear where Centres had given significant practice in ray-trace work.

- (a) Good judgement of the normal line was apparent in many responses, as was accurate drawing of the incident line at 30° .
- (b) Many candidates still separated pins by less than 5.0 cm. A number attempted to space them exactly 5.0 cm apart, often misjudging and losing the mark. The requirement is that pins should be as far apart as is reasonably possible for ray-tracing with 5.0 cm as a minimum separation.
- (c) A good number of candidates drew accurate lines, obtaining good values for a and b and an answer for n which was in the expected range. Many correctly omitted a unit but some gave cm or $^\circ$.
- (d) There were some good, accurate drawing skills apparent in many answers but a number of candidates seemed not to recognise that thicker, poorly drawn lines would produce unreliable values.
- (e) Many obtained angles close to 30° and realised that, even if they were not identical, the values of α and θ could be regarded as equal because the difference was within the limits of experimental accuracy. However, some still do not recognise this concept, requiring the values to be identical.
- (f) Answers which referred to poor experimental practice or 'human error' did not gain credit. Candidates who had experience of these methods realised the inherent difficulty of placing pins accurately, often because of the thickness of the pins themselves.

Question 4

A good number of candidates achieved well here as the brief was based on familiar techniques in thermal energy work. Others however found it challenging.

There were some very clear answers with a significant amount of good detail. Most of these followed the structure suggested by the question and it was clear from many responses that the bullet points had been used by candidates as a checklist of what was to be included.

Candidates should read the brief carefully. Many long answers contained little that could be credited while more concise responses addressed the required investigation closely and gained full marks.

Many used diagrams to help explain their plan and a significant number of marks could be gained in this way. It should be recognised that it is much simpler to draw a table or graph rather than describe it in the text and good examples of this were seen.

A good number realised that the basic equipment should include a thermometer and stop-watch and that a beaker and insulation would be required. Some lost this mark by assuming that one or other of these items would be included and not specifically stating that this apparatus would be needed.

A large number of candidates described the experiment for measuring temperatures at regular intervals over a fixed period of time. Some chose to measure the time for the temperature to drop by a fixed amount and this was acceptable, particularly if the initial water temperature had been specified as equal in each case.

There were, incorrectly, descriptions of experiments in which water was heated and temperatures measured as they rose while layers of insulation were gradually applied. This was, presumably, not a technique which had been experienced previously.

It was quite acceptable to heat water provided that, at some point, it was clearly stated that the heating stopped before taking temperatures as the water cooled.

As the brief was to test the effect of increasing the number of layers of insulation, plans which merely compared a beaker with no insulation against a beaker with some insulation could not gain the mark for 'repeating with additional layers' although the basic method could be credited.

It is good practice to include units along with quantities on table headings or graph axes and some clear examples of this were seen.

The final 2 marks were available for precautions, possible difficulties which might be encountered or additional points relating to practical techniques. It was here that differences clearly emerged between those candidates who were used to carrying out a range of experiments and those who were not.

PHYSICS

Paper 0625/61 Alternative to Practical

Key messages

- Candidates will need to have had a thorough grounding in practical work during the course, including reflection and discussion on the precautions taken to improve reliability and control of variables.
- Candidates should be aware that, as this paper tests an understanding of experimental work, explanations will need to be based on data from the question and practical rather than theoretical considerations.
- Numerical answers should be expressed clearly, to the appropriate number of significant figures and with a correct unit, where applicable. Candidates should know that these techniques will be tested at some point in the paper.
- Candidates should be ready to apply their practical knowledge to unusual situations. Questions should be read carefully to ensure that they are answered appropriately.

General comments

The aim of the examination is to enable candidates to display their knowledge and understanding of practical physics techniques, including the following:

- plotting graphs
- tabulating readings
- manipulating data to obtain results
- drawing conclusions
- dealing with possible sources of error
- controlling variables
- making accurate measurements
- choosing the most suitable apparatus

It is assumed that, as far as possible, the IGCSE course will be taught so that candidates undertake regular practical work as an integral part of their study of physics. This examination should not be seen as suggesting that the course can be fully and effectively taught without practical work. Some of the skills involved in experimental work, including graph plotting and tabulation of readings, can be practised without doing experiments. However, there are parts of this examination in which the candidates are asked to answer from their own practical experience.

