PHYSICS

Paper 0625/11
Multiple Choice Core

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

General comments

Some candidates found this paper challenging. Candidates performed best on **Questions 1** and **19** while **Questions 3** and **16** proved the most difficult. Candidates should be advised to read all questions and options carefully before choosing their answer.

Comments on individual questions

Question 2

The majority of weaker candidates were unable to deduce information about speed from a distance-time graph.

Question 3

Many candidates found this question challenging. It required candidates to know that the acceleration of free fall without air resistance is constant, and to be able to recognise a graph indicating this. Even able candidates tended to opt for **A**: the graph showing that acceleration increased uniformly with time.

Question 7

Many candidates failed to read this question carefully and chose option **D**, giving the spring's length rather than its extension.

Question 16

Only the very strongest candidates answered this question correctly. Option **C** was very popular, suggesting a belief that the temperature of ice increases as it melts.

Question 20

Option **A** was a common choice in this question on waves, indicating a misconception that the boat would show a steady movement in the direction of motion of a wave front.

Question 21

Wave diffraction was unfamiliar to many candidates with only the strongest candidates answering correctly.

Question 23

Despite the labelled diagram, many candidates believed that violet light refracted less at face 1 and more at face 2 (Option **B**).

Question 28

Although a large majority knew that electrons were involved in the charging process, the direction of movement was unclear.

Question 29

Even many of the most able candidates incorrectly thought that moving the lamp to the left side of the resistor would increase the current in it.

Question 34

All options were popular in this question on the role of an earth wire, suggesting considerable uncertainty on this topic.

PHYSICS

Paper 0625/12
Multiple Choice Core

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

General comments

While many candidates answered most questions well, **Question 16** caused difficulty for a large number of candidates. Candidates should be advised to read all questions and options carefully before choosing their answer.

Comments on individual questions

Question 3

This question was challenging for many candidates. It required candidates to know that the acceleration of free fall without air resistance is constant, and to be able to recognise a graph indicating this. Even able candidates tended to opt for **A**: the graph showing that acceleration increased uniformly with time.

Question 7

Most candidates failed to read this question carefully and chose option **C**, giving the spring's length rather than its extension.

Question 12

This question on pressure was generally well answered, although many candidates chose **B**, presumably believing that the heels were shown from the side, and not as stated in the question.

Question 16

Only the very strongest candidates answered this question correctly. The concept of change of state happening at constant temperature was unfamiliar to most candidates.

Question 18

All options were equally popular on this question on transfer of thermal energy suggesting a lack of knowledge of this topic.

Question 23

A large proportion of candidates did not believe that a ray of light could pass through a rectangular glass block without being deviated, and therefore chose diagram **B** as the incorrect one.

Question 29

Most candidates, including many of the more able, thought that moving the lamp to the left side of the resistor would increase the current in it.

Question 40

This question concerned the half-life of a radioactive source. A large number of candidates opted for **B**, failing to take into account that there were two half-lives involved.

PHYSICS

Paper 0625/13
Multiple Choice Core

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

General comments

Question 1 was very well answered, but other questions on this paper caused difficulty for candidates with **Questions 3**, **14** and **16** proving particularly challenging. Candidates should be advised to read all questions and options carefully before choosing their answer.

Comments on individual questions

Question 3

This was found to be one of the most challenging questions on the paper. It required candidates to know that the acceleration of free fall without air resistance is constant, and to be able to recognise a graph indicating this. Many candidates opted for **C** representing acceleration rising at an increasing rate with time.

Question 9

Stronger candidates often performed well in this question dealing with conservation of energy, although weaker ones tended to choose option **C**, believing that work done against friction was equal to the sum of the gravitational potential energies at **X** and **Y**.

Question 10

The most common misconception here was to believe that high efficiency must involve less use of energy per hour.

Question 12

This question on pressure was generally well answered, although a significant number of candidates chose **B**, presumably believing that the heels were shown from the side, and not as stated in the question.

Question 13

The barometer and manometer were confused by a number of candidates in this question.

Question 14

Only the strongest candidates were familiar with Brownian motion with all the incorrect options being more popular than the correct answer.

Question 16

Only the very strongest candidates answered this question correctly.

Question 21

More candidates opted for **A** than the correct answer, confusing the effect on wavelength of the slower wave in shallower water.

Question 22

Most candidates thought that the angle of reflection was 20°, failing to deduce it from the normal.

Question 26

Many candidates failed to double the distance in this question, causing them to choose option **A**.

Question 28

While this question was answered well by many, a common mistake among weaker candidates was to believe that a conducting metal rod could become charged.

Question 29

Even many of the most able candidates thought that moving the lamp to the left side of the resistor would increase the current in it.

Question 31

A significant number of candidates chose the series circuit **C** rather than the parallel arrangement.

Question 32

The popularity of option **A** here suggested confusion over the roles of fuses and earth wires.

Question 36

Weaker candidates were very unclear about the operation and use of a relay.

PHYSICS

Paper 0625/21
Multiple Choice Extended

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

General comments

Many candidates performed well on this paper. Candidates found most **Questions 2**, **6** and **22** the most challenging.

Comments on individual questions

Question 2

Here candidates had to know that the acceleration of free fall without air resistance is constant, and to be able to recognise a graph indicating this. While stronger candidates answered correctly, the most common error was to believe that acceleration increased uniformly.

Question 6

Circular motion proved a challenging topic for many candidates, with many believing that there was no acceleration.

Question 15

This question concerned pressure and kinetic theory. Weaker candidates frequently chose **A**, thinking that the average kinetic energy of gas molecules, rather than their momentum, changes during collisions with the container walls.

Question 16

Although stronger candidates answered this question correctly, option **C** was a very popular choice suggesting a belief that the temperature of ice increases as it melts.

Question 21

Although this question was quite well answered, a popular mistake was to choose option **A** with these candidates failing to appreciate the effect of wavelength on the amount of diffraction.

Question 22

Weaker candidates were often not confident enough in their knowledge of the nature of images to choose the correct option. The popularity of options **B** and **C** might suggest that many thought the descriptions must be different for the two images.

Question 30

A significant number of candidates thought that moving the lamp to the left side of the resistor would increase the current in it.

PHYSICS

Paper 0625/22
Multiple Choice Extended

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

General comments

Candidates performed well on a number of questions on the paper with the best-answered being **Questions 4**, **5**, **8** and **13**. Those which proved the most challenging were **Questions 6**, **22** and, particularly, **31**.

Comments on individual questions

Question 2

This question required candidates to know that the acceleration of free fall without air resistance is constant, and to be able to recognise a graph indicating this. Many candidates opted for **A**, representing acceleration increasing uniformly with time.

Question 6

Circular motion proved a challenging topic for many candidates, with many believing that there was no acceleration.

Question 7

A significant number of candidates failed to read this question carefully and chose option **C**, giving the spring's length rather than its extension.

Question 12

The most common error in this question on energy was choosing **C**, considering gravitational potential, rather than total energy.

Question 15

Although stronger candidates answered this question correctly, Option **C** was a very popular choice suggesting a belief that the temperature of ice increases as it melts.

Question 19

Although generally candidates coped well with this question on rate of emission of infra-red, a significant number chose **A**, perhaps thinking that this was correct because it showed the object whose temperature would drop most quickly.

Question 22

Weaker candidates were often not confident enough in their knowledge of the nature of images to choose the correct option. The popularity of options **B** and **C** suggested that many thought the descriptions must be different for the two images.

Question 31

A very large proportion of candidates, even the most able, failed to appreciate that doubling the diameter of the wire (rather than its cross-sectional area) would not have an equal but opposite effect to doubling its length, and they therefore chose option **B**.

Question 38

Although a large majority of candidates knew that the β-particles would be deflected towards the top or bottom of the page, many of them either misused the left-hand rule, or overlooked the fact that the particles had a negative charge.

PHYSICS

Paper 0625/23
Multiple Choice Extended

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

General comments

Some parts of this paper were very well answered. **Questions 5**, **7**, **8**, **12** and, particularly, **13**. However, Questions **6**, **10**, **14**, **20** and **21** were the most challenging for many candidates.

Comments on individual questions

Question 2

This question required candidates to know that the acceleration of free fall without air resistance is constant, and to be able to recognise a graph indicating this. Although stronger candidates answered correctly, many candidates opted for **A**, representing acceleration increasing uniformly with time, with others choosing **C**, representing acceleration rising at an increasing rate.

Question 6

Circular motion proved a challenging topic for many candidates, with many believing that there was no acceleration.

Question 10

This question concerned the speed of a falling ball. Many candidates believed that dropping the ball from twice the height would double its speed just before it hit the ground. The significance of the v^2 term in ½ mv^2 was overlooked or not understood.

Question 14

Only the strongest candidates were familiar with Brownian motion with option **C** being more popular than the correct answer.

Question 20

More than half the candidates incorrectly chose option **A**. This was a true statement about the nature of sound and light waves, but did not explain the effect described. Candidates should be warned that a statement, although true, might not be the correct answer to a question, and they should read carefully what is required from the question.

Question 21

Many candidates were not secure enough in their knowledge of the nature of images to choose the correct option. The popularity of options **B** and **C** might suggest that they thought the descriptions must be different for the two images.

Question 28

The most common error here was to believe that a conducting metal rod held in a hand could become charged.

Question 29

A number of candidates thought that moving the lamp to the left side of the resistor would increase the current in it.

