PHYSICS

Paper 0625/11
Multiple Choice

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

General comments

Candidates found questions **3**, **4**, **9**, **11**, **14** and **32** particularly easy. Only question **34** was very poorly answered.

Comments on individual questions

Question 1

Although a sizeable majority of responses to this measuring cylinder question were correct, a significant number of candidates chose **C**. Possibly they judged by eye how many extra cubes would fit into the cylinder, or they failed to read the question carefully and included the cube already there.

Question 2

A number of candidates opted for **D** here, despite this distractor including the phrase ‘at constant speed’. These candidates probably did not realise that a car that is slowing down is accelerating, albeit negatively, so rejected option A, which was the key.

Question 16

Although most responses to this question on thermometers were correct, many candidates chose option B, not attempting any calculation and simply reading the number from the scale.

Question 18

The causes of convection currents were generally well known, with the most common confusion being over the increase in density of air when it is cooled.

Question 19

This was a simple recall question about the nature of visible light and γ-rays; although the majority of responses were correct, others were apparently guessing. Possibly some candidates thought that both types of wave could not be transverse.

Question 21

Many candidates mistakenly answered that television pictures are transmitted from satellites to Earth using radio waves. The syllabus gives this as a use of microwaves in one of several specific examples of applications of electromagnetic waves.

Question 27

This question concerned the magnetisation of iron rods inside a solenoid. The most common mistake was to think that reversing the battery connections would cause the rods to repel, whereas before the change they had attracted.

Question 30

A significant number of candidates chose **D** in this question, not realising that a thin wire would have a higher resistance than an otherwise similar thick wire.

Question 34

All distractors were popular in this question on fuses, with option **C** attracting considerably more candidates than the key (**D**). It was explained that the lamp was not faulty, so the wrong choice of fuse would not be apparent and the lamp would work normally. The point is that a fuse that is rated too highly for a particular purpose is a hidden danger.

PHYSICS

Paper 0625/12
Multiple Choice

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

General comments

In this paper the best answered questions were **1**, **3**, **4**, **7**, **9**, **11**, **14**, **19** and **29**. Two questions were found to be particularly difficult, namely questions **22** and **33**.

Comments on individual questions

Question 6

This question on density involved candidates in determining the mass and the volume of the evaporated liquid in order to calculate its density. Although it was quite well answered, many candidates simply divided the original mass by the original volume, ignoring the fact that the mass indicated on each balance included the mass of the measuring cylinder.

Question 10

This question concerned work done and power, the point being that the work done continues to increase, whereas power in this example is constant. All of the distractors proved popular, suggesting much guessing by those unable to reason which were the correct pair of graphs.

Question 12

Pressure was the topic for this question. A good proportion of candidates correctly chose option A, with the others usually opting for B; it is possible that these did not notice that the views shown were from underneath the shoe, as explained, and not from the side.

Question 16

Most responses to this question on thermometers were correct, but many chose option B, not attempting any calculation and simply reading the number from the scale.

Question 18

The causes of convection currents were generally well known, with the most common confusion being over the increase in density of air when it is cooled.

Question 22

Few candidates were aware that television pictures are transmitted from satellites to Earth using microwaves; the syllabus gives this as one of several specific examples of uses of electromagnetic waves.

Question 25

This question on sound was usually well answered, with the most common error being not to calculate the time *difference*; candidates should read the question carefully, especially words in bold type.

Question 30

Many candidates did not take account of the fact that all three meters were in series with a component, so could not be voltmeters. It should be remembered in this type of question that it is possible for the correct response in all three columns to be the same.

Question 33

This question asked about the effect on the brightness of one lamp in a circuit when another lamp was removed. Candidates were expected to appreciate that the removal of lamp Y would increase the total resistance of the combination of lamps X and Y, thus reducing the brightness of lamp Z. The most common misconception was that lamp Z would remain at the same brightness.

Question 40

Although the majority of candidates knew and understood the term ‘nucleon’, a significant number confused it with ‘neutron’.

PHYSICS

Paper 0625/13
Multiple Choice

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

General comments

Candidates performed best in questions **2**, **5**, **8**, **10**, **15**, **32**, **33** and **38**. The greatest difficulty was with questions **12** and **34**.

Comments on individual questions

Question 1

Although a sizeable majority of responses to this measuring cylinder question were correct, a significant number of chose **C**. Possibly they judged by eye how many extra cubes would fit into the cylinder, or they failed to read the question carefully and included the cube already there.

Question 3

A number of candidates opted for **D** here, despite this distractor including the phrase 'at constant speed'. These candidates probably did not realise that a car that is slowing down is accelerating, albeit negatively, so rejected option A, which was the key.

Question 6

This question on resultant force and acceleration was generally well answered, although distractor **C** was chosen quite commonly. These candidates failed to add the two resistive forces and then realise that their total was less than the force from the engine.

Question 11

The most common error here was caused by a lack of understanding that the *useful* work done by the escalator and the lift was the same in each case.

Question 12

This question concerned the simple barometer, and candidates needed to be aware that the *difference* in liquid levels could be used to find the atmospheric pressure. A significant number opted for **C**, failing to appreciate that the lower level was not zero.

Question 20

Many candidates were not aware that television pictures are transmitted from satellites to Earth using microwaves. The syllabus gives this as one of several specific examples of uses of electromagnetic waves.

Question 25

This question concerned the magnetisation of iron rods inside a solenoid. The most common mistake was to think that reversing the battery connections would cause the rods to repel, whereas before the change they had attracted.

Question 26

In any question involving echoes students must always take care that they have considered the time taken for the sound to travel out *and return* to its source, and many failed to do so here.

Question 29

A significant number of candidates chose **D** in this question, not realising that a thin wire would have a higher resistance than an otherwise similar thick wire.

Question 34

All distractors were popular in this question on fuses, with option **C** attracting more candidates than the key (**D**). It was explained that the lamp was not faulty, so the wrong choice of fuse would not be apparent and the lamp would work normally. The point is that a fuse that is rated too highly for a particular purpose is a hidden danger.

PHYSICS

Paper 0625/21

Core Theory

Key Messages

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

Candidates should concentrate on answering the question just as it has been asked. Marks are only awarded for the specific answers required, not for comments on related matters or a general discourse about the situation.

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.

General comments

This paper requires candidates to have a sound knowledge and understanding of all sections of the Core syllabus. Candidates appear to have had sufficient time to complete all the questions included within the examination paper. There were very few instances where parts of questions were not attempted by candidates.

Weaknesses in English language skills are not penalised by Examiners who seek to give credit for correct physics responses even if the presentation, spelling, punctuation and grammar are not always of a good standard. There were a few instances where careless or poorly presented responses prevented candidates from being awarded marks. Candidates should be reminded to present their responses clearly, to show all stages in any calculations that they undertake and to carefully check all of their responses so as to ensure that they will benefit from the full range of marks available.

Questions that focused on the heat and mechanics sections of the syllabus were well answered by candidates of all abilities. Many candidates were also able to demonstrate their good knowledge and understanding of standard equations to solve numerical problems related to density, current, resistance and speed.

The questions on the converging lens and electricity were answered well by higher ability candidates and proved to be challenging to those candidates whose knowledge and understanding was less secure. Candidates of all abilities struggled to give responses worthy of credit to Question 6 on the manometer and gas pressure along with Question 11 on the forces acting on a current carrying conductor.

Comments on specific questions

Question 1

(a) This question was answered well by nearly all candidates; the small number that gave an incorrect response invariably gave the volume as 10.5 cm^3.

(b) This question was also well answered by candidates. A small number of candidates drew their line at 25 cm^3 rather than adding 25 cm^3 to the initial volume of 15 cm^3.

(c) This question proved very difficult for all but the highest scoring candidates. Candidates found it very difficult to explain that in comparison to a wider measuring cylinder the volumes of water added to a narrow measuring cylinder would result in a noticeable increase in the height. Many of the responses that failed to receive credit were too vague stating that the scale was easier to read or more accurate. A very small number of candidates gave a correct response in terms of improved sensitivity.

Question 2

(a) This question was very well done by candidates of varying abilities. The majority of candidates gained full credit. A very small number of responses used an incorrect equation to calculate the mass. The second part of this question was well answered by many candidates. A significant number of candidates, however, forgot to add the mass of the pallet.

(b) This question was not well answered, the common misconception being that the brick, despite being made of the same material, had a lower or higher density. The candidates' responses suggest that density is an area of the syllabus that is not well understood.

Question 3

(a) Some of the lowest scoring candidates did not understand the terms 'quantity' and 'unit' giving answers in terms of 'logs' or 'trucks' or stating incorrect units such as 'joule'.

(b) This question was very poorly completed by the lower scoring candidates. Common incorrect responses included 'weight' and 'distance'.

(c) A good proportion of the candidates successfully answered this question. A common pattern of responses to this question was correct answers for parts **(i)** and **(ii)** and in part **(iii)** an incorrect response, with candidates believing that the power would increase.

(d) Only the most able candidates did well on this question. Common incorrect responses included 'kinetic' and 'potential' energy.

Question 4

(a) The majority of candidates gave the answer of mercury. A significant number gave the alternative correct response of alcohol. There were a few incorrect responses with 'water' being a common error.

(b) This question was answered well by the highest scoring candidates although 'vacuum' was often spelt incorrectly. Common misconceptions included air, glass and mercury.

(c) This question was answered correctly by all but the weakest candidates who lost at least some of the credit available for identifying the fixed points. A small number of candidates lost credit due to careless presentation of their responses.

(d) There were many vague responses particularly from the weaker candidates who gave similar answers to both parts of this question. The higher scoring candidates often gave detailed explanations of the mechanism of expansion. Some of these candidates then lost credit for stating that 'molecules expand' rather than 'mercury expands'.

Question 5

(a) This question was answered well by middle and higher ability candidates. Common misconceptions amongst the lower scoring candidates included 5 hours, 5.3 hours, 6 hours or 6.5 hours.

(b) This question was well answered by all.

(c) This question was also well answered by all. A very small number of candidates failed to give any response to this question.

(d) Some candidates correctly identified the 'small roads' without stating 'at the end of the journey', and so did not receive any credit.

(e) This question was completed well by candidates of all abilities. On this occasion candidates were not penalised for using incorrect abbreviations for the unit km / h. In future, candidates may be expected to correctly state the value to an appropriate number of significant figures with the correct unit. A small number of candidates calculated the speeds for each section and then averaged the values. A very small number of candidates converted the speeds and calculated the answer correctly in m / s.

Question 6

This question was not answered well by candidates.

(a) In many cases candidates answered by either repeating the question or by stating that there was 'no pressure'.

(b) This question was correctly answered by only a minority of the highest scoring candidates. The most common incorrect response was a tick placed in the first box indicating a pressure of 3 cm of oil greater than atmospheric pressure.

(c) The first part was answered well by all but the lowest scoring candidates. For the second part there were some excellent, well written and logical responses from the highest scoring candidates. Many candidates were able to score at least some credit for recognising that molecules moved faster or were involved in collisions. A small number of incorrect responses were in terms of temperature increasing evaporation of the gas.

Question 7

(a) There were many correct responses; some candidates failed to gain full credit as a result of only ticking one box in each part. Candidates should be advised to make responses rather than not fully completing questions.

(b) The comments given above to part **(a)** above also apply here.

(c) The most common misconceptions included 'red', 'white' and 'yellow'.

(d) About a third of the middle and higher ability candidates gained credit for 'infra-red'. Misconceptions included 'ultraviolet', which was common, and the various forms of radiation produced through radioactive decay. There were very few correct responses to the last part of this question.

Question 8

Middle and lower ability candidates would benefit from greater experience of working with lenses and drawing ray diagrams.

(a) There were many correct responses but a common misconception was to describe the 'focal point' as the 'focal length'.

(b) A surprising number of candidates did not follow the instructions and thus failed to gain credit which they might have obtained. For example, some candidates only drew one ray, or having drawn two rays failed to label the intersection, or having drawn the rays and labelled the intersection failed to include an acceptable image.

Question 9

(a) This question was well answered by all.

(b) The majority of candidates calculated the resistance correctly. Many of the middle and higher scoring candidates were also able to obtain credit for the calculation of the current. The most common incorrect response was 2 A. A small number of candidates lost the final unit mark for writing the unit as 'a' rather than 'A'. The second part of this question was not well answered. The most common incorrect responses for the potential difference were zero and 6 V. A small but significant number of candidates, having given a correct response, lost a mark for not including the correct unit.

