PHYSICS

Paper 0625/11
Multiple Choice

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

General comments

Questions 13 and **36** were the best-answered on this paper, with **questions 9** and **21** being found the most difficult.

Comments on Specific Questions

Question 3

Although more than half the candidates chose correctly in this question, there was a fair amount of confusion between speed and acceleration for a falling object.

Question 4

Many candidates believed that the unit for weight is the kilogram.

Question 9

Very few candidates' responses were correct in this question about the availability of energy from sources. A sizeable proportion thought that the energy produced by nuclear fission is *not* always ava and even more that solar energy *is* always available. Reliability of energy sources is an impor consideration when studying this topic.

Question 11

A significant proportion of candidates responded that the drawing pin would produce greater force at its point compared with that at the flat end where the force was applied.

Question 17

Most candidates correctly identified that heat would reach the man very quickly by radiation only, although a significant number opted for distractor C (convection only). The question twice referred to the man being heated *rapidly*, and there was no option for 'convection and radiation only'. It is worth stressing in teaching that only radiation can cause virtually immediate heating.

Question 20

The most common mistake in this question about the frequency of waves was to divide the time by the number of waves produced, rather than the other way round; this is a common error.

Question 21

Distractor D was chosen by a large proportion of the candidates in this question about the uses of electromagnetic waves; careful reference to the syllabus is recommended.

Question 22

Refraction and critical angle was the topic here, and a substantial number of candidates appeared to be unable to deduce the answer and resorted to guessing.

Question 25

Most of the errors here involved failing to double the distance from the boat to the sea bed when considering how far the sound had travelled in the 3.0s. This is often a problem in any question on echoes.

Question 29

Many candidates thought that an ammeter and a voltmeter would be needed to measure e.m.f. and p.d.

Question 35

There appeared to be a considerable amount of guessing in this question on electromagnetic induction.

PHYSICS

Paper 0625/12
Multiple Choice

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

General comments

On this paper, **Questions 2**, **4**, **14** and **37** were particularly well-answered; **Questions 9** and **22** were found the most difficult.

Comments on Specific Questions

Question 3

Although generally well-answered, a significant number of candidates indicated that the ball would fall with increasing acceleration, perhaps confusing this with speed.

Question 5

Many candidates thought that weight is measured in kilograms, a common mistake.

Question 9

Very few candidates' responses were correct in this question about the availability of energy from sources. A sizeable proportion thought that the energy produced by nuclear fission is *not* always ava and even more that solar energy *is* always available. Reliability of energy sources is an impor consideration when studying this topic.

Question 11

A significant proportion of candidates responded that the drawing pin would produce greater force at its point compared with that at the flat end where the force was applied.

Question 18

Most correctly identified that heat would reach the man very quickly by radiation only, although a significant number opted for distractor C (convection only). The question twice referred to the man being heated *rapidly*, and there was no option for 'convection and radiation only'. It is worth stressing in teaching that only radiation can cause virtually immediate heating.

Question 22

Distractor D was chosen by a large proportion of the candidates in this question about the uses of electromagnetic waves; careful reference to the syllabus is recommended.

Question 25

Most of the errors here involved failing to double the distance from the boat to the sea bed when considering how far the sound had travelled in the 3.0s. This is often a problem in any question on echoes.

Question 29

Many candidates thought that an ammeter and a voltmeter would be needed to measure e.m.f. and p.d.

Question 35

A significant number of candidates did not realise that fuse 2 was wrongly (and dangerously) placed.

Question 40

The most common error here was a belief that increasing the filament current would increase the beam deflection.

PHYSICS

Paper 0625/13
Multiple Choice

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

General comments

A large number of questions were very well answered in this paper, particularly **Questions 5**, **6**, **8, 11**, **12**, **13**, **15**, **16**, **18**, **28**, **31** and **40**. No questions were found particularly difficult.

Comments on Specific Questions

Question 3

Some candidates showed confusion between the speed and acceleration for a falling object.

Question 4

Many candidates believed that the unit for weight is the kilogram.

Question 7

This question concerned stretching a spring, and a significant number of candidates forgot to sub original length when calculating the extension; this is a commonly seen error in questions about springs.

Question 9

Although this was well answered by most candidates, several opted for B, indicating that a descending aircraft gains gravitational energy.

Question 14

The relatively small number of candidates who failed to answer this question on evaporation correctly, generally believed that the remaining water's molecules would gain energy in the process.

Question 23

Dispersion of light by a prism was the topic here, and the question was not particularly well answered. By far the most commonly-chosen distractor was D; these candidates knew that dispersion started at the first face of the prism, but did not notice that the direction of refraction was shown incorrectly.