Question 35

The popularity of option **B** here suggested confusion over the roles of fuses and earth wires.

Question 38

Although most candidates knew that α-particles would be deflected towards the left or right, many of them either misused or misunderstood the left-hand rule.

PHYSICS

Paper 0625/31
Core Theory

Key messages

- Candidates should note the number of marks available and the space allocated for responses as these factors provide a clear indication of the type of answer that is expected. For example, for a two-mark question, two distinct points should be given.
- In calculations, candidates should set out and explain their working clearly. Credit may be given for correct working even if the final answer is incorrect.
- Before starting their response, candidates are advised to read the question carefully, paying attention to the command words, to ensure they focus their answers as the question requires.

General comments

A high proportion of candidates performed well on this paper. Non-numerical questions posed more of a challenge to many candidates than numerical questions. Some areas of the syllabus were better known than others. In particular, energy transfers, the arrangement of particles in liquids and gases, evaporation and nuclide electromagnetic induction were not well understood.

Equations were generally well known by all but the weakest candidates. Many candidates understood how to apply equations to fairly standard situations well. On occasion however, when asked to apply their knowledge to a new situation, they were less confident and displayed a lack of breadth of understanding of the use of the equation. More practice in applying equations in unfamiliar situations would deepen candidates' understanding.

The majority of candidates indicated by their knowledge and skills that they had been correctly entered for this Physics Core paper. However, a significant minority of candidates found the subject matter and level of some questions very easy, and they may have benefited from being prepared and entered for the Extended Theory paper.

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.

Candidates did not seem to find any difficulty in completing it in the allocated time and relatively few left answers to questions blank.

Comments on specific questions

Question 1

(a) The majority of candidates answered this question correctly. The most common error was to give a time representing the maximum speed.

(b) Most candidates answered this question well. However weaker candidates used an incorrect transformation of speed = distance/time, i.e. distance = speed/time.

(c) (i)(ii) The majority of candidates identified B as the forces acting on the cyclist at a time of 20 seconds. Most of these candidates then gave a correct explanation for their choice.

Question 2

(a) A number of candidates found this question challenging. The majority of these failed to subtract the original length from the extended length for each of the loads. A common error was to identify one of the extensions and to add this to the values in the table.

(b) Most candidates gained at least partial credit in this question. However candidates often gave vague or unclear descriptions of how to improve the accuracy of the measurements.

(c) (i) The majority of candidates labelled the lines correctly and gave an adequate explanation.

(ii) The majority of candidates drew a suitable line for elastic band C.

Question 3

(a) Only the stronger candidates answered this question fully correctly and recognised that the force must be applied further away from the pivot than the support for the barrier.

(b) Many candidates answered this question well but a large number thought that moment = force ÷ distance from pivot.

(c) Many candidates found this question challenging. In many answers there was confusion of forces and distances in attempts at principle of moments calculations.

Question 4

(a) (i) Many candidates answered correctly but a significant number thought that the energy gained by the load due to its increase in height was kinetic energy.

(ii) This was only answered well by the strongest candidates. A common error was to state that the energy contaminated the surroundings.

(iii) Many candidates correctly stated the principle of conservation of energy but few went on to correctly link the principle to the example of the motor.

(b) The vast majority of candidates answered this question well but there were some vague and imprecise statements about benefits and problems associated with coal-fired power stations.

Question 5

(a) (i) The majority of candidates answered this question well.

(ii) The majority of candidates gained partial credit but very few went on to gain full credit by showing total internal reflection of the ray at the flat surface.

(b) (i)-(iii) The majority of candidates correctly drew the ray from the headlights to the observer, but very few correctly labelled the diagram, and even fewer stated a correct version of the law of reflection.

Question 6

(a) Only the strongest candidates gained full credit for this question. Many candidates gave descriptions of evaporation here, and others gave only vague and imprecise statements about the arrangement and movement of molecules in the liquid water and the water vapour.

(b) The majority of candidates recognised the process of evaporation, but only more able candidates gave adequate descriptions. A common error was to attempt to describe boiling.

(c) Many candidates answered this question well. Weaker candidates used incorrect transformations of the equation pressure = force/area.

Question 7

(a) Most candidates correctly identified the missing wave from the spectrum.

(b) The majority of candidates answered correctly.

(c) A number of candidates failed to answer correctly with all three options being chosen in roughly the same proportion.

(d) Only more able candidates were capable of giving a clear difference between sound waves and electromagnetic waves.

Question 8

(a) A number of candidates failed to put an A or a V in either meter.

(b) The majority of candidates correctly calculated the resistance of the wire. Weaker candidates used an incorrect transformation of $V = IR$.

(c) Only the strongest candidates were able to link a decrease in current to the increased resistance of the thinner wire.

Question 9

(a) The majority of candidates answered well. Weaker candidates gave materials such as copper and steel.

(b) (i) Many candidates correctly calculated the output voltage of the transformer. In weaker answers, numbers were given in some form of ratio, which could not be given any credit.

(ii) Only more able candidates linked the step down transformer to either the number of turns on the coils or the change in voltage from one coil to another.

(c) While there were a number of strong answers, the vast majority of candidates failed to clearly describe the advantages of transmitting electricity at a high voltage.

Question 10

(a) This question was generally answered well.

(b) (i) Many candidates correctly identified end A and end B. Weaker candidates often had the poles reversed.

(b)(ii)(iii) While many candidates gained partial credit on this question, there was a lack of precision in a large number of answers.

(c) Some candidates were able to give 2 distinct answers. However the majority only gave one answers but gave it twice with different phrasing.

Question 11

(a) The most able candidates gave descriptions which were often very clear and precise, supported by good diagrams. The majority of candidates however, showed little familiarity with how to use the equipment to demonstrate electromagnetic induction.

(b) The majority of candidates answered this question correctly.

(c) Many candidates were able to give suitable methods of increasing the e.m.f. in the wire.

Question 12

(a) Only the most able candidates gained full credit. The most common error was to state that electrons were one of the particles found in the nucleus, whilst others simply gave nucleons as the name of a particle in the nucleus.

(b) Many candidates gave clear explanations of what is meant by the term *isotope*. The most common error was to state that the number of neutrons was the same, and that the number of protons differed.

PHYSICS

Paper 0625/32
Core Theory

Key Messages

- All candidates should be reminded to check their responses carefully. Errors such as failing to answer part of a question, using an appropriate number of ticks in a tick box question or the omission of a unit would then be avoided.
- Candidates should be reminded to record their answers clearly and legibly to ensure that maximum credit can be awarded.

General Comments

Candidates applied their knowledge and understanding to a variety of contexts across the Core syllabus. There were some areas of the syllabus that provided greater challenge to candidates; in particular, the questions on waves, electromagnetism and radioactivity. All but the lowest scoring candidates were able to use and apply standard equations such as the pressure and transformer equations.

Many candidates showed their working clearly when completing questions requiring calculations. This is important as partial credit may be awarded where the stages of working are shown even if the final answer is incorrect.

A very high proportion of candidates attempted all questions. They expressed their ideas clearly used correct terminology. A small but significant number of candidates scored very high marks and may have benefitted from being prepared and entered for the Extended Theory paper.

Comments on specific questions

Question 1

(a) There were a high proportion of correct responses to this question. The most common error was giving distance instead of speed.

(b) There were many correct responses to this question. A common error was to give a tick alongside C to D.

(c) Only the best prepared candidates gained full credit on this question.

(d) Many candidates answered this question correctly. There were a small number of candidates who gave no answer to this question.

Question 2

(a) This question was generally answered well but in some cases candidates could only be given partial credit for indicating two instruments for measuring length, for example, metre rule and tape measure.

(b) Only the very weakest candidates failed to give the correct answer to this question.

(c) This question was well answered by nearly all candidates.

(d) There were many correct answers to this question.

Question 3

(a) This question was not well answered and a few candidates ticked both boxes.

(b) Most candidates gave correct answers for this question.

(c) This was well answered by all but the weakest candidates.

(d) This question was well answered by most candidates. However some responses failed to gain credit as the answer given was too vague, for example, “the see saw tilts”.

Question 4

(a) This question was generally answered well.

(b) Many correct responses to this question were seen. Candidates who gave an incorrect response to **(a)** often gained full credit for an error carried forward.

(c) There were a high proportion of correct responses to this question. A common misconception was that weight changed when standing on one foot.

Question 5

(a) There were many incorrect responses to this question including conduction, convection and evaporation.

(b) Many candidates gained at least partial credit for this question recognising that the dull black can would have a higher temperature. There were some common misconceptions. A significant number of candidates thought that black objects either attracted heat or were better conductors and shiny, light coloured objects were better insulators.

(c) Many candidates gained at least partial credit on this question.

Question 6

(a) Many correct responses were seen. Common errors included reflected ray and refraction.

(b) Stronger candidates answered both parts of this question well.

(c) This question proved challenging for many candidates. Few candidates gave responses in terms of the angle of incidence not being equal to the angle of reflection. Those that gained partial credit often referred to the image not being equal distance to the mirror as the object.

Question 7

(a) Full credit was gained by the best prepared candidates. Many candidates gained partial credit for 450 m not realising that the distance travelled is towards and back from the fish.

(b) Stronger candidates answered this question well.

(c) Most candidates gave a range of acceptable responses. Sound, longitudinal and transverse waves were common responses that did not gain any credit.

Question 8

(a) This was well answered by the better prepared candidates.

(b) Stronger candidates answered this question well.