Question 10

This question was not answered well by middle and lower scoring candidates.

(a) Candidates gave a variety of correct responses to this question including 'potential divider', 'potentiometer' and 'rheostat'. There was a large range of incorrect responses including 'fuse', 'LDR' and 'resistor'.

(b) Very few candidates gave correct responses. The most common error was to reverse the voltages but a range of answers were seen suggesting that candidates were not sure how to answer the question.

(c) There were large numbers of incorrect responses to this question. The highest scoring candidates were able to justify the increase in brightness in terms of reduced resistance and gained all of the available credit.

Question 11

This question was not well answered by candidates.

(a) Very few candidates were able to identify the correct response to this question, the most common incorrect response being the first box ticked indicating towards the N pole.

(b) Many candidates obtained the first marking point for correctly showing a battery connected to the bare wires. A very small proportion of candidates were able to show the magnetic field correctly positioned above and below the current carrying conductor. This is an area of the syllabus that needs to receive greater attention.

Question 12

(a) This question was well answered by candidates of all abilities, many obtaining full credit. Those that did not often lost credit for incorrectly stating the charges on electrons and/or neutrons.

(b) The majority of candidates obtained at least some of the available credit.

PHYSICS

Paper 0625/22
Core Theory

Key Messages

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

Candidates should concentrate on answering the question just as it has been asked. Marks are only awarded for the specific answers required, not for comments on related matters or a general discourse about the situation.

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.

General Comments

A high proportion of candidates had clearly been well taught and prepared for this paper. There remains the tendency to think less rigorously and logically in non-numerical questions than in numerical questions. Equations were generally well known by many of the candidates but they often struggled when required to rearrange the equations.

Often candidates had been well taught how to apply their knowledge and understanding to fairly standard situations. On occasions, when asked to apply their knowledge to a new situation, they could become confused and display a lack of breadth of understanding. More practice in applying knowledge and understanding in unfamiliar situations would deepen candidates' understanding and improve their performance in the examination.

Failure to read the question carefully and the subsequent omission of part of an answer was a major factor in weaker candidates losing marks.

The majority of candidates indicated, by their knowledge and skills, that they were correctly entered for this Physics Core paper. However, a significant minority of candidates found the subject matter and level of some questions very easy and so accessible to them that they would have been better entered for the Extended Theory paper.

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

Comments on specific questions

Question 1

(a) The majority of candidates were able to calculate a time for the race, and compare their value with the record time. However, a significant number were unable to correctly find the difference between a time of 2.55 and 3.20.

(b) Candidates were not penalised again for mistakes made in the earlier calculation. The majority of candidates were successful in obtaining most of the available credit, although only the better candidates gained full credit. The most common mistake was failing to convert the 6 kilometres into metres.

Question 2

(a) Only the better candidates recalled that the turning effect of a force is called a moment, and very few were able to correctly indicate force *F* as being upwards and at the left hand edge of the cardboard.

(b) Most candidates correctly indicated that the matchbox would topple over onto its side, but only the very best candidates were able to explain that the centre of mass would be vertically above the right hand edge of the box as it toppled.

(c) The majority of candidates realised that the filing cabinet would topple, but again the explanations were very weak and often not worthy of any credit.

Question 3

(a) Most candidates did well; the lack of detail in responses often resulted in the loss of some credit.

(b) (i) Only the weakest candidates did not achieve credit for this.

(ii) The vast majority of candidates correctly plotted the six points, with only the weakest losing marks on this section.

(iii) and (iv) Once again, the vast majority of candidates had been well prepared for this type of question, and usually gained the credit for these two sections.

(v) Many candidates gained some credit for recognising that the straight line through the origin showed that extension and load are (directly) proportional, but failed to be precise enough in their description of what happened to the extension of the spring when the load was doubled. The most common insufficient response was simply "increases".

Question 4

(a) and (b) The majority of candidates recognised that the liquid in the thermometer would rise or move along the tube, but then in part **(b)** failed to link this to an expansion of the liquid.

(c) The majority of candidates gained the credit for this, but there were a significant number of candidates who failed to recall that the boiling point of water at standard atmospheric pressure is 100º C.

(d) This item was very poorly answered, with only the very best candidates recognising that the capillary tube was narrow to facilitate a large movement of the liquid for a small temperature change.

Question 5

(a) Most candidates were able to recognise the different states of a substance and scored full credit.

(b) The majority of candidates answered this well. Of the three descriptions, that of condensation caused most problems to candidates.

Question 6

(a) Only the best candidates were able to indicate the focal length of a lens on the diagram.

(b) (i) The majority of candidates gained partial credit for drawing a correct ray, but then failed to draw and label the image at the correct position.

(ii) This relatively straightforward item was very poorly answered, with some candidates' descriptions having no relationship to the image they had just drawn.

Question 7

(a) The majority of candidates were able to analyse the circuits and switches correctly.

(b) The majority of candidates successfully reasoned that all of the lamps would light when all of the switches were closed.

(c) The vast majority of candidates recognised that when switch 1 was opened, none of the lamps would light.

Question 8

(a) Most candidates recalled that an electric current was a result of electrons or charges moving in the wire, or that the unit of electric current is the ampere. However, very few candidates were able to explain that a current was produced as a result of connecting a potential difference across the wire.

(b) (i) The majority of candidates correctly calculated the value of the combined resistance. The most common error was in using the equation for a parallel combination instead of a series combination.

(ii) Using their earlier value for the combined resistance, the majority of candidates were able to calculate the current indicated by the ammeter. The most common error was in rearranging the equation $V = IR$.

(iii) The majority of candidates recognised that increasing the circuit resistance would result in the ammeter reading decreasing, but fewer recognised that this would also result in decreasing the potential difference across the 4.0 Ω resistor.

Question 9

(a) The majority of candidates stated a suitable material for either or both of the coils and the core. The most common error was to transpose the materials for the two parts of the transformer.

(b) The majority of candidates correctly evaluated the number of turns in the secondary coil to score full credit. Failure to show any method of working resulted in the loss of credit for some of the candidates who simply stated a final value on the answer line.

(c) (i) The majority of candidates recognised that the filament in the lamp would burn out when connected to a mains supply.

(ii) Only average and above candidates correctly drew two or more lamps in parallel with the transformer output. The most common error was to draw three lamps in series.

Question 10

(a) The majority of candidates scored well on this item, with many having a good knowledge of the magnetic field pattern for a bar magnet. The most common reasons for loss of credit were either magnetic field lines overlapping, or an incorrect or contradictory direction of the magnetic field.

(b) (i) Only average and above candidates were able to draw the magnetic field pattern both around and inside the solenoid. Once again, some credit was frequently lost due to overlapping field lines.

(ii) This relatively straightforward item seemed to cause confusion, with many candidates incorrectly stating that a magnet should be inserted into the tube rather than naming a material.

(iii) Many candidates recognised that a current carrying coil used to provide a magnetic field is called a solenoid.

Question 11

(a) The majority of candidates were able to recognise three types of radioactive emissions. Only the very weakest candidates did not gain some credit for this item.

(b) Weaker candidates often selected one of the incorrect options, with “it will take $x/2$ seconds for all the atoms in the sample to decay” being selected quite often.

(c) The majority of candidates scored at least some credit for this section, but there was considerable lack of understanding of this topic shown by many candidates.

Question 12

(a) The majority of candidates scored full credit, but weaker candidates seemed to select particles at random for their answers.

(b) Only average and above ability candidates seemed able to understand the nuclear notation used to describe isotopes. In part **(i)**, many candidates thought that 17 was the number of neutrons in a nucleus of chlorine, and in part **(ii)** “electrons” was a very common response. In part **(iii)**, weaker candidates performed numerous calculations with the different combinations of numbers, or simply left the answer space blank.

PHYSICS

Paper 0625/23
Core Theory

Key Messages

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

Candidates should concentrate on answering the question just as it has been asked. Marks are only awarded for the specific answers required, not for comments on related matters or a general discourse about the situation.

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.

General Comments

A high proportion of candidates had clearly been well taught and prepared for this paper. There remains the tendency to think less rigorously and logically in non-numerical questions than in numerical questions. Equations were generally well known by better and by slightly below average candidates but many struggled when required to rearrange the equations.

Often candidates had been well taught how to apply their knowledge and understanding to fairly standard situations. On occasions, when asked to apply their knowledge to a new situation, they could become confused and display a lack of breadth of understanding. More practice in applying knowledge and understanding in unfamiliar situations would deepen candidates' understanding and improve their marks in the examination.

Failure to read the question carefully and the subsequent omission of part of an answer was a major factor in weaker candidates losing marks.

The majority of candidates indicated by their knowledge and skills that they were correctly entered for this Physics Core paper. However, a significant minority of candidates found the subject matter and level of some questions very easy and so accessible to them that they would have been better entered for the Extended Theory paper.

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

Comments on specific questions

Question 1

(a) (i) The majority of candidates correctly calculated the time. However, a significant number made errors including adding the two times.

(ii) Most candidates gained full credit. Candidates were not penalised again for any mistakes carried forward from **(a)(i)**.

(b) (i)(ii) Most candidates correctly read the volume and divided by 50 to give a correct answer for one drop.

Question 2

(a) Many candidates thought the barometer was filled with water.

(b) Many candidates thought that the space above the liquid was occupied by air.

(c)(d) Many candidates seemed to have a poor understanding of how the barometer worked.

(e) Many candidates thought that the liquid level would rise if air leaked into the space above the liquid.

Question 3

(a) The majority of candidates gained credit for this section.

(b) Descriptions were generally poor, with most candidates gaining only partial credit, usually for the idea that the molecules move apart during melting.

(c) Most candidates knew freezing point, but a large number thought that this was 1 ºC for ice turning into water.

Question 4

(a) Only the better candidates seemed able to explain why metals were good conductors. A large number of weaker candidates failed to score on this part.

(b) Most candidates gained credit for this section, as the majority recognised that the rod would become charged.

Question 5

(a) Only the weakest candidates failed to identify the component as a lamp.

(b) (i) Many candidates correctly calculated the current in the circuit and gained full credit; others would have scored more if they had shown their method of working.

(ii) Many candidates did not realise that the readings on the ammeters would be the same as that in **(b)(i)**.

(c) (i) The majority of candidates knew the correct symbol for a voltmeter, but far fewer were able to draw it correctly connected across the resistor.

(ii) Candidates were not penalised again for any mistakes carried forward from **(b)(i)**.

Question 6

(a) The majority of candidates scored some credit for their description of how to permanently magnetise a steel rod.

(b) Most candidates correctly identified the force between a N and S pole.

(c) Most candidates correctly stated the induced poles on the iron rod.

(d) A large number of candidates thought there would be an attractive force between the magnet and the rod.

Question 7

The majority of candidates scored the first marking point, but many thought that a sound wave was a transverse wave and a surface water wave was a longitudinal wave.

Question 8

(a) (i) A number of candidates only ticked **one** box. This was usually the box indicating that sound travels through air.

(ii) The majority of candidates recognised that sound cannot travel through a vacuum.

(b) (i) A number of candidates failed to state that the first sound heard would travel direct from the explosion.

(ii) Many candidates scored most or all of the available credit for calculating the speed of sound. The most common error was in using 6.0 seconds as a time instead of 0.6 seconds.

Question 9

(a) (i) Many candidates found the calculation involving the transformer equation difficult but could possibly have gained some more credit if they had clearly set out their method of working.

(ii) Many candidates recognised that the lamp would be dimmer, but failed to state that the voltage would be lower.

(b) (i) Very few candidates stated that the transformer was used to increase voltage.

(ii) Many candidates did not realise that a **step-down** transformer was needed.

Question 10

(a) Most candidates were successful, but many tried to read too much into a straightforward item and attempted to write an equation based on the efficiency equation.

(b) Despite their problems with part **(a)**, the vast majority recognised that for a high efficiency the wasted energy needed to be kept as low as possible.

(c) This was probably one of the best scoring questions on the paper, with the majority of candidates gaining most or all of the available credit.

Question 11

(a) Only the very best candidates gained any credit for this question. Very few candidates were able to see the link between alpha particles and the distances involved meaning that the only radiation detected would be background. However in part **(b)** many candidates mentioned that alpha particles could only travel a few centimetres in air.

(b) Most candidates scored in part **(i)** by stating that the detection rate would decrease, but were let down by weak explanations in **(ii)**.