Questions on experimental techniques were answered much more effectively by candidates who clearly had experience of similar practical work and much less successfully by those who, apparently, had not.

The practical nature of the examination should be borne in mind when explanations, justifications or further developments are asked for. For example see **Questions 2(d) and (e), 3(b)(ii), (c) and (d), 4(a) and b(ii)**.

It is expected that numerical answers will be expressed to a number of significant figures which is appropriate to the data given in the question or a measurement carried out by the candidate.

Comments on Specific Questions

Question 1

- (a) The majority of candidates successfully recorded the length in mm but some gave their answer in cm. Many candidates made a sensible suggestion about the reason for not including X in the measurement
- (b) One of a number of suitable precautions could be used here. Most candidates chose to describe perpendicular viewing of the scale. This needed to be clearly expressed to gain the mark. Vague references to vertical, horizontal, parallel or eye-level must be avoided so that answers are clear.
- (c) Most candidates labelled the graph axes correctly and drew them the right way round, choosing a suitable scale. Plotting was generally accurate. Many candidates drew a well-judged straight line although some lost the mark by drawing a 'dot-to-dot' line whilst others drew a straight line that did not match the plots. Some candidates lost the final mark because their line was too thick or the plots too large.
- (d) Candidates needed to realise that the line does not pass through the origin so the length is not proportional to the load.
- (e) Candidates were expected to use the graph line to find the load value requested. Those who did were often successful.

Question 2

- (a)&(b) Most candidates drew a carefully constructed ray-trace showing familiarity with this type of experiment and the ability to follow the instructions in a logical manner. A minority of candidates confused the angle of incidence with the glancing angle.
- (c) Measurements of angle α and distance x were done with care by the majority of candidates.
- (d) Here candidates were required to make a judgement based on the results. The statement needed to be clear, saying that either the results support the suggestion or they do not. The justification then needed to match the statement with wording that showed a clear understanding of the concept of results being within, or beyond, the limits of experimental accuracy.
- (e) Successful candidates made a relevant suggestion from their experience. Others made vague suggestions that only amounted to writing that they would follow the instructions carefully. This did not score the available marks. Some candidates appeared to be relying on answers they had learned from past papers that were not appropriate for this experiment (for example, using a darkened room so that the rays can be easily seen).

Question 3

- (a) Most candidates recorded the value for room temperature with the correct unit.
- (b)(i) Some candidates recorded the total temperature drop for the second response.
 - (ii) Candidates who wrote a theoretical description of evaporation did not score this mark. Candidates needed to write a practical reason for the difference such as the rate of cooling decreasing as the temperature becomes closer to room temperature.
- (c) Here again candidates needed to write from their experience of similar experiments carried out during the course to suggest practical changes such as longer time gaps or a higher initial water temperature.

- (d) Candidates were expected to observe that B should be used because the line of sight is perpendicular to the scale and in line with the bottom of the meniscus. Whilst many candidates knew the word 'meniscus' there is evidence of confusion about the meaning. The meniscus is the curved surface of the liquid. Some candidates seemed to be writing that the top or bottom of the meniscus is called the meniscus and this led to confusing answers. The word 'meniscus' was not required so those candidates who wrote a clear description were able to score the mark.

Question 4

- (a) (i) The candidates needed to show the length of the pendulum from the bottom of the clamp to the centre of the pendulum bob.
- (ii) Candidates needed to show the metre rule close to the pendulum and measuring from the base of the clamp. Few candidates realised that the set square shown in Fig. 4.1 was to lead them to a description of its use as an aid to taking the scale reading from the metre rule by holding the set square as a horizontal marker between the centre of the pendulum bob and the rule.
- (b)(i)&(ii) Many candidates were able to read the stop watch correctly. An explanation of the use of 20 oscillations to minimise the effect of reaction time errors proved more challenging for candidates. Some wrongly thought that the time for one oscillation is taken 20 times and then averaged.
- (c) Many candidates gave their answer to a suitable number of significant figures but few realised that the unit is s^2 .

Question 5

Many candidates coped well with the challenge of this planning question. Those who followed the guidance in the question were able to write concisely and address all the necessary points. Many candidates drew a correct diagram. Some positioned the voltmeter wrongly, either in series with the other components or across a variable resistor instead of the test wire. Circuit symbols were usually correct but the variable resistor symbol (if used) was often confused with the thermistor. Construction of a table of readings helps candidates to organise their thoughts and write clearly about how to carry out the investigation. The table needed to include columns for type of wire, voltage, current and resistance with correct units for the quantities.