(c) Only the best prepared candidates gained full credit. Many candidates gained partial credit for recognising that the unit of frequency was Hz.

Question 9

(a) (i) Only stronger candidates answered this question correctly. A common error was to change or control the current.

(ii) Many candidates answered correctly. A common error was iron.

(iii) The better prepared candidates gave correct responses. Partial credit was obtained by a small number of candidates who gave a correct equation but an incorrect value.

(b) Many candidates gained partial credit, usually for lower current or lower energy losses. A common misconception was that electricity is transmitted faster at higher voltages.

Question 10

(a) Many correct responses were seen. A small number of candidates did not give a response to this question.

(b) Many candidates gained at least partial credit here. A common misconception was that the variable resistor was a fuse cutting the electricity when the current or voltage was too high.

(c) This was generally answered correctly.

(d) This question was well answered by only the strongest candidates. The most common error seen in weaker answers was that the component was a resistor to control the current or voltage.

Question 11

(a) (i) Many vague responses were seen. For example, stating that a direct current is a current directly from the source or power supply.

(ii) Stronger candidates gave fully correct answers. A common error was to give copper or metal because it is a good conductor of electricity.

(b) There were some very good answers worthy of full credit from the strongest candidates.

(c) This question was not well answered with many vague responses about high voltage given.

Question 12

(a) This question proved challenging for most candidates.

(b) (i) Many correct responses were seen to this question.

(ii) This was well answered by the strongest candidates.

(c) Only stronger candidates answered this question well.

(d) There were many vague responses to this question about wearing goggles, gloves or a lab coat that could not be credited.

PHYSICS

Paper 0625/33
Core Theory

Key Messages

- All candidates should be reminded to check their responses carefully. Errors such as failing to answer part of a question, using an appropriate number of ticks in a tick box question or the omission of a unit would then be avoided.
- Candidates should be reminded to record their answers clearly and legibly to ensure that maximum credit can be awarded.
- Candidates should be reminded to read questions carefully and note the space available and the number of marks allocated to questions. These indicators provide clear information as to the type of response expected. Where the question states the number of pieces of information required, only this number should be given.
- Candidates should be encouraged to set out and explain the stages in their working clearly. It is possible that partial credit can be awarded for the stages in working even if the final answer is incorrect.
- Candidates should be encouraged to attempt every question on the examination paper.

General Comments

There were many strong performances on this paper indicating that many candidates were well prepared. Some areas of the syllabus were better known than others. The questions on energy and electromagnetics proved to be challenging for all but the strongest candidates. Many candidates were able to demonstrate that they had learnt all sections detailed in the Core syllabus and were able to answer questions that use this learning in a variety of contexts. A small number of the strongest candidates may have benefitted from being prepared and entered for the Extended Theory paper.

All but the lowest scoring candidates had been well prepared for questions that involved calculations. Many candidates were able to solve numerical problems using equations in standard situations.

A significant number of candidates left parts of a question unanswered indicating that their knowledge and understanding was less than secure. However, there was no evidence to indicate that candidates did not have sufficient time had to complete the paper.

The English language ability of most of the candidates was appropriate for the demands of this paper. Very few candidates were unable to express themselves adequately. In a small number of cases credit could not be given for responses that were illegible.

Comments on specific questions

Question 1

(a) There were many correct responses to this question.

(b) Most candidates answered this question correctly.

(c) Correct responses were usually given. A common incorrect response was 60 minutes.

(d) This question produced a high proportion of correct responses. Common errors were 70 km and 100 km.

Question 2

(a) There were many correct responses this question.

(b) (i) (ii) There were many correct responses to both parts of this question.

(c) Better prepared candidates identified friction as the force stopping the bicycle but many candidates were then unable to explain that friction takes place when two surfaces are rubbing together.

Question 3

(a) (i) This question was only answered well by stronger candidates. The question clearly indicates that the spring is oscillating. There were few correct responses and many candidates gave vague responses about moving downwards that could not be credited.

(ii) As in the previous part of this question, there were a high proportion of vague responses. The most common response was in terms of the spring moving upwards.

(b) (i) Better prepared candidates stated the principle of conservation of energy well.

(ii) Very few candidates gained full credit for their response to this question. Strong answers showed an awareness that energy was being transferred to the surroundings. The most common error seen was to state that gravity stopped the oscillations of the spring.

Question 4

(a) Many correct response were seen for this question.

(b) (i) Fully correct responses were usually given by stronger candidates. Other candidates generally gained some credit for a partially correct response.

(ii) This was answered well by some candidates. Incorrect responses often referred to wood floating or wood being a strong material.

(c) (i) Many correct responses from better prepared candidates were seen. The most common incorrect value given was 800. A number of candidates did not give the correct unit in their answers with a common error being N/m.

(ii) This was answered well by most candidates.

Question 5

(a) Many candidates gained partial credit here with only the better prepared candidates answering fully correctly.

(b) This question was challenging for almost all candidates. A small number of candidates gave rather vague responses about insulation but there were very few that explained that trapped air acted as the insulator.

Question 6

(a) (i) Many correct responses were given for the direction of travel of the ray of light.

(ii) In this part there were significantly fewer correct responses seen for the angle of incidence and the angle of reflection.

(iii) This was answered well by most candidates.

(b) The law of reflection was not well understood and this question was only answered well by the strongest candidates.

Question 7

Stronger candidates gave clear, correct responses and gained full credit. However, there were many vague and incorrect responses. A significant number of these did not refer to the time interval between the lightning and the thunder. Misconceptions included sound being heard more quickly or louder by the person on the hill as they were closer to the clouds and the lightning being brighter because the person in the house was closer.

Question 8

(a) Most candidates answered this question correctly.

(b) This question was only answered correctly by stronger candidates.

(c) Correct responses were given by only the best prepared candidates. A small proportion of candidates gained partial credit for responses that indicated rubbing with a cloth.

Question 9

(a) This question proved challenging for most candidates. A common incorrect response was that d.c. was directly from the source or battery. Other misconceptions included a.c. being more efficient and a.c. and d.c. having different kinds of charges currents or voltages.

(b) (i) Correct responses were given by better prepared candidates. A common error was to give resistor as an answer but various other components were also seen including lamp, battery, switch and transformer.

(ii) This question was well answered by only the strongest candidates.

(c) (i) There were many correct responses to this question. A small but significant number of candidates did not state the unit or gave an incorrect unit.

(ii) This question proved challenging. Candidates did not appear to know that the fuse value should be slightly above the value of the current through the appliance.

(d) There were a number of incorrect and vague responses to this question. Typical responses were in the form of preventing problems such as the heater getting too hot.

Question 10

(a) This question was often well answered.

(b) This question proved challenging for all but the strongest candidates.

(c) A high proportion of correct and partially correct responses were seen.

Question 11

(a) This was well answered by most candidates.

(b) A high proportion of candidates obtained the correct value.

(c) Many candidates obtained at least partial credit for this question. There were many vague responses, for example, "cheaper" that could not be credited. A common misconception was that higher voltages allowed electricity to be transmitted faster.

Question 12

(a) (i) This question was answered correctly by most candidates.

(ii) Many candidates gained partial credit for responses to this question. However, very few obtained full credit.

(b) (i) This question was challenging for almost all candidates. Many responses included a magnet being wired to the galvanometer.

(ii) This question was answered well by stronger candidates.

PHYSICS

Paper 0625/41
Extended Theory

Key messages

- Candidates are reminded that the units required in calculations are the base units: m, kg, s, A, V etc. and not multiples and sub-multiples of these units. These should always be stated where required in order to maximise credit available.
- In calculations that depend on the use of a formula, it is always appropriate to state the formula as this may allow partial credit to be awarded, even if this formula is subsequently wrongly transposed.

General comments

There were some strong performances and in general candidates answered questions requiring a numerical answer better than those requiring statements, descriptions or explanation. In numerical work, the strongest candidates showed themselves consistently able to use the correct formula and the given data correctly. These candidates generally dealt with questions requiring explanation or descriptions well with succinct answers in appropriate scientific language. Weaker candidates tended to write more rambling answers and often missed the required point entirely or contradicted a correct point already made.

Comments on specific questions

Question 1

(a) (i) Most candidates calculated the final speed correctly and drew the correct straight line graph. Others calculated the final speed correctly but misinterpreted the scale of the speed axis of the graph. Full credit could not be awarded if a line of constant speed was drawn from the point of maximum speed. A vertical line from the point of maximum speed to the time axis was acceptable. Common mistakes were to use the numerical acceleration value as the final speed, or to draw a graph of negative gradient from maximum speed to zero.

(ii) A correct value of the distance travelled was most easily found by using the area under the graph, and many correct values were obtained. Partial credit was awarded for obvious use of the area but with wrong subsequent work and for correct substitution of the numbers from the graph followed by wrong calculations.

(b) The strongest answers showed an awareness of the effect of air resistance on the falling feather. Many candidates however failed to take air resistance into account and drew a straight line graph through the origin.

(c) Most candidates answered this question correctly.

Question 2

(a) (i) Most candidates used the correct formula, calculated the pressure correctly and gave the correct unit.

(ii) There were many correct answers. Weaker candidates often failed to write down a correct formula and began the answer with a division of the two numbers.

(iii) Most candidates knew that the weight of the tanker was the same as the force of the water on its base.

(b) A majority of candidates could state that the depth below the surface lessens, clearly recognising that this is because of the greater density of sea water. Fewer could be awarded credit for stating that this had to happen because the force on the bottom of the tanker is greater in sea water than in fresh water.