Question 12

(a) (i)(ii) Only the best candidates gained full credit, with very few candidates giving a clear description of nucleon number.

(b) Part **(i)** was poorly understood by most candidates, but some were able to score in part **(ii)** since allowance was made so as not to penalise again their earlier error.

(c) Not all candidates realised that the number of electrons in a neutral atom is the same as the proton number. However, most candidates were able to describe where electrons are found in an atom.

PHYSICS

Paper 0625/31
Extended Theory

Key messages

Candidates should be advised to attempt an answer whenever possible. Candidates who leave answer spaces blank cannot gain any credit. Perhaps they have no understanding of the question and no knowledge of a possible answer. Alternatively, they may lack any confidence that the possible answer in their mind is correct and decide not to write anything down in case it is wrong. In the latter case, they are unwise in their decision; their possibly vague idea may have some credibility and could gain them some credit. Candidates who are leaving a lot of questions blank because they find the paper too challenging would probably be better advised to sit the Core paper where the questions are designed to be more easily accessible.

In answering a numerical question, it is sufficient to write down a formula using symbols for the quantities involved. However, if asked to state the definition of a physical quantity, words or symbols may be used, but the symbols used should be explained.

General comments

The syllabus for this paper is wide-ranging. The objective of the paper is to examine a good proportion of the topics involved, and to allow as many candidates as possible to demonstrate their capabilities over various types of question, The general impression was that this paper succeeded in that objective. It was clear that a very large majority of the candidates had been guided by their teachers to direct their studies in a very effective manner, whatever their innate ability. A good range of marks was achieved over all types of question.

Comments on specific questions

Question 1

(a) Density has a definition, mass / volume or mass per unit volume, and various possible units, for example kg / m^3. Candidates who wrote such answers as mass per m^3 had mixed the two ideas and could not be rewarded. This was also the case for those who wrote m / V without explaining the symbols.

(b) (i) It was encouraging that so few candidates had confused the data given in this question, and few failed to obtain the correct answer to this.

(ii) The correct approach was to divide the volume calculated in **(i)** by the area of the sheet; the many candidates who realised this usually arrived at the correct answer.

(c) (i) The acceptable suggestions were a micrometer or callipers, not a ruler.

(ii) Some action needed to be described before the process of measuring, for example checking the zero of the measuring device or cutting the sheet into a number of pieces. This aspect was omitted by many candidates, and some credit lost. The next step was either to measure the thickness of one sheet in several places, or to measure the thickness of several sheets stacked together. Descriptions were sometimes unclear. The last action was the calculation of the thickness of one sheet from the measurements, and it was usually possible to credit this.

Question 2

(a) Most candidates could identify the vector quantities in the list.

(b) (i) Some candidates did not examine the graph line with sufficient care and wrote down 4 s.

(ii) Values obtained for the gradient depended on the accuracy of reading the graph, with some tolerance allowed. Most candidates were successful.

(iii) The area under the graph was the method clearly used by most candidates, although a few used equations of motion but with less success. The time value from **(i)** was needed for full credit to be possible.

(c) To their credit, the majority of candidates drew the correct continuation of the graph.

Question 3

(a) (i) Few candidates had any difficulty in quoting the PE and KE formulae and using them correctly, but a small number did not square the speed in the KE calculation.

(ii) Some spurious ideas were put forward, but most candidates could identify air resistance as the cause of the difference, or suggest an energy loss caused by it.

(b) (i) A majority of the candidates could state that the air resistance increases.

(ii) Many candidates failed to realise that the answer had to be a force, and quoted the value of the KE from **(a)(i)** or the mass of the parachutist.

Question 4

(a) (i) Candidates generally recognised that the vacuum or glass reduced conduction, but some confused conduction with radiation and stated, for example, that silvered surfaces reflect heat and are therefore bad conductors.

(ii) All surfaces reflect, absorb and emit some thermal radiation, so candidates had to state that silvered surfaces are good reflectors or bad absorbers, and poor emitters of thermal radiation. Many candidates failed to address either of these ideas, and marks were generally low.

(b) The need for a lid, a stopper or cork was usually recognised and its property of minimising loss of thermal energy by the processes of convection or evaporation. Very few candidates also included the fact that a stopper made of an insulator would also minimise loss by conduction.

Question 5

(a) (i) Many candidates stated or implied that the process of evaporation requires a liquid to be heated, and so lost credit. The statement that faster molecules, or those with higher energy, escape was required.

(ii) In general this was not well answered. The requirement was to state that as sweat evaporates, the sweat remaining on the body becomes colder (because the faster molecules have escaped). Heat then flows from the body to the colder sweat. Neither of these ideas was expressed with any clarity on a large number of scripts.

(b) (i) This posed little difficulty for the majority of candidates.

(ii) Candidates often have more difficulty dealing with change of state calculations than with those about change of temperature, and this proved to be the case on this occasion. Although many used $Q = mL$ successfully, others failed to do so, often including the temperature change in their calculations.

Question 6

(a) (i) The same considerations apply to the definition of pressure here as applied to the definition of density in **1(a)**.

(ii) There were 3 marks and 3 ideas required for a complete answer. Almost all the candidates gained credit for stating that molecules collide with the walls of the box and exert a force on the walls. The last marking point, very infrequently awarded even to very able candidates, was for explaining in some way that the combined force of all the molecules divided by the area of wall with which they collide produces the pressure.

(b) (i) The need to use $p = h\rho g$ was recognised by a good majority of candidates. Failure to convert mm to metres led to a penalty for some.

(ii) The answer obtained in **(i)** needed to be subtracted from the given atmospheric pressure. Some candidates added the pressures. Many showed little awareness of the required approach. A minority gained full credit.

Question 7

(a) Many answers were disappointing, showing little certainty as to the correct rays to draw. Only a small minority of those who drew the correct rays also stated the value of both the height of the image and its distance from the lens with the accuracy required.

(b) An incorrect or incomplete ray diagram in **(a)** meant that many candidates could not state the nature of the image. Various reasons for explaining why an image was virtual were offered, some of which were unacceptable. Candidates are recommended to learn that a virtual image cannot be seen on a screen, whereas a real image can be.

Question 8

(a) Knowledge of the range of the audible frequency range is required by the Core syllabus. A sizeable proportion of the candidates could not recall the values (15-25 Hz up to 15-25 kHz).

(b) The terms compression and rarefaction led most candidates to correct responses to **(i)** and **(ii)**. Some candidates referred to waves rather than to molecules or air layers and did not gain credit for this.

(c) (i) The connection between amplitude and the loudness of sound was correctly made by the majority.

(ii) This proved more difficult than **(c)(i)**. Many candidates did not deduce that a decrease in wavelength leads to an increase in the frequency or the pitch of the sound.

(d) A good deal of thought was required to analyse the information provided in the question. It was pleasing to see that among the minority of candidates who arrived at the correct value for the speed, not all were candidates achieving high marks on the whole paper. Some compensatory credit was available to candidates who quoted $v = 2d / t$, or who used 1.6 s or 500 m in their attempts, and there was a good number of these.

Question 9

(a) This question tested not only the knowledge of switching in circuits, but also the powers of observation of candidates. A surprising number failed to provide the correct responses.

(b) (i) Candidates needed to appreciate that the lamps were in parallel and therefore all had the full battery voltage across them. Answers of 6 V and 3 V were common.

(ii) Many candidates gained full credit, sometimes with an incorrect voltage from **(i)** carried forward.

(c) This question tested the ability of all candidates. Many based their response on comparing current or resistance values and could gain no credit. If candidates based their answers on the use of either $P = IV$, $P = I^2R$ or $P = V^2/R$, they gained at least some credit. Use of the correct values or wrong values carried forward from **(b)** usually led to creditworthy values for the power of each lamp.

Question 10

(a) To show the variation in the strength of the field, at least 3 circles centred on the wire were required. Some candidates drew their circles freehand with insufficient care so that an increase in the spacing of the circles was not clearly apparent. A compass is recommended for this purpose. There were fairly common errors in recalling or applying the corkscrew rule.

(b) (i) It was difficult with some answers to be sure that the candidate was showing a downward arrow on AB and an upward arrow on CD even if Fleming's left-hand rule had been applied. Some answers suggested that there was confusion on the part of candidates between motor behaviour and dynamo behaviour. The words 'induced current' were not infrequently seen.

(ii) A very small number of candidates could be awarded credit here. An explanation in terms of the moments of the two forces being in the same sense was required.

(iii) The function of a split-ring commutator is not well understood.

Question 11

(a) (i) For full credit, the answer 2 protons and 2 neutrons was required. Partial credit was awarded for the answer 'helium nucleus'.

(ii) The word 'electron', not electron<u>s</u>, gained the credit.

(b) Ionisation needed to be described as the removal or gaining of one or more electrons.

(c) (i) This was a question placing a high demand on candidates' knowledge. Two ideas were needed. First, that the path taken was the result of a force acting. In addition, that the force was perpendicular to the particles' paths, or changes its direction as the direction of motion changes, or, more simply, occurs because the particles carry a charge. Only a few of the answers supplied were worthy of credit for this idea.

(c) (ii) Candidates are more familiar with this type of question. A good answer showed smooth curves beginning at the point where the particles enter the field, with alpha up the page and beta down the page, with the beta curve having the greater curvature. A compensation mark was possible for curves in the wrong direction but opposite. Most candidates could be awarded at least 2 of the possible 3 marking points.

PHYSICS

Paper 0625/32
Extended Theory

Key Messages

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

- Candidates need to take particular care when drawing diagrams. In this paper it particularly applied to ray and wave diagrams. Examiners try to give credit for careful freehand diagrams, but it is strongly recommended that candidates use the appropriate instruments when drawing such diagrams.
- Candidates should concentrate on answering the question just as it has been asked. Marks are only awarded for the specific answers required, not for comments on related matters or a general discourse about the situation.
- Candidates must set out and explain their working correctly. If working is poorly laid out or missing and the final answer incorrect, it is often impossible for the Examiner to give partial credit for those parts of a candidate's thinking that were correct.

General Comments

A high proportion of candidates had clearly been well taught and prepared for this Extended Theory paper. However, a significant minority of candidates found the subject matter and level of some questions so difficult that these questions were inaccessible to them; such candidates would have been better entered for the Core paper.

The majority of candidates had generally learnt the required equations well. Often candidates had been well taught how to apply equations to fairly standard situations. However, they often made errors in rearranging equations. On occasions, when asked to apply their knowledge to a new situation, they could become confused and display a lack of breadth of understanding of the use of the equation. More practice in applying equations in unfamiliar situations would deepen candidates' understanding and improve their marks in the examination.

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

Comments on specific questions

Question 1

The majority of candidates scored well on this question. Weaker candidates could often remember the required equation but did not then apply it correctly.

(a) The most frequent error was to use an area instead of the volume of water.

(b) Many candidates scored gained full credit. Common errors were using $p = F/A$ or $p = mgh$.

(c) Again many candidates gained full credit. Common errors were using the wrong pressure or failing to transpose the equation $p = F/A$ correctly.

Question 2

(a) (i) Most candidates gained credit here. Examiners tried to be generous with misspelling of Hooke, but in some cases the spelling was too different for the Examiners to be certain of the candidate's intention. The other common error was to try to describe the law rather than name it.

(ii) Most candidates gained full credit but a significant number of candidates described the relationship between load and extension rather than the feature of the graph. These last three words were emboldened with the aim of helping candidates to avoid this error.

(b) Although almost all strong candidates scored this mark, a significant number did not take sufficient care with their sketch. Frequently candidates correctly drew upward curving graphs but the curves then went vertical or even to the left, which was not acceptable.

Question 3

(a) As shown in the mark scheme, there were a number of ways in which credit could be obtained for this question.

(b) Nearly all candidates lost some of the available credit through lack of precision in their answer. Also candidates often wrote down a number of spurious extra readings and this was not acceptable.

(i) Some clear description of a suitable type of heater was required. For example, without a considerable description about measuring gas consumption and calorific value, simply stating Bunsen burner was not acceptable.

(ii) Nearly all candidates quoted some sort of balance but there was often lack of precision about exactly which mass readings would be taken.

Question 4

(a) The graphs were generally well answered, the most frequent error being a poor choice of scale. Scales involving multiples of 3 or 7 etc. are poor scientific practice and were not accepted.

(b) (i) This was well answered, but with a significant number of unit errors.