In the description, readings of voltage and current followed by reference to the calculation of resistance were required. Candidates then needed to state clearly that the process was repeated with wires of different materials. Some candidates were not clear about whether they meant different materials or different lengths or diameters of wires of the same material.

The key variables here are the length and diameter of the wires. A significant number of candidates knew that the micrometer should be used to check the diameter of the wires.

PHYSICS

Paper 0625/62 Alternative to Practical

Key messages

To achieve well in this examination candidates need to have a thorough grounding in practical work during the course. Candidates should have as much personal experience of carrying out experiments themselves as possible. The practical work should include reflection and discussion of the significance of results, precautions taken to improve reliability and control of variables.

Candidates should be advised to read the questions through very carefully to ensure that they are answering the question as written, and not simply recalling the answer to a different question.

General comments

The aim of the examination is to enable candidates to display their knowledge and understanding of practical physics techniques. These include:

- handling practical apparatus and making accurate measurements
- tabulating of readings
- graph plotting and interpretation
- manipulating data to obtain results
- drawing conclusions
- understanding the concept of results being equal to within the limits of experimental accuracy
- dealing with possible sources of inaccuracy
- control of variables
- choosing the most effective way to use the equipment provided.

The majority of candidates entering this paper were well prepared and it was pleasing to see that the range of practical skills being tested proved to be accessible to the majority of the candidature. Most candidates demonstrated that they were able to draw upon their own personal practical experience to answer the questions. No parts of any question proved to be inaccessible to candidates and there was no evidence of candidates running short of time. The majority of candidates were able to follow instructions correctly, record measurements clearly and perform calculations accurately and correctly. Units were well known and were invariably included, writing was legible and ideas were expressed logically. However, candidates seemed less able to derive conclusions from given experimental data and justify them.

All questions provided opportunities for differentiation, but particularly good, was **Question 1(d)**, where only the more able candidates were able to suggest valid reasons why different students carrying out the experiment with care, and using the same apparatus, may not obtain identical results.

The vast majority of candidates finished the paper and there were few scripts with substantial numbers of no responses to the question set. There were some scripts which showed an exemplary understanding of practical skills but equally, there were those which demonstrated a lack of graph skills, poor understanding of significant figures and a lack of comprehension of good practice in carrying out experiments.

Comments on specific questions

Question 1

- (a) The values of potential difference and current were almost always recorded, but the scale of the voltmeter defeated many, with values of 0.625 V and 0.7 V often appearing. The resistance of the length of resistance wire was usually calculated correctly, but the value was sometimes recorded to too many significant figures. Candidates were also penalised if they rounded their answers incorrectly
- (b) Candidates found difficulty comparing the resistance values for the two different lengths of wire and suggesting a relationship between the length of a wire and its resistance. Most candidates stated that as the length of a wire increased, so did its resistance. Only the more able candidates went that bit further and suggested that the length of the wire was directly proportional to the resistance.
- (c) Most candidates were able to compare the two given resistances and conclude that $R_1 = 2R_2$. The idea of experimental tolerances is beginning to be better understood by candidates.
- (d) Although this was a more demanding final part to the question, it was surprising that many candidates were not able to give at least one sensible practical reason as to why the results obtained on repeating the experiment might be different from the values previously obtained. Only a minority of candidates suggested that the power supply might run down or that a heating effect in the wires would change the resistance. It was surprising that comments about the practical difficulty in placing the sliding contact exactly at the required place on the wire were virtually non-existent.

Question 2

- (a) The ray traces drawn by candidates were usually neat and accurate. The normal NL was almost invariably drawn in the correct position, the points E and M correctly labelled and the line FE drawn to the left of the normal with an angle of incidence $40^\circ (\pm 1^\circ)$. Candidates did as instructed, and marked in the positions of the pins and labelled them P_1 and P_2 . In the majority of cases, the pins had been placed too close together. In image location using pins, the pins used should be placed at least 5 cm apart.
- (b) The instruction to draw a line joining the positions of P_3 and P_4 was usually carried out. The point K where this line crossed CD was sometimes marked on NL instead of CD.
- (c) The values of α and x were usually measured to within the tolerance allowed ($\pm 2^\circ$ and ± 2 mm).
- (d) Because candidates had two pairs of values to consider here, they found it difficult to decide if their results showed that the pairs of values were equal, or not, when experimental error was considered. For many candidates, the values for α and β were usually very close and could be considered equal, but the values for x and y were too far apart to be considered to be equal, even allowing for experimental error. In this situation, the answer expected was no, α and x , were not equal to β and y .
- (e) Most candidates were able to suggest one sensible precaution that should be taken when using optics pins to trace the paths of rays of light. A common incorrect answer here was for candidates to state that the experiment should be carried out in a dark room. In experiments of this type, the experimenter wants as much light as possible to fall on the glass block so that the pins can be correctly aligned and the path of the ray determined.