Question 3

(a) Almost all candidates stated correctly that molecules of the gas collide with the walls of the container and gained credit. However, very few candidates mentioned momentum. Of those who did, the most common error was refer to increase or decrease of momentum rather than change of momentum.

(b) This question was challenging for many candidates. In **(i)**, candidates were as likely to subtract 120 from 760 rather than, correctly, adding 760 and 120. Some simply wrote down 760 or attempted a calculation using $P = hdg$. In **(ii)** there was frequently misunderstanding with many answers differing from the one given in **(i)**. In **(iii)**, the requirement to use Boyle's law was usually recognised, but substitution of the correct numbers was rare, with very few gaining full credit.

Question 4

(a) Almost all candidates identified evaporation as the cause of the decrease in volume and temperature. Most of these could explain how, in terms of molecules, the temperature and volume decrease.

(b) A greater decrease in volume and temperature was usually identified, with good reasoning in terms of the action of the fan. Some candidates suggested that the fan blows water molecules away from the surface of the water, rather than removing vapour molecules from above the surface. Good responses in terms of reducing humidity above the water surface were sometimes given.

(c) Few candidates understood they had to explain why the water receives heat from the surroundings and therefore cools less than it would in an insulating container. Credit was awarded for stating that the metal bowl is a good thermal (or heat) conductor. However, such statements were rare, with many referring to the metal surface being a good reflector or poor absorber of radiation which was irrelevant to the situation. Only the strongest candidates stated that the metal transferred heat from the surroundings to the water.

Question 5

(a) The arrangements of molecules needed to be described as in a lattice, or regular, for ice, and as irregular or random for water. The movement of molecules needed to be described as vibration for ice and as moving around or sliding over each other for water. Statements about the spacing of molecules were not rewarded. Most candidates omitted or showed confusion about one of the 4 required points.

(b)(i) A correct formula or correct use of the numbers without a stated formula was usually seen, with a large proportion of candidates continuing to calculate the mass.

(ii) If the correct formula could be recalled, the energy removed was usually calculated correctly. There were however, a considerable number of candidates who failed to answer this question.

Question 6

(a) In **(i)**, many candidates wrote down the speed of light rather than a speed of sound in the range of acceptable values. In **(ii)**, most candidates recalled the correct range.

(b)(i) A common mistake was due to failure to convert the given value of the wavelength to metres.

(ii) This question proved challenging for many candidates and the concept of rarefactions in sound waves was not well understood.

(iii) Those candidates who had been able to answer **(ii)**, and some who had not, were able to make acceptable statements about the separation of molecules and the pressure at rarefactions in the wave.

Question 7

(a) (i) Most candidates were able to show the incident ray passing through the first face of the prism without change of direction. A good proportion of these candidates also showed the correct total reflection at the sloping face. Others showed wrong total internal reflection or refraction.

(ii) It was necessary to draw the lower prism with the correct shape and of the correct orientation for any credit to be awarded here. Some carelessness was evident with the shape, and wrong orientation was often seen. Plane mirrors were also sometimes seen.

(b) Most candidates gained at least partial credit but there was clearly much uncertainty about the concept of critical angle.

Question 8

(a) Most candidates gave the correct value of 12 V.

(b) The common approach was to begin with a calculation of the current but some candidates used the correct value subsequently without showing the calculation. Some wrong formulae for calculating the energy transferred were written down. Amongst those quoting the correct formula a common error was to fail to convert 40 minutes to seconds.

(c) The conversion of chemical energy to electrical energy was given by most candidates but the conversion of electrical to thermal or heat was much less frequently referred to.

Question 9

Most candidates gained at least partial credit for this question. A common error in many answers was to suggest that the thin cable had more resistance and would therefore allow less current to pass through it.

Question 10

(a) Answers to this question showed that knowledge about force on a conductor in a magnetic field is not in general well known. Various misconceptions were evident in the answers given. These included, for example, magnetisation of the wire and attraction to a pole of the magnet. Only the strongest candidates gained full credit on this question.

(b) The tendency was for misconceptions that applied in **(a)** to continue in **(b)**. Some answers went on to suggest electromagnetic induction. For example, “alternating current causes movement left and right as e.m.f. is induced”, or similar, was written.

Question 11

(a) This question was challenging for most candidates with only the very strongest answering correctly.

(b) Many good responses to this question were seen. In some answers there was careless drawing with the radial nature of the lines not satisfactorily shown.

(c) (i) Many candidates missed the significance of the word ‘why’ in the question and wrote answers in terms of the charges that move through the wire. Credit was only available for stating that the charge on the sphere attracts electrons from earth, or that there is a p.d. between the sphere and earth.

(ii) The relevant formula could usually be quoted. The common subsequent error was in failing to convert minutes to seconds for substitution into the formula.

Question 12

(a) (i) Most candidates answered this question correctly giving one of the acceptable answers. The answer ‘protons’ was not credited.

(ii) Recall of the complete symbol for a β-particle was essential for a correct value of Z to be quoted. Only stronger candidates were able to demonstrate this knowledge and many weaker candidates gave the value of Z as 96 or, less frequently, 95.

(b) As in **(a)(ii)** for a β-particle, recall of the complete symbol for an α-particle was problematic for many candidates. Following this the symbol for the Np nucleus was inevitably wrong.

(c) Candidates who arrived at the correct answer of 940 years or 2 half-lives did so by first calculating the number of atoms remaining when 6×10^{14} atoms that decayed. Without this first step, it was difficult for a candidate to proceed successfully, but partial credit was awarded for showing the halving of 8×10^{14} atoms that occurred in 470 years.

PHYSICS

Paper 0625/42
Extended Theory

Key messages

- It is essential that candidates show their working and write down the equations used. Credit may be awarded for any correct working shown even if the final answer to a question is incorrect.
- Candidates should be reminded to read the questions carefully and to ensure they address the focus of the question as it has been set.

General comments

A high proportion of candidates performed well on this paper. Equations were generally well known but the use of these equations and the quantities represented were not always fully understood. There were frequent examples where candidates substituted numbers from the question in the wrong place in equations.

Generally candidates followed the rubric of the questions. However, candidates should not give more than one answer to a question as alternatives.

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, were unable to use this knowledge to show understanding.

Overall the English language ability of the vast majority was adequate for the demands of this paper. Only a small minority of the candidates had difficulties with language and struggled to express themselves adequately.

Comments on specific questions

Question 1

(a) (i) The majority of candidates answered this question well but occasionally contradictory statements were seen such as "speed is constant".

(ii) This was generally answered well. The most common error was the use of incorrect units for acceleration.

(iii) Many candidates gained credit but some candidates confused a reduction of acceleration with deceleration.

(b) Many candidates answered this well. Usually candidates realised the need to estimate the area under the graph and a range of methods were shown. Many were excellent approximations but others were too inaccurate or simply wrong.

Question 2

(a) (i) The majority of candidates gained full credit for this question.

(ii) The standard of responses to this part was very variable. Many candidates correctly stated scalar but gave no explanation or an incorrect one.

(b) (i) The majority of candidates answered correctly.

(ii) A good attempt was made by many candidates, who generally appreciated that momentum was conserved. But there were also a full range of errors. These included candidates missing the information that the empty car has a speed of 4 m / s and/or assuming that the cars stick together, or missing out the empty car altogether after the collision and incorrect rearrangement and manipulation of the equation.

(iii) Most candidates gained full credit for this part. The most common error was failing to mention elastic or strain energy in the spring. Candidates' answers were then often merely a repetition of the information in the question.

Question 3

(a) (i) Many candidates thought the space contained air or a gas.

(ii) Most candidates gained full credit on this question.

(iii) Only the strongest candidates answered this correctly. Often there were statements about the levels in the dish and the tube but nothing about the vertical distance between the mercury surfaces.

(b) (i) Most candidates gained credit on this part but often 15 was added rather than subtracted from 760.

(ii) Most candidates recognised that Boyle's Law was required here although many were unable to distinguish which pressure value they should be using. Weaker candidates often made basic errors of physics such as attempting to use $p_1 / p_2 = V_1 / V_2$ or $p = h\rho g$.

Question 4

(a) The majority of candidates gained full credit. The most common error was the incorrect application of the efficiency equation. Many candidates who showed insufficient working but then made a subsequent mistake could not be given credit for what could have been a correct knowledge of the equation.

(b) Many candidates answered this question well. However, a wide range of words were used for energy, particularly e.m.f. showing a lack of understanding of the question. Other common incorrect responses seen included "stored energy" and "electrical energy".

(c) Only the strongest candidates correctly answered this question. Many responses gave little more than was included in the question, e.g. vague references to pollution or cost without any suitable qualification. More specific responses were required to gain credit.

Question 5

(a) Whilst many candidates could give descriptors for both ice and water, very often they were not direct opposites or alternatives. Therefore, no credit could be awarded for 'comparison'.

(i) Although stronger candidates answered this correctly, a number of candidates gave vague statements about arrangements of molecules that could be taken as either a gas or a liquid. These statements did not gain credit.

(ii) Many candidates incorrectly stated that molecules could move freely in liquids.

(b) (i) This was well answered and nearly all candidates gained full credit.

(ii) The majority of candidates gained full credit for correct answers. A number of weaker candidates applied incorrect physics used the equation involving specific heat capacity and temperature change. They recognised that freezing takes place at a constant temperature leading them to the wrong answer of 0 J.

