PHYSICS

Paper 0625/11
Multiple Choice

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

General Comments

In this paper candidates found **Questions 2**, **5**, **12** and **24** the easiest. Difficulty was found with **Questions 21** and **25**.

Comments on Specific Questions

Question 3

This question involved calculating average speed, and many weaker candidates used the average value of the maximum and minimum speed to obtain option **C** rather than dividing the total distance by the total time.

Question 4

Although a large proportion of candidates of all abilities coped well with this question, a common error for the less able was to confuse weight with density, thus arriving at option **C**.

Question 6

In this generally well-answered question the most popular distractor was **D**; this showed a situation with zero resultant force, but not zero turning effect.

Question 7

The common mistake in this question was to choose the *extra* extension produced by increasing the load from 2.0 N to 3.0 N (option **B**), rather than the total extension.

Question 13

Option **B** was a popular distractor, despite the fact that this showed zero starting pressure.

Question 17

Some candidates believed that warm air would flow away from the heater under the cupboard.

Question 21

This question on the electromagnetic spectrum showed that most candidates were either unaware that infra-red causes the most heating, or that it is positioned just beyond the red end of the visible spectrum; many chose position **B**.

Question 25

This example of the effect of magnetic attraction was new to most candidates, and most responses were incorrect.

Question 26

A significant number of the weaker candidates chose option **C** in this question. As this is the exact opposite of the correct response, it is possible that these candidates were unclear about the meaning of 'open' and 'closed' with reference to a switch, even though the question was carefully worded to help any who were unsure about this.

Question 32

Able candidates had little difficulty with this question about a potential divider, but others were unable to use the 1:2 ratio of the resistor values to arrive at a value of 8.0 V across the 20 Ω resistor. Most either thought that the voltage would be split evenly between the two resistors, or that each would receive the full 12 V.

Question 35

Many of the weaker candidates believed that high-voltage transmission made the process faster.

PHYSICS

Paper 0625/12
Multiple Choice

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

General Comments

In this paper candidates found **Question 24** the easiest. **Questions 11** and **21** were found difficult by many.

Comments on Specific Questions

Question 3

This question involved calculating average speed, and many weaker candidates used the average value of the maximum and minimum speed to obtain option **C** rather than dividing the total distance by the total time.

Question 7

Able candidates coped easily with this question on extension of a spring, but almost as many weaker ones opted for **A** as chose the correct response.

Question 11

This question on the barometer showed that the great majority of candidates knew that the level would fall, but more than half of these also believed that the pressure inside the tube would fall; the concept of the (Torricellian) vacuum was unfamiliar.

Question 12

Many thought that both the temperature of the water and the average speed of the water molecules would increase.

Question 15

A good majority of candidates appreciated that an object with a higher thermal capacity needs more thermal energy to raise its temperature by a certain amount than with one with a lower thermal capacity, but many of these thought that the reverse was true when the objects cooled. An alternative reason is the possibility, as in previous years, that some believed that the responses in the two columns must be different, which of course is not the case.

Question 17

Some candidates believed that warm air would flow away from the heater under the cupboard.

Question 21

This question on the electromagnetic spectrum showed that most candidates were either unaware that infra-red causes the most heating, or that it is positioned just beyond the red end of the visible spectrum; many chose position **B**.

Question 26

A significant number of the weaker candidates chose option **C** in this question. As this is the exact opposite of the correct response, it is possible that these candidates were unclear about the meaning of ‘open’ and ‘closed’ with reference to a switch, even though the question was carefully worded to help any who were unsure about this.

Question 28

Many of the less able candidates believed that the p.d. across the 4.0 Ω resistor was 2.0 V. It seems likely that they were confusing series and parallel circuits and so thought that the 6.0 V would be ‘shared’ between the resistors.

Question 31

Many candidates confused resistors in series and parallel and added the two values to give 10 Ω.

Question 32

Able candidates had little difficulty with this question about a potential divider, but others were unable to use the 1:2 ratio of the resistor values to arrive at a value of 8.0 V across the 20 Ω resistor. Most either thought that the voltage would be split evenly between the two resistors, or that each would receive the full 12 V.

PHYSICS

Paper 0625/13
Multiple Choice

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

General Comments

In this paper candidates found **Questions 1**, **2** and **24** the easiest. **Question 21** was found difficult by many.

Comments on Specific Questions

Question 3

This question involved calculating average speed, and many weaker candidates used the average value of the maximum and minimum speed to obtain option **C** rather than dividing the total distance by the total time.

Question 4

A majority of the less able candidates believed weight to be an example of mass, rather than force.

Question 6

Many candidates chose option **B** here, including many stronger candidates; although they correctly determined the size of the third force, they did not notice that the car was travelling at a constant speed. The resultant force therefore had to be zero, and the missing force (friction) must be backwards.

Question 15

Option **A** was chosen by more of the weaker candidates than the correct option (**B**); these candidates were not aware that the substance would be at constant temperature while it was melting.

Question 16

Much guessing by weaker candidates was evident in this question on thermal radiation.

Question 17

Many candidates believed that warm air would flow away from the heater under the cupboard.

Question 21

This question on the electromagnetic spectrum showed that most candidates were either unaware that infra-red causes the most heating, or that it is positioned just beyond the red end of the visible spectrum; many chose position **B**.

Question 26

A significant number of the weaker candidates chose option **C** in this question. As this is the exact opposite of the correct response, it is possible that these candidates were unclear about the meaning of ‘open’ and ‘closed’ with reference to a switch, even though the question was carefully worded to help any who were unsure about this.

Question 28

The great majority of candidates knew that a longer wire would have a higher resistance, but many of these were less sure about the effect of changing the diameter.

Question 32

Able candidates had little difficulty with this question about a potential divider, but others were unable to use the 1 : 2 ratio of the resistor values to arrive at a value of 8.0 V across the 20 Ω resistor. Most either thought that the voltage would be split evenly between the two resistors, or that each would receive the full 12 V.

Question 34

The popularity of option **B** with less able candidates suggests that they did not notice that the cell in experiments 2 and 3 had been turned round compared with experiment 1.

Question 39

A common mistake here was to confuse the loss of four *nucleons* when an α-particle is emitted with the loss of two *neutrons*. This led candidates to choose option **A** in relatively large numbers.

PHYSICS

Paper 0625/14
Multiple Choice

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

General Comments

No questions caused widespread difficulty on this paper, with **Question 23** and, particularly, **Question 1** being very well answered.

Comments on Specific Questions

Question 1

This question was a very straightforward starter and nearly all candidates chose correctly.

Question 2

Many of the weaker candidates did not notice that the graph was distance-time, not speed-time, therefore believing that the object was accelerating.

Question 3

In this question concerning an echo, a large proportion of candidates made the mistake of not halving the distance calculated from the given speed and time.

Question 4

A majority of the less able candidates believed weight to be an example of mass, rather than force.

Question 6

A large number of candidates chose option **B** here, including many stronger candidates; although they correctly determined the size of the third force, they did not notice that the car was travelling at a constant speed. The resultant force therefore had to be zero, and the missing force (friction) must be backwards.

Question 9

The popularity of distractor **A** in this question showed much confusion over the fact that each engine did the same amount of work, one only being the most powerful because of the smaller time taken.

Question 16

Much guessing by weaker candidates was evident in this question on thermal radiation.

Question 27

The popularity of option **B** suggests that many candidates were unfamiliar with the term ‘electromotive force’.

Question 28

The popularity of option **B** with less able candidates suggests that they did not notice that the cell in experiments 2 and 3 had been turned round compared with experiment 1.

Question 29

The great majority of candidates knew that a longer wire would have a higher resistance, but many of these were less sure about the effect of changing the diameter.

Question 33

A high proportion of candidates chose option **D**, perhaps confusing the term ‘ferrous’ with ‘hard magnetic material’. This led them to believe incorrectly that metal **Q** was non-ferrous.

Question 38

Weaker candidates resorted to guessing in this question on the effect on the nucleus of α-emission.

PHYSICS

Paper 0625/21

Core Theory

Key Messages

Apart from basic matters of learning, there were four further aspects where candidates could have improved their performance.

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

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General Comments

A high proportion of candidates were able to demonstrate their knowledge and understanding of key concepts. There were some areas of the syllabus that were not as well understood as others; in particular the questions on measuring gas pressure, kinetic theory, the reflection and refraction of light, the electromagnetic spectrum and half-life proved to be more challenging.

Most candidates were able to use and apply standard equations such as $V = IR$. A significant proportion of candidates were unable to correctly determine the distance travelled from a velocity–time graph. Also candidates of all levels of achievement were unsure how to use a manometer to calculate pressure.

In a small but significant number of cases candidates left parts of a question unanswered suggesting that topics had not been covered well or that candidate's knowledge and understanding was less than secure. The sections of the syllabus that had questions which included no response were reflection and refraction of light, magnetic fields and half-life. In only one or two cases were a candidate's responses to parts of a question illegible.

The vast majority of candidates completed all questions in the time allocated for the paper indicating that candidates were given sufficient time to make their responses.

Comments on Specific Questions

Question 1

(a) There were many correct responses. Where credit was not given, candidates used vague statements such as "take the reading at eye level".

(b) There were many correct responses that resulted in full credit.

(c) All but the weaker candidates were successful here.

Question 2

(a) This was answered well by most candidates.

(b) Most candidates gained full credit.

(c) This was not a well answered question, with a proportion of candidates giving no response.

Question 3

(a) Many suggested values of a few grams or hundreds of kilogrammes for estimating a candidate's mass. Others gave incorrect or missing units. A common misconception in part **(ii)** was that the mass of the chair would be less on the moon.

(b) The majority of candidates gained partial credit for stating that pressure increased with a lower surface area in contact with the ground. For part **(ii)** only the higher scoring candidates were able to give a correct explanation in terms of the movement of the centre of mass.

Question 4

This was answered well by all candidates. Those that did not gain full credit often included "electrical" as an early response.

Question 5

(a) (i) This was answered correctly by the majority of candidates.

(ii) A significant proportion of lower scoring candidates did not gain this mark.

(b) There were many very good responses to this question. Some of the best responses came from candidates who had clearly carried out the task themselves. Of those that did not gain full credit the omissions were either detail on the distance or when to commence timing. A small number of candidates gave responses in terms of standing in front of a wall and timing an echo. In such cases credit was given for responses that would provide an acceptable result.

Question 6

(a) (i) There were many correct responses.

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

(b) (i) This was answered correctly by the majority of candidates.

(ii) A correct response was usually seen.

Question 7

(a) (i) This was well answered by only the better prepared candidates. A common misconception was that the water next to the heater became hot by convection.

(ii) Many correctly referred to the density decreasing and warm water rising. Fewer referred to the liquid expanding. The lower scoring candidates often failed to gain credit for poorly expressed answers in terms of the "particles expanding" or the "molecules becoming less dense".