(ii) This was generally well answered. Candidates could gain partial credit by attempting to calculate the area under the graph even if a subsequent error was made. Examiners were, however, only able to award this if it was clear that an area method was being used and that the candidate was not merely quoting some vaguely related equation. Candidates should be encouraged to show their working clearly.

Question 5

It was expected that candidates would use a ruler and compass in order to produce carefully drawn answers. Good freehand diagrams were condoned as long as it was clear that candidates' diagrams showed the correct features. In most cases it was easier to gain credit with accurate diagrams using ruler and compass.

(a) (i) This was normally correct and misspellings were condoned as long as the word could not mean anything other than diffraction, e.g. direfraction was often seen and was not acceptable.

(ii) There were many excellent carefully drawn, accurate diagrams which were awarded full credit. The following was expected: two straight, parallel waves in the outer harbour, three part-circular waves in the inner harbour and a constant wavelength throughout.

(b) (i) As in **(a)(i)** this was normally well answered but ambiguous wording or misspelling was not acceptable, e.g. reflaction or rarefaction.

(ii) There were again many excellent carefully drawn, accurate diagrams which gained full credit. The following was expected: four parallel, straight waves joined on to the original waves and sloping down to the right.

Question 6

In parts **(a)** and **(b)** many candidates drew excellent carefully drawn, accurate diagrams. Other candidates probably had the correct idea but through carelessness of drawing or lack of detailed knowledge lost marks.

(a) It was possible to gain full credit through careful drawing of the reflected rays without measuring angles as some tolerance was allowed. However, it was probably easier to achieve by use of a protractor.

(b) As stated in the question, it was not intended that candidates would make any calculations. It was expected that candidates would draw both rays refracted down and that the projection back would locate the image in a reasonable position under the water surface.

(c) This standard calculation was correctly carried out by most candidates but weaker candidates made a variety of mistakes in applying the Snell's Law equation.

(d) Nearly all candidates gained the credit for a correct medical use with an acceptable diagram. Many weak answers did little more than restate the question as a use, e.g. "in hospitals" is insufficient. A reference to total internal reflection was acceptable but some vague answers could equally well have applied to telecommunications so could not be accepted. Very few candidates scored the final mark for a clear detailed description of the light carrying the required information.

Question 7

(a) A significant number of candidates found this difficult. The most common mistakes were either only using one panel, or dividing the area of the panels by 260 W instead of multiplying by 260 W.

(b) This was generally well answered; candidates were not penalised for correctly carrying forward an incorrect result from **(a)**. Weaker candidates often inverted the efficiency equation or did not think through correctly the input and output powers.

(c) This question showed that even in a somewhat unfamiliar application, many candidates had been well taught the principles of series and parallel resistors. The majority of candidates correctly realised that device B and device C (or device A and device C) needed to be connected in series across 20 V. Often a mistake was made in connecting the correct devices in parallel.

(d) This was another standard calculation carried out correctly by most candidates. Weaker answers failed to invert the intermediate result 1/12. There were also a significant number of really weak answers where the sum of the two resistances was calculated.

Question 8

This was a typical example of a question where many candidates were familiar in general terms with the Physics of the situation but did not think through this particular situation or failed to express their answers in a logical manner answering the question asked. Many of the answers in parts **(b)** and **(c)** were far too vague.

(a) There were many good answers where the diagram was drawn with a considerable amount of care. The features expected were: three complete circles or ellipses centred on X, a clear indication that the spacing between the lines increases as the radius increases and at least one arrow to show a clockwise field with no contradiction.

(b) There were many good, clear detailed responses using either the iron filings or compass methods. A significant number of answers quoted a rule which could be used to remember the pattern but which is not an experiment so was unacceptable.

(c) There were again many clear, well expressed answers but also answers with vague descriptions of fields, currents and forces that said little about the Physics of the situation.

(d) This was generally well answered.

Question 9

(a) Most candidates scored well in this part of the question. A few weaker answers had more than one tick in a line of the table, which meant that no credit could be given.

(b) (i) Most candidates gained partial credit for increasing, and many also gave good explanations.

(ii) Although many good answers made it clear that there would be no output, a significant number of answers were a bit vague saying, for example, no change, which might or might not have been intended as no output, so could not be accepted. Many answers gave as explanation that transformers do not work with d.c. but this is insufficient as the required response had to be in terms of change of field or flux.

Question 10

(a) There were many correct completions of the table but also many weaker responses that showed a lack of knowledge of this topic. One common error with an otherwise correct table was to put 1, 2 and 3 for the neutron line.

(b) (i) Most candidates correctly identified beta particles.

(ii) There were many well argued responses that scored both marks either showing directly that it was beta radiation or using the reverse argument to show that it could not be alpha or gamma.

(c) and (d) Most candidates gave the correct responses of fusion, released and fission. As long as it did not lead to confusion, a certain amount of misspelling was condoned.

Question 11

(a) (i) Nearly all candidates correctly stated electrons.

(ii) There were many good responses that stated that the cathode was heated or mentioned thermionic emission. Answers in terms of “the filament” could not be accepted as there is no filament identified in the diagram of the oscilloscope so these answers are unclear.

(iii) Many good answers mentioned avoiding collisions with air molecules or stopping the electron beam. Avoiding deflection of the beam did not score but was often seen.

(b) This part was correctly answered by most candidates.

PHYSICS

Paper 0625/33
Extended Theory

Key Messages

This paper mainly examines supplementary topics from the syllabus. In order to score well on this paper, candidates need to be familiar with the entire syllabus including the core material. Although questions concentrate on the extension material, it is inevitable that certain core topics will be also tested.

Candidates who perform well are able to produce thorough and accurate answers to questions that test several different skills. Some credit is awarded for the simple recall of facts, formulae and relationships. Other, often more abstract, questions require the candidate to give explanations that require a detailed understanding of some aspect of the topic examined. Some questions require accurate and thoughtful calculations. The most challenging of these are likely to involve calculations in which more than one stage is necessary before the answer can be reached.

When a calculation is requested, candidates should be especially careful in the operation of their calculators. It is always unfortunate when a candidate who has produced the correct working out, does not obtain the correct answer because the addition button has been pressed instead of the multiplication button. Other common errors include calculations such as 12 / 2 / 3 where the candidate is trying to calculate 12 / (2 / 3). When calculations involve angles, the candidate should usually ensure that the degrees mode is selected.

General Comments

An occasional candidate finds the time to write out answers in pencil before tracing over them in ink; not only is this a waste of the candidate's time but it can lead to an answer which is less legible than it would otherwise be. This should be strongly discouraged.

Similarly, answers which are written sideways in the margin or above crossed out material can be difficult to read or even to interpret. The amount of space available for written answers should be enough for an answer that obtains full marks but when a candidate has filled this space up and wishes to write more, it is best to write the rest of the answer in a blank space elsewhere in the paper and to make reference to the location in the original answer space. Under no circumstances should any answers be written on the front page.

Comments on Specific Questions

Question 1

(a) (i) This answer was very commonly correct with the overwhelming majority of candidates stating that the line was straight or had a uniform gradient. A few candidates, who might well be advised to read the question more carefully, made no reference to the graph and simply offered a definition of constant acceleration.

(ii) This part was a calculation using numbers which the candidate was expected to obtain from the graph. Most candidates produced the correct numerical answer from the values 36 m / s and 48 s. Other correct values, however, could be used to calculate the acceleration. There remain some candidates who are unsure of the unit of acceleration; a common misunderstanding leads to the incorrect unit m / s^{-2}.

(b) (i) The correct, horizontal line was very commonly given, here. Candidates who did not use a ruler to produce the answer could still gain the credit, provided a little care was taken to produce the line.

Candidates should be advised, however, to bring a set of correct drawing equipment (sharp pencil, ruler, protractor, compasses) to the examination in case they are needed.

(ii) This final section of the question proved rather more testing. The candidates that realised that the total area under the graph could be determined by adding the area of a triangle and a rectangle, frequently scored full credit here. Those candidates that used kinematics formulae, or average speed calculations, were rarely so successful.

Question 2

(a) (i) This calculation was very frequently correctly performed. Some candidates were less familiar with the definition of density and tried to incorporate the time 7.0 hours into the working out. It is unfortunate that some candidates obtained the correct numerical value but followed it with an N to represent the unit as the newton.

(ii) An encouraging proportion of the candidates calculated this answer correctly and produced the correct power of ten and gave the correct unit. Sometimes candidates obtained full credit for using their incorrect answer to **(i)** entirely correctly in this part of the question.

(iii) This part was disappointingly answered. Many candidates, of course, gave the correct answer with the correct unit but there were also those who left the answer space blank, did not divide their value of **(ii)** by the time period given in the question or used a time of 7.0 (units usually unspecified) or more commonly 420 s. Candidates should be encouraged to show full, clear working.

(b) (i) Most candidates gained credit by giving an acceptable definition of *renewable*. Candidates should be discouraged from simply defining the meaning of the word in a more general context; simply stating that such an energy source is one that can be renewed was considered to be simply a restatement of the question and was not given credit.

(ii)
(iii) Many candidates were able to give two examples of renewable energy sources.

Question 3

(a) This was generally well answered with many candidates correctly distinguishing between *speed* and *velocity*. An occasional candidate gave the correct distinction the wrong way round.

(b) (i) This was very frequently well answered. A very few candidates drew an arrow that was either approximately in the direction of the resultant velocity or that was so poorly drawn as to be in no obvious direction at all.

(ii) It was encouraging when candidates drew the correct vector diagram and showed the resultant velocity arrow in the correct direction. Surprisingly, however, rather fewer candidates used the diagram to determine the size of the resultant velocity. It was very disappointing that very few candidates realised that the direction needed to be give as an angle. The most commonly stated direction was *south-east*. This is a horizontal direction that does not apply to this parachutist.

(iii) Only a minority of candidates used the resultant velocity from **(ii)** to calculate the kinetic energy here.

Question 4

(a) Almost all candidates were successful here. The few confusions that did arise, led some candidates to divide 8500 by 10 or to give the unit of weight as the kilogram. A very small number of candidates converted 8500 kg to grams before multiplying by the gravitational field strength.

(b) (i) Many candidates calculated the pressure exerted correctly. Many others omitted the factor of two and obtained an answer that was double the correct value. More rarely, confusion led to an answer that was half the correct value. Almost all candidates gave the unit of pressure as Pa or slightly more long-windedly as N / m^2.

(ii) This explanation was, to some extent at least, asking the candidates to explain what was meant by *pressure*. There were a significant number of candidates who performed well on the rest of the question but who scored very poorly here. Phrases such as *the plank spreads out the pressure* reveal that the idea of pressure is not as thoroughly understood as it might be. A few candidates made no reference to the increased area of contact produced by using a plank. Some candidates produced very good answers which commented on the ratio of the area of contact of the plank to that of the crane driver's boots.

(c) (i) This was often correctly answered. A few candidates gave answers such as *the instant a force is applied*. These candidates need to be more familiar with every part of the syllabus.

(ii) Whilst some answers showed that the candidate had a clear idea of what was required, other candidates gave answers which were not sufficiently exact to gain credit. Examples included *all the moments are equal* and *the upward force equals the weight*; these statements are only true in certain circumstances.

Question 5

(a) Many candidates gained full credit here. A rather disappointing answer was the statement that evaporation is natural whereas boiling is caused by humans.

(b) Many candidates scored the first marking point by referring to the breaking of bonds or otherwise but few candidates scored the second point by explaining what happens to the thermal energy supplied.

(c) This was poorly answered by a very large number of candidates. Only a minority of candidates made any reference at all to the measurements that need to be made. Determining the mass of the steam produced or condensed is not, of course, straightforward. It was, however, particularly disappointing to see candidates suggesting methods such as those that involved determining the mass of steam collected in a balloon by placing the balloon on an electronic balance.

Question 6

(a) (i) Many candidates scored two marks here. The question, however, refers to the molecular structure of a gas and of a liquid. Answers that offered information not related to the structure did not score here.

(ii) Many candidates supplied good statements and explanations, but those explanations that did not refer to the forces between the molecules were not able to gain credit.

(b) (i) Many candidates calculated the correct answer here. Candidates who attempted to answer the question using proportions, frequently gave a volume that was smaller than the original volume of the helium in the cylinder.

(ii) The only correct answers here referred either to the reduced speed or kinetic energy of the molecules. Any reduction in the separation of the molecules is likely to be opposed by the reduced pressure encountered by the rising balloon and so this suggestion was not credited.