Question 29

Many candidates thought that an ammeter and a voltmeter would be needed to measure e.m.f. and p.d.

Question 39

The popularity of option D suggests that there is a misconception that lead repels ionising radiation rather than absorbing it.

PHYSICS

Paper 0625/21
Core Theory

Key Messages

Apart from being well prepared to answer questions from across the Core syllabus there are further aspects of examination preparation that could have helped some candidates improve their performance.

Candidates should note the number of marks available and the space allocated for responses as these factors provide a clear indication of the type of answer that the Examiner is expecting. For example, on a two mark question the Examiner is expecting two distinct points, not two versions of the same point. Candidates are advised to read carefully through their responses to make sure that what they have written has the intended sense. Concise explanations are often the best.

In calculations, candidates must set out and explain their working correctly. The Examiner may be able to give credit for working if the final answer is correct, due to the merit of the work. However, when a candidate makes an error and no working is shown, it is often impossible for the Examiner to give any reward for the question.

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. Some areas of the syllabus were better known than others; in particular moments and the production and transmission of sound were not well understood.

Equations were generally well known by all but the weakest candidates. Many candidates understood well how to apply equations to fairly standard situations. On occasions however, 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 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 they may have benefited from being prepared and entered for the Extended Theory paper.

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

This is a paper where all of the questions are compulsory. Candidates did not seem to find any difficulty in completing it in the allocated time and relatively few left answers to questions blank.

Comments on specific questions

Question 1

(a) (i) Only a very small minority of candidates were unable to give the correct reading from the stopclock.

(ii) Many candidates gained full credit, but a significant number went astray in converting their reading into seconds.

(b) Most candidates received full credit here. The most common error was in using an … of the average speed equation.

Question 2

(a) Most candidates had been well prepared for this type of question and correctly applied the equation linking density, mass and volume. Weaker candidates once again used an incorrect form of the equation or substituted the values incorrectly.

(b) Many candidates gained full credit, but a surprising number thought that the mass of water was greater than the mass of an equal volume of mercury.

(c) A significant number of candidates thought that the mass of mercury increases when it expands or that its density stays the same or increases.

Question 3

(a) Only the better candidates recalled that the turning effect of a force is called a moment.

(b) (i) Many candidates failed to state anything about the moments but rather talked vaguely about the forces or the distances.

(b) (ii) Only the better candidates produced correct answers for the position and direction of the reaction force at the pivot.

Question 4

(a) Few candidates could be awarded full credit. Many mentioned the number of vibrations but omitted to include any reference to time such as ‘per second’.

(b) (i) Very few candidates scored full credit. Many tried to answer in terms of the prongs clashing together.

(b) (ii) Correct responses relating to the decrease in amplitude were very rarely seen.

(b) (iii) Very few correct responses were seen. A significant number of candidates thought the pitch of the lower frequency would be higher.

Question 5

(a) The correct answer was usually stated.

(b) The majority of candidates gave the correct answer for this question.

(c) Most candidates scored well in this question. The most common error was lack of precision in responses and a surprising number failed to refer to a balance of any description. Candidates would benefit from practising writing methods for such simple experimental procedures.

(d) Candidates usually quoted two correct observations. One common error was to state that the temperature would be rising.

Question 6

(a) (i) Most candidates correctly identified refraction at B.

(ii) Many candidates were unable to state the correct value for the angle. The most common erroneous value was 55 degrees. This may have been down to candidates ignoring the information in the question and measuring the angle.

(b) Most candidates scored well with this question. Weaker candidates only showed refraction at one of the boundaries. The order of the spectrum was well known, as very few candidates indicated that the red light was below the blue light.

Question 7

(a) Very few candidates correctly indicated the focal length of the lens. Only slightly more wer identify a principal focus of the lens.

(b) Most candidates scored well on this question, with a large number identifying all three correc descriptions.

(c) Many candidates gained credit. The most common error was poor precision in showing the refraction in the lens. A significant number of candidates thought that merely drawing over one the existing rays was sufficient for the mark.

Question 8

(a) Only the most able candidates scored well on this relatively straightforward question. Most candidates thought that the magnetic field near the centre of the bar magnet was vertical rather than horizontal or that the direction was towards the N pole.

(b) Many candidates displayed a poor understanding of the magnetic properties of these common metals. Many would benefit from carrying out similar straightforward practical experiments involving magnets and magnetic/non-magnetic materials.

Question 9

(a) The correct answer was usually indicated.

(b) Many candidates scored full credit, although some did not give the correct unit and a significant number tried some convoluted calculation to find the current in the circuit.

(c) The majority of candidates were able to calculate the resistance of the resistor. The most common errors were in rearranging the equation $V = IR$ and failing to correctly convert mA to A.

(d) The effect of adding another resistor in parallel was not well understood. Only the more able candidates scored full credit.

Question 10

(a) A good number of the candidates understood how to draw components in parallel across the output of a transformer.

(b) Many candidates gained the full credit for this calculation. However, a significant number scored zero through simply giving a bald incorrect answer. Candidates should be encouraged to show their working in all calculations in order that credit can be given for partially correct responses.

(c) Only more able candidates realised that the motors would slow down.

Question 11

(a) (i) Many candidates were able to give the correct missing values.

(a) (ii) Many candidates did not realise that the count rate from the source had halved somewhere between 40 s and 60 s.

(b) The correct answer was rarely seen. Only the most able candidates linked the information to background radiation.

Question 12

In general candidates were well prepared for this type of question, with few blank responses being se

(a) Many candidates gained credit, although weaker candidates confused the proton number with nucleon number or the number of neutrons.

(b) Many candidates gained credit, although weaker candidates confused the number of neutrons with the mass number or the proton number.

(c) (i) Many candidates gained credit, although weaker candidates confused the number of electrons with the mass number or the number of neutrons.

(c) (ii) Many candidates stated that the electrons could be found orbiting the nucleus. The most common error was to state that electrons were found in the nucleus

(d) Many candidates correctly deduced the values of X and Y. The most common incorrect values were 216 for X and 86 for Y.

PHYSICS

Paper 0625/22

Core Theory

Key Messages

Apart from being well prepared to answer questions from across the Core syllabus there are further aspects of examination preparation that could have helped some candidates improve their performance.

Candidates should note the number of marks available and the space allocated for responses as these factors provide a clear indication of the type of answer that the Examiner is expecting. For example, on a two mark question the Examiner is expecting two distinct points, not two versions of the same point. Candidates are advised to read carefully through their responses to make sure that what they have written has the intended sense. Concise explanations are often the best.

In calculations, candidates must set out and explain their working correctly. The Examiner may be able to give credit for working if the final answer is correct, due to the merit of the work. However, when a candidate makes an error and no working is shown, it is often impossible for the Examiner to give any reward for the question.

General comments

Many candidates were able to demonstrate their sound knowledge and understanding of physics by answering the questions from the various sections of the Core syllabus. There was no indication of candidates having insufficient time to complete the paper. In some cases there were gaps in candidates' knowledge as evidenced by candidates leaving parts of questions incomplete, for example, **2(d)(ii)**, **9(a)(ii)**, **11(a)(i)** and **11(a)(ii)**.

Examiners look to give credit for correct responses even if spelling, punctuation and grammar are not good. There is no penalty for weaknesses in English language skills. However, candidates would be well advised to check their written responses so as to ensure the meaning is as they intended. All candidates need to be encouraged to present their responses neatly. In particular, candidates should note that poorly presented circuit diagrams with gaps or unclear symbols, or ray diagrams that are not drawn using a rule to produce thin, single lines, may limit the credit available to them. The poor presentation of answers by a very small number of candidates prevented any credit being awarded for the responses submitted to some questions.

The questions on the mechanics, energy, electrical circuits and light sections of the syllabus produced the best responses from candidates. Many candidates were able to score high marks in numerical questions that required the use of a standard equation. A small number of candidates missed out on obtaining maximum credit on numerical questions through not including an appropriate unit alongside their correct responses when this was not given.

The questions on the transfer of heat, magnetism, waves and radioactivity topics were generally not well answered by candidates, who might have benefited from further revision of these areas. In some instances candidates tried to offer the Examiner a choice of possible answers to a question including some contradictory responses; in such cases, an incorrect response alongside a correct response does not gain any credit. Some candidates could benefit from further advice on examination technique.

Comments on specific questions

Question 1

(a) This question caused problems for candidates who had limited experience of using a stopwatch, a common incorrect response being 7.2 s for the first recorded time that was 7.02 s. A small proportion of less well-prepared candidates copied the figures from the stopwa responses as, for example, "00.07.02". Further incorrect responses included a small candidates who gave answers to one significant figure, for example 7 s stated three times. very small minority of candidates were unable to give the correct reading from the stopclock.

(b) This was generally well answered.

(c) The vast majority of candidates were able to state that distance needed to be measured in order to calculate average speed.

(d) The last part of this question was generally well answered, however there were some vague answers such as "change block" or "change gradient" that were not given credit.

Question 2

(a) This question resulted in high marks for the better prepared candidates. Less well-prepared candidates incorrectly stated the equation for distance and obtained an answer that should have been checked.

(b) A significant number of candidates were unable to determine the distance travelled by the lorry as it slowed down, the most common misconception being a repeat of the answer given in part **(a)**.

(c) Very few candidates failed to gain credit for the total distance covered.

(d) (i) There were many correct responses for part **(d)** as a result of allowing errors to be carried forward. A small number of candidates forgot to include the unit with their correct response.

(d) (ii) A significant number of candidates failed to make a response to the final part of this question.

Question 3

This question was well answered by candidates of all abilities.

(a) Many high and middle ability candidates gained full credit for part **(a)**.

(b) Responses for part **(b)** generally resulted in most candidates being given some credit. A common response was to give two versions of the same marking point, for example "fossil fuels are being used up" and "fossil fuels are non-renewable"; in such cases only one of the responses gained credit.

Question 4

(a) This question resulted in many high scoring responses. Many candidates correctly identified the candidate lying on the floor as producing less pressure. Better prepared candidates were also able to give a correct explanation in terms of the greater area, however there were some who believed that the lower pressure was as a result of the body being at rest or relaxing.

(b) Part **(b)** also produced many correct responses from candidates of all abilities.

Question 5

High scoring responses were obtained from those candidates who had revised this section of the syllabus well.

(a) There were many correct responses for the measurement of the wavelength. A small number of candidates failed to give the answer in mm and others measured more than one wavelength.

(b) Many candidates gained only partial credit for part **(b)**; invariably this was scored for a reference to amplitude having height. Very few candidates were able to explain frequency, giving responses in terms of the "number of waves" or the "the speed a wave travels".

(c) The better prepared candidates generally ticked the correct response.

Question 6

(a) This question was not well answered. Many candidates were unable to use the informati in the question to provide high scoring responses. A significant number of candidates scor first marking point for identifying glycerol having the highest boiling point and water having highest thermal capacity. The second and third points were given by the highest scoring candidates only.

(b) Candidates did not score well on part **(b)**. In part **(ii)** responses commonly included a range of terms such as "condensation", "diffusion" and "evaporation" indicating some confusion amongst candidates. In part **(iii)** relatively few candidates were able to represent a convection current correctly. Many responses included arrows pointing in contradictory directions. A significant number produced a convection current in the reverse direction.

Question 7

(a) This question was well answered by the very best candidates. Many candidates were able to identify three of the four electrical components, with the variable resistor often being identified as simply a resistor.

(b) Candidates of all abilities were able to draw a series circuit with a correct ammeter symbol. There were many very poorly presented circuit diagrams; the ability to draw clear, unambiguous circuit diagrams is an important scientific skill and candidates should be warned that they might lose credit for poor presentation. A small number of candidates drew a parallel circuit and a significant number of the less able candidates drew a circuit that did not contain an ammeter. The last mark was scored by better prepared candidates.

Question 8

It was clear that many candidates did not have a secure knowledge and understanding about magnetic properties and consequently fewer than anticipated gained full credit for this question.

Question 9

(a) This question was not well answered. Those candidates that had been given opportunities to map the field around a current carrying conductor or a magnet were able to draw a field line pattern and a small number were able to score full credit. A significant number of candidates, however, did not attempt this part of the question.

(b) (i) There was some confusion in the responses given, with some candidates believing that the circuit breaker acted in the same way as a fuse in having a melting wire. There were also many vague responses suggesting that the circuit breaker "controlled" the current or power.

(b) (ii) Candidates have obviously learnt the equation linking current, resistance and voltage well and consequently there were many correct responses to the calculation. However, very few were able to use their answer to indicate that the current would have no effect on the circuit breaker.

Question 10

This was well answered by many candidates. However, there were examples of some very poorly presented ray diagrams in which candidates had not used a rule to draw single thin straight lines. Future candidates should be warned that such diagrams may not receive full credit.

Question 11

(a) This question was not well answered by candidates. There were very few correct responses, many candidates giving a list of the particles making up an atom or making no response to the question.

(b) Only the best prepared candidates scored highly on this question.

Question 12

This question resulted in the majority of candidates gaining credit for two of the four available marking These were for identifying that the box was a container for radioactive material and for the lead absorbing radiation.

PHYSICS

Paper 0625/23

Core Theory

Key messages

Apart from being well prepared to answer questions from across the Core syllabus there are further aspects of examination preparation that could have helped some candidates improve their performance.

Candidates should note the number of marks available and the space allocated for responses as these factors provide a clear indication of the type of answer that the Examiner is expecting. For example, on a two mark question the Examiner is expecting two distinct points, not two versions of the same point. Candidates are advised to read carefully through their responses to make sure that what they have written has the intended sense. Concise explanations are often the best.

In calculations, candidates must set out and explain their working correctly. The Examiner may be able to give credit for working if the final answer is correct, due to the merit of the work. However, when a candidate makes an error and no working is shown, it is often impossible for the Examiner to give any reward for the question.

General comments

It was pleasing to note that well-prepared candidates were able to demonstrate their sound knowledge and understanding of various sections of the Core syllabus. It would appear that candidates of all abilities had sufficient time to complete the paper. However, in some sections of the paper questions were not attempted by significant numbers of candidates indicating gaps in their knowledge and understanding that need to be addressed in the future.

Examiners look to give credit for correct responses even if spelling, punctuation and grammar are not good. There is no penalty for weaknesses in English language skills. However, candidates would be well advised to check their written responses so as to ensure the meaning is as they intended. All candidates need to be encouraged to present their responses neatly. In particular, candidates should note that poorly presented circuit diagrams with gaps or unclear symbols, or ray diagrams that are not drawn using a rule to produce thin, single lines, may limit the credit available to them. The poor presentation of answers by a very small number of candidates prevented any credit being awarded for the responses submitted to some questions.

The questions on the electrostatics, heat transfer and sound sections of the syllabus produced the best responses from candidates. Many candidates were able to score very well in numerical questions that required the use of a standard equation. A small number of candidates missed out on obtaining maximum credit on numerical questions through not including an appropriate unit alongside their correct responses when this was not given.

The questions on the electromagnetic spectrum, electrical circuits and uses of radioactivity were not well answered by candidates. These sections of the syllabus would benefit from further attention.

A significant number of candidates did not make any response to some parts of questions. Candidates need to be encouraged to read through questions carefully and to use key words to apply their knowledge and understanding to the different contexts in which questions are asked.

Comments on specific questions

Question 1

This question was answered well by most candidates. Candidates of lower ability generally obtained cr for only four of the six available marking points, giving a partially complete answer for the thickness of the block as 4.4 cm.

Question 2

(a) This question proved challenging for candidates of all abilities. Kinetic energy was a common incorrect response, with candidates not taking note of the statement: "They run up the hill at a steady speed".

(b) This was correctly answered by only the best prepared candidates.

(c) A common misconception was to give an answer related to the athletes' preparation and fitness.

Question 3

This question was well answered by most candidates.

Question 4

The first three parts of this question were answered well by candidates of all abilities. All except the least well-prepared candidates were able to explain the actions needed to make the thermometer give a zero reading.

Question 5

This question was answered well by better prepared candidates. A small but significant number of candidates, however, did not make responses to various parts of this question indicating gaps in their knowledge and understanding. Unfortunately there were some very poorly presented ray diagrams. Candidates need to be encouraged to draw neat diagrams using thin, single lines that have been drawn with the aid of a ruler. Candidates should not expect to be given credit for inaccurate or poorly presented ray diagrams. Part **(c)** was answered correctly by only a small number of candidates.

Question 6

This question was answered well by the large majority of candidates.

Question 7

This question was answered well by candidates of all abilities.

Question 8

This question was answered well by those candidates that had revised this section of the syllabus carefully. A number of candidates did not make responses to parts **(c)** and **(d)**.

Question 9

This question proved to be challenging for candidates of all abilities. A significant number of candidates failed to make responses to various parts of this question indicating that their knowledge and understanding was not secure. Very few correct responses were seen to part **(c) (ii)**.

Question 10

This question was not answered well by candidates. Again a significant number of candidates did not make responses to some parts of this question, for example parts **(b)(i)** and **(c)(i)**.

Question 11

This question was answered well by only the best prepared candidates. Again a significant nu candidates did not make responses to some parts of this question including parts **(a)(i)**, **(a)(ii)** and (also part **(b)(iii)**.

Question 12

Those candidates who had not revised the transformer equation were unable to calculate the output voltage from the transformer. A number of candidates did not attempt the calculation or the last part of this question.

PHYSICS

Paper 0625/31
Extended Theory

Key messages

Candidates should take note of the credit available for each question and the space allocated for the response, as these provide an indication of the type of answer that is expected.

In high scoring questions requiring descriptions or explanations, the Examiner is looking for a number of distinct points, rather than seeing the same point repeated in a number of different ways. For the longer numerical questions, candidates often make the mistake of trying to reach a solution by the use of a single formula. They are reminded that the solution is often to be reached in two stages, each requiring the use of a different formula. The answer arrived at by the first stage is then used for substitution into the formula needed for the second stage. It is particularly important for these extended calculations that candidates set out and explain their working clearly. Without this, the Examiner is unable to give any credit for partial answers or where an arithmetic slip has been made.

General comments

The highest achieving candidates showed great consistency over all aspects of the paper, and are to be congratulated on their performance. However, it is good to report that a large proportion of the candidates showed strength in some questions on the paper, and their failing was in lack of consistency. Only a small proportion of candidates were weak in all questions on the paper.

It was very evident in this paper that a majority of candidates achieve much more success with numerical questions than with other types of question. Most have clearly been well-drilled in the learning of formulae and how to manipulate them. Often the only failing in this type of question is the omission of or a mistake in the unit. The impression gained from seeing many partially or totally unsuccessful verbal answers is that candidates begin to write without sufficient initial planning or forethought as to what they are going to write. Much benefit would be gained by candidates if rather more time were spent in gathering their thoughts as a preliminary to writing.

Comments on specific questions

Question 1

(a) Most candidates could state an acceptable version of Hooke's law. Those who expressed the law as a formula needed to explain the symbols used.

(b) (i) A graph representing a direct proportion is a straight line, or a line with a constant gradient, and it passes through the origin. In many answers one or other of these requirements was omitted.

(ii) It was unusual for candidates not to be able to calculate the correct numerical value of *k*. However, a large proportion lost some credit by omitting the unit.

(iii) The continuation of the graph needed to be a curve with a positive gradient. Most candidates made a good attempt.

(iv) Most answers correctly showed a straight line through the origin. A good proportion of the candidates also correctly drew the line with a smaller gradient than the original one.

Question 2

(a) The majority of candidates used the appropriate formulae and calculated the correct valu acceleration and the force. Most candidates also wrote down the correct units.

(b) (i) Less success was achieved with this calculation. Many candidates could quote the formula relatin power and work, so gaining partial credit, but subsequently failed to use the data correctly.

(ii) Most candidates recognised that the gravitational potential energy of the train had to be increased or that there was an opposing force down the slope. Fewer went on to say that this required more work to be done or more energy had to be provided by the engine. The final marking point, very infrequently awarded, had to make the link between the need for additional energy and the idea of power, for example by stating that, to maintain the constant speed, more energy needed to be supplied in the same time. Candidates are generally very good at recalling equations when making numerical calculations; they should be encouraged to also refer to them when writing explanations.

Question 3

(a) (i) Many examples of devices depending on the moments of forces for their action were quoted. However, some candidates suggested, for example, a type of vehicle, without pinpointing the device within the vehicle where the moment of a force was applicable; such examples were not rewarded.

(ii) Those who wrote ‘there is a resultant force’ and ‘there is a resultant moment’, gained the full credit in the most straightforward way. Many made equivalent statements conveying the same ideas and were also rewarded. Some addressed the force aspect correctly, but could not then find the correct wording to deal with the moments aspect, using terms such as ‘clockwise force’ and ‘anticlockwise force’. A significant minority of the candidates clearly had little idea of the meaning of equilibrium.

(b) (i) The force in the spring was not represented by an arrow on the figure, and the distance of the point of attachment of the spring to the pivot was not labelled; these two factors may have contributed to the difficulty experienced by candidates in reaching the correct answer. Very few correct values of the force in the spring were seen.

(ii) The basic point that the weight of the rod had no moment about the pivot was seldom seen in the answers given. However, a mark was awarded for recognition of the idea that the centre of mass of the rod acted at the pivot.

Question 4

(a) Greater success was achieved in **(i)** than in **(ii)**. The energy change in **(i)** was in general stated to be gravitational potential energy to kinetic energy, and gained credit. However, many simply reversed this energy change for their answer to **(ii)**, thus missing the point that the cyclist was moving at constant speed. Comparatively few candidates identified the overall change as chemical to gravitational potential energy. Some credit was allowed however for a reference anywhere to thermal or heat energy being generated.

(b) A good majority of candidates gained full credit for both **(i)** and **(ii)**. Many who failed to calculate the kinetic energy correctly in **(i)** by failing to square the speed in their calculation, could nevertheless be awarded full credit in **(ii)** with their wrong value carried forward.

Question 5

(a) This question was not well answered by most candidates, even by those who gained high marks overall. In **(i)**, many stated that convection only takes place in a liquid or in a fluid, or simply that convection does not take place in air. The idea that convection would mean warm air rising and not moving sideways was seldom addressed. In **(ii)**, the required answer that air is a bad thermal conductor, or even does not conduct, was again rarely seen.

(b) Rather more success was achieved with this answer, although there seems to be some confusion on the part of some candidates between the meanings of emission and absorption.

(c) Few candidates suggested that the good conducting properties of copper ensures tha[...] of the copper sheet does not become cooler than the other. Many answers instead ref[...] radiating properties of the surfaces.

Question 6

(a) Almost all the candidates gained at least partial credit for their answers to this question. The word in the final blank space required recall of the definition of pressure, and choices other than the word 'area' was the most common reason for the loss of credit.

(b) (i) It is possible that some candidates did not read the introduction to the question carefully enough, with many answers seeming to suggest that the bottle collapsed at the moment that the cap was replaced. Others conveyed the idea that the removal of the water from the bottle had a bearing on why the bottle collapsed. Only the most able candidates gave coherent full explanations.

(ii) In spite of the difficulties in providing correct responses in **(i)**, candidates were on more familiar ground in this numerical question. Many fully correct calculations were seen.

Question 7

(a) (i) Most candidates could correctly name the process as 'diffraction'.

(ii) A good proportion of the answers suggested a reduction in the speed of the waves or that the water to the right of the barrier is shallower, and gained the credit.

(iii) Though not often well expressed, many of the answers satisfactorily conveyed the idea of a greater angular spread of the wavefronts.

(b) (i) Badly worded explanations were frequent. The words 'oscillation' or 'vibration' were rarely used, and it was often difficult to decipher which factors were being described as being at right angles to each other.

(iii) A large number of candidates did not realise that the 2.4 m dimension on the figure was the length of two waves, and used 2.4 m as the wavelength. Most of these, however, subsequently used the correct relationship and so gained most of the available credit.

Question 8

(a) Acceptable labelled sketches and descriptions enabled most candidates to be awarded full credit.

(b) (i) Partial credit was given for any reference to a magnetic field in the core. For full credit, much less frequently awarded, the field had to be described with appropriate wording, such as alternating or simply changing.

(ii) Only a very small number of candidates understood that the currents in the primary and secondary coils have the same frequency.

(iii) The best route to a correct answer involved the use of two syllabus formulae, one from the Core equating the voltage ratio to the turns ratio, and the other from the Extended syllabus equating the powers in the two coils. Many candidates wrote down the first of these, but some failed with the algebra. Only a small proportion knew and correctly used the second.

Question 9

(a) A good proportion of the candidates could recall the relationships between resistance and length and between resistance and area of cross-section.

(b) Many candidates failed to recall the correct formula, Some of those who could recall $P = IV$ transposed it wrongly.

(c) Few candidates achieved the final correct answer, but many gained compensation marks for correct steps towards that answer. Correct fractional changes to the resistance or the current were rewarded, taking into account use of the wrong current carried forward from **(b)**.

Question 10

(a) It is possible that it was a lack of care, rather than lack of knowledge, which meant tha candidates could be awarded full credit for their sketches of the path of the beam.

(b) In both **(i)** and **(ii)** there were many wrong answers, suggesting a general lack of ability to interpret traces on an oscilloscope screen.

Question 11

(a) (i) Many candidates were content to describe only one of the changes, 1 to zero or zero to 1. References to both changes needed to be made. A small minority of answers suggested that a NOT gate has two inputs.

(ii) The only requirement here was to suggest that the thermistor's resistance changes with temperature. Some candidates were under the impression that a thermistor controls temperature.

(b) (i) A complete answer required reference to the increase in the resistance of the thermistor when its temperature falls, the consequent increase in the p.d. across it, how this provides a zero input to the NOT gate, and an output of 1 from the NOT gate to switch on the warning light. Candidates are often found to be weak at explaining logical sequences such as this, and might benefit from practice.

Only the ablest candidates could be awarded full credit. The weakest tended to write in general terms describing the overall behaviour of the circuit, and gained no credit. The second point from those listed above was the least likely to be awarded to other candidates. References to current through the NOT gate were ignored.

(ii) Very few candidates could suggest that a change in the value of the resistance of R would change the temperature at which the lamp switches on.

PHYSICS

Paper 0625/32
Extended Theory

Key Messages

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

Candidates must read the question carefully and make sure they follow the rubric of the question. In particular, candidates must not try to maximise their chances by giving more than the required number of answers to a question. If two alternative answers are given, one correct and the other incorrect, the candidate will almost always score no credit. There were examples in questions involving tick boxes where candidates gave more answers that instructed, some of which were obviously mutually contradictory.

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

Particularly in questions requiring extended calculation, candidates must set out and explain their working correctly. Often a candidate uses an unusual method with an unclear explanation or gives no working or poor working. If this leads to the correct answer, the Examiner may be able to give credit due to the merit of the work. When an error is made in the middle of such work, it is usually impossible for the Examiner to see anything of merit so no credit can be awarded.

General Comments

A high proportion of candidates had clearly been well taught and prepared for this paper. Equations were generally well known by most of the candidates. Sometimes candidates had learnt the equations but not where their use was appropriate, quoting invalid equations which did not apply to the question asked.

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

All but the very strongest candidates would benefit from more practice in applying their knowledge in unfamiliar situations. This would deepen candidates' understanding and improve their results for the examination. Many candidates, when asked to apply their knowledge to a new situation, become confused and unable to use what knowledge they do have. Often candidates have been well taught how to apply equations to fairly standard situations but display a lack of breadth of understanding of their use in contexts outside of a Physics laboratory.

Only a very small minority of candidates found the subject matter and level of some questions so difficult that these questions were inaccessible to them and would have been better entered for the Core paper. The vast majority of candidates indicated by their knowledge and skills that they were correctly entered for this Extended Theory paper.

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

Normally answers are required to 2 significant figures; candidates should be guided by the data in the question. Fractions should not be used in final answers. With the exception of **Question 2(b)**, the use of units by candidates was overall very good and instances of forgotten or wrong units were rare.

Comments on specific questions

Question 1

(a) The majority of candidates gave correct answers.

(b) It was expected that a tangent would be drawn at the steepest part of the curve and that the change of velocity and change of time values would be taken from this tangent. This was done accurately by the very best candidates, who scored full credit. As the very steepest part of the graph was straight, it was acceptable, in this case, to take values from this part of the graph. Some candidates did this successfully but many who followed this route lost credit by taking values from parts of the graph where it had started to curve. Some candidates from both routes lost credit through lack of care in reading off the values from points on the graph, which had otherwise been correctly identified.

(c) The vast majority of middle range and better candidates gave correct answers.

Question 2

(a) This multi-step calculation was correctly carried out by many candidates. It was not necessary to allow for the time between the beams in addition to the time to reach the beams, although credit was given to a number of candidates who did this correctly. A significant number of weaker candidates did not understand the situation and manipulated the numbers from the question in a wide variety of erroneous ways. This was a typical situation where candidates often did not help themselves by setting out their working in a confused manner.

(b) The majority of candidates gave correct answers. Many of the candidates who lost credit tried to use the weight or acceleration due to gravity in their calculation. There were rather more instances than usual in recent years of incorrect or missing units on this part question.

(c) Most candidates stated correctly that the acceleration increased and normally went on to give a correct explanation in terms of reduced mass. However, a minority wrote about the change of weight and this was not sufficient to gain the full credit.

Question 3

(a) Both parts of this question were generally well answered with no common misconceptions. Some candidates may have had a correct understanding but merely wrote direction as a difference between vector and scalar quantities. It was necessary to specify which had direction, vector or scalar.

(b) This question was testing the candidates' ability to draw a vector diagram, which was clearly specified in the question. It was not acceptable to calculate the answer using trigonometry, which is not on the syllabus. There were many really good, accurate diagrams scoring full credit. However, many candidates drew the vectors for both the original forces from the same point, possibly merely copying the diagram from the question, without realising that the only way to progress from there is to draw a parallelogram. Many candidates did not specify from which force they had measured the angle in their answer.

Question 4

There are many different questions that can be asked about the kinetic theory and candidates need to think through what is required in each situation. They often write down everything they know to the detriment of answering the particular question. In this case, collisions with the walls of the container, between air molecules or between smoke particles are irrelevant. Frequently candidates mentioned these, but did not address the actual question. Examiners try to ignore such irrelevancies but often the answers are so confused that it is difficult to award any credit. The kinetic theory is a topic where candidates need lots of practice answering questions about a wide range of situations and to receive plenty of guidance about which terms and expressions are appropriate and meaningful. A few candidates were let down by poor powers of expression or knowledge of English.

(a) Random movement was frequently mentioned but different directions less often.

(b) What was required here was a clear statement about collisions between smoke and a... necessary to mention that there were air molecules and smoke particles. In this insta... not required to state the other essential relevant fact that the air molecules causing the... motion are invisible.

(c) Many candidates mentioned a change of size of the dots, which would not be observed. The feature that was looked for was the disappearance and appearance of the dots or change of focus. Few candidates gained credit for this part