(b) (i) There were many correct responses to the first part of the question.

(ii) Many candidates repeated their response to part **(i)** or gave vague responses that were not worthy of credit. A frequent incorrect response was in terms of preventing burns if the tank was touched.

Question 8

(a) (i) This question was not answered well. Many candidates made no response.

(ii) This was well answered by most candidates.

(b) (i) Most candidates gained credit for their response to this question.

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

(iii) This question was not well answered. There were very many vague responses involving answers in the form “45 + 45 = 90”.

Question 9

(a) A common misconception was a “battery” or a “cell”.

(b) A correct response was usually given.

(c) The table was well completed by those candidates who understood and could interpret circuit diagrams.

(d) and **(e)** Correct responses were seen from candidates of all abilities.

(f) Many candidates obtained both marks. Common misconceptions included candidates stating that the fuse was a resistor or that a fuse varied the amount of current.

Question 10

(a) Many partially incorrect responses were seen.

(b) Almost all described a procedure detailing whether or not attraction and/or repulsion occurred. Only the better prepared candidates made clear that repulsion was required to identify the two magnets to gain full credit.

(c) The majority of better prepared candidates gave a correct response.

(d) Only the best prepared candidates gave correct responses.

Question 11

(a) The better prepared candidates gave creditworthy responses. A common response that was not given credit was “waves”.

(b) Most candidates obtained both marks.

(c) This was answered well by better prepared candidates.

(d) (i) Almost all knew a suitable use for X-rays.

(ii) This was well answered by better prepared candidates. There were many vague responses including wearing goggles, gloves or a lab coat and some confusion with radioactivity and the need to wear protective lead suits.

Question 12

(a) Points were plotted and reasonable lines were drawn by many candidates.

(b) There were many correct responses.

(c) This question was generally well answered by only the better prepared candidates.

PHYSICS

Paper 0625/22
Core Theory

Key Messages

Apart from basic matters of learning, there were four further aspects where candidates could have improved their performance.

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

General Comments

A high proportion of candidates were well prepared for this paper. Equations were generally well known but some struggled to recall the equations.

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

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

Comments on Specific Questions

Question 1

(a) The majority of candidates gave good responses, but a significant number lost a mark through poor accuracy in determining times from the graph.

(b) The more able candidates explained the motion for a distance-time graph. However, most described a velocity-time graph, and some did not respond.

Question 2

(a) The majority of candidates had either seen or carried out this experiment, but explaining the procedure adequately proved challenging. There was a lack of precision and detail in many cases.

(b) Many candidates were able to outline a simple test to confirm the position of the centre of mass; some responses were inadequately expressed.

Question 3

(a) (i) Most candidates were successful, but a significant number added the two masses instead of subtracting the mass of the empty beaker.

(ii) Most candidates were at least partially successful in this part. Some had the equation for density inverted.

(b) (i) The most common error was to write "convection" instead of "conduction".

(ii) There were many partially correct responses, but very few that were fully correct. The most common omission was not to state that the liquid would expand when heated. The most common error was to talk about the density of molecules decreasing when they were heated.

(c) (i) The majority of candidates found this straightforward.

(ii) Many candidates were successful at this part, but some wrote vague or irrelevant responses.

Question 4

(a) The majority of candidates answered this well.

(b) There were many correct explanations in terms of the forces being equal and acting in opposite directions.

(c) Most candidates were successful, but there were quite a few candidates who did not respond.

(d) A significant number of candidates wrote answers about why the balloon had burst, rather than answering the question as stated.

Question 5

(a) (i) Most candidates answered this correctly, with the most common error being downwards instead of upwards.

(ii) The most common error here was to put direction instead of shape.

(b) (i) Most candidates answered this correctly.

(ii) There were many vague responses such as "It is lost", or "It decreases".

Question 6

(a) The majority of candidates were able to correctly complete the flow chart.

(b) There were many correct responses seen, but many candidates referred to a renewable source of energy as one that could be re-used.

(c) (i)(ii) Very few candidates seemed able to give valid advantages or a disadvantage of hydro-electric power. Many did not respond, and others simply gave one advantage, such as "it is renewable", that had been stated in the stem of the question.

Question 7

(a) Some candidates did not refer to the concept of pressure, and tried to answer in terms of friction.

(b) (i)(ii) Most candidates correctly stated that the pressure would decrease, and the best answers explained the decrease in terms of molecular bombardment.

Question 8

(a) Many candidates gained partial credit, but very few scored full marks. Despite being given the critical angle for the glass, many candidates went on to draw a refracted ray at the glass/air interface.

(b) (i) Some mistakenly gave answers such as "sound" as being the missing region.

(ii) Many candidates were successful; others tried to answer in terms of the person in the room breaking a beam of red light.

(iii) Some candidates were able to give two common properties of electromagnetic waves. The most common correct responses were "transverse waves", "same speed" and "ability to travel through a vacuum". One of the most common errors was to refer to the waves as all being longitudinal.

Question 9

(a) The majority of candidates scored this mark, but some responses were left blank.

(b) A few candidates stated that repulsion of a known magnet was a correct test for showing that the iron rod had become a magnet. The majority of candidates thought that attracting iron or steel was sufficient, without stating that the iron or steel must be unmagnetised.

(c) The majority of candidates thought that iron could be used to make a permanent magnet.

(d) Many candidates gave acceptable descriptions of how the permanent magnet could be demagnetised.

(e) (i) Most candidates recognised the magnet as an electromagnet. The most common error was to refer to it as a temporary magnet.

(ii) Many candidates were able to give a suitable advantage of the electromagnet, such as "it can be easily switched on and off", or "it is easy to alter the strength of the electromagnet".

(iii) Many candidates gave suitable suggestions for the use of electromagnets.

Question 10

(a) (i) Most candidates scored this mark. A very common error was to give iron as a suitable material for the coils.

(ii) Most candidates scored full marks or, through showing their working, gained partial credit.

(b) Most candidates were successful, but a large number of candidates ticked two boxes instead of one.

Question 11

(a) Many candidates were at least partially successful, but the majority did not give an acceptable explanation of background radiation. Many answers paraphrased the question, such as "it is radiation that comes from the background".

(b) Very few candidates were successful in this part. The most common answer was "a radiation detector".

(c) Many candidates scored well on this question. A common error was to add the nucleon number and the proton number to give one or more of the answers.

(d) (i) Most candidates were successful.

(ii) Very few correct responses were seen to this part.

(iii) Many candidates answered this question by repeating the answers to **11(c)**. The majority scored at least one mark, with the most common error being to give 1 or 2 as the number of electrons in an alpha particle.

Question 12

(a) Many candidates were successful, but some either labelled the variable resistor or did not respond.

(b) Few candidates were able to put the ammeter and voltmeter in the correct sentence.

(c) (i) The majority of candidates correctly calculated the resistance of the thermistor as 640 Ω. Some started with the equation for resistance inverted.

(ii) Many candidates were successful, but some thought that the current would either decrease or stay the same.

PHYSICS

Paper 0625/23
Core Theory

Key Messages

Apart from basic matters of learning, there were three further aspects where candidates could have improved their performance:

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

General Comments

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

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

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

Comments on Specific Questions

Question 1

(a) Many candidates gave fully correct answers. The most common error was to forget that volume = length × cross-sectional area, and to try and use some variation of πr^2.

(b) Some candidates made errors in subtracting the times from the digital clock. The most common error was in converting 2 hours and 15 minutes into a decimal fraction; a large number put 2.15 instead of 2.25. With error carried forward allowed, most candidates gained at least partial credit on this section.

(c) Many candidates were successful, but a significant number used the inverse of the equation required.

(d) Many candidates were successful, but a large percentage did not give an adequate reason to support their statement about the boy’s estimate.

Question 2

(a) The majority of candidates gave completely correct answers.

(b) (i) Most candidates gave correct answers. The most common error was an incorrect transformation of the equation density = mass ÷ volume.

(ii) With error carry forward allowed, the majority of candidates were successful here.

Question 3

This was one of the best answered questions on the paper, with candidates displaying a good recall of common units.

Question 4

(a) Many candidates were fully successful. The most common error was to add the two forces instead of subtracting.

(b) Most candidates gave a correct description of the effect of the resultant force on the car's motion. However, a significant number thought that it would make the car move backwards.

Question 5

This question was well answered by the majority of candidates, who displayed a sound understanding of distance-time graphs.

(a) The majority of candidates were successful.

(b) This part was answered well.

(c) The majority of candidates found this straightforward.

(d) Many candidates scored full marks. The most common error was not converting the time into seconds.

Question 6

(a) There were many responses gaining full marks, but a significant percentage did not link the type of power station to its correct energy source.

(b) The majority of candidates were able to complete the flow chart for the solar power station.

Question 7

(a) The majority of candidates were able to recall the names of the four changes of state.

(b) Most candidates displayed a good understanding about the arrangement and motion of particles in a gas. A common mistake was to think that the particles expand when the gas is heated.

(c) There were some very good responses seen, but the majority of candidates were unable to link the evaporation of the liquid to its cooling effect on the hand.

Question 8

(a) The majority of candidates answered this correctly.

(b) There were some very good answers seen, but the majority of candidates were unable to locate the position of the image in the mirror.

(c) Candidates found this question quite challenging, with very few fully correct answers. The most common error was to state that the position of the image was unchanged.

Question 9

Candidates found the question on waves challenging, with very few gaining full credit.

(a) (i) The majority of candidates scored only partial credit in this part.

(ii) A very common error was to give ‘sound’ as another type of transverse wave.

(iii) Most candidates correctly calculated the distance moved by the wavefront as 30 cm.

(b) (i) There were many good attempts at drawing the wavefronts in shallow water, and many of these scored full marks.

(ii) Few candidates were successful here.

Question 10

Many candidates found this question on electrostatics to be challenging.

(i) Most candidates were able to state that the cloth would be negatively charged; better candidates were able to name the electron as the particles that had been transferred to the cloth.

(ii) The more able candidates scored full credit; for others, explanations were lacking in detail or incorrectly referred to magnetic poles.

(iii) Few candidates scored full credit; many candidates did not go beyond the idea that the shirt became charged.

Question 11

(a) The majority of candidates were at least partially successful.

(b) Many candidates scored full credit, but a significant number used an incorrect transformation of $V = I \times R$.

(c) Many candidates could not identify component X as a lamp. Those who did often went on to give a correct description of its purpose.

(d) The best candidates gave adequate descriptions of how the fuse would prevent further damage to the circuit.

Question 12

(a) Many candidates scored full credit, but some thought that the electron was to be found in the nucleus and consequently placed the particles in the wrong order.

(b) Many candidates gained at least partial credit here.

(c) A large number of candidates scored full credit for this question. Many other candidates would possibly have gained more credit if they had set out their working more clearly.