(c) Many candidates failed to give the correct response and gave vague descriptors such as digital thermometer or electrical thermometer.

Question 6

(a) (i), (ii) & (b) The vast majority of candidates ticked the correct boxes.

(c) (i) Many candidates correctly gave a speed in the range 1300 to 1700 m / s. However, a significant number seemed to have remembered a number related to the speed of some wave in some medium but could not remember which wave in which medium, e.g. they quoted the speed of sound in air or the speed of light in a vacuum.

(ii) The majority of candidates answered this correctly, whether or not they knew the correct value in **(i)**, as long as they used their speed to calculate the wavelength without further error. The most common error was a failure to convert the frequency correctly from kHz to Hz. There was also confusion between the unit and the symbol for wavelength, with some candidates quoting lambda as the unit.

(d) Many candidates gained full credit giving three part-circular wave crests centred on the gap, spreading out at least 45° each side of the centreline, with the wavelength constant and the same as the wavelength before the wave reached the barrier. It was not essential that candidates used a compass but measurement and great care were needed to gain full credit with a freehand drawing. Strong candidates invariably use a compass and measured the wavelengths to produce accurate and correct diagrams.

Question 7

(a) Most candidates gained credit here. A common error was to add an arrow to the line through the rectangle.

(b) This question was generally answered well. The most common error was to give an output of zero for inputs of zero and one, indicating confusion with an AND gate.

(c) This was generally answered well. Many weaker candidates drew a truth table for a gate with two inputs.

Question 8

(a) The majority of candidates answered this correctly. A significant number only changed one of the waves in the spectrum however.

(b) (i) 2×10^8 m / s was a very common incorrect response and many candidates omitted a unit.

(ii)1 There were a large number of candidates who were unable to recall the correct equation. Weaker candidates did not recognise that they were working with speeds and attempted to answer in terms of sin i / sin r, substituting speed data for angles i and r.

(ii)2 The equation for critical angle was well known so some credit could obtained for correct working from an incorrect value of n in **1**. A few candidates made errors when rearranging the critical angle equation, moving the sine for the equation to become c = 1 / sin n rather than using the inverse sine operation.

(iii) The majority of candidates correctly named the process as total internal reflection. A significant number referred to total internal refraction.

Question 9

(a) Most candidates answered correctly. However, a significant number gave the answer as 1.5 V, possibly thinking that the cells were connected in parallel.

(b) (i) A significant number of candidates failed to invert their answer after adding the fractions giving an answer of 0.05 Ω.

(ii) Most candidates recognised that the total resistance was 55 Ω added to their answer for **(i)**.

(iii) Many candidates found this question challenging. Candidates needed to recognise that the total e.m.f. is across the total resistance not just across the 55 Ω resistor. Although I = V/R was well known, many candidates did not appreciate the current through the 55 ohm resistor was the equivalent circuit current. Consequently the expression V / 55 was widely seen.

(c) Only stronger candidates gained full credit on these parts. Some candidates misread this part of the question completely calculating actual currents.

Question 10

(a) Very few candidates gained full credit. Many candidates did not follow the instructions in the question, and gave charges that were not in terms of *e*. Many candidates obtained credit for the correct charge on the proton and beta particle. Common mistakes were to give the charge on an alpha particle as +*e* rather than +2*e* and to state that the neutron and gamma ray were charged.

(b) (i) Only the most able candidates gained credit on this question.

(ii) Most candidates gained credit here, clearly demonstrating an understanding that alpha and beta particles carry opposite charges.

(iii) Most candidates answered this correctly recognising that gamma rays are uncharged.

Question 11

(a) Most candidates answered this question well. Weaker candidates struggled to recognise that 3 half-lives was available from the data. Other common errors were to calculate the number of atoms after four half-lives, or having realised that 12 days was equivalent to three half-lives, to merely divide the number of atoms in the sample by three.

(b) Only the strongest candidates gained full credit. Many candidates recognised the need to subtract the background count of 16 at the start of the answer but some did not add the background count of 16 back on after correctly dividing 144 by 8 so 18 was often seen as the final answer.

PHYSICS

Paper 0625/43
Extended Theory

Key messages

- Candidates should be advised to read the questions carefully before starting their responses to ensure they answer the question as it has been set.
- Candidates should be advised to show all their working even when a calculator has been used to obtain a numerical answer as partial credit may be available for correct working when the final answer is incorrect.

General comments

There was a wide range of attainment on this paper with some candidates showing a deep and insightful knowledge of the subject at this level. Many candidates were able to demonstrate strong familiarity with both the core and extended topics of the syllabus and gave relevant, concise answers which fully answered questions. On some occasions candidates did not supply the relevant unit with answers however, with the unit degree (°) frequently omitted after the numerical value of an angle even by candidates who supplied units elsewhere.

Comments on specific questions

Question 1

(a) This was almost always well answered and the majority of candidates were awarded full credit. There were, however, a few candidates for whom the unit of acceleration caused confusion.

(b)(i) Although many candidates continued the graph correctly, many others did not. A common error was to draw a straight line from the end of the line already on the graph to the point (10 s, 0 m / s).

(ii) This was almost universally correct.

Question 2

(a) Most candidates carried out the correct calculations for the two moments and deduced that the resultant moment would be in the anticlockwise direction. A very substantial number of candidates, however, added the two individual moments rather than subtracting them.

(b)(i) Many candidates who had added the two separate moments in **(a)**, subtracted them here.

(ii) The correct answer was only given by stronger candidates with the answer 900 N being the most popular.

Question 3

(a)(i) This was very frequently correct. Occasionally candidates confused the two quantities or stated that only vectors have a magnitude.

(ii) Although many candidates answered correctly, both a statement and an explanation were required and these were not supplied by all candidates.

(b)(i) Most candidates answered this well. Some did not write down the correct defining equation for momentum or did not substitute the number from the question in the correct manner. However, most errors were made in supplying the appropriate unit. A noticeable proportion of candidates gave *newton* as the unit of momentum.

(ii) This was almost always correctly answered. A few candidates who supplied the correct formula did not write down the power of two when substituting in the number or, in a similar manner, did not square the speed when performing the calculation. The correct unit, however, was almost always supplied.

(c)(i) The correct answer was commonly given but some candidates stated that the total momentum would be reduced.

(ii) Few candidates stated that the total kinetic energy would increase and fewer gave the correct explanation. Most stated that it would decrease or, more usually, that the kinetic energy of one section would increase whilst the kinetic energy of the other section would decrease. This latter response did not answer the question.

Question 4

(a)(i) Most candidates were familiar with the appropriate formula and applied it correctly.

(ii) More candidates subtracted the answer to **(i)** than added it on. Others simply quoted the value of the atmospheric pressure. Only a minority were awarded full credit.

(b)(i) Although some candidates gave unambiguous and correct answers, this was a question where the meaning of the answer supplied was not always clear or was too general. The frequently seen answer “The levels change” was not sufficiently precise.

(ii) This question proved challenging. Many candidates gave unclear answers and the answers that were clear were often incorrect.

Question 5

(a)(i) Almost all candidates answered this question correctly.

(ii) There were a significant number of good answers and full credit was quite frequently awarded. There were, however, candidates whose answers did not include a description of the effect on the density or whose answers suggested that a decrease in the volume of the block resulted in a decrease in the density. A small minority described the effect of a temperature increase.

(b)(i) Many answers were awarded full credit for producing the correct final answer. There were a number of alternative approaches however, and several incorrect answers were given fairly often. Some candidates gave 4.0×10^4 J as the final answer. Another common source of inaccuracy was to attempt to use the formula $Q = mc\Delta T$. This generates a problem when a substitution has to be made for ΔT. There were also candidates who divided the specific latent heat of fusion by 0.12 (kg) or who multiplied by the time taken to obtain the power.

(ii) Only a minority of answers gave a sufficiently precise suggestion. The answer “Heat is lost” was not considered to be sufficiently precise.

Question 6

(a)(i) Whilst some answers were well drawn and accurate, many other diagrams showed a diffraction pattern that did not take into account the size of the gap relative to the wavelength. In some cases, the wavelength drawn varied quite widely within the diagram.

(ii) Many candidates found this question challenging with most responses showing diffraction that was not sufficiently extensive.

(b) Although many candidates answered correctly, common sources of inaccuracy included reversing the correct answers for the P-wave and the S-wave and the suggestion that ultrasound is transverse.

Question 7

(a)(i) Only the strongest candidates answered this correctly. Values for the speed of sound in air were commonly given, as was 3.0×10^5 m / s or 3.8×10^8 m / s.

(ii) The correct answer was very frequently given.

(iii) This question was usually well answered.

(b)(i) Many candidates were able to suggest a sensible reason for preventing the escape of microwaves. Answers in terms of efficiency and answers in terms of eliminating a danger were given by a similar number of candidates.

(ii) Only a small number of candidates suggested a further application of microwaves. A significant number suggested their use in microwave ovens which the question had excluded.

Question 8

(a) This was often well answered although many candidates evaluated 1 / sin(1.5°).

(b)(i) Only a small number of candidates gave answers in terms of either frequency or wavelength.

(ii) This part was generally well answered although sin(1.5°) was used in some calculations and some candidates simply divided 45(°) by 1.5 in order to obtain an answer of 30°.

(iii) This was often well answered with the most common error being the omission of the reflected ray.

Question 9

(a) A very significant majority of candidates gave the correct answer.