Question 3

- (a) It was evident from the estimates of a suitable object to screen distance given by candidates, that they had little experience of this type of practical work. Most estimates of the distance were far too small and a large proportion of the candidature measured the distance from the diagram in Fig. 3.1. Any distance between 50 cm and 200 cm was accepted.
- (b) Descriptions of how to find the best position of the screen to obtain a sharply-focussed image on it were very poor. Many answers referred to moving the lens, despite being told in the question that it was the screen that was being moved. The best answers referred to moving the screen slowly and moving it back and forth until the sharpest image was obtained.
- (c) The calculation of the focal length of the lens from the given formula was well done. Many candidates however lost one of the two available marks either by quoting the answer to too few/many significant figures or neglecting to include the unit, as requested.
- (d) Most candidates were able to state one correct difference between the appearance of the object and its image.
- (e) About half the candidature correctly circled the three procedures that were sensible for this experiment. Some answers were spoiled because candidates then went on to circle more than the three correct answers.

Question 4

- (a) There continues to be an improvement in the standard of graph plotting. Candidates nearly always chose sensible horizontal and vertical scales. The instruction to start both axes at the origin was ignored by some candidates who were penalised for this. There was much less evidence of the use of scales that increased in inconvenient increments, such as 3 or 7. Choosing such scales makes the points much harder to plot by the candidates and more difficult for Examiners to check the candidates' plotted points. There were many excellent, carefully drawn, best-fit lines produced by candidates. However, there were still too many graphs where the candidate's attempt at a best-fit line was forced through the origin. The resulting line was anything other than best fit.
- (b) Only a small number of the more able candidates stated that the quantities a and b were not directly proportional because although the graph produced was a straight line, it did not pass through the origin. It is to be a very popular misconception by candidates, that a straight-line graph indicates direct proportionality between the two plotted quantities.
- (c) Most candidates calculated the quantities mX , Pa , and Qb correctly. The unit of Pa , and Qb was often missing or incorrect, despite the unit for moment being given in the first part of the question.
- (d) This more demanding final part caused problems. The more able candidates realised that the two calculated moments were unequal because the moment of the weight of the rule had not been considered or that the pivot was not placed at the centre of mass of the rule.

Question 5

This was the second time that a planning exercise has been set on the June paper. The question discriminated well, with the full range of marks being awarded to candidates.

Although it was not a requirement to draw a diagram, many candidates took the hint given, and used a diagram to aid their explanation. Candidates should be made aware that some of the marks available may be awarded from a carefully drawn diagram. It was relatively rare to see a neat, well labelled diagram – most were rough sketches drawn without the aid of a ruler. Candidates were fortunate that neatness was not being assessed.

Most candidates described a sensible method to investigate the effect of draughts on the rate of cooling of hot water. Investigations were based on temperature measurements of a fixed volume of hot water as the fan cooled it. The occasional candidate did not use all fan speeds available to them but merely measured the time for the water to cool without a fan and then with the fan set on one particular speed.

Most candidates appreciated that to make the investigation a fair test, equal volumes of water should be used in both cases. Other popular key control variables stated were the distance of the fan from the beaker and the room temperature. The idea that the starting temperature of the water in both beakers should be identical, was stated far less frequently.

Despite the instruction given to candidates to draw a table with headings, tables were often missing. The headings in many of the tables given by candidates did not relate to the given investigation. Difficulty was experienced here because candidates needed to show fan speed, temperature and time in their tables and many were unsure how to cope with three variables. Where suitable tables were drawn, credit was often lost because there were no units in the column headings.

Only the more able candidates were successful in explaining how they would use their readings to reach a conclusion. Most candidates knew intuitively that the faster the speed of the fan, the quicker the water would cool, and merely stated so. Good explanations as to how they would use the data generated in their table to reach a conclusion were rare.