PHYSICS

Paper 0625/31
Extended Theory

Key Messages

Candidates could have improved their performance by taking account of the following points:

- Numerical answers often require the use of a formula. A mark is usually awarded for a correct statement of the formula either in algebraic form, using recognisable symbols, or in words. Candidates are strongly advised to write down the formula rather than to begin their answer with numbers. The numbers used may not suggest correct use of the formula, and the formula in the candidate's mind may have been wrongly rearranged.

- It is sometimes the case that, in an explanation or description, a candidate writes a correct statement followed by another statement that contradicts the first one, thus losing credit. Candidates should read carefully what they have written. It is then possible that they would spot the mistake and cross out any wrong material.

General Comments

The candidates in general were well-prepared and in most cases could communicate well. On some scripts answers proved difficult to read. In some cases this was due to poor hand-writing, in others it was because candidates appeared to have written their answers in pencil and then over-written in pen.

Many candidates produced work of a very high standard indeed throughout the paper. There were two 4-mark questions, one involving extended writing, the other a calculation, that were particularly demanding and it was not unusual for such candidates to be awarded full credit. Such candidates clearly have much innate ability and had responded well to good teaching.

Most candidates tended to be strong in some topic areas but showed lack of knowledge or understanding in others. In general, such candidates showed their greatest strength in recall of learnt material and in numerical work, and tended to have difficulty in expressing their ideas convincingly in other areas.

In general it was uncommon to see questions where no attempt was made to produce an answer. Many candidates showed a reasonable grasp of ideas in limited areas of the syllabus.

Comments on Specific Questions

Question 1

(a) (i) Credit was given for a mention of acceleration, though this was denied if a candidate wrote 'acceleration at constant speed', wording not infrequently seen, but clearly a contradiction.

(ii) It was more difficult to recognise that the graph illustrated decreasing acceleration. No credit was allowed for 'changing acceleration', and 'deceleration' was clearly wrong.

(b) Some candidates did not take note of the fact that the explanation needed to be in terms of the forces acting and wrote answers in terms of energy instead. Credit was most frequently awarded for a mention of weight (or the force of gravity) and air resistance. Many candidates also correctly identified terminal or constant speed when these forces are equal. Fewer made reference to the initial acceleration being that due to gravity alone or the decrease in acceleration that occurs. The remaining creditworthy point, which was not often made, was for the idea that air resistance increases as speed increases.

Question 2

(a) (i) The formula for pressure was well known and the calculations were mostly correct with few unit errors.

(ii) The two pressures were often added rather than subtracted, as candidates did not realise that the pressure given in the question was the total pressure on the top surface.

(iii) The correct formula was nearly always seen, and with the possible benefit of an error carried forward from **(ii)**, many correct answers were seen.

(b) There was possibly difficulty for some candidates in explaining why the tension is not 3.5×10^4 N. Many answers showed a lack of understanding of some of the forces involved and some of the answers tended to be vague. Few made a clear statement about the involvement of the weight of the block or of the cable, or used the word mass rather than weight. Some clearly had an idea about buoyancy but did not know the word itself and were unable to express the idea in a way that could be credited.

Question 3

(a) Candidates are used to using the formula $W = mg$ to calculate a weight and many gained credit for stating this formula. However, there was confusion in many cases in using 80 kN as the weight in order to find the mass. The calculation frequently produced the wrong number or the wrong unit or both. A small proportion of candidates arrived at the correct answer of 8000 kg.

(b) Most candidates knew or correctly quoted density = mass ÷ volume and gained credit. Some subsequently rearranged it incorrectly. Others confused kg and g and arrived at answers with the correct number but with the wrong unit.

(c) Many gained credit for quoting the correct formula, but sometimes there were problems with units.

(d) The correct answer of 30% or 0.3 was often seen, in spite of the previous difficulties over the units of the numbers used.

Question 4

(a) (i) Candidates were expected to make two statements of difference from a choice of three: the spacing of molecules, the movement of molecules or the arrangement of molecules. Some made two statements from one of the choices and could only be awarded a single mark. In some cases the statements were too vague to be rewarded.

(ii) The essential point was that energy is needed to overcome the attractive forces between the molecules (‘intermolecular’ bonds). Answers that could not be rewarded usually made general points about specific latent heat.

(b) (i) A large number of correct answers were seen. A small proportion of answers showed division of the specific latent heat by the mass rather than their multiplication.

(ii) Some candidates mentioned only one type of energy, suggesting that the question had not been understood.

Question 5

(a) Attempts to define specific heat capacity tended to be completely correct or totally wrong.

(b) Many completely correct answers were seen. However, frequently there was a mistake in the unit of the answer. Partial credit could often be awarded for a calculation of the change in temperature, but less frequently for a statement of the formula, and rarely for a calculation of the energy, clearly the most difficult aspect.

(c) Most candidates only addressed the reduction of heat loss by conduction from the block and suggested lagging. Only a small minority suggested ideas for reducing radiation. Even some of the latter suggested painting the surface matt black. A few made more subtle but acceptable points such as raising temperature of the surroundings or heating for a shorter time.

Question 6

(a) (i) It was apparent that many candidates measured incorrectly or did not handle the idea of the scaling factor. Answers were either in the correct range from 2.4 to 2.8 cm (or equivalent in mm), or had no similarity to these values.

(ii) The correct formula was often seen, but thereafter there were numerous examples of the division of the speed in m / s by the wavelength in cm or mm.

(b) Refraction in the wrong direction was seen almost as often as in the correct one, but partial credit was often possible for the refracted wavefronts being continuous with the incident ones.

(c) The idea that the frequency of waves does not change is not well instilled, showing that many candidates do not fully understand the concept of frequency. A good proportion of candidates gaining the highest overall marks did not answer this correctly.

Question 7

(a) (i) Full descriptions of the image were uncommon. Candidates often missed one or two of the descriptive factors.

(ii) Candidates who wrote down ‘S’ probably confused focal length with focal point. Others wrote down various wrong pairs of letters such as QR. It was unusual to see the correct response of RS.

(iii) Many candidates did not draw an eye or indicate its position in any way. Of those providing an answer, the majority placed the eye correctly.

(b) (i) Candidates who drew two rays chose to draw one parallel to the axis refracting through the point F and the other as a straight line through the centre of the lens. Quite a few candidates did not draw the image correctly.

(ii) Various wrong rays were seen.

Question 8

(a) (i) Clear statements that the coil was cut by the magnetic field of the magnet, or that the magnetic field linked with the coil changes, were rarely seen. There were frequent references, for instance, to the magnetic field of the coil.

(ii) Many candidates found it difficult in **1.** and more particularly in **2.** to express themselves about what they thought would happen to the needle of the meter.

(b) (i) A large majority used the formula relating voltages and turns correctly.

(ii) **1.** Many applied $P = IV$ correctly.

2. Candidates sometimes calculated 90% of a quantity other than power. Some found 90% of the answer in **1.** and got no further. However, a good number succeeded in obtaining the correct current.

Question 9

(a) (i) It was not unusual to see $R = 1/R_1 + 1/R_2$ quoted as the formula. Others gained credit for correctly quoting the formula even if they did not use it correctly. Those who used ‘sum of resistors ÷ product of resistors’ were more likely to get both marks. Some clearly know the rule for equal resistors in parallel and simply wrote down the answer.

(ii) Many attempts did not add 500 Ω to the answer to **(i)**.

(iii) A large majority, many with the use of the wrong value from **(ii)** carried forward, were successful.

(b) A significant number recognised that the current would increase, but could not explain why in terms of the fall in the total circuit resistance or the resistance of the parallel combination.

Question 10

(a) Reasonable attempts at equal spacing of the field lines were expected. Some carelessness in this respect was in evidence, particularly among those attempting freehand drawing. More success was achieved with the direction of the field.

(b) Most candidate successfully placed equal numbers of + and – signs, with only a minority reversing them.

(c) Many correct calculations of the current were seen, but omission of the unit was rather a common feature.

Question 11

(a) Many answers described ‘properties’ rather than giving the ‘nature’.

(b) Candidates needed to convey two ideas, first for suggesting opposite deflections of the two types of particle, and the second that β-particles underwent greater deflection than α-particles. Many succeeded in both respects, but some suggested deflections towards positive and negative poles of the magnet.

(c) Better attempts were in general made here than with **(b)**. References to α-particles were sometimes made, but ignored.

(d) (i) Credit was given for references to α-particle or helium nucleus. Helium atom or simply helium were not credited.

(ii) Most candidates could write down the correct number.

PHYSICS

Paper 0625/32
Extended Theory

Key Messages

There were three important aspects where candidates could have improved their performance.

- Candidates must read questions very carefully and answer the question that is asked, not the one the candidate thinks has been asked. Often a question is about a familiar situation but the actual question is different from that expected by the candidate. This was particularly the case in **Question 9(a)(ii)** about the material of the coils.
- Similarly, credit can only be gained by the specific answers required, not for comments on related matters or a general discourse about the situation. This occurred frequently in **Question 4(b)** and **(c)** about sensitivity and linearity.
- Particularly in questions requiring extended calculation, candidates must set out and explain their working correctly. Often a candidate uses an unusual method with an unclear explanation or gives no working or poor working. If this leads to the correct answer, the examiner may be able to give some credit. When an error is made in the middle of such work, it is usually impossible for the examiner to see anything of merit. This was especially so in **Question 9(b)(ii)**.

General Comments

The majority of candidates had clearly been well taught and prepared for this exam. They were able to apply their knowledge and understanding of physics to the questions set, and produce correct responses. Equations were generally well known but the use of the equations and the quantities represented were not always understood.

There remains the tendency to think less rigorously and logically in non-numerical questions than in numerical questions.

Sometimes candidates seemed to try to maximise their chances by not really committing themselves to their responses and making them conditional using words like “probably”, “might” or “could”. Examiners are unable to give credit when it is not clear whether a candidate really intended to make a statement or not. Also sometimes more than one answer to a question was given. If two answers are given, one right and the other incorrect, the candidate will almost always gain no credit. There were very few examples in questions involving tick boxes where candidates gave more answers that instructed, some of which would obviously be mutually contradictory.

All 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, become confused and unable to use what knowledge they do have. Often candidates had been well taught how to apply equations to fairly standard situations but displayed a lack of breadth of understanding of their use in contexts outside of a physics laboratory.

Only a very small minority of candidates found the subject matter and level of some questions so difficult that these questions were inaccessible to them and would have been better entered for the Core paper.

Overall the use of units by all candidates was good with the exception of **Question 6(a)(ii)** where many candidates did not quote any unit. The omission of units or use of incorrect units almost always results in a loss of credit.

Comments on Specific Questions

Question 1

(a) Most candidates correctly explained that the dots became further apart. The most common insufficient response was “the distances are different”.

(b) (i) This was generally well answered

(ii) Candidates who lost credit often did so because of incorrect use of distance, using 0.0076 m, or by dividing the correct distance by the incorrect time of 0.04 s.