Question 7

(a) (i) A very high fraction of the candidates gave an answer in terms of light of a single colour and gained credit this way. Rather fewer mentioned frequency which is technically more correct, or even wavelength.

(ii) Whilst many candidates simply wrote down the correct value given in the question, others either attempted a calculation of some sort or gave a written definition of frequency.

(b) (i) An encouraging number of candidates was able to calculate the refractive index from the two relevant speeds and only a relatively small minority attempted to use the ratio sin(i)/sin(r).

(ii) There were many correct calculations here and the unit supplied was nearly always correct.

Question 8

(a) This was frequently correct. Many correct answers used terms such as *de-localised electrons* or more simply *free electrons*.

(b) Some candidates gave answers which made it clear that the concept of electrostatic induction was understood. Other candidates, however, gave answers in which charge was scraped from the nylon rod on to the copper sphere. Those candidates who gave answers that charged the sphere by induction but then removed the charged rod before the earth connection, did not score full credit here.

(c) The majority of candidates correctly indicated the direction of the electric field that surrounded the charged sphere, but a rather smaller number drew the pattern of the field with sufficient attention to detail. In some cases the diagram was difficult to interpret and did not spread the field lines at all evenly.

Question 9

(a) (i) Most candidates identified the common feature of the two uranium isotopes' nuclei. References to the number of electrons in the atom were ignored as the question asked about the nuclei.

(ii) This mark was very commonly scored by the candidates.

(b) Only a minority of candidates gave answers that suggested a familiarity with the results of this experiment. A few candidates produced very good answers indeed that addressed both the description and the explanation. A common confusion was to suggest that the weak penetrating property of α-particles would prevent any detection to the right of the thin gold foil.

Question 10

(a) This factual recall was very often correct but some candidates revealed confusion with the output tables of other logic gates. The candidates whose output for the input 0, 1 differed from that for the input 1, 0 might have given more careful consideration to what such an answer implied.

(b) (i) Many candidates gave answers which were consistent with the answer given in **(a)** and this revealed an understanding of what is happening here.

(ii) There were many correct answers to this part.

(c) The majority of candidates answered this part either correctly or in accordance with the previous answers supplied.

Question 11

(a) (i) Many candidates gained full credit here by the correct application of the formula $P = VI$. A minority of candidates took the power to be 18 W and lost a single mark for a factor of ten error. There were candidates who attempted to use other formulae such as $I = V/R$.

(ii) This calculation was performed inaccurately by a large number of candidates. In addition to candidates who did not convert 30 minutes to seconds or did so wrongly, there was a significant minority of candidates who did not attempt to use $E = Pt$ or even $E = VIt$.

(b) Most candidates scored at least some credit here for stating that the current is reduced when the transmission voltage is high and many candidates also scored one or two other marks. There remain candidates who state that the higher voltage produces a lower resistance in the cables and some answers reveal that the distinction between current and voltage is not always thoroughly understood.

PHYSICS

Paper 0625/04
Coursework

General comments

This year saw a significant increase in the number of Centres entering for coursework assessment. Regular Centres continued to produce work of the correct standard to justify the credit awarded and used tried and tested investigations which allow candidates to show their abilities to the best effect. This was also true of the majority of new Centres.

There were, however, a number of 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.

The majority 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 candidates.

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.

PHYSICS

Paper 0625/51
Practical

Key Messages

- Candidates need to have had a thorough grounding in practical work during the course, including reflection and discussion on the significance of results, precautions taken to improve reliability and control of variables.
- Candidates should be aware that, as this paper tests an understanding of practical work, explanations will need to be based on data from the question or the implications of observations rather than theoretical considerations.
- The paper should be read carefully so that written answers address those specific points referred to in the questions rather than more general aspects of the same topic.
- Drawings, such as diagrams and graphs, need to be carried out with care in order to show the candidates' responses clearly.
- Numerical answers should be expressed clearly, to the appropriate number of significant figures and with a correct unit where applicable.
- Where questions ask for a specified number of suggestions, such as for practical precautions or experimental conditions, candidates should take care not to provide excess answers.

General Comments

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

- graph plotting
- understanding the significance of the best fit graph line
- determination of the gradient of a straight graph line
- drawing ray diagrams
- tabulation of readings
- manipulation of data to obtain results
- drawing conclusions
- understanding the concept of results being equal within the limits of experimental accuracy
- dealing with possible sources of inaccuracy
- control of variables
- making accurate measurements and observations
- choice of the most effective way to use the equipment provided

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 general level of competence shown by the candidates was sound. Very few candidates failed to attempt all sections of each of the questions and there was no evidence of candidates suffering from lack of time. Many candidates, who appeared to have had a good level of practical experience, dealt well with the range of practical skills tested. The candidates who scored the highest marks were able to answer with confidence the sections involving careful thought about techniques or the significance of results. In this examination, lack of personal experience was particularly noted in Question 4.

Some candidates have clearly had access to the mark schemes from past papers. It should be realised that these are written primarily for Examiners. Answers such as 'Statement to match readings' or 'Justified by reference to the readings' show learning of mark scheme instructions rather than understanding of the questions.

Comments on Specific Questions

Question 1

(a) Most candidates successfully measured the dimensions of the block and recorded all of them with the correct unit.

(b) Most candidates drew the outline of the face of the block described in the question but some chose one of the larger faces. The line AC was usually accurately drawn. A minority of candidates measured the wrong angle and some recorded 90° for *α*.

(c) A significant number of candidates recorded 90° for *θ*, apparently giving the angle through which the blocked tipped until it was flat on the bench. A pleasing number of candidates realised that they should take several readings and recorded them well. The average value should have been recorded to no more than the nearest 0.5° to show a realisation that it is difficult to take the protractor reading to a high level of accuracy in this experiment.

(d) Here candidates were asked to think carefully about their experiment and 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, e.g. 'My results support the suggestion', and justify their statement with reference to the results, e.g. 'There is only 1° difference between *α* and *θ*'. Candidates should recognise that results from practical work lie within a permissible range of accuracy and that two results do not need to be identical for them to be considered as representing the same value.

Question 2

(a) Most candidates successfully recorded room temperature.

(b) – (d) Most candidates correctly recorded the units (s, °C, cm). Some candidates did not record time *t* = 0 s in the table. Most recorded steadily decreasing temperatures giving the values to at least the nearest 1°C and also recorded realistic *d* values that related to their temperature readings.

(e) (i) Candidates were expected to realise that the graph line did not pass through the origin. Those who added a comment that not all the points were on the line were not awarded the mark as they had demonstrated that they did not understand the significance of a best-fit straight line.

(ii) Candidates needed to show that they realised that *d* was measured from a point on the thermometer below the 0°C graduation. Although this was expressed in a variety of ways, many candidates successfully showed their understanding.

(iii) Many candidates found this part difficult. They needed to show the importance of measuring, with a ruler, the length of as much of the scale as possible and then dividing by the appropriate number. Although vernier callipers are not mentioned in the syllabus, candidates who showed that they understood how to use them were awarded the marks. A micrometer would not be a suitable instrument to use.

Question 3

(a) Most candidates completed the table successfully. Some recorded currents or potential differences that were clearly much too large. This was probably due to misreading an unfamiliar meter.

(b) Most candidates were able to label the graph axes correctly and choose a scale that made good use of the grid. Plotting was generally accurate, but a significant number of candidates lost the line mark, usually by drawing a dot-to-dot line rather than a best-fit line.

(c) Candidates should have drawn a large triangle, using <u>at least</u> half of their line, in order to determine the gradient. Candidates should recognise that triangles covering as much of the line as possible will produce the most accurate determination of gradient. Candidates who had worked through the question with care and precision obtained a gradient value very close (or equal) to the current values in the table. These candidates were rewarded the final mark for the overall quality of their experiment and graph work.

Question 4

This question is based on simple experiments, requiring only limited apparatus, to locate the image in a plane mirror and to measure angles of incidence and reflection. It was disappointing to see that some candidates appeared to be unfamiliar with these experiments or to have forgotten the experiments that they had carried out during their IGCSE course. These candidates produced ray traces that were not realistic.

(a) - (l) Many candidates drew a neat, accurate ray trace, following the instructions with care. Relatively few however, gained credit for placing their pins as far apart as possible which is a precaution that should be taken to obtain an accurate result. The most competent candidates used a large pin separation, well in excess of the minimum of 5 cm required by the mark scheme. Measurements of *a* and *b* were usually accurate.

(m) As in **Question 1**, candidates were asked to think carefully about their experiment and 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, e.g. 'My results support the suggestion', and justify their statement with reference to the results, e.g. 'There is only small difference between *a* and *b*, within the limits of experimental accuracy'.

(n) Some candidates made a sensible suggestion relating to the placing of the pins, e.g. 'place the pins as far apart as possible', 'view the bases of the pins' or 'make sure the pins are vertical'. Others made vague statements that did not address the question. Some had apparently learned responses from mark schemes and made suggestions unrelated to this experiment (e.g. 'use a darkened room' – a response that would be suitable for a lens experiment with an illuminated object).

PHYSICS

Paper 0625/52
Practical

Key Messages

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- Drawings, such as diagrams and graphs, need to be carried out with care in order to show the candidates' responses clearly.
- Numerical answers should be expressed clearly, to the appropriate number of significant figures and with a correct unit where applicable.
- Where questions ask for a specified number of suggestions, such as for practical precautions or experimental conditions, candidates should take care not to provide excess answers.

General comments

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

- graph plotting
- understanding the significance of the best fit graph line
- determination of the gradient of a straight graph line
- drawing ray diagrams
- tabulation of readings
- manipulation of data to obtain results
- drawing conclusions
- understanding the concept of results being equal within the limits of experimental accuracy
- dealing with possible sources of inaccuracy
- control of variables
- making accurate measurements and observations
- choice of the most effective way to use the equipment provided

Candidates entering this paper were well prepared and it was pleasing to see that the range of practical skills being tested proved to be accessible to the majority of the candidature. The majority of candidates demonstrated good practical skills and understanding, and were able to use their practical expertise in carrying out the different tasks. 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 invariably included, writing was 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, were questions 1 and 4, where the conclusions and the justifications in support of them allowed the better candidates to demonstrate their ability. 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.

Quoting an answer to an appropriate number of significant figures or decimal places still causes difficulty for many candidates. All data should be recorded so as to reflect the precision to which the measuring instrument has been used. The number of significant figures given for calculated quantities should be appropriate to the least number of significant figures in the raw data used. There were also many examples of instances where a candidate had repeated a measurement and had overwritten their first answer. This often made it difficult for the Examiner to see what the reading was, and sometimes the Examiner was unable to award the mark. Candidates should be encouraged to cross out completely and to re-write their answers so that there is no ambiguity. Candidates still find difficulty in choosing an appropriate scale to plot their graphs and in drawing a best fit line to display their data.

Comments on Specific Questions

Question 1

(a) Most candidates gained the *d* mark although a small minority produced some physically impossible numbers. The *x* and *y* values given by candidates were mainly within the acceptable range; the most common error was to express them without the decimal place. Candidates are expected to be able to read, and record, a length measurement to the nearest 0.1 cm.

(b) Some candidates lost credit here by quoting their values of *M* to 5 significant figures. A minority of candidates omitted the unit or gave kg or cm as the unit.

The average was generally calculated correctly, however occasionally the two *M* values were subtracted instead of added.

(c) There was often agreement between the measured mass *M* with the average calculated in the previous part, **(b)(iii)**, but it sometimes looked as though candidates had altered their results to make them match.

(d) Not many candidates gained all of the available credit here.

There were lots of statements such as ‘the mass was placed wrongly’, ‘the metre rule does not have a precise scale’ or ‘human error/parallax’ which were not creditworthy because the stem of the question clearly stated that the experiment had been carried out with care.

The most common correct answer given was ‘the rule wasn’t balanced’ or some reference to the rule not being uniform. Fewer gave an indication that ‘the rule is difficult to balance’.

(e) The vast majority of correct answers involved looking through the slot of a round 100 g mass – a very sensible thing to do if a slotted mass had been used. Some took this approach but rotated the slot through 90 ° without showing the hole in the centre and so did not gain any credit.

There were answers involving the mean of readings from the edges, although a small number of candidates subtracted rather than added and thus did not locate the 5 cm / 10 cm point but merely measured the radius without realising how this might be used.

A small number of candidates used a mark on the side of the rule or mass.

Question 2

(a) (b) The vast majority of candidates gained all the available credit. Only a small number of candidates incorrectly gave the temperature value at $t = 0$ s as the room temperature value.