PHYSICS

Paper 0625/63 Alternative-to-Practical

Key messages

- Candidates will need to have had a thorough grounding in practical work during the course, including reflection on the precautions taken to improve reliability and the importance of controlling variables.
- Candidates should be aware that, as this paper tests an understanding of experimental work, explanations will need to be based on data from the question and practical rather than theoretical considerations.
- Numerical answers should be expressed clearly, to the appropriate number of significant figures and with a correct unit, where applicable. Candidates should know that these techniques will be tested at some point in the paper.
- Candidates should be ready to apply their practical knowledge in planning and designing an experiment to investigate a given brief. It is important for candidates to have a wide experience of practical work so that they can include this background knowledge in the design.

General comments

The aim of the examination is to enable candidates to display their knowledge and understanding of practical physics techniques, including the following:

- plotting graphs
- tabulating readings
- manipulating data to obtain results
- drawing and justifying conclusions
- dealing with possible sources of error
- controlling variables
- making accurate measurement
- choosing the most suitable apparatus.

It is assumed that, as far as possible, the IGCSE course will be taught so that candidates undertake regular practical work as an integral part of their study of physics. This examination should not be seen as suggesting that the course can be fully and effectively taught without practical work. Some of the skills involved in experimental work, including graph plotting and tabulation of readings, can be practised without doing experiments. However, there are parts of this examination in which the candidates are asked to answer from their own practical experience.

Questions on experimental techniques were answered much more effectively by candidates who clearly had experience of similar practical work and much less successfully by those who, apparently, had not. The breadth of candidates' experience of experimental work was apparent in the quality of their analysis of results and their comments on procedures.

This was seen in the clear practical details given by some candidates in **Questions 1(b)(ii)** and **(g)**, **Question 2(d)** and **Question 3 (e)**.

Where explanations or justifications are required, candidates should base them on practical considerations, using data from the question. Theoretical responses are not usually adequate, particularly when reference to results is asked for. Good detail was seen in many of the answers to **Question 3(d)(ii)**.

It is expected that numerical answers will include a matching unit and will be expressed to a number of significant figures which is appropriate to the data given in the question. These points were demonstrated in many of the responses to **Questions 1(d)** and **(e)**, **Question 2(c)(ii)** and **Question 3(c)(iii)**.

Candidates need to be mindful that use of a 'recurring' symbol, does not indicate the intended number of significant figures and will lose credit given for this aspect of the answer.

Each Alternative to Practical examination will include a question in which candidates will be asked to outline a plan for an investigation. These questions will always be able to be answered by careful reading of the brief and the logical application of sound experimental practice. Many candidates showed good practical knowledge when answering **Question 4** but it was clear that a number had not been prepared for this or had limited experience of basic experimental work.

Comments on specific questions

Question 1

This question was well answered by many, although some found aspects of the question to be challenging.

- (a) The majority read the forcemeter correctly.
- (b) The volume of water in the measuring cylinder was generally as expected. However, both 151 and 152 cm³ were seen. Many described the technique of observing the bottom of the meniscus at right angles to the scale. A number gave one or other of these precautions rather than both and a minority of candidates described how the scale was constructed or outlined the displacement experiment.
- (c) The majority of candidates recorded the expected lower forcemeter reading although mistakes did occur with the scale being read in reverse order and 1.3 N being recorded. The volume was generally correct.
- (d) Most calculated ρ_1 correctly from their readings but fewer gave the appropriate unit of g/cm³.
- (e) Many recorded the mass to the nearest gram but some merely repeated the reading on the scale of the balance or shortened it to 241.3 g. 241.0 g was seen, with candidates not recognising this as an incorrect answer both in terms of the value of the decimal place and also being expressed to the nearest 0.1 g.
- (f) ρ_2 was often calculated correctly but there was sometimes confusion over how the average value should be obtained.
- (g) Many answers referred to inaccurate experimental techniques and did not gain the marks. It was expected that responses should highlight the inherent sources of inaccuracy in the suggested methods, such as measuring the mass of the empty measuring cylinder after it had contained water rather than before. A number of candidates did point this out.

The second mark, for a suggested improvement, was harder to achieve for most.

Question 2

Many candidates tackled this question well.