(c) Most candidates attempted the question using the equation $a = (v-u)/t$ and were generally successful. A frequent error here was division by 0.04. Many candidates lost credit due to the use of distances rather than speeds in their calculation or merely calculated the mean of the two speeds from part **(b)**. Candidates did also use alternative methods, some of which were successful, but often this proved to be more difficult and errors were made. It was important for candidates to show the equation and method clearly when calculating the acceleration here. Many, who made errors, gained compensatory marks this way. Often those, who did write down an appropriate equation, substituted an incorrect speed in the equation or used merely one speed from part **(b)**.

Question 2

(a) This was generally well answered by stronger candidates. However many candidates lost credit through not recalling Boyle’s Law correctly or making an incorrect substitution. Working was often unclear and sometimes spread randomly across the page, so, when errors were made, it was difficult for Examiners to see anything worthy of credit. There was also confusion with the use of Pa or kPa as the unit and there were errors of a factor of 1000.

(b) Most candidates gained full or most of the credit in this question. Frequently candidates mentioned collisions between molecules becoming harder. While that is true, it is not relevant to this question about pressure. Any mention of collisions with the walls/cylinder/piston was frequently omitted. Some candidates did mention collisions with walls but did not say they were harder or more frequent.

(c) Many candidates correctly calculated the force on the piston. However, here too a significant number were confused with the use of Pa, kPa, N or kN and there were factor of 1000 errors.

Question 3

(a) This was answered very well with many candidates gaining full credit for their calculations.

(b) (i) Most candidates correctly calculated the kinetic energy. The most common error was, having stated the correct equation, not squaring the velocity.

(ii) Most candidates were able to calculate the maximum distance by equating gravitational potential energy gained and kinetic energy lost but many weaker candidates did not appreciate this link and tried to use a variety of incorrect principles.

(iii) Most candidates correctly stated air resistance or thermal energy produced. However, a significant number of answers were vague references to “energy lost in the surroundings”.

(c) The majority answered correctly but a significant number gave extension limit in **(i)** and named a variety of incorrect laws in **(ii).**

Question 4

In parts **(b)** and **(c)** many candidates did not answer the question asked. Often there were comments about accuracy or response time, which were not asked. Also in the explanations, candidates often gave a definition of sensitivity or linearity, which again was not asked in the question. What was required was a correct statement about the effect on sensitivity or linearity.

There was also clear evidence here of poor use of English. A significant minority of candidates made statements about the thermometer responding faster when what they possibly meant was that the thread moved more. Candidates should be aware that faster refers to speed, which relates distance and time.

(a) This was well answered by most candidates, although a significant number were unaware of what was measured by meter Z.

(b) Whilst a significant number of candidates realised that the thermometer becomes more sensitive, they were unable to provide an explanation for this. Weaker explanations often made comments about the larger surface area being in contact with the source rather than more expansion of the liquid or made comments about response time.

(c) Again, only the most able candidates clearly stated that the thermometer was not linear, and gave an explanation linking the movement of the thread to the diameter of the capillary. There were also a large number who made comments about the liquid rise being affected when they should have made more of an explicit link.

Question 5

(a) Although this question was mostly well answered, a significant number of candidates answered in terms of waves rather than answering the questions in terms of the strip. There was also a lack of precision of wording in both parts e.g. not specifying unit time in **(i)** or displacement from the mid-position in **(ii)**.

(b) Many candidates correctly determined the time interval for the first echo, but made errors in determining the time for the third echo.

(c) A significant number of candidates did not give speeds in the correct range. The most common error was to give speeds in water and steel similar to the speed of sound in air.

(d) This was well answered but a significant number made factor of 1000 errors by using 95 Hz not 95 kHz.

Question 6

(a) **(i)** The majority of candidates were able to state the equation correctly although many weaker candidates divided the speeds the wrong way round.

(ii) Most candidates went on to evaluate the speed of light in glass correctly; a significant proportion omitted the unit for speed.

(b) **(i)** There were many correct responses. However, a considerable proportion of candidates were unable to apply Snell's Law correctly in this case when light is refracted into air. A common mistake was inverting the sines of the angles resulting in the incorrect answer of 26°.

(ii) This was well answered.

(c) Most candidates gained some credit here. However, descriptions were often too vague or lacked essential detail, such as describing multiple reflections or light travelling down and back again. Although not required by the question, a diagram was a perfectly acceptable way of giving this extra detail.

Question 7

(a) Most candidates gained full credit.

(b) (i) Most candidates recognised that there were no forces acting on the brass needle. Some weaker candidates stated that brass is a magnetic material and others stated that because both ends were being attracted they would both be pulled equally and therefore the needle would stay stationary.

(ii) Most candidates were able to give correct explanations about the magnetic needle aligning with the strong magnetic field or mentioned attraction between N and S poles.

(c) A significant number of candidates did not appreciate that steel not iron was a suitable material for making permanent magnets.

Question 8

(a) Only more able candidates gained credit here by correctly stating that e.m.f. is the energy supplied in driving unit charge around a circuit. Weaker candidates stated that e.m.f. was a force or the voltage in a circuit.

(b) This was well answered by most candidates.

(c) There was a varied response to this question. Most candidates made a good attempt at calculating the energy but some muddled up energy with charge, whilst a few attempted unsuccessfully to use the equation for specific heat capacity. Of those candidates choosing the correct approach, many did not realise time had to be in seconds.

Question 9

(a) (i) A significant number of candidates did not name the correct process. Common insufficient responses were “induction” or “magnetic induction”. A significant number of weaker candidates did not name any process; a common response of this type was “transformer”.

(ii) Many weaker candidates made the error here of answering what they thought was the question rather than what was asked. They assumed they were being asked about the core material and did not realise that this question asked about the material for the coils. Of those correctly choosing copper some did not state that it is a good conductor, merely saying it conducts, which is also true for many unsuitable materials.

(b) (i) Most candidates correctly calculated the number of turns. The most common error was in either using an incorrect form of the equation, or incorrectly rearranging the equation.

(ii) An appreciable proportion of stronger candidates showed clear, detailed working, which made it easier for them to arrive at the correct solution and gain full credit. The most common mistakes were in either using an incorrect equation linking power in the two coils, or not realising that the current in the secondary coil was 6 A. Many weaker candidates seemed to try to fit numbers into calculations without clear understanding.

Question 10

(a) Most candidates gained full credit on this part question. The most common error was to refer to helium atoms rather than nuclei.

(b) Most candidates gave correct responses.

(c) Most candidates gave a correct response.

(d) Lack of clarity in response often led to candidates not gaining full credit. The most common problem was not clearly stating that isotopes were of the same element. Frequently, mention was made of element**s**. It was seldom made clear that the candidate meant that a variety of elements have isotopes. Often the candidates gave the impression that they thought the isotopes themselves were different elements. A few candidates gained full credit by quoting an example and writing down the nuclide notation of two isotopes of an element.

Question 11

(a) (i) Most candidates gained credit here, though some candidates did not know the function of the cathode. Some thought it was for focusing or accelerating the electron beam

(ii) Most candidates gave a correct response.

(b) (i) The majority of candidates correctly identified the voltages for the spot at B, but only more able candidates gave the correct response for the spot at C.

(ii) Many candidates did not gain credit here. The most common reason for this was not stating that the potential difference between the X plates was zero volts. Also a conceptual difficulty on this question arose from a few candidates thinking that a higher plate voltage would give greater repulsion, therefore stating that Y_2 should be higher voltage than Y_1.

PHYSICS

Paper 0625/33
Extended Theory

Key Messages

Candidates could improve their performance by taking account of the following points.

- The numerical value of any quantity nearly always needs a unit after the number if the numerical value is to have any interpretable meaning. One exception is the quantity *efficiency* and another is *refractive index*. By leaving out a unit or by supplying the wrong one, a candidate's answer is likely not to be awarded full credit.
- It is important that candidates realise that the answers given need to be legible and answers that cannot be understood cannot be credited. Candidates who write on top of a previous answer risk producing answers that cannot be interpreted. This is sometimes the case even when the previous answer has been erased. The new answer should be written neatly next to the crossed-out original or in a blank space, with reference to its new location made in the original answer space.
- Although it is possible to obtain full credit by only supplying the correct answer on the answer line, in the absence of any working out, most errors will result in the awarding of no credit. Candidates should be advised to follow the advice on the front cover of the paper and show their working.

General Comments

There were many good scripts, where accurate and knowledgeable responses revealed a clear understanding of the subject at this level. There were also those who were less familiar with the topics tested and whose answers did not reveal a clear insight into the subject.

Comments on Specific Questions

Question 1

(a) Many candidates drew two correct lines on the graph grid and received full credit. A very few candidates drew a line for the runner suggesting an initial acceleration from zero to 10 m / s during the first second.

(b) (i) This answer could be obtained either from using the area under the graph or from the equation that defines speed. Many candidates obtained the correct answer by one or other of these methods but many more used the formula.

(ii) This was slightly more challenging and a few candidates multiplied the final speed of the car by the total time to obtain an answer that was too big. Many more candidates, however, calculated the correct answer using the area under this graph.

(iii) This was the most testing section of the paper and very few candidates showed any working out. The most popular answer given was 2.0 s which is the time when the speeds of the runner and the car are equal. The candidates who gave the correct answer were in the minority and very rarely offered any explanation as to why this was correct.

Question 2

(a) The correct answer was very commonly given here even by the candidates who performed less well elsewhere on the paper.

(b) (i) The correct formula was used by the majority of candidates but many of these did not convert the distance from kilometres to metres and gave an answer that was a thousand times too small. The number of candidates who expressed the answer in standard form was rather small.

(ii) A very few candidates attempted this by setting the kinetic energy of the train equal to the work done and then determining the speed from the kinetic energy. A significant number of the answers received no credit here.

(iii) Many answers offered a correct suggestion but a few candidates suggested that the speed was smaller than the calculated answer because of safety requirements.

(c) Only a minority of candidates gave a correct answer to this part. The most common suggestions were: 'in the direction of motion' and 'away from the centre'.

Question 3

(a) This was correctly answered on most scripts and full credit was awarded very frequently. A few candidates misunderstood the wording and only drew one arrow from each box on the left.

(b) Most candidates gave a sensible answer here and were rewarded. The answer 'it releases a large quantity of energy' required further qualification and was not, when written on its own, given any credit.

(c) (i) This was frequently correct but a few candidates simply supplied the mass whilst a few others divided the mass by 500 m. A few candidates gave an answer in pounds.

(ii) This calculation was very commonly correct and the answer was almost invariably given in standard form.

(iii) This calculation was also frequently correct. The correct answer was sometimes spoiled by the addition of the unit *joule*.

Question 4

(a) Since the word *linear* is given in the question, it does not, on its own, constitute a satisfactory answer; more was required.

(b) The correct answer was commonly supplied and only occasionally was it spoiled by the omission of the negative sign.