(c) (d) Again, most candidates achieved full credit, a value of θ_H below 60 °C or a missing unit being the main causes of losing marks. Very few candidates gave an unacceptable unit.

(e) The majority of candidates from some Centres were not able to give any sensible method for estimating the volume of water required, and the converse happened in other Centres, with concise ratio approaches being seen.

Some candidates filled all the available space with an explanation of how they arrived at their estimate; others, more eloquently, gave a simple statement of two temperature changes and a ratio calculation.

(f) Many standard answers were seen, variations of 'the same room temperature' being most common.

Common errors involved leaving out the word 'initial' or not saying which of the water samples should have the same volume. There were many references to equipment or to redundant second conditions based upon environmental factors. There were many candidates giving extra, incorrect, answers (both here and in **1(d)**) which negate previous correct responses.

Question3

(a) – (d) most *h* values were clearly given in cm, although some candidates had the whole set of values, incorrectly, in double figures or high values which were probably heights above the bench.

Most candidates continued to calculate $1/h$ correctly but some seemed to divide or multiply *u* and *h*. There were a lot of excess significant figures, which were condoned here, even though candidates were obviously not able to plot their points to that precision. Only a small number of rounding errors were seen in the calculation of $1/h$. A surprising number of candidates expressed $1/h$ as a fraction and lost the available mark.

(e) Many candidates found the graph difficult to plot and full credit was infrequent.

Missing axis labels, poor scales (often in intervals of 0.3), incorrect plots (1.01 instead of 1.1 was common) and poorly judged, thick lines with large plots were all seen.

Not many candidates 'joined the dots' but there were quite a number of lines which were forced through zero or were just not best fit, generally ignoring one or two points that did not fit on the line the candidate wanted.

There were also a number of scales expressed in fractions, following a set of fractional $1/h$ values. This lost both scale and plot marks whereas fractional $1/h$ values with a decimal scale could be marked and gain credit.

(f) Many candidates were awarded some of the available credit.

Neglecting to show the method used on the graph was a common mistake despite the instruction being given in the question. There were a number of triangles which, although not tiny, just did not cover half the line. The candidates in these cases realised the triangles should be of reasonable size but just did not go to the next stage. It might have been that the triangles covered half the data points but the candidates had extended the lines well beyond them.

(g) It was rare to find a value for the focal length within the allowed range. Correctly determined focal lengths were sometimes let down by excess significant figures or by a missing unit.

It is possible that some Centres gave candidates lenses with focal lengths other than 15 cm, but unless this was stated in the Supervisor's Report (which it sometimes was), Centre values could not be allowed as there was not the pattern of correct answers to indicate what the Centre value should be.

Question 4

This was probably the best question for the majority of candidates but some did poorly in it through lack of attention to precision, rounding, clear diagrams and units.

(a) There were many good answers but expression of *V* to at least 1 decimal place and *I* to 2 decimal places often depended on Centres, as did the size of the values. There were clear notes from some Supervisors regarding deviations from the equipment listed in the Confidential Instructions which allowed Centre values to be given. However, in other Centres where values were larger than expected, there was not sufficient pattern to allow credit.

Resistances were generally calculated correctly, with few rounding errors. Only a small minority of candidates added up the voltages incorrectly.

(b) The diagram was generally well done but careless drawing lost some marks with crosses within lamp symbols that were too small.

There were pleasingly few meters or lamps with lines through them and only a very small number of square-shaped meters drawn.

Most circuits were correctly drawn in parallel but there were some in series or with the voltmeter in series with the parallel branch or with one of the lamps.

A few showed the voltmeter across the power supply which, as a resistor was included in the circuit, could not be given.

It was sometimes very difficult to see how the readings recorded could have been obtained from the circuits shown, without perhaps some intervention from a Supervisor.

There were some Centres which indicated that help had been given and marks were deducted on a case-by-case basis. This was usually the question where candidates required help.

(c) A significant number of candidates did not produce creditworthy answers. Although many deduced correctly whether or not the suggestion was supported, far fewer gave expressions such as 'too different' or 'outside the limits of experimental accuracy' to justify their answer. Instead, candidates merely stated the obvious such as 'they aren't equal' which was insufficient. More gained the mark if their values were within 10%, and saying 'nearly equal' or 'close' as a justification.

It was pleasing to see occasional candidates giving answers such as 'within/outside the 10% limit of experimental accuracy'.

(d) There were many correct answers here. Some candidates indicated that the lamps glowed, but without giving any comparison and so could not be given the credit. One Centre did indicate that their lamps only glowed in parallel and this allowed a Centre value to be awarded. A significant number of candidates stated that 'the lamps are hotter when you touch them' – correct, but a practice to be discouraged!

There were also many attempts at theoretical explanations involving potential difference and power, ignoring the word 'evidence' stated in the question.

PHYSICS

Paper 0625/53
Practical

Key Messages

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General comments

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

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- dealing with possible sources of inaccuracy
- control of variables
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- choice of the most effective way to use the equipment provided

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

Questions on experimental techniques were answered much more effectively by candidates who clearly had a background of similar practical work and much less successfully by those who, apparently, had not. The quality of the results obtained was also a reflection of the candidates' experience of experimental 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 3(g) which required a reference to results rather than theory and in the clear practical details given by some candidates in Question 1(d). Less good responses indicated that candidates had not read the specific requirements of the questions carefully and this was also apparent in Question 2(c).

Some questions on the paper required responses involving drawing. Many good examples were seen, in Questions 4(c) and 4(e) for instance, where candidates' line judgement and intended precautions were clear.

It is important for candidates to recognise that imprecise drawings or thick lines on graphs will not guarantee clarity and may lead to inaccurate measurement.

It is expected that data should be recorded so as to reflect the precision to which the candidate has used the measuring instrument. Calculated answers should be expressed to a number of significant figures which is appropriate to the raw data obtained by the candidate. This was demonstrated in many good responses to Questions 1, 3 and 4. Other candidates needed to be mindful of this requirement and use of a 'recurring' symbol, which does not indicate the intended number of significant figures, or expression of a set of numerical answers to an inconsistent number of significant figures, must be avoided.

Question 2(d) required two experimental conditions to be suggested and many correct answers were seen. However, there were responses with more than two suggestions, some of which were incorrect, negating previous acceptable conditions.

Comments on Specific Questions

Question 1

This was a straightforward question and was tackled well by many candidates.

(a) The lengths were generally recorded correctly and the calculation of the magnification was usually accurate, with the value in the expected range of 2.5 to 3.5. Some candidates needed to take care with units as they were sometimes omitted from the lengths and attributed, incorrectly, to the magnification which, as a ratio, has no unit.

(b) This part of the question was also done well, with many achieving the more difficult measurements of the triangular object and image successfully. Candidates generally found the more straightforward calculation easier than that in part **(a)**, with an M value within 10% of m as expected.

(c) Many suggested that the findings supported the statement, which was the expected response. This was then followed up by some with the preferred justification that they were within the range of experimental accuracy. More gave the acceptable justification that they were almost the same. It should be noted that the latter was not acceptable as the initial statement, which needed to indicate positively that the candidate's idea was supported.

Candidates should recognise that results from practical work lie within a permissible range of accuracy and that two results do not need to be identical for them to be considered as representing the same value.

(d) A clear inverted triangle was usually seen, sometimes with the edges blurred as would be expected in the experiment but not required for the mark.

A number of candidates clearly reported the difficulties of taking measurements in this optics experiment.

Among the better responses were references to the hand and rule obstructing the light, the image having blurred edges and, more frequently, the difficulty of avoiding movement of the screen when measuring.

(e) Correct responses included the precautions of ensuring that extraneous light did not interfere with the experiment and moving the screen back and forth to obtain the sharpest image.

Although two precautions were asked for, some candidates gave additional answers. In this case, a number of extra answers were correct or neutral and did not have a detrimental effect. However, candidates should be aware that this is not good practice.

Question 2

Good responses to this question were seen from a majority of candidates, although the later sections proved challenging for many.

(a) Indication of the appropriate units was largely correct and, where marks were lost, it was generally in omitting the unit, possibly because the candidate had not read the question fully. Units attached to the data values in the columns, rather than at the head of the table, were accepted but candidates should be aware of the increased possibility of contradictory answers in this case.

There were good records of θ, mostly decreasing and only very infrequently showing the room temperature, incorrectly, at $t = 0$.

(b) Many candidates found, as expected, that the average rate of cooling was greater for the thermometer bulb near the bottom of the beaker, with the greater temperature change for this thermometer used as justification for the choice. Full marks were gained by those who also stated that the changes for each thermometer had taken place over the same time interval, or who calculated a comparative rate of decrease in temperature.

A lower final temperature for the thermometer bulb near the surface sometimes gave rise to some opposite, incorrect, responses, which ignored any difference in starting temperatures as the hot water cooled between experiments.

Some candidates had very similar temperature changes for the two thermometers and a statement that there was no significant difference, with a suitable justification, was acceptable in this case.

(c) This was the most challenging part of the question for candidates across the whole achievement range.

It related to general practical precautions which should be taken when measuring the temperature of liquids and which were suggested by the results of the experiment.

The most straightforward answers were often the best, with stirring or keeping the thermometer at the same depth being given as ways of overcoming the differential cooling rates. Both of these precautions come from direct experience of measuring temperatures, supported by the findings of the experiment described in the question.

A number of candidates gave examples of safe working, such as the wearing of gloves or goggles, ignoring the requirement that the precaution should be suggested by the results rather than general practice.

(d) It was expected that conditions should be those that could affect the comparison of cooling rates. Many good responses were seen, regarding the position of the thermometers, the volume and initial temperature of the water and relevant environmental conditions such as room temperature.

The question required two suggestions but some candidates, having responded correctly, went on to give extra incorrect answers. This invariably negated at least one of the acceptable answers.

Question 3

This question was answered well by many candidates.

(a) Most were able to draw the correct symbol for a voltmeter connected in parallel with the lamps. Candidates should note that a line shown through the circle is not acceptable.

(b) (c) (d) Potential differences recorded to at least one decimal place and currents recorded to at least two decimal places, as expected, were often seen.

(e) Many calculated the correct values for R, with an appropriate consistent number of significant figures. Where this was not the case, it was generally in the omission of the decimal place for a whole number value or inaccurate rounding.

(f) Correct units were usually given, although it was clear that some candidates were unused to the conventions employed in tables, responding with the quantity rather than the unit, e.g. ‘voltage’ rather than ‘V’ or ‘volts’.

A few candidates gave W rather than V for the unit of potential difference.

(g) While many candidates recognised that the appropriate resistance values did not support the suggestion, fewer gave examples of the calculated values as evidence for this opinion. A full response also required the candidate to indicate that the comparative figures were outside the limits of experimental accuracy rather than stating merely that they were 'different'.

Depending on the lamps which had been supplied to candidates, the required resistances may have been close in value and a statement and justification matching these results was quite acceptable.

There were a number of answers which gave a theoretical justification showing calculations for resistors in parallel circuits and ignoring the results which had been obtained. Candidates should be aware that explanations on this paper should refer primarily to the practical situations which have been experienced, or their implications, rather than to theoretical considerations.

(h) Some good answers referring to observations of the difference in brightness of the lamps as an indicator of temperature were seen. Candidates need to recognise that they will be expected to make this kind of connection between an observation and its implication.

(i) A good many candidates were able to show a voltmeter in parallel with lamp **L** alone.

Question 4

Although some excellent responses were seen, obtaining full credit, this graph question was found to be the most challenging on the paper for the whole range of candidates.

(a) Increasing values of h were recorded by the majority, with only a few candidates apparently measuring the length of the pendulum instead. Corresponding, decreasing, values of t were generally recorded.

(b) Values of T and T^2 were often correct. Some candidates could improve on the use of appropriate numbers of decimal places, an excess or insufficiency sometimes leading to later difficulties with plotting.

(c) Some good skills were seen in graph work, with clearly labelled axes and accurate plots shown with fine crosses or points in circles. The advice is that plotted points should, preferably, be marked with small fine crosses. Small dots are acceptable but are sometimes obscured when the line is drawn through them, making it more difficult to award the mark for correctly plotted values. A sharp pencil should be used for the plots and for the line so that accurate drawing may be achieved and errors easily corrected.

Simple scales, each axis occupying more than half of the grid were seen. Candidates should be aware of the difficulties introduced with unusual intervals or axis markings. Plotting was generally good with the particular difficulty of T being plotted instead of T^2.