(b)(i) This was generally correct although a minority attempted to apply the formula for the resistance of resistors in parallel.

(ii) This was often correct although some candidates calculated an answer that assumed that all three resistors were in parallel with each other. Some answers were equal to the reciprocal of the correct value.

(c)(i) A very common answer was obtained by evaluating 12 / 20 and only a small number of candidates were awarded full credit.

(ii) This was quite well answered either by supplying the correct answer or by using the erroneous answer from **(i)** in an entirely correct fashion. Despite this, a significant proportion of the candidates calculated an answer using a time of 6.0 (minutes) rather than 360 (s).

Question 10

(a)(i) More candidates suggested that the wire would move in the direction of the magnetic field than at right angles to it.

(ii) Only a minority of candidates stated that a vibration would be produced.

(b)(i) Only the strongest candidates answered this correctly**.** Very few answers made any reference to induction or to the electromotive force (e.m.f.) induced.

(ii) Many candidates stated that the deflection would be through a smaller angle or that the reading would be reduced. A much smaller number indicated that the direction of the deflection would be unchanged. Some candidates incorrectly stated that the deflection would also be slower.

(iii) This was generally well answered.

Question 11

(a)(i) This was usually well answered although some candidates reversed the proton number and the nucleon number. A few answers included the neutron number in the answer. A few candidates wrote the numbers on the right-hand side of the atomic symbol rather than on the more conventional left-hand side.

(ii) This was often correctly answered and full credit was very frequently awarded.

(b)(i) This was well answered and most candidates were awarded full credit. Some candidates placed the α-particle on the left of the equation as though it were absorbed by the plutonium nucleus.

(ii) Whilst many candidates gave the correct final answer, a small number gave the answer 1.2×10^{10} atoms. Another source of inaccuracy was to calculate an answer using only two half-lives. Some candidates who did this labelled the value 9.6×10^{10} with a 1, 4.8×10^{10} with a 2 and 2.4×10^{10} with a 3. Such candidates were effectively counting inclusively rather than in the more conventional manner.

PHYSICS

Paper 0625/51
Practical Test

Key messages

- Candidates 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 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 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. 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.

Comments on specific questions

Question 1

(a) Candidates were expected to show that they understand how to use a horizontal straight edge, or ensure perpendicular viewing of the rule, or other similar precaution to avoid a parallax error.

(b) (i) Most candidates counted the correct number of oscillations and obtained a value for t within the range permitted.

(ii) Most candidates correctly divided t by 20 and included the correct unit.

(iii) This question gave candidates the opportunity to make a sensible practical suggestion. Amongst a variety of good responses, “it would be easy to lose count” or “the pendulum could stop swinging”, showed realistic practical awareness.

(c) (i) Although most candidates correctly calculated T^2, few gave the correct unit.

(ii) Most candidates sensibly gave their answers to two or three significant figures but relatively few took sufficient care to use $l = 0.5$ m, or divided by T instead of T^2.

(d) (i) Some candidates gave good answers about the effect of reaction time or the difficulty in measuring l with accuracy. Some misunderstood the question and thought that a text book was being used to replace the pendulum bob. Candidates should be encouraged, when appropriate, to compare a value obtained by experiment with the ‘accepted’ value and think through any possible reasons for a discrepancy.

(ii) Some candidates explained the use of a fiducial mark very well. A vague reference to ‘repeats’ was insufficient for credit however. Candidates need to refer, for example, to repeating with different lengths or an increased number of oscillations.

Question 2

(a) Most candidates recorded realistic temperatures of hot and cold water and calculated the average correctly. Most specified the correct unit for temperature.

(b) Most candidates recorded the temperature of the mixture within the tolerance allowed.

(c) Here candidates were able to show their knowledge of good practice by mentioning perpendicular viewing of the thermometer scale, taking the temperature reading as soon as the reading stopped changing or carrying out the experiment without undue delay to minimise heat lost to the surroundings.

(d) (i) Most candidates drew a careful and accurate diagram showing correct use of the lid and insulation.

(ii) Most candidates showed that they had carried out the repeat procedure with care, producing results within the tolerances allowed.

(iii) Here many candidates showed their ability to consider their results and their significance carefully.

(iv) Many candidates made good suggestions here.

Question 3

(a) Most candidates showed care and precision and obtained good results in this question. Well drawn ray-traces were generally produced from which they obtained accurate readings of i and r. It is easier to obtain good results if the distance of the pin P is as far from the block as possible. However in many answers the pin placement was too close to the block. A minority of candidates obtained the first set of results but their ray-traces showed that they had predicted further results rather than actually obtaining them by experiment.

(b) Most candidates labelled the graph axes correctly and drew them the right way round. Plotting was generally accurate. Many candidates drew a well-judged straight line although some drew a ‘dot-to-dot’ line whilst others drew a straight line that did not match the plots. In some answers lines were too thick or the plots too large.

(c) Candidates needed to show that they had used a large triangle and many candidates obtained a value that was within the permitted tolerance.

(d) Stronger candidates referred to their graphs and gave valid comments on the quality of their measurements. However, many wrote vague statements that did not fit their results. Only the strongest candidates wrote convincingly about the amount of ‘scatter’ of their points around the best-fit line. Their comments were judged on the evidence on the graph, regardless of the theoretical values.

Question 4

Many candidates answered this question well. Successful candidates were able to write a brief, logical account, using the guidelines given. Firstly candidates had to draw a circuit diagram. This required candidates to think carefully about the method and decide on the arrangement of the components within the circuit. Strong answers gave circuits that demonstrated this planning, and included correct standard circuit symbols. Next they needed to explain the method and many candidates appreciated the need to repeat the procedure using different numbers of resistors in the parallel arrangement. The table headings had to match the method and be shown clearly with the correct units. Columns for number of resistors, current and potential difference were required. Most candidates were then able to give other relevant suggestions involving precautions designed to improve the reliability of results, the control of variables or how a graph could be used to display the results. Some candidates appeared to misunderstand the investigation – investigating resistors in parallel – and seemed to describe, for example, an experiment to determine resistance of a resistor.

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.

There were many instances where answers had been overwritten making it difficult to read the intended final response. Candidates should be encouraged to cross out completely and to rewrite their answers so that there is no ambiguity.

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
- recording of readings in a table
- 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 were well prepared and able to demonstrate their 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, 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 draw conclusions backed up by evidence, or to present well thought out conclusions.

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

The ability to record readings to an appropriate level of precision, usually reflecting the measuring instrument being used, or to quote a derived result to an appropriate number of significant places, caused difficulty for many candidates. Some candidates had difficulty in choosing an appropriate scale to plot their graphs and in drawing a best-fit line to display their data.

Comments on specific questions

Question 1

(a)(i)-(iv) The scale reading of the metre rule at the point where it balanced with no load was usually given to the nearest millimetre and was within the 0.5 cm allowed tolerance from 50.0 cm.

The distance *x* between the 20.0 cm mark and the pivot was almost always recorded correctly. The distance *y* between the centre of load Q and the pivot at balance was usually quoted to the nearest millimetre. 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.

The value of the weight *W* of the load was usually calculated correctly and was within the range of values allowed.

(b) Most candidates, on repeating the procedure carried out in **(a)**, using a different suitably chosen value of distance *x*, chose a value of *x* which was greater than 5.0 cm from their previous one.

(c) In most cases, the two values of *W*, the weight of load Q, determined by the two balancing exercises were different. Only the more able candidates were able to suggest one reason why these values differed. Far fewer candidates were able to give two valid reasons for a possible cause of this difference. Having performed the experiment twice, and having discovered how difficult it is to get the rule to be as near as possible to being balanced, it was expected that candidates would realise that this would be an obvious source of error in the determination of the value of *W*.

(d) Most candidates calculated an average value from their two measured values of *W* correctly. Many candidates, however, did not give their answer to a suitable number of significant figures for the experiment. Two or three significant figures were expected, but answers were frequently quoted to four or more significant figures.

Question 2

(a) Values of potential difference and current were almost always recorded to a suitable number of decimal places. The resistance of the resistor was usually calculated correctly. A small number of candidates rounded their answers incorrectly.

(b) Most candidates connected the wandering lead to the correct point in the circuit and recorded values of potential difference and current that were less than previously. Units were usually given, but when a unit was missing, it was nearly always the unit of resistance.

(c)(i),(ii)& (d)(i),(ii) Candidates who rearranged the circuit correctly and recorded their values of potential difference and current accurately, usually ended up with calculated values of the unknown resistor *R* that were within 10% of each other.

(e) Most candidates were able to state whether or not their results supported the statement given. Far fewer candidates were able to give a convincing justification for their statements. The idea of experimental tolerances and whether two measured quantities are close enough to be considered equal was not well understood by the majority of candidates.

(f) Only the strongest candidates were able to give a practical reason why the value of potential differences obtained if the experiment were to be repeated might be different from the values they actually obtained. A minority of candidates suggested that the power supply might run down.

Question 3

(a) The ray traces drawn by candidates were usually neat and accurate. The normal was almost invariably drawn in the correct position, the line **AB** the correct length and the angle of incidence 20° (± 1°).

(b) Most candidates 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.

(c) The table was usually completed with the distance values *d* inserted for the different angles of incidence considered. In a number of instances there were no corresponding pin holes in the ray trace sheet which indicated that candidates had attempted to calculate the values of *d*, rather than perform the experiment and use the pins to locate the reflected images.