- (a) Many good answers were seen with a correct voltmeter symbol on the main part of the circuit, in parallel with terminals **P** and **Q**.

However, a lot of candidates gave incorrect answers, frequently showing the voltmeter in series or connected across a small section of the resistance wire or connecting wires.

Most read the voltmeter correctly. However, 0.34 A was seen on a number of occasions.
- (b) Some good graphical skills were apparent in many answers.

Many chose a suitable scale and labelled the axes correctly, although a number were reversed, with I/A on the y-axis. Small scales, occupying less than half of the grid were commonly seen.

Plotting was generally good. Where unusual scales had been suggested, plotting was often more awkward and mistakes occurred. The most straightforward plots came from scales of $1\text{ cm} = 0.1\text{ V}$ and $1\text{ cm} = 0.05\text{ A}$.

Many candidates indicated the plots with fine crosses as advised in previous reports to Centres. Small dots are acceptable but are often obscured when the line is drawn through them, making it more difficult to award the mark for correctly plotted values. A sharp pencil should be used for the plots and for the line so that accurate drawing may be achieved and errors easily corrected.

The common response was an attempt at a best-fit straight line although there were more than the usual number of lines which joined the plots together in an irregular fashion. This is never acceptable for the mark.

A small number of scripts showed no attempt to draw a line to the plots.

- (c) Many answers lay within the expected range, with a clear triangle shown on the graph.

However, the resistance unit was often omitted or the value expressed to only 1 or to more than 3 significant figures.

- (d) Only a few candidates realised from the increasing values of current in the experiment that shorter lengths of resistance wire would produce excessive currents.

- (e) Many drew the expected rectangle with strike-through arrow but there were a number who showed thermistor symbols or combinations of thermistor/variable resistor. Quite a number of candidates, presumably unfamiliar with circuit diagrams, made up an inappropriate symbol.

Question 3

The early parts of this question were well answered by candidates across the ability range.

Explanations and practical details were challenging for some.

- (a) Responses were often correct. However, some measured θ to line **AB** rather than the normal as shown on the diagram and obtained 60° or 120° .
- (b) Many gave 5.0 cm as the pin separation and a good number indicated a greater value which was still within the bounds of the ray-trace sheet. The requirement is that pins should be as far apart as is reasonably possible for ray-tracing with 5.0 cm as a minimum separation.
- (c) A lot of candidates drew accurate lines, obtaining good values for a and b and the expected answer for n expressed to 2 or 3 significant figures. Many correctly omitted a unit but some gave cm or $^\circ$.
- A number of candidates seemed not to recognise that thicker, poorly drawn lines would produce unreliable values.
- (e) Many obtained angles close to 30° and realised that, even if they were not identical, the values of α and θ could be regarded as equal because the difference was within the limits of experimental accuracy. However, some still do not recognise this concept, requiring the values to be identical. Where angles had been measured incorrectly, credit was given to responses which did not support the suggestion that they should be equal.
- (e) Answers which referred to poor experimental practice or 'human error' did not gain credit. Candidates who had experience of these methods realised the inherent difficulty of placing pins accurately, often because of the thickness of the pins themselves.

Question 4

A good number of candidates achieved well here as the brief was based on familiar techniques in thermal energy work. Others however found it challenging and a number made no attempt or only a brief attempt at a response.

There were some very clear answers with a significant amount of good detail. Most of these followed the structure suggested by the question and it was clear from many responses that the bullet points had been used by candidates as a checklist of what was to be included.

Candidates should read the brief carefully. Many long answers contained little that could be credited while more concise responses addressed the required investigation closely and gained full marks.

A very small number of candidates gave a plan for a completely different experiment, sometimes based on one of the questions in the paper. No credit can be given in these circumstances.

Many used diagrams to help explain their plan and a significant number of marks could be gained in this way. It should be recognised that it is much simpler to draw a table or graph rather than describe it in the text and good examples of this were seen.

A good number realised that the basic equipment should include a thermometer and stop-watch and that a beaker and insulation would be required. Some lost this mark by assuming that one or other of these items would be included and not specifically stating that this apparatus would be needed.

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It is good practice to include units along with quantities on table headings or graph axes and some clear examples of this were seen.

The final 2 marks were available for precautions, possible difficulties which might be encountered or additional points relating to practical techniques. It was here that differences clearly emerged between those candidates who were used to carrying out a range of experiments and those who were not.