(c) Many answers consisted of one or two correct differences, but there were also answers that suggest erroneously that the sensitivity is related to the speed of a thermometer's response to a sudden temperature change.

(d) (i) The number of answers that implied a slower rate of temperature fall was almost equal to the number of correct answers. Not all candidates realised that the painted thermometer would eventually reach equilibrium at room temperature.

(ii) The correct box was indicated infrequently.

Question 5

(a) There were many answers that related the specific latent heat of fusion to melting but only a small proportion of these obtained full credit by making a correct reference, in some way, to a unit mass.

(b) (i) There were those candidates who realised exactly what was required and easily produced the correct answer. Some others used a wrong mass or tried to use a temperature change of some sort.

(ii) This calculation produced two main types of response. Many candidates obtained the correct answer with the appropriate unit by substituting the correct figures into the correct formula. There were others who did not reveal that they understood what was expected. There were a few correct answers with the wrong unit.

(iii) Although the basic mechanism of convection was understood, only a minority of candidates referred to the greater density of the cooled water.

Question 6

(a) (i) The locations of the positions A and E were sometimes appropriate and sometimes not. Position E was quite commonly on the same side of the lens as A, which is not correct.

(ii) The correct answer to this part of the question depended on the location of position A given in the previous section. Only a minority of candidates ticked a box that corresponded to their previous answer.

(iii) Most candidates underlined at least one correct answer here and many underlined both correct answers.

(b) (i) There was a mixture of correct and incorrect answers here; often candidates overlooked to mention that the frequency of the light does not change.

(ii) There were many correct answers but some candidates gave answers that only referred to the frequency or the amplitude of violet light.

Question 7

(a) (i) There were many acceptable explanations given but some did not answer in a way that revealed the difference asked for.

(ii) In both parts of this section, there were some good answers. Candidates did not always give their explanations in terms of compressions.

(b) (i) This part was in the main correctly answered. The most common error was to multiply the wavelength of the sound by its speed.

(ii) Most candidates realised what was required here and were able to state why the sound could not be heard.

(iii) The correct calculation was commonly performed and full credit was commonly awarded. The most frequently made error involved the introduction of a factor of two either into the formula or into the final answer.

Question 8

(a) (i) This was correct very often. A few ammeter symbols were drawn in parallel with the battery, the wire, the variable resistor or even with a section of connecting wire.

(ii) Only a minority of candidates made an appropriate suggestion to this part.

(b) (i) Many candidates made some progress here supplying an intermediate answer of 300 (V). Rather fewer, however, produced a correct final answer. There were candidates who obtained *75 000 W* but who then subtracted some other quantity from it before giving a final answer.

(ii) Many candidates realised that the power loss would be reduced and most even gave the reason in terms of the decrease in the resistance. Of those who gave a numerical value to the reduction, the vast majority stated incorrectly that it would be halved.

Question 9

(a) Only a minority of candidates answered this correctly. Answers such as ‘fission’, ‘radioactive decay’ or ‘chemical reaction’ were not unusual. The answer ‘fussion’ cannot be credited.

(b) (i) Only a few candidates gave a complete answer here although many stated that the particles were either charged or moving.

(ii) Many candidates gave the correct equation and defined the additional term. A few other candidates gave equations that included $P = VI$ or other electrical equations.

(c) (i) Although some candidates obtained full credit for both parts, many candidates did not give a correct direction.

(ii) Only a small fraction of the candidates drew the arrow in the correct direction. Most other directions within the page were indicated by some candidates.

Question 10

(a) Electromagnetic induction is quite poorly understood by many candidates and only a minority gave a satisfactory explanation.

(b) Very few candidates referred to either the change in the direction of the deflection or to the increase in its magnitude. .

(c) Many good answers were given here and many candidates were awarded full credit and most of the remaining candidates were awarded some credit.

Question 11

(a) (i) There was a variety in the answers offered here with some candidates correctly stating that gamma-radiation would need to be emitted and then giving a correct explanation. Candidates who suggested other types of radiation (some suggested infra-red) usually found it impossible to explain the choice satisfactorily.

(ii) Many candidates explained why the isotope should not have a half-life that was long and others gave reasons for it not being too short. Many candidates made both points.

(b) This was well answered by some candidates but others put ticks in either the first column or the fourth column or in both.

PHYSICS

Paper 0625/04
Coursework

General Comments

Many Centres have continued to produce work of a high standard, therefore justifying the credit awarded. Also the majority have used stimulating and 'open-ended' investigations which allow candidates to show their abilities to the best effect. It is pleasing to see that points made from previous reports were noted.

There were still a few Centres where the credit awarded did not accord with the standards expected. In these cases it was due either to teachers at the Centre being too generous in their marking or, more commonly to Centres choosing assessment tasks which were not appropriate to the skills being assessed.

A large number of samples illustrated clear annotated marks and comments, which was helpful during the moderation process. The candidates at the majority of Centres were given many excellent opportunities to demonstrate their practical skills using a varied range of tasks from different areas of the specification; clearly a large amount of good work has been completed by teachers and students. It is advisable that a maximum of two skill areas should be assessed on each practical exercise.

If more than one teacher has been involved in the assessment of practical skills, then it is very important that internal moderation is undertaken, to ensure that the standards applied for all candidates are comparable. This is made easier where all candidates do the same tasks, and the same mark schemes are used. It is acceptable to use different tasks, but this will require considerably more effort to be made to ensure that marks for one teaching group can be compared directly with those of another. It is best if just one teacher takes on the role of internal Moderator, as this is the only way to ensure that the same standards have been applied for the entire entry from one Centre. The external Moderators cannot change the rank order within a Centre; it is the Centre's responsibility to ensure that this is correct.

Skill C1: Using and Organising Techniques, Apparatus and Materials.

This skill involves following instructions and as such cannot be combined with skill C4 which involves writing instructions. The credit awarded depends on the complexity of the instructions followed, which may be simple one step instructions, more complex multi-step instructions, or instructions which are branched, that is, where there are, at some point, two possible routes to take. The decision as to which route is taken depends on interpretation of an observation.

Skill C2: Observing, Measuring and Recording.

This skill involves making and recording observations. Tasks may be quantitative, involving measurements of qualitative observations. Care must be taken not to provide too much guidance on exactly what to observe and how to record it. The provision of tables and other formats, even in outline, limits the credit which can be awarded.

Trivial exercises involving one or two readings are not sufficient evidence for the higher credit.

Skill C3: Handling Experimental Observations and Data.

This skill involves processing results and finding patterns to arrive at a conclusion. It is much easier to demonstrate this skill if there is data to process. Most suitable of all are tasks from which a graph is produced as this makes it easier to find and explain patterns.

Again care must be taken to not give too much help in the way of leading questions or pre-drawn axes. In this skill also such assistance lowers the credit available.

Skill C4: Planning and Evaluating Investigations.

Here a detailed plan must be written before the investigation is started. It is also essential that the plan is then carried out as this enables an evaluation to be made and improvements suggested.

Very simple exercises are not really suitable as there must be opportunity to explain how variables are to be varied, measured or held constant.

Mark schemes should be related both to the task and to the criteria in the syllabus and should not be a slight rewording of the assessment criteria.

It is more straightforward, and can save extra work, if a Centre finds a number of suitable tasks and then sticks with them.

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 will need to be based on practical, rather than theoretical, considerations.
- Numerical answers should be expressed clearly, to the appropriate number of significant figures and with a correct unit, where applicable. Candidates should know that these techniques will be tested at some point in the paper.
- Candidates should be ready to apply their practical knowledge to different situations. Questions should be read carefully to ensure that they are answered appropriately.

General Comments

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

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

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

Questions on experimental techniques were answered much more effectively by candidates who clearly had regular experience of similar practical work.

The practical nature of the examination should be borne in mind when explanations or justifications are required, for example in **Question 1** parts **(c)** and **(d)**.

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

Comments on Specific Questions

Question 1

(a) The majority of candidates successfully recorded the distances, using the correct unit and calculated *W* correctly.

(b) (i) Some candidates did not mark a position for **Q**. A significant number indicated a position to the right of the 50.0 cm mark, contradicting the evidence in part **(a)** of a correct position having been used.

(ii)–(vii) Most candidates recorded values of *a*, *b* and *c* that were within the tolerance allowed. Calculations were generally correct but relatively few candidates seemed to be able to apply the knowledge that the product of a weight in N and a distance in cm will result in a quantity with the unit Ncm.

(c) Here candidates were asked to think carefully about their experiment, in particular how reliable they thought their readings might be, and to make a judgement on the results. The Examiners awarded marks in relation to the candidates' own results. Successful candidates were able to make a clear statement and justify it by commenting on the closeness (or otherwise) of aP to $bQ + cW$.

(d) This part gave candidates the opportunity to comment on the experiment they had carried out and to identify a difficulty that they had encountered. Confident candidates were able to explain simply that it is very difficult to balance the metre rule exactly on the pivot. There are many possible ways to answer this part and candidates were given credit for a suitable, thoughtful comment.

Question 2

(a) Most candidates recorded a suitable value for the temperature of the hot water but a small number appeared to have recorded room temperature.

(b) Most candidates labelled the graph axes correctly and drew them the right way round. Better candidates chose scales that produced plots that occupied more than half of the graph grid in both directions. Plotting was generally accurate. Many candidates drew a well-judged curve, although some lost the mark by drawing a 'dot-to-dot' line whilst others drew a straight line that did not match the plots. Some candidates lost the final mark because their line was too thick or the plots too large.

(c) Most candidates correctly concluded that the rate of cooling was decreasing, but the justification proved to be more challenging. The most confident candidates stated that the gradient was decreasing. Others justified their statement by showing that the temperature differences between readings at equal time intervals were decreasing. This was credited but it was a more lengthy explanation for the candidates to write. Some wrongly concluded that the rate of cooling was decreasing because the temperature was decreasing. Candidates' statements and justifications were judged in accordance with their recorded readings.

Question 3

(a) Most candidates recorded realistic values for the potential difference and current. The potential difference had to be given to at least one decimal place, and the current to at least two decimal places, in order to gain the marks. The majority of candidates calculated the resistance correctly.

(b) A good number of correct circuit diagrams were seen. Lamps in series, the voltmeter in series with the lamps and the ammeter in parallel were the most common errors. A significant proportion of candidates with incorrect circuit diagrams obtained subsequent readings that matched the correct circuit, indicating that the circuit had been correctly rearranged but incorrectly drawn. It is important that candidates are able to set up a circuit from a given diagram and are also able to draw a correct circuit diagram from a given circuit arrangement.

(c) Most candidates recorded sensible values here and calculated correctly. In part **(i)** the correct use of units for current, potential difference and resistance was rewarded. In part **(ii)** the resistance was expected to be given to two or three significant figures.

(d) Candidates were asked here to demonstrate their familiarity with this type of experiment and also their ability to consider the control of variables. The most confident candidates suggested current as the variable and explained that a variable resistor could be used to control the current. Other workable solutions were also given credit.