(d) The standard of graph plotting was good. Candidates nearly always chose horizontal and vertical scales that made use of at least half of the given grid. A small number of weaker candidates used scales that increased in inconvenient increments, such as 3 or 7 which made the points much harder to plot.

There were many excellent, carefully drawn, smooth curves produced by candidates. However, there were still many graphs where the points were joined dot-to-dot, and best-fit lines were attempted. Many candidates drew a straight line through the origin when the evidence of the plots was overwhelmingly a curve. The concept of best-fit was clearly not well understood by all candidates.

(e) Some good answers to this question were supplied by candidates.

Question 4

Although it was not a requirement to draw a diagram, many candidates did so and used this to aid their explanation. However there were few neat, well-labelled diagrams. Most were rough sketches drawn without the aid of a ruler.

Many candidates did not identify both items of additional apparatus they would require to carry out the investigation, namely a stopwatch and a source of heat such as a Bunsen burner or an electrical heater.

The majority of candidates used a thermometer to monitor and record the temperature of the water in the beakers at regular time intervals. This was not necessary, as the investigation was to determine whether using a lid reduces the time it takes to heat a beaker of water to boiling point. It was only necessary to measure the time that it took the water to boil in both cases. A thermometer was not necessary.

Most candidates appreciated that to make the investigation a fair test, equal volumes of water should be used in both cases. 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. Where tables were produced, the headings in most of them did not relate to the given investigation. They contained column headings relating to temperature and not to the time it took to boil the water in both cases. Where suitable tables were drawn, there were often 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 that the beaker of water with the lid would take the shorter time to boil and merely stated so.

PHYSICS

Paper 0625/53
Practical Test

Key Messages

- Candidates 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

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.

Comments on Specific Questions

Question 1

(a) Most candidates were able to record sensible, decreasing temperatures for the smaller surface area.

(b) (i) Similarly most candidates recorded smaller, faster decreasing temperatures for the larger surface area. A few candidates recorded the initial temperature in both beakers before the temperature had reached a maximum and consequently the temperatures at t_0 were less than at t_{30}.

(ii) Units for t and θ were usually correct as were the values for t. Some candidates incorrectly presented the unit for temperature as C° and others failed to give any units for both time and temperature.

(c) Sensible precautions were usually evident although reference to parallax often lacked an explanation.

(d) (i) Several acceptable conclusions were given relating the idea that the larger surface area gave a larger temperature difference in the same time. Weaker candidates were able to calculate the temperature fall but often omitted to mention this was in the same time. Some really able candidates calculated the rate of temperature loss for each beaker.

(ii) Suggested changes to the apparatus were usually sensible as was the effect on the temperature. However, explanations were often weak

(e) Most candidates were able to suggest a sensible factor to keep constant, the most popular being a reference to the amount of water.

Question 2

(a) This was well answered with most candidates recording a set of five increasing values. A few candidates failed to consistently record their values to at least 2 decimal places.

(b) The calculated values of *R* were correctly given by nearly all the candidates.

(c) Graph work was generally good with correct labelling of both axes with a quantity and a unit. The choice of scale for the *V*/V was often awkward however with candidates choosing to use the values for *V* from the table on the major grid lines. This unfortunately led to a ×6 scale. Plots were appropriately marked although the expected curved line was occasionally either thick or wobbly.

(d) Many candidates were able to give a simple explanation of the graph shape usually stating that *R* increased as *V* increased but usually failed to state that the quantities were not directly proportional. For this to be true the graph would have to be a straight line through the origin.

(e) Only a minority of candidates knew the correct symbol for a variable resistor although the majority knew it had to be connected in a series circuit.

Question 3

(a)(i)(ii) Sensible values for h_O and h_I with a correct unit were usually given and most candidates were able to calculate the magnification *M* without a unit.

(iii) Substitution into the equation for f_1 was good and most candidates obtained a value within the required range. Those candidates whose value for f_1 was outside the range were still able to gain partial credit by recording their answer to 2 or 3 significant figures with an appropriate unit.

(iv) The majority of candidates found it hard to suggest a way to improve the apparatus and often blamed it on their own experimental technique.

(b)(i)(ii) Many candidates obtained accurate measurements and performed correct calculations throughout these questions.

(iii) The candidates who were familiar with the limits of experimental accuracy usually answered this correctly.

(c) Candidates who are used to looking at images in experimental work were able to suggest a suitable precaution.

Question 4

Most candidates were able to suggest a workable arrangement to compare the strengths of different samples of thin paper. The most popular of these involved suspending the arrangement vertically and applying a force to the bottom hook. The force applied was usually in the form of a mass hanger with suitable masses, although occasionally a newton meter was used. The best examples also included a clearly labelled diagram showing the arrangement. This method requires the upper hook to be fixed and a few candidates failed to make this clear. In this type of method the force was increased until the paper ripped and the strongest paper was identified as the one which supported the greatest force before ripping. Results were usually either presented on an appropriate bar chart or in a suitably labelled table.

Other candidates ignored the use of a quantifiable force and chose to stretch the paper samples by physically pulling the hooks apart. This method required the use of a ruler to measure how much the paper stretched as the pulling force was increased until the paper ripped. Again results were presented either on an appropriate bar chart or in a suitably labelled table.

The use of control variables was good with the most popular being paper width or paper thickness/length. Occasionally responses were vague and size of paper was unqualified. Although repetition of measurements is an important part of planning it is important to state what is being repeated.

PHYSICS

Paper 0625/61
Alternative to Practical

Key messages

- Candidates 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 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 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
- 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.

Comments on specific questions

Question 1

(a) The majority of candidates successfully measured l.

(b) Candidates were expected to show that they understood how to use a horizontal straight edge, or ensure perpendicular viewing of the rule, or other similar precaution to avoid a parallax error.

(c)(i) Most candidates correctly calculated T.

(ii) This question gave candidates the opportunity to make a sensible practical suggestion. Amongst a variety of good responses, "it would be easy to lose count" or "the pendulum could stop swinging", showed realistic practical awareness.

(iii) Although most candidates correctly calculated T^2, few gave the correct unit.

(iv) Most candidates sensibly gave their answers to two or three significant figures but relatively few took sufficient care to use $l = 0.5$ m, or divided by T instead of T^2.

(d)(i) Some candidates gave good answers about the effect of reaction time or the difficulty in measuring l with accuracy. Some misunderstood the question and thought that a text book was being used to replace the pendulum bob. Candidates should be encouraged, when appropriate, to compare a value obtained by experiment with the 'accepted' value and think through any possible reasons for a discrepancy.

(ii) Some candidates explained the use of a fiducial mark very well. A vague reference to 'repeats' was insufficient for credit however. Candidates needed to refer, for example, to repeating with different lengths or an increased number of oscillations.

Question 2

(a) The majority of candidates read the thermometer correctly and went on to calculate the average successfully.

(b) Here candidates were able to show their knowledge of good practice by mentioning perpendicular viewing of the thermometer scale, taking the temperature reading as soon as the reading stopped changing or carrying out the experiment without undue delay to minimise heat lost to the surroundings.

(c) Most candidates drew a careful and accurate diagram showing correct use of the lid and insulation.

(d) Here many candidates showed their ability to consider their results and their significance carefully. Their answers were judged according to their results in **(a)**.

(e) Many candidates made good suggestions here.

Question 3

(a) Almost all candidates followed the instruction correctly.

(b) It is easier to obtain good results in this type of experiment if the distance of the pin **P** is as far from the block as possible. However in many answers the pin placement was too close to the block. Few candidates (including many who had a sensible position for **P**) were able to explain that the larger distance improves accuracy. Many candidates measured the angle correctly.

(c) Most candidates labelled the graph axes correctly and drew them the right way round. Plotting was generally accurate. Many candidates drew a well-judged straight line although some drew a 'dot-to-dot' line whilst others drew a straight line that did not match the plots. In some answers, lines were too thick or the plots too large.

(d) Candidates needed to show that they had used a large triangle and many candidates obtained a value that was within the permitted tolerance.

Question 4

Many candidates answered this question well. Successful candidates were able to write a brief, logical account, using the guidelines given. Firstly candidates had to draw a circuit diagram. This required candidates to think carefully about the method and decide on the arrangement of the components within the circuit. Strong answers gave circuits that demonstrated this planning, and included correct standard circuit symbols. Next they needed to explain the method and many candidates appreciated the need to repeat the procedure using different numbers of resistors in the parallel arrangement. The table headings had to match the method and be shown clearly with the correct units. Columns for number of resistors, current and potential difference were required. Most candidates were then able to give other relevant suggestions involving precautions designed to improve the reliability of results, the control of variables or how a graph could be used to display the results. Some candidates appeared to misunderstand the investigation – investigating resistors in parallel – and seemed to describe, for example, an experiment to determine resistance of a resistor.

Question 5

(a) Many candidates correctly identified *c*.

(b)(i) Many candidates recognised that the plots were sufficiently close to the best-fit line and concluded that the load and extension are directly proportional because the graph showed a straight line through the origin.

(ii) Many candidates gave the result to two or three significant figures with the correct unit.

PHYSICS

Paper 0625/62
Alternative to Practical

Key messages

- Candidates should be reminded to carefully read the questions before starting their responses. It may help to recommend the habit that candidates underline key words so that important points in the question do not get missed.
- Numerical answers should be expressed clearly, to the appropriate number of significant figures and with a correct unit where required.

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
- recording of readings in a table
- 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

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.