A fine, best fit straight line was attempted by many. Marks were lost by the few who showed lines which joined plots together or who drew thick lines. Well-judged curves were acceptable if the plots indicated this.

(d) Many showed a clear triangle method on the graph for determining the gradient, with fewer utilising at least half of the line drawn. Candidates should recognise that triangles covering as much of the line as possible will produce the most accurate determination of gradient.

(e) It was expected that the precaution suggested would relate to, for example, a practical explanation of how parallax errors had been avoided, with the line of sight perpendicular to the reading on the rule, or how it was ensured that the rule was vertical, for instance by the use of a set square. There were some good, clear, responses given both in diagrammatic and/or written form but some of the more complex, unworkable solutions had clearly not been those taken during the experiment.

A number of candidates needed to have read the question more carefully to avoid giving precautions which they took to ensure that oscillations were uniform.

PHYSICS

Paper 0625/61
Alternative to Practical

Key Messages

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- Where questions ask for a specified number of suggestions, such as for practical precautions or experimental conditions, candidates should take care not to provide excess answers.

General Comments

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

- understanding the significance of the best fit graph line
- determination of the gradient of a straight graph line
- drawing ray diagrams
- tabulation of readings
- manipulation of data to obtain results
- drawing conclusions,
- understanding of the concept of results being equal within the limits of experimental accuracy
- dealing with possible sources of inaccuracy
- control of variables
- making accurate measurements
- understanding the most effective way to use equipment

It is assumed that, as far as is 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 regular practical work. To achieve well in this examination, candidates should have as much personal experience of carrying out experiments themselves as possible. In this examination, lack of personal experience was particularly noted in Question 5.

Clearly, some of the skills involved in practical work can be practised without doing experiments. These include graph plotting and tabulation of readings. However, there are parts of this examination in which the candidates are effectively being asked to answer from their own practical experience. Questions on experimental techniques were answered much more effectively by candidates who had experience of similar practical work and much less successfully by those who, apparently, had not.

Many candidates will have prepared for the examination, very sensibly, by working through some past papers. However if this was done with little understanding, candidates gave answers that would have been correct in a similar question from a previous session, but were not appropriate to this question paper.

Some candidates have clearly had access to the mark schemes from past papers. It should be realised that these are written primarily for Examiners. Answers that have been learned from past mark schemes and applied to the current examination have not gained marks. Answers such as 'Statement to match readings' or 'Justified by reference to the readings' show learning of mark scheme instructions rather than understanding of the questions.

Comments on Specific Questions

Question 1

(a) Most candidates successfully measured the dimensions of the block and recorded all of them with the correct unit. The line AC was usually accurately drawn. A minority of candidates measured the wrong angle and some recorded 90° for α.

(b) Answers between a minimum of 3 and a maximum of 20 were accepted as being practical. Candidates who added a unit did not gain credit.

(c) Here candidates were asked to think carefully about the experiment, relating it to their own experience of using a protractor, and make a judgement on the results. The Examiners awarded marks in relation to the candidates' own value for the angle. Successful candidates were able to make a clear statement, e.g. 'The results support the suggestion', and justify their statement with reference to the results, e.g. 'There is only 1° difference between α and θ'.

Question 2

(a) Most candidates successfully recorded the temperature.

(b) Most candidates correctly recorded the units (s, °C, cm or mm). Some candidates recorded one or more inaccurate *d* value. All the *d* values should have been recorded to the nearest mm, including the value at 10.0 cm that some candidates recorded as 10 cm in spite of all their other values being recorded to the nearest mm.

(c) (i) Candidates were expected to realise that the graph line did not pass through the origin. Those who added a comment that not all the points were on the line were not awarded the mark as they had demonstrated that they did not understand the significance of a best-fit straight line.

(ii) Candidates needed to show that they realised that *d* was measured from a point on the thermometer below the 0°C graduation. Although this was expressed in a variety of ways, many candidates successfully showed their understanding.

(d) Many candidates found this part difficult. They needed to show that they had measured the length of most or all of the scale and then divided by the appropriate number.

Question 3

(a) Many candidates completed the table successfully. The knowledge of units was usually good although some candidates recorded the wrong unit for the length, or no unit. The most common mistake for the electrical units was to use 'C' for current.

(b) Most candidates were able to label the graph axes correctly and choose a scale that made good use of the grid. Plotting was generally accurate, but a significant number of candidates lost the line mark, usually by drawing a dot-to-dot line rather than a best-fit line. The most common plotting error was to plot the third value at 1.1 V or 1.2 V instead of at 1.01 V.

(c) Candidates should have drawn a large triangle, using <u>at least</u> half of their line, in order to determine the gradient. Candidates should recognise that triangles covering as much of the line as possible will produce the most accurate determination of gradient.

Candidates who successfully obtained a gradient value within the tolerance allowed, and gave it to two or three significant figures, were awarded the final mark even if their triangle was too small to gain the previous mark.

Question 4

This question is based on simple experiments, requiring only limited apparatus, to locate the image in a plane mirror and to measure angles of incidence and reflection. It was disappointing to see that some candidates appeared to be unfamiliar with these experiments or to have forgotten the experiments that they had carried out during their IGCSE course. These candidates produced ray traces that were not realistic.

(a) - (c) Many candidates drew a neat, accurate ray trace, following the instructions with attention to the details. The candidates are expected to use a sharp pencil, ruler and protractor with care to demonstrate their practical skill.

(d) Candidates were asked to think carefully about the experiment and 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, e.g. 'My results support the suggestion', and justify their statement with reference to the results, e.g. 'There is only small difference between *a* and *b*, within the limits of experimental accuracy'.

(e) Some candidates made a sensible suggestion relating to the placing of the pins, e.g. 'place the pins as far apart as possible', 'view the bases of the pins' or 'make sure the pins are vertical'. Others made vague statements that did not address the question. Some had apparently learned responses from mark schemes and made suggestions unrelated to this experiment (e.g. 'use a darkened room' – a response that would be suitable for a lens experiment with an illuminated object).

Question 5

(a) Candidates were asked to calculate the distance *x*. Most who used the information given obtained the correct answer. A significant number of candidates took measurements on the diagram although there was no instruction so to do. It is possible that they had practised on past papers where measurements on the diagram had been required and then assumed that this was the case here, rather than carefully reading the question.

(b) Most candidates realised that a range of *m* values is used to obtain a more reliable final result.

(c) Most candidates were able successfully to calculate the average value but many did not correct the value obtained to a suitable number of significant figures (two or three).

(d) Here candidates were expected to draw on their own experience of a standard moments experiment that they had encountered during their IGCSE course. Candidates with the practical experience were able to write confidently about the difficulty of obtaining exact balance and how they would judge an average balance point as closely as they were able. Some wrote about the difficulty of placing the centre of the load exactly on the 90 cm mark and how they would overcome that problem. This was another sensible approach that gained full credit.

PHYSICS

Paper 0625/62
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 significance of results, precautions taken to improve reliability and control of variables.
- Candidates should be aware that, as this paper tests an understanding of practical work, explanations will need to be based on data from the question or the implications of observations rather than theoretical considerations.
- The paper should be read carefully so that written answers address those specific points referred to in the questions rather than more general aspects of the same topic.
- Drawings, such as diagrams and graphs, need to be carried out with care in order to show the candidates' responses clearly.
- Numerical answers should be expressed clearly, to the appropriate number of significant figures and with a correct unit where applicable.
- Where questions ask for a specified number of suggestions, such as for practical precautions or experimental conditions, candidates should take care not to provide excess answers.

General comments

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

- understanding the significance of the best fit graph line
- determination of the gradient of a straight graph line
- drawing ray diagrams
- tabulation of readings
- manipulation of data to obtain results
- drawing conclusions,
- understanding of the concept of results being equal within the limits of experimental accuracy
- dealing with possible sources of inaccuracy
- control of variables
- making accurate measurements
- understanding the most effective way to use equipment

It is assumed that, as far as is 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 regular practical work. To achieve well in this examination, candidates should have as much personal experience of carrying out experiments themselves as possible.

Candidates entering this paper were well prepared and it was pleasing to see that the range of practical skills being tested proved to be accessible to the majority of the candidature. The majority of 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 observations 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 2 (d) and 3 (e), where the conclusions and the justifications in support of them allowed the better candidates to demonstrate their ability.

Quoting an answer to an appropriate number of significant figures or decimal places still causes difficulty for many candidates. All data should be recorded so as to reflect the precision to which the measuring instrument has been used. The number of significant figures given for calculated quantities should be appropriate to the least number of significant figures in the raw data used.

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

Question 1

(a) Many candidates gained the first mark for *M* values. Some lost marks by giving their answer to 5 significant figures, but far fewer candidates gave their answer to too few significant figures. A number omitted the correct unit (g), and some weaker candidates gave kg or cm.

The average was generally calculated correctly, but some candidates subtracted the masses, instead of adding them.

(b) There were many correct answers, the most common incorrect value being 112g.

(c) Only a small number of the more able candidates gained two marks here.

There were lots of statements such as 'the mass was placed wrongly', 'the metre rule doesn't have a precise scale' or 'human error/parallax' which were not creditworthy because the stem of the question clearly stated that the experiment had been carried out with care.

The most common correct answer given by candidates was 'the rule wasn't balanced' or some reference to the rule not being uniform. Fewer gave an indication that 'the rule might be difficult to balance'.

It was a delight to come across answers which gave concise, precise explanations, particularly if they gave good accounts of why the mass or metre rule might not have their centre of mass at the centre.

(d) The vast majority of correct answers involved a line on the side of the block or a description of how to find the reading at the centre from the readings at the edge. The simplest answers showed this perfectly clearly in a diagram.

Quite a number confused the answer expected with an attempt to describe how to locate the centre of gravity of the mass. I suppose this is down to a misinterpretation of the question but a clear reading of the text states precisely what is being asked for.

Question 2

(a) The vast majority of candidates gained credit, although there were some incorrect values given, of which '14 °C'' and '21°C' were the most common incorrect values.

(b) The units were done well and it only a few candidates got the temperature symbol wrong. Omission of one or both units was the biggest cause for loss of credit, but this was by only a small minority of candidates.

(c) Most candidates gained credit here, with only a few omitting or giving an incorrect unit (even on low scoring scripts). There were only a few incorrect values, such as 12.5 or 14 cm^3.

(d) A majority of candidates gained some credit for the estimate, with many also gaining credit for a good accompanying explanation.

Quite a number used 78°C as their starting point to give an answer outside the allowed range but still gained some credit. Some candidates were quite confused and gave the difference between 74 and 66 as the answer.

(e) Many standard answers were seen, variations of 'the same room temperature' being most common.

Common errors involved leaving out the word 'initial' or not saying which of the water samples should have the same volume. There were many references to equipment or a second environmental condition and there were also candidates giving extra incorrect answers which negated their only correct answer.

Question 3

(a) There were many good answers with only relatively few outside the allowed range. The common errors were to read V as 0.35 or to give an estimate just outside the range.

Resistances were generally calculated correctly, with a few rounding errors producing 1.55 Ω, which was penalised.

(b) The majority of candidates read the voltages correctly. Half values were sometimes seen, particularly if this had occurred in **(a)**.

(c) Only a very small minority added up the voltages incorrectly.

(d) The diagram was generally well done but careless drawing lost some marks with crosses in lamp symbols that were too small or with lower case 'a' in the ammeter symbol.

There were pleasingly few meters or lamps with lines through them and very few cases of the old lamp symbol being used.

One or two showed V_P in the voltmeter symbol and so lost credit.

Most circuits were correctly drawn with the lamps in parallel but there were some in series or with the voltmeter in series with the parallel branch or with one of the lamps. The ammeter was generally in the right place. Some candidates showed the voltmeter across the power supply, which was allowable here.

Some candidates were not content with drawing in one ammeter or voltmeter in their circuits, multiple voltmeters and/or ammeters were seen.

(e) A significant number of candidates did not produce creditworthy answers. Although many deduced correctly that the suggestion was not supported, far fewer gave expressions such as 'too different' or 'outside the limits of experimental accuracy' to justify their answer. Instead, candidates merely stated the obvious such as 'they aren't equal', which was insufficient. It was pleasing to see phrases such as 'outside the 10% limit of experimental accuracy' being occasionally used by some of the more able candidates.

(f) There were many correct answers here. A significant number of candidates stated that 'the lamps are hotter when you touch them' – correct but a practice to be discouraged! Occasionally, the comparative was missing and therefore credit could not be awarded.