Question 4

(a)–(g) Most candidates were able to follow the instructions and complete an accurate ray-trace sheet. Only a minority of candidates appeared unfamiliar with this type of procedure thus producing a poor diagram. A few candidates used an angle of incidence of 60° instead of 30°. The most common cause of inaccuracy here was to place the pins too close to each other. Accuracy is improved if the pins are placed a good distance apart. Candidates should be taught to place the pins as far apart as possible. The minimum distance of 5 cm that is indicated here should not be seen as the ‘correct’ or optimum distance.

(h)–(j) Measurements were generally recorded accurately and the calculations carried out correctly. The refractive index was expected to be recorded to two or three significant figures and with no unit. Candidates who had carried out the experiment with care and precision obtained two values of refractive index that were both within the tolerance allowed and were rewarded for this.

(k) Successful candidates made a relevant suggestion from their experience. Vague suggestions, such as they would follow the instructions carefully, were not credited. Some candidates appeared to be relying on answers they had learned from past papers. ‘Use a darkened room’ was a fairly common response – sensible for a lens experiment using an illuminated object but not for this experiment where it is important to see the pins clearly.

PHYSICS

Paper 0625/52
Practical Test

Key Messages

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

Centres are provided with a list of required apparatus well in advance of the examination date. Where centres wish to substitute apparatus, it is essential to contact Cambridge to check that the change is appropriate. Any changes must be recorded in the Supervisor's report.

General Comments

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

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

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

All questions provided opportunities for differentiation, but particularly good, was **Question 1**, where only the more able candidates were able to use the results they had obtained in parts **(b)** and **(c)** to discuss whether the suggestion that doubling the length of the pendulum should double the time period, and to justify the statement that they had made. In part **(e)** few candidates listed sufficient length values that they would plan to use in the laboratory to continue the investigation further.

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

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

Note that it is important for Centres to provide details of changes made to the specified apparatus, and possibly specimen results if appropriate, so that Examiners can give full credit to candidates' results which lie outside the expected tolerance values. Cambridge should agree major changes to apparatus in advance of the examination date.

Comments on Specific Questions

Question 1

(a) This was a straightforward question, which was answered well. There were, however, a number of cases where candidates contradicted what they had drawn, in what they wrote below the diagram. Other candidates gave answers which were insufficient with regard to the detail of measuring, e.g. hold the pendulum still or allow it to hang vertically. Sometimes insufficient care was taken with the drawing, with large gaps being left between the rule and the pendulum, or the rule not reaching the clamp or the centre of the bob.

(b) (i) Most candidates had clearly measured 20 oscillations and their times were within the allowed range.

(ii) The calculation of the period of the pendulum was generally correct. However, some candidates got the division the wrong way around, whilst others did a division which bore no relation to the time for 20 oscillations that they had previously measured.

(iii) Many candidates claimed, incorrectly, that by measuring the time for 20 oscillations rather than for just one, that human/reaction time error would be reduced. Only the more able candidates realised that it was the effect of the error that was being reduced by producing a smaller percentage error in the time for one oscillation. The majority of those candidates who did succeed here, did so by referring to taking an average. There were, however, some very clear and correct explanations referring to the reduction of the percentage error in the result.

(c) The majority of candidates obtained a value for the time for one oscillation of the longer pendulum which was within the allowed tolerance and was given with the correct unit.

(d) Only the most able candidates scored both marks for this part of the question. A significant number claimed their results, which clearly showed that the period did not double with length, did in fact support the statement. The justification of the statement was rarely creditworthy, many candidates not commenting on the significance of the difference between their observed values and results expected by the hypothesis. Many candidates merely stated that 'the results are different'.

(e) Candidates were expected to give at least three additional values of length that they would use in order to continue the investigation. A majority of candidates gave only one or two extra values. Even when three or more values were given, these often included 50 cm and 100 cm, despite the instruction that the new values were to be additional ones. A minority of candidates misunderstood what was required and talked about additional apparatus.

Question 2

(a) (i) The majority of candidates recorded a sensible value for the temperature of the hot water; in most cases it was above 50°C.

(ii) Only half of the candidates succeeded in giving a sensible precaution that they took to ensure that their temperature reading was as reliable as possible. The most common correct answers were to wait for the temperature to stop rising and to ensure that the thermometer did not touch the beaker. Avoiding parallax was often mentioned, but rarely qualified for credit; to obtain credit, candidates must state how parallax is avoided when taking a reading.

(b) Only a small minority of candidates did not gain credit here.

(c) Again, this part was very well done. Occasionally, the unit of temperature was omitted in the final answer.

(d) Many candidates lost marks here by giving generalised answers which did not specifically relate to the question, as it was asked. There were many references to the surface area of the beaker, or the material from which the beaker was made, but these are not applicable to the experiment in question. The most popular correct answers were room temperature and heat loss to the surroundings/evaporation.

(e) Most candidates had some success with this part, and often they included a well-drawn diagram. Some candidates contradicted what they had drawn with what they wrote, and were penalised for it. The question was misunderstood by a minority of candidates who answered in terms of how to fill a measuring cylinder, or provided details as to why a measuring cylinder is more accurate than a beaker in terms of resolution.

Question 3

(a) (i) The majority of candidates gained full credit for voltage and current values which were consistent with the power source and meters listed in the Confidential Instructions. Some candidates did not record the data so as to reflect the precision of the measuring instruments, for example the ammeters provided should have enabled current to be recorded to two decimal places. A minority of candidates recorded impossible currents of 100 A or more, perhaps having misread the ammeter or having incorrectly adjusted their meter setting to the mA range.

(ii) The calculation of resistance was done well. Where the mark was lost, it was normally due to the candidate making a rounding error in the calculation.

(b) Most candidates were successful with the circuit diagram. It is important that the correct standard electrical symbols are used when drawing circuit diagrams.

(c) (i) This was answered well, with most candidates giving correct units for current, voltage and resistance, and not contradicting themselves.

(ii) The calculation was usually correct, but sometimes marks were lost by quoting the answer to an inappropriate number of significant figures, usually 1 or 4.

(d) (i) Some candidates were unable to draw the standard symbol for a variable resistor. Many gave potentiometer or thermistor symbols whilst others left the arrow head off their symbol.

(ii) Candidates were required to label on a circuit diagram a suitable position for a variable resistor to be placed in order to vary the current in all the lamps. Many candidates successfully marked the correct position; however, sometimes it was marked in the voltmeter branch, in a branch with one of the lamps or in the centre of the power supply or switch. Only occasionally was the variable resistor shown in parallel.

Question 4

(a)–(h) The results recorded by candidates in the table revealed that many found this experiment challenging. Most candidates drew the normal and the 30° line correctly. The required lines on the ray trace were usually all present and were neat. Where lines were missing, generally the fourth one, candidates often made up values to insert in the table. The majority of candidates did not place their pins at least 5 cm apart, many did not label the pins and some candidates had multiple pin holes. A minority of candidates drew perfect diagrams but with no evidence of pin holes.

(i) The graph proved to be straightforward with many candidates scoring well. The graph was accessible even for those candidates who obtained the wrong results for the experiment. Only a minority of candidates reversed the axes, and some chose scales that made too little use of the graph paper available. Scales which involved multiples of 3, 7 etc. were much less evident this year than in previous years. Best fit lines were usually well judged, but dot-to-dot lines or curves were still in evidence. The standard of point plotting and of line drawing continues to improve and there was not as much evidence this year of large dots or thick lines.

(j) When asked to state and justify whether their graph showed the angles α and θ were directly proportional, there were about as many no as there were yes answers. About half the candidature believed that a straight line was sufficient evidence to ensure direct proportionality. These candidates did not realise that the graph line must also pass through the origin.

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

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

Questions on experimental techniques were answered much more effectively by candidates who clearly had regular experience of similar practical work.

The practical nature of the examination should be borne in mind when explanations or justifications are asked for. This was seen in some of the excellent, straightforward responses to **Question 2(c)**, which required references to results rather than theory, and in the clear practical details given by some candidates in **Question 1(c)**, **2(d)** and **4(e)**.

It is expected that numerical answers will be expressed to a number of significant figures that is appropriate to the data given in the question or a measurement carried out by the candidate. This was demonstrated in many good responses to **Question 1**.

Candidates may be asked to develop techniques previously described in a question. Many candidates showed good basic practical knowledge when answering **Question 1(d)**.

Comments on Specific Questions

Question 1

Overall, this question was well done by many candidates. Sections involving details of practical methods proved challenging for some.

(a) Measurements were carried out carefully by most candidates and suitable units were included, although these were sometimes omitted or were incorrect.

(b) The majority of candidates measured correctly and calculated differences accurately. Sometimes scales were read incorrectly, producing negative values which were recorded without comment.

The equation was used appropriately by many but it was common to see an answer expressed to 4 significant figures rather than the expected 2 or 3.

Repeated readings using loop **Q** often produced a value of *M* close to that determined from the use of loop **P.**

(c) A good number of responses included the most straightforward explanations of ensuring equal distances between the loop and rule at either end or lining the loop up with the top of the rule. Some gained the mark by suggesting that a protractor could be used to ensure that there was a right angle between the loop and the string below it. Some suggested that the masses should be an equal distance from the bench, which would clearly not be observed when the experiment was being done.

(d) Many candidates found this question challenging. The expected response of repeating the experiment with different sized loops was seen but was often negated by suggesting that the masses should also be changed. The idea of at least 3 additional loop sizes, allowing a graph to be drawn, was suggested in the best responses and a few of these extended this to state that proportionality would be indicated by a straight line through the origin.

Methods involving repeats with calculation of the ratio of d_B/d_A to determine if it remained constant were given credit. Some recognised that two such calculations could be done with the results of the current experiment.

Question 2

This question was done well by a number of candidates.

(a) Decreasing thermometer readings were recorded by many candidates. If the initial water temperature was low, tables sometimes showed a succession of identical readings. It is important that hot water is provided which will produce a clear cooling curve. Candidates should be advised to estimate to 0.5°C rather than record integer values, so that they might reduce the risk of a number of identical readings together.

It was usual to see the time values expressed correctly.

(b) There were many correct answers with units given appropriately as °C/s. A small number of candidates expressed this and subsequent cooling rates to only 1 significant figure, obtaining the same answer for each, when their original calculations had shown clear differences. This prevented identification of a suitable pattern for use in part **(c)**.

(c) Many gave an appropriate value for x_4, deducing that the cooling rate was decreasing in each subsequent 90-second period, but by a smaller increment as time passed. Some incorrect answers used an average cooling rate from previous values or gave explanations based on theoretical considerations rather than reference to the data.

(d) Good responses, referring to stirring prior to reading the temperature, waiting for the reading to stop rising at the start or taking readings perpendicularly to the scale were seen.

(e) A number of possible factors were suggested, including the initial temperature or volume of the hot water and the size of the beaker. Candidates suggesting the first of these factors needed to take care to include the word 'initial' as 'hot water temperature' is too general a response.

Question 3

Many found this question challenging.

(a) Many candidates carried out appropriate measurements, recording potential differences to at least 1 decimal place and currents to at least 2 decimal places.

(b) The calculations were done correctly by most candidates and showed decreasing values in the majority of cases.

(c) Some good graphical skills were seen, with clearly labelled axes and accurate plots shown with fine crosses. The advice is that plotted points should, preferably, be marked with small fine crosses. Small dots are acceptable but are often obscured when the line is drawn through them. Large dots are not acceptable as the intended value cannot be determined clearly. A sharp pencil should be used for the plots and for the line so that accurate drawing may be achieved and errors easily corrected.

Scales were not always appropriate so that plotted points did not occupy at least half of the grid or were difficult to place because of unusual scale intervals. There were some cases in which candidates reversed the values on the *x*-axis, starting with 0.900 m, presumably in the order of the table.

Candidates are expected to be able to plot points between two scale lines as well as on the lines, as appropriate.

Many candidates produced a fine, straight, well-judged line of best fit and only a very few simply joined points together. There were some who did not draw a line at all, despite the other aspects of the graph being there. This prevented any judgement of the correct use of a triangle method in part **(d)** as this must be drawn to coordinates on the line rather than to data points.

(d) Many responses showed a value for *G*, obtained by the correct method with a triangle occupying as much of the line as possible.

There were many fewer correct answers for *r*, even when the gradient showed a value within the expected range. *r* was numerically equal to *G* and needed a simple transposition; many candidates recorded a different value, sometimes dividing by one of the values of *l*. The required 2 or 3 significant figures and unit of Ω/m were not always seen.

Question 4

Many candidates performed well on this question.

(a) Many measured *f* accurately for the first mirror distance.

(b) There was good correlation between the first and second *f* values in many responses but some had significant differences, presumably because of the slightly unusual nature of the technique.

Most candidates calculated an average value accurately.

(c) Most responses showed careful measurement and accurate use of the equation to produce the two values of *f*.

(d) Some instances of good agreement between F_1 and F_2 were in evidence but that was not always the case. The latter was allowed for in **d(ii)**.

In comparing focal length values, some candidates looked for equality rather than recognising that the suggestion could be supported if the values were within the limits of experimental accuracy. Very few with large differences in the values justified their answer by suggesting that the values were outside the limits of experimental accuracy. Most simply pointed out that they were different.

(e) Many candidates were able to recognise the precautions taken. Common correct responses related to a darkened room to produce a clear image and slowly moving the lens or screen backwards and forwards to ensure it was sharply focused. Ensuring that the object, lens and screen were perpendicular to the bench and that the object and centre of the lens were the same height above it were also suggested.

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 will need to be based on data from the question and practical rather than theoretical considerations.
- Numerical answers should be expressed clearly, to the appropriate number of significant figures and with a correct unit, where applicable. Candidates should know that these techniques will be tested at some point in the paper.
- Candidates should be ready to apply their practical knowledge to unusual situations. Questions should be read carefully to ensure that they are answered appropriately.

General Comments

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

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

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

Questions on experimental techniques were answered much more effectively by candidates who clearly had regular experience of similar practical work.

The practical nature of the examination should be borne in mind when explanations, justifications or further developments are asked for. For example, see **Question 1** parts **(d)** and **(e)** and **Question 5** parts **(b)** and **(c)**.

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

Comments on Specific Questions

Question 1

(a) The majority of candidates recorded the distances correctly with the appropriate unit.

(b) Most candidates successfully calculated X and Y but some divided by 10 instead of multiplying, and others recorded values that were not related to x and y. Most candidates were able to calculate W_1 correctly.

(c) Some candidates did not mark a position for **Q**. A significant number indicated a position to the right of the 50.0 cm mark, apparently ignoring the calculated values of X, Y, W_1 and the weights of **P** and **Q**.

(d) Here candidates were asked to think carefully about the experiment, in particular how reliable they thought the readings might be, and to make a judgement on the results. The Examiners awarded marks in relation to the candidates' own results. Successful candidates were able to make a clear statement and justify it by commenting on the closeness (or otherwise) of W_1 and W_2.

(e) This part gave candidates the opportunity to comment on the experiment, using their experience of similar experiments carried out during the course, and to identify a difficulty that they had encountered. Confident candidates were able to explain simply that it is very difficult to exactly balance the metre rule on the pivot. There are many possible ways to answer this part and candidates were given credit for a suitable, thoughtful comment.

Question 2

(a) Most candidates correctly read the thermometer scale. A few recorded 80.5.

(b) A few candidates made no entry here. Some wrote 'time' and 'temperature' but most wrote correct units.

(c) Most candidates labelled the graph axes correctly and drew them the right way round. Suitable scales were selected by many candidates and the accuracy of plotting was good in the majority of cases. Many candidates drew a well-judged curve although some lost the mark by drawing a 'dot-to-dot' line whilst others drew a straight line that did not match the plots. Some candidates lost the final mark because their line was too thick or the plots too large.

(d) Most candidates correctly concluded that the rate of cooling was decreasing but the justification proved to be more challenging. The most confident candidates stated that the gradient was decreasing. Others justified their statement by showing that the temperature differences between readings at equal time intervals were decreasing. This was credited but it was a more lengthy explanation for the candidates to write. Some wrongly concluded that the rate of cooling was decreasing simply because the temperature was decreasing.

Question 3

(a) The majority of candidates recorded the potential difference correctly. Of those, not all went on to record the current correctly and some gave wrong units. Most candidates calculated the resistance correctly.

(b) (i) A good number of correct circuit diagrams were seen. Lamps in series, the voltmeter in series with the lamps and the ammeter in parallel were the most common errors. It is important that, during their course, candidates learn to set up a circuit from a given diagram and are also able to draw a circuit diagram from a given circuit arrangement.

(ii)–(iii) Here candidates were expected to give the resistance to two or three significant figures and to include the unit Ω.

(c) Candidates were asked here to demonstrate their familiarity with this type of experiment and also their ability to consider the control of variables. The most confident candidates suggested current as the variable and explained that a variable resistor could be used to control the current. Other workable solutions were also given credit.

Question 4

(a) Most candidates were able to follow the instructions and complete an accurate ray-trace sheet. Only a minority of candidates appeared unfamiliar with this type of procedure thus producing a poor diagram. A few candidates used an angle of incidence of 60° instead of 30°.

(b) A significant number of candidates marked the pin positions too close to each other. In this type of experiment, accuracy is improved if the pins are placed a good distance apart. During their course, students should be taught to place the pins as far apart as possible. The minimum distance of 5 cm that is indicated here should not be seen as the 'correct' or optimum distance.

(c) Most candidates followed the instructions with care and drew neat, thin lines.

(d) The majority of candidates measured the distances accurately and then went on to calculate the refractive index correctly. It was expected that the value would be given to 2 or 3 significant figures and with no unit.

(e) Successful candidates made a relevant suggestion from their experience. Vague suggestions, such as they would follow the instructions carefully, were not credited. Some candidates appeared to be relying on answers they had learned from past papers. 'Use a darkened room' was a fairly common response – sensible for a lens experiment using an illuminated object but not for this experiment where it is important to see the pins clearly.

(f) A significant number of candidates did not show the ray box in a correct position. There was a variety of wrong positions and some candidates showed no position.

Question 5

(a) A minority of candidates realised that for a period of $T = 2.0\,s$, the value $T^2 = 4.0\,s^2$ on the graph would give the required length. However, candidates who clearly showed their method and read accurately from the graph were able to gain some credit whether they used $T^2 = 4.0\,s^2$ or $T^2 = 2.0\,s^2$.

(b) Candidates were expected to be able to explain in some convincing way that the method would reduce the effect of the error due to reaction time. Many different wordings were possible and credit was given for sensible answers.

(c) Candidates were expected to reflect on their own experience of experimental work during the course and make suitable practical suggestions. Many candidates did not appear to use their experience to answer the question and, as a result, made impractical suggestions.

PHYSICS

Paper 0625/62
Alternative to Practical

Key Messages

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

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

General Comments

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

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

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

All questions provided opportunities for differentiation, but particularly good, were **Questions 1(c)**, **4(c)(ii)** and **4(c)(iii)**, where the conclusions and the justifications in support of them, or the suggestions made, allowed the better candidates to demonstrate their ability.

Comments on Specific Questions

Question 1

(a) This was a straightforward question, which was answered well. There were, however, a number of cases where candidates contradicted what they had drawn, in what they wrote below the diagram. Other candidates gave answers which were insufficient with regard to the detail of measuring, e.g. hold the pendulum still or allow it to hang vertically. Sometimes insufficient care was taken with the drawing, with large gaps being left between the rule and the pendulum, or the rule not reaching the clamp or the centre of the bob.

(b) (i) Most candidates recorded the time shown by the stopwatch correctly. A number of candidates regarded the 40 as seconds and gave the reading as 28.67. A minority of candidates interpreted the reading as 28 minutes and 40 seconds and wrote down 1720.

(ii) The calculation of the period of the pendulum was generally correct. However, some candidates got the division the wrong way around, whilst others did a division which bore no relation to the time for 20 oscillations that they had previously measured.

(iii) Many candidates claimed, incorrectly, that by measuring the time for 20 oscillations rather than for just one, that human/reaction time error would be reduced. Only the more able candidates realised that it was the effect of the error that was being reduced by producing a smaller percentage error in the time for one oscillation. The majority of those candidates who did succeed here, did so by referring to taking an average. There were however some very clear and correct explanations referring to the reduction of the percentage error in the result.

(c) Only the more able candidates scored both marks for this part of the question. A significant number claimed their results, which clearly showed that the period did not double with length, did in fact support the statement. The justification of the statement was rarely creditworthy, many candidates not commenting on the significance of the difference between their observed values and results expected by the hypothesis. Many candidates merely stated that 'the results are different'.

(d) Candidates were expected to give at least three additional values of length that they would use in order to continue the investigation. A majority of candidates gave only one or two extra values. Even when three or more values were given, these often included 50 cm and 100 cm, despite the instruction that the new values were to be additional ones. A minority of candidates misunderstood what was required and talked about additional apparatus.

Question 2

(a) (i) This proved to be straightforward for most candidates. When the thermometer was misread, the most common incorrect answer was 90.2°C.

(ii) Only about half of the candidates succeeded in giving a sensible precaution that they would take to ensure that the temperature reading for the hot water was as reliable as possible. The most common correct answers were to wait for the temperature to stop rising and to ensure that the thermometer did not touch the beaker. Avoiding parallax was often mentioned, but rarely qualified – to obtain credit, candidates must state how parallax is avoided when taking a reading.

(b) There were very few incorrect answers to this part. An error carried forward from **(a)(i)** was invariably correct.

(c) Again, answers to this part were usually correct. The unit of temperature was usually given correctly, and only contradicted on rare occasions. Occasionally, the subtraction was reversed and a negative answer given.

(d) Many candidates lost marks here by giving generalised answers which did not specifically relate to the question, as it was asked. There were many references to the surface area of the beaker, or the material from which the beaker was made, but these are not applicable to the experiment in question. The most popular correct answers were room temperature and heat loss to the surroundings/evaporation.

(e) Most candidates had some success with this part and often they included a well-drawn diagram. Some candidates contradicted what they had drawn with what they wrote, and were penalised for it. The question was misunderstood by a minority of candidates who answered in terms of how to fill a measuring cylinder, or provided details as to why a measuring cylinder is more accurate than a beaker in terms of resolution. Occasionally candidates talked about 'parallel' viewing, and qualified this by adding 'to the water surface' or showed in their diagram that 'perpendicular' was intended.

Question 3

(a) (i) Most candidates scored full marks. Common errors were giving the voltmeter reading as 2.2 V and/or the ammeter reading as 0.82 A. Units were sometimes missing, and sometimes reversed, and occasionally the unit of current was given as I.

(ii) The resistance of the lamp filaments was usually calculated correctly; a minority of candidates rounded their answers incorrectly and gave their answer as 2.85 Ω.

(b) Most candidates were successful with the circuit diagram. It is important that the correct standard electrical symbols are used when drawing circuit diagrams.

(c) Although most candidates calculated the resistance of the lamp filaments correctly**,** about half of the candidates gave their answers to more significant figures than the raw data that they had been supplied with, and were consequently penalised.

(d) (i) Some candidates were unable to draw the standard symbol for a variable resistor. Many gave potentiometer or thermistor symbols whilst others left the arrow head off their symbol.

(ii) Candidates were required to label on a circuit diagram a suitable position for a variable resistor to be placed in order to vary the current in all the lamps. Many candidates successfully marked the correct position; however, sometimes it was marked in the voltmeter branch, in a branch with one of the lamps or in the centre of the power supply or switch. Only occasionally was the variable resistor shown in parallel.

Question 4

(a) The normal was usually identified and labelled correctly on the diagram. Some candidates did, however, mark the dotted mirror line instead.

(b) Most candidates were able to suggest a distance between the pins that was within the accepted range, and also included a unit with their answer. Most of the incorrect responses to this question gave a distance which was < 5 cm. Many candidates measured the distance AB from the given diagram, and gave 8.4 cm as their answer, which was acceptable.

(c) (i) This was a straightforward graph to plot, with many candidates scoring well. It was rare to see the axes reversed, and most candidates chose a suitable scale using at least half of the grid supplied. Occasionally a candidate would end the y-axis at 100, which placed the last plot outside the limits of the grid. Plotting was generally good and the best fit lines were well judged. There were some dot-to-dot lines and also some curves. Occasionally a candidate ignored his/her correctly plotted points altogether, in order to draw a line through the origin.

(ii) When asked to state and justify whether their graph showed the angles *α* and *Θ* were directly proportional, there were about as many no as there were yes answers. About half the candidature believed that a straight line was sufficient evidence to ensure direct proportionality. These candidates did not realise that the graph line must also pass through the origin.

(iii) Correct answers to this part were rare. Of those candidates who did give a correct response, pin thickness was identified as the problem, with fewer giving mirror thickness. One very good answer talked about refraction and double images because of the thick mirror glass. Answers listing examples of poor experimental practice were not given credit, as it was stated in the stem of the question that the experiment had been carried out with care.

Question 5

(a) The calculation was almost always correct, but many candidates ignored the instruction to give their answer to a suitable number of significant figures.

(b) This was fairly well answered. The most popular correct answers were to darken the room or to repeat the measurements /experiment. A common incorrect answer was to move the lens slowly back and forth, which would not be applicable to this particular experiment where the lens distance is fixed and the screen moved.

(c) Again, most candidates scored at least partial credit. The most common correct answers were that the image was inverted and had a different size. Candidates were often unfamiliar with the word 'inverted', but clear attempts to explain what they meant were given credit. A common incorrect response was that the image was virtual. Occasionally some candidates mistakenly thought that the triangular shaped object was a prism and discussed the dispersion of light.

PHYSICS

Paper 0625/63
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 will need to be based on data from the question and practical, rather than theoretical, considerations.
- Numerical answers should be expressed clearly, to the appropriate number of significant figures and with a correct unit, where applicable. Candidates should know that these techniques will be tested at some point in the paper.
- Candidates should be ready to apply their practical knowledge to unusual situations. Questions should be read carefully to ensure that they are answered appropriately.

General Comments

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

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

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

Questions on experimental techniques were answered much more effectively by candidates who clearly had regular experience of similar practical work.

The practical nature of the examination should be borne in mind when explanations or justifications are asked for. This was seen in some of the straightforward responses to **Question 2(d)**, referring to results rather than theory, and in the clear practical details given by some candidates in **Questions 1(d)**, **2(e)** and **4(d)**.

It is expected that numerical answers will be expressed to a number of significant figures that is appropriate to the data given in the question or a measurement carried out by the candidate. This was demonstrated in many good responses to **Question 1**.

Candidates may be asked to develop techniques previously described in a question or may well be referred to situations with which they are not familiar. Many candidates showed good basic practical knowledge when answering **Question 1(e)** and **Question 5**.

Comments on Specific Questions

Question 1

Overall, this question was well done by many candidates. Sections involving details of practical methods proved challenging for some.

(a) Measurements were carried out carefully by most candidates and suitable units were included, although these were sometimes omitted or were incorrect.

(b) The majority of candidates measured correctly and calculated differences accurately.

(c) The equation was used appropriately by many but it was common to see an answer expressed to 4 significant figures rather than the expected 2 or 3.

(d) A good number of responses included the most straightforward explanations of ensuring equal distances between the loop and rule at either end or lining the loop up with the top of the rule. Some gained creditby describing use of a spirit level or obtaining a right angle between the loop and the string below it. Some merely determined that the strings were vertical and were not given credit.

(e) Many candidates found this question challenging. The expected response of repeating the experiment with different sized loops was seen but was often negated by suggesting that the masses should also be changed. The idea of at least 3 or 4 additional loop sizes, allowing a graph to be drawn, was suggested in the best responses and a few of these extended this to state that proportionality would be indicated by a straight line through the origin.

Methods involving repeats with calculation of the ratio of d_B/d_A to determine if it remained constant were given credit.

Question 2

This was the question that many candidates were able to answer most successfully.

(a) Most read the temperature accurately, with only a few candidates recording it as 20.1°C.

(b) It was usual to see the time values expressed correctly.

(c) There were many correct answers with units given appropriately as °C/s. A small number of candidates expressed this and subsequent cooling rates to only 1 significant figure, obtaining the same answer of 0.1°C/s for each, when their original calculations had shown clear differences. This prevented identification of a suitable pattern for use in part **(d)**.

(d) Many gave an appropriate value for x_4, deducing that the cooling rate was decreasing in each subsequent 90-second period, but by a smaller increment as time passed. Some incorrect answers used an average cooling rate from previous values or gave explanations based on theoretical considerations rather than reference to the data.

(e) Good responses, referring to stirring prior to reading the temperature, waiting for the reading to stop rising at the start or taking readings perpendicularly to the scale were seen. However, conditions in the room were often stated as were examples of basic laboratory practice, such as not taking the thermometer out of the water to read it or taking care with hot water. These are not precautions to ensure reliable readings and were not given credit.

Question 3

Many found this question challenging.

(a) The best responses showed the simplest parallel connection of the voltmeter across the centre of the circuit. Credit was given to connections to the crocodile clip, even to the tip, but not to the resistance wire on either side of it. A number of voltmeters with incorrect series connections were seen.

(b) The calculations were done correctly by the majority of candidates. Values recorded to more than 2 decimal places may have led to confusion in plotting.

(c) Some good graphical skills were seen, with clearly labelled axes and accurate plots shown with fine crosses. The advice is that plotted points should, preferably, be marked with small fine crosses. Small dots are acceptable but are often obscured when the line is drawn through them. Large dots are not acceptable as the intended value cannot be determined clearly. A sharp pencil should be used for the plots and for the line so that accurate drawing may be achieved and errors easily corrected.

Scales were not always appropriate so thatplotted points did not occupy at least half of the grid or were difficult to place because of unusual scale intervals. Candidates are expected to be able to plot points between two scale lines as well as on the lines, as appropriate.

Many candidates produced a fine, straight, well-judged line of best fit and only a very few simply joined points together. There were some who did not draw a line at all, despite the other aspects of the graph being there. This prevented any judgement of the correct use of a triangle method in part **(d)** as this must be drawn to coordinates on the line rather than to data points.

(d) Many responses showed a value for G, obtained by the correct method with a triangle occupying as much of the line as possible.

There were fewer correct answers for r, even when the gradient showed a value within the expected range. r was numerically equal to G and needed asimple transposition; many candidates recorded a different value, sometimes dividing by one of the values of l. The required 2 or 3 significant figures and unit of Ω/m were not always seen.

Question 4

The most successful candidates obtained their best performances on this question but some had difficulty with some of the practical aspects.

(a) Many measured f correctly to 1 decimal place. The correct scale factor of 5 was not always applied. Sometimes other values from the table were used instead.

(b) Most candidates calculated an average value accurately.

(c) Some very good, well explained answers were seen. Many responses showed correct use of the formula. In comparing focal length values, some candidates looked for equality rather than recognising that the suggestion could be supported if the values were within the limits of experimental accuracy.

(d) Evidence of a background in practical work was apparent in many answers. Some candidates may not have experienced the precautions necessary to obtain reliable results in optics experiments. Common correct responses related to a darkened room to produce a clear image and slowly moving the lens or screen backwards and forwards to ensure it was sharply focused. Ensuring that the object, lens and screen were perpendicular to the bench and that the object and centre of the lens were the same height above it were also suggested.

Question 5

Explanations, involving the application of basic practical skills to unusual situations, proved to be challenging.

(a) There were a good number of accurate measurements, particularly from those candidates who had clearly drawn construction lines to help the alignment of the protractor.

A solution to the practical problem of measuring between two three-dimensional objects was required and a number of good answers were seen. These involved fixing a protractor to the stand, ensuring that it lined up with one edge, or using a vertical reference such as a plumb line or spirit level. Some did not see the second part of the question in the experimental context and explained how they had measured the angle on the question paper.

(b) A good number of candidates recognised that ambient light or a possible zero error in the meter could be the reason and suggested sensible solutions. Several incorrectly thought that the solar panel or the circuit had retained current or voltage after switching off.

(c) This was well answered by many candidates who suggested at least one aspect which should be kept constant. Current to the lamp, or its brightness, the distance between the lamp and solar panel and the relative heights of the lamp and solar panel were the most common correct responses.