The majority of candidates were well prepared and the range of practical skills being tested were accessible to most of the candidature. Most candidates demonstrated that they were able to draw upon their own personal practical experience to answer the questions. The majority of candidates were able to follow instructions, 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. There were some responses 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.

The vast majority of candidates finished the paper and there was no evidence that candidates were short of time.

Comments on specific questions

Question 1

(a)(i) Most candidates were able to deduce the distance *x* by using the information supplied and the diagram in the figure.

(a)(ii) Although there were some very good answers to this question, many candidates did not recognise that the markings on the rule would be covered up by the load, suggesting that they had never carried out an experiment of this type. Stronger candidates realised that if scale readings were taken on either side of the load, the mean of these two values should be 20.0cm if the load was correctly placed on the rule.

(b) The calculation of *W* was usually done correctly but weaker candidates gave incorrect rounding of their final answer.

(c) Candidates were expected to draw upon their practical experience to suggest another suitable value for *x* to use when repeating the given procedure to determine another value for the weight *W* of the load Q. Many suggested new values of *x* that differed from the original value of *x* by only a few millimetres suggesting candidates were not familiar with such experiments.

(d) Only stronger candidates were able to suggest one reason why the two values of *W* differed. Far fewer candidates were able to give two valid reasons as to a possible cause of this difference. Candidates who had performed an experiment of this type, knew how difficult it is to get the rule to be as near as possible to being balanced, and realised that this would be an obvious source of error in the determination of the value of *W*. Other acceptable answers were that the load obscures the scale and that the position of the centre of the load on the rule is hard to judge.

(e) Some good answers to this question were supplied by candidates.

Question 2

(a)(i)&(ii) Most candidates read the voltmeter and the ammeter scales correctly. The resistance of the resistor was usually calculated correctly from these meter readings. Some candidates rounded their answers incorrectly and occasionally the unit of resistance was missing.

(b) Only the stronger candidates were able to state correctly whether or not their results supported the suggestion that the resistance *R* of the resistor was constant. However, even fewer were able to give a convincing justification for their statements. The idea of experimental tolerances and whether two measured quantities are close enough to be considered equal was not well understood by the majority of candidates.

(c)(i)&(ii) The majority of candidates realised that the wires **AB** and **CD** could be replaced by a rheostat, but far fewer could draw a completely correct circuit diagram of the new arrangement. The symbol for a rheostat was frequently confused with that of a thermistor. The standard of drawing was often poor with lines drawn through resistor, ammeter and voltmeter symbols.

Question 3

(a) Most candidates were able to name one correct variable that affects the time taken for one oscillation of a mass on a spring, but many struggled to name a second. The question specifically made reference to a spring but many candidates made incorrect references to a pendulum.

(b)(i) This question proved challenging for many candidates. Most could deduce from the results in **Table 3.1** that the period increased with increase of length. Candidates found the results in **Tables 3.2** and **3.3** harder to analyse and far fewer candidates stated that in both cases an increase in mass and amplitude had no effect on the period of the pendulum.

(b)(ii) Most candidates were able to suggest a sensible precaution to take in order to get reliable results.

Question 4

Although it was not a requirement to draw a diagram, many candidates did so and used this to aid their explanation. However there were few neat, well-labelled diagrams. Most were rough sketches drawn without the aid of a ruler.

Many candidates did not identify both items of additional apparatus they would require to carry out the investigation, namely a stopwatch and a source of heat such as a Bunsen burner or an electrical heater.

The majority of candidates used a thermometer to monitor and record the temperature of the water in the beakers at regular time intervals. This was not necessary, as the investigation was to determine whether using a lid reduces the time it takes to heat a beaker of water to boiling point. It was only necessary to measure the time that it took the water to boil in both cases. A thermometer was not necessary.

Most candidates appreciated that to make the investigation a fair test, equal volumes of water should be used in both cases. 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. Where tables were produced, the headings in most of them did not relate to the given investigation. They contained column headings relating to temperature and not to the time it took to boil the water in both cases. Where suitable tables were drawn, there were often 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 that the beaker of water with the lid would take the shorter time to boil and merely stated so.

Question 5

(a)(i) The length of the line **AB** was usually measured correctly to the nearest millimeter. However some candidates did not include the unit.

(a)(ii) Most candidates marked the position of pin P_2 on the incident ray, but in almost half the answers seen, it was marked too close to point B. The minimum acceptable length of BP_2 was 5.0 cm.

(b) The standard of graph plotting was good. Candidates nearly always chose horizontal and vertical scales that made use of at least half of the given grid. A small number of weaker candidates used scales that increased in inconvenient increments, such as 3 or 7 which made the points much harder to plot.

There were many excellent, carefully drawn, smooth curves produced by candidates. However, there were still too many graphs where the points were joined dot-to-dot, and best-fit lines were attempted. Many candidates drew a straight line through the origin when the evidence of the plots was overwhelmingly a curve. The concept of best-fit was clearly not well understood by all candidates.

(c) Many candidates thought that a necessary and sufficient condition for the graph of *i* against *d* to indicate direct proportionality between these two quantities was that the graph passed through the origin. The fact that the graph was a curve was ignored.

A minority of candidates who were able to plot the graph correctly, stated that the graph did not support the suggestion that *i* was directly proportional to *d* because it was a curve/not a straight line passing through the origin.

(d) Only the strongest candidates could suggest one or two practical difficulties in obtaining accurate readings in an experiment of this type and many could only give one.

PHYSICS

Paper 0625/63
Alternative to Practical

Key messages

- Candidates should be reminded to carefully read the questions before starting their responses. It may help to recommend the habit that candidates underline key words so that important points in the question do not get missed.
- Numerical answers should be expressed clearly, to the appropriate number of significant figures and with a correct unit where required.

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.

Comments on specific questions

Question 1

(a) The thermometer readings and the completion of the table were generally well done. In a few cases the units to be added to the column headings were omitted.

(b) This part asked for two precautions to ensure that the readings of the temperature were made as accurately as possible. Sometimes changes to the procedure of the experiment itself were given instead, in which case credit could not be awarded.

(c) In **(i)** candidates needed to refer to the results explicitly, and to give appropriate figures which related to the full 3-minute cooling period (such as that B cooled by 15 degrees while A cooled by only 9.5 degrees). Some candidates gained partial credit by stating that the larger area resulted in a greater rate of cooling, or a bigger temperature drop in the same time.

Good responses to **(ii)** included lagging the sides of each beaker so the heat could only be lost from the surface. There were a number of sensible suggestions made in some answers which could not be credited because they did not answer the question and described changes to the method rather than to the apparatus. An example of this was to suggest starting each beaker at the same temperature.

(d) This was usually well answered.

Question 2

(a)(i) The strongest candidates produced accurate responses to this question and measured to the nearest millimetre. However there were many answers which were not precise enough.

(ii) Good answers calculated the magnification from the two heights given in **(i)**. An error in those values could be carried forward, but if they were correct it was occasionally left as a fraction: $2\frac{2}{3}$ or just 8/3. This was considered to be not worked out and could not be credited. Stronger answers were presented as decimal figures.

(iii) There were a number of correct answers which comprised two or three figures plus an appropriate unit.

(iv) A number of candidates were able to apply their knowledge to this situation and answered well. Weaker candidates offered answers relating to avoiding parallax with a ruler, for instance, were not given credit. Stronger answers were given which included ideas such as your hand or the ruler casting a shadow on the screen, awareness that the image might be a little indistinct, or that it would be very easy to knock the screen out of position.

(b) Stronger answers to this question were able to give two values for *f*. However a majority of candidates found this challenging and were then unable to state whether the results supported the suggestion. Few students were able to clearly justify their answer by referring to the 'limits of experimental uncertainty'. It was common just to quote the two values or write "No because 14.6 and 15.4 are not equal".

(c) Many candidates were able to give an additional precaution.

Question 3

(a), (b) The ammeter readings were generally well done and the table was successfully compiled.

(c) A number of candidates found plotting the graph more challenging. Many did not use sensible scales or the plotted points occupied less than half the grid. Better graphs showed a smooth, curved line.

(d) Stronger candidates answered this question well stating the correct observed relationship between potential difference and resistance. Many of these candidates went on to give a reference to the decreasing gradient. For a straight line, it was not correct to say that *R* was *proportional* to *V*, unless they had incorrectly drawn their line through the origin.

(e) The only acceptable symbol for a rheostat was the one given in the syllabus – a resistor with a diagonal arrow through it. A few candidates gave the potential divider symbol instead. If this was drawn as part of in the correct circuit to supply a variable voltage then it was accepted.

Question 4

This question was designed to determine the strength of paper by the maximum force a strip could take without tearing. Most candidates approached the question in this way but some used other acceptable interpretations which generally involved the amount the paper would stretch under load. A number of candidates suggested a workable way of putting the paper under tension. It was often suggested that one end could be fixed (such as by a clamp stand or a hook on the ceiling) and weights attached to the other end or that each end could be pulled with equal but opposite forces.

Good answers explained how to measure the applied force and described how to present results. Suggestions for presenting results included in a table (with columns specified, appropriate to the investigation the candidate was pursuing) or as a bar chart (with quantities stated). A few candidates produced good sketches to illustrate their answers which were also acceptable. These were often clear and providing they were well labelled, showed much of the detail which was required for a strong answer.

Most candidates were able to give quantities to be kept the same to ensure a fair test (e.g. having the same width of paper each time) and practical considerations such as applying the weights carefully in order to avoid jerking the paper.