There were also many attempts at theoretical explanations involving potential difference and power, ignoring the word 'evidence' in the stem of the question.

A minority of candidates incorrectly stated that 'the lamps would glow equally in parallel but the 'first' one would be brighter than the rest in series'.

Question 4

(a) The majority of candidates calculated T correctly, with very many fewer being consistent with the number of significant figures that they quoted their values to. 2 or 3 significant figures consistently quoted gained full credit. The 1.8 value for *T* was generally left as 2 sig. figs. with the other values of *T* quoted to 3 or 4 sig. figs. There were also rounding errors, particularly with 1.275 and 1.925.

(b) Many candidates did not give adequate answers here, quoting ‘accuracy’ or ‘human error’ or ‘difficult to measure’ without coming up with the required key words or providing sufficient detail.

Probably the single most common correct answer included a reference to ‘mean’ or ‘average’.

(c) Only about half of the candidates adequately explained how parallax could be avoided and a number of them only just adequately enough.

Common statements given by candidates which were not credited included: a reference that parallax should be avoided but not how, that the string should be held taut and that the pendulum should not be moving whilst measurement of length was taken.

(d) Many clear, simple diagrams were seen and given full credit. However, many careless diagrams negated what might have been reasonable ideas and there seemed an unwillingness to erase an initial inadequate stab at an answer in favour of adding extensions or scribbling out the original. Some candidates ignored the suggestion that a diagram may be drawn and came up with an insufficiently clear written description.

The most common cause of lost credit was the omission of the rule or locating it too far from the blocks. Fewer candidates left gaps between bob and blocks but many more produced a totally unworkable arrangement.

Question 5

(a) There were few very good graphs. Many candidates chose a vertical scale which did not permit the points to occupy at least half the grid. Some candidates, possibly in an attempt to make the points fit the grid exactly, chose a scale which increased in very inconvenient increments, such as multiples of 3 and 7 – these are unacceptable. Choosing scales like these makes the points almost impossible to plot with any accuracy, and also impossible for Examiners to check. There were also many graphs where the straight line was biased to one side of the points or even forced through a (false) origin. Thus, the concept of a best-fit or trend line is clearly not well understood. Had candidates read **(b)** immediately below the grid they would have seen that a gradient was required and that therefore a straight line was to be expected. A number of candidates plotted the points with large blobs rather than the accepted small cross or tiny dot surrounded by a circle, and lines were frequently thicker than they ought to be.

(b) When determining a gradient, the triangle needs to be clearly shown on the (straight) line and it must be at least half the length of the line, preferably more, in order to produce an accurate result. Despite the instruction to show clearly on the graph how the information was obtained, many candidates gave no indication at all on the grid, and thus did not gain any credit. There were, however, many excellent attempts at this from the more able candidates, with the graph was clearly marked with the triangle on which they based their calculation.

(c) There were some very unlikely numbers quoted for the focal length of the lens, and of those that were in the correct range, many were given to an unrealistically large number of significant figures given the original data, or had the unit omitted.

(d) Many candidates gained some credit here but far fewer gave two sensible precautions. ‘Darkened room/brighter light’ and ‘make repeated measurements and take an average’ were common acceptable answers. It was encouraging to see some examples of the less popular answers such as ‘fix/clamp a rule in place’ and ‘mark the centre of the lens holder’.

‘Moving the lens back and forth’ was a common mistake and ‘parallax’ was a common unacceptable answer. The screen was often omitted from a list of apparatus to be kept vertical. Multiple additional answers stating incorrect precautions were a regular occurrence and often negated marks previously scored.

PHYSICS

Paper 0625/63
Alternative to Practical

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

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

The practical nature of the examination should be borne in mind when explanations or justifications are asked for. This was seen in some of the excellent, straightforward responses to Question 3(c) which required a reference to results rather than theory and in the clear practical details given by some candidates in Question 5(d). Less good responses indicated that candidates had not read the specific requirements of the questions carefully and this was also apparent in Question 1(d).

Some questions on the paper required responses involving drawing. Many good examples were seen, in Questions 2(a) and 2(d) for instance, where candidates' intended precautions and line judgement were clear. It is important for candidates to recognise that imprecise drawings or thick lines on graphs will not guarantee clarity and may lead to inaccurate measurement.

It is expected that numerical answers will be expressed to a number of significant figures which is appropriate to the data given in the question or a measurement carried out by the candidate. This was demonstrated in many good responses to Questions 2, 3, 4 and 5. Other candidates needed to be mindful of this requirement and use of a 'recurring' symbol, which does not indicate the intended number of significant figures, or expression of a set of numerical answers to an inconsistent number of significant figures must be avoided.

Question 1(e) required two experimental conditions to be suggested and many correct answers were seen. However, there were responses with more than two suggestions, some of which were incorrect, negating previous acceptable conditions.

Comments on specific questions

Question 1

Good responses to this question were seen from a majority of candidates, although the later sections proved challenging for many.

(a) The vast majority of candidates recorded room temperature correctly. When errors occurred they were most commonly to read the thermometer as 20.4^{o}C.

(b) Indication of the appropriate units was largely correct and, where marks were lost, it was generally in omitting the time unit or indicating seconds rather than minutes, showing the importance of reading the question carefully. Units attached to the data values in the columns, rather than at the head of the table, were accepted but candidates should be aware of the increased possibility of contradictory answers in this case.

The values of *t* were usually entered correctly with some candidates, quite acceptably, converting the times stated in the question to seconds and giving the matching unit.

(c) Many candidates correctly identified that the average rate of cooling was greater for the thermometer bulb near the bottom of the beaker, with the greater temperature change for this thermometer used as justification for the choice. Full credit was gained by those who also stated that the changes for each thermometer had taken place over the same time interval, or who calculated a comparative rate of decrease in temperature.

The lower final temperature for the thermometer bulb near the surface gave rise to some opposite, incorrect, responses, which ignored the different starting temperatures.

(d) This was the most challenging part of the question for candidates across the whole achievement range.

It related to general practical precautions which should be taken when measuring the temperature of liquids and which were suggested by the results of the experiment.

The most straightforward answers were often the best, with stirring or keeping the thermometer at the same depth being given as ways of overcoming the differential cooling rates. Both of these precautions come from direct experience of measuring temperatures, supported by the findings of the experiment described in the question.

A number of candidates gave examples of safe working, such as the wearing of gloves or goggles, ignoring the requirement that the precaution should be suggested by the results rather than general practice.

(e) It was expected that conditions should be those that could affect the comparison of cooling rates. Many good responses were seen, regarding the position of the thermometers, the volume and initial temperature of the water and relevant environmental conditions such as room temperature.

The question required two suggestions but some candidates, having responded correctly, went on to give extra incorrect answers. This invariably negated at least one of the acceptable answers.

Question 2

Although some excellent responses were seen, this graph question was found to be the most challenging on the paper for the whole range of candidates.

(a) It was expected that the precautions suggested would relate to, for example, practical explanations of how parallax errors could be avoided, with the line of sight perpendicular to the reading on the rule, or how it could be ensured that the rule was vertical, for instance by the use of a set square. There were some good, clear, responses given both in diagrammatic and/or written form and workable alternative solutions were accepted.

A number of candidates needed to have read the question carefully to avoid giving precautions for ensuring that oscillations were uniform or indicating measurement to the centre of the bob without recognising that h was shown in the accompanying diagram.

(b) Values of h were often recorded correctly, with corresponding accurate calculations of H. Candidates needed to take care with rounding and consistent significant figures, especially when whole numbers were included.

(c) Values of T and T^2 were often correct. Some candidates could improve on the use of appropriate numbers of decimal places, an excess or insufficiency sometimes leading to later difficulties with plotting.

(d) Some good skills were seen in graph work, with clearly labelled axes and accurate plots shown with fine crosses or points in circles. 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, making it more difficult to award the mark for correctly plotted values. A sharp pencil should be used for the plots and for the line so that accurate drawing may be achieved and errors easily corrected.

Scales involving intervals of 0.05 and 0.04 were seen in the better responses, with the former being handled more confidently. Candidates should be aware of the difficulties introduced with unusual intervals or axis markings.

Plotting was generally good with the particular difficulties of the 1.18 T^2 value being plotted as 1.08 or T being plotted instead of T^2.

A fine, best fit straight line was attempted by many. Marks were lost by the few who showed lines which joined plots together or drew thick lines. Well-judged curves were acceptable if the plots indicated this.

(e) Many showed a clear triangle method on the graph for determining the gradient, with fewer utilising at least half of the line drawn. Candidates should recognise that triangles covering as much of the line as possible will produce the most accurate determination of gradient.

(f) Repeating readings to obtain an average value for t was the most common suggestion for making results more reliable and timing over a greater number of oscillations was also seen in the better papers.

Question 3

This question was answered well by many candidates.

(a) Most were able to draw the correct symbol for a voltmeter connected in parallel with the lamps. Candidates should note that a line shown through the circle is not acceptable.

(b) Many gave the correct values for R, with an appropriate consistent number of significant figures. Where this was not the case, it was generally in the omission of the decimal place of 8.0 Ω or inaccurate rounding.

Correct units were usually given, although it was clear that some candidates were unused to the conventions employed in tables, responding with the quantity rather than the unit, e.g. 'voltage' rather than 'V' or 'volts'.

A few candidates gave W rather than V for the unit of potential difference.

(c) While many candidates recognised that the appropriate resistance values did not support the suggestion, fewer gave examples of the calculated values as evidence for this opinion. A full response also required the candidate to indicate that the comparative figures were outside the limits of experimental accuracy rather than stating merely that they were 'different'.

There were a number of answers which gave a theoretical justification showing calculations for resistors in parallel circuits and ignoring the results which had been obtained. Candidates should be aware that explanations on this paper should refer primarily to the practical situations which have been described, or their implications, rather than to theoretical considerations.

(d) A good many candidates were able to show a voltmeter in parallel with lamp **L**.

Question 4

This was often the question for which the whole range of candidates gained the majority of the marks available.

(a) Most read the measuring cylinders correctly, recognising that each graduation represented 2 cm^3.

(b) The calculation of density was carried out accurately by many candidates and the appropriate unit of g / cm^3 was given. If a candidate had given incorrect responses to part **(a)**, a matching correct calculation was accepted.

(c) Possible causes of inaccuracy in the procedure described were looked for here.

Good responses included reference to the measurement of the object's mass after immersion rather than before it and the possibility of the water adding to the mass, or of the measuring cylinder not being read from the bottom of the meniscus. Although it was not specifically clear from the description on the paper, the possibility of the balance not having been set to zero correctly was acceptable as it showed an understanding of the care with which such measurements must be carried out.

Question 5

This was a straightforward question with measurements taken directly from the paper and was tackled well by many candidates.

(a) The lengths were generally read correctly and the calculation of the magnification was usually accurate. Some candidates needed to take care with units as they were sometimes omitted from the lengths and attributed, incorrectly, to the magnification which, as a ratio, has no unit.

(b) This part of the question was also done well, with many achieving the more difficult measurements to the apexes of the triangles with accuracy. Candidates generally found the more straightforward calculation easier than that in part **(a)**.

(c) Many suggested that the findings supported the statement, which was the expected response as the values of m and M were within 10% of each other. This was then followed up by some with the preferred justification that they were within the range of experimental accuracy. More gave the acceptable justification that they were almost the same. It should be noted that the latter was not acceptable as the initial statement, which needed to indicate positively that the candidate's idea was supported.

Candidates should recognise that results from practical work lie within a permissible range of accuracy and that two results do not need to be identical for them to be considered as representing the same value.

(d) A number of candidates had clearly experienced the difficulties of taking measurements in an optics experiment such as this. However, the degree of exposure to practical work seemed to be shown in the real differences between their answers and those of others.

Among the better responses were references to the hand and rule obstructing the light, the image having blurred edges and the difficulty of avoiding movement of the screen when measuring.

Straightforward practical solutions such as fixing a scale to the screen, ensuring that the image was as well focused as possible and clamping the screen to the bench were suggested.

(e) Correct responses included the precautions of ensuring the experiment was carried out in a dark room, checking that the object and lens were the same height above the bench and moving the screen back and forth to obtain the sharpest image.

Although only one precaution was asked for, this was another question in which some candidates gave additional answers. In this case, most extra answers were correct or neutral and did not have a detrimental effect. However, candidates should be aware that this is not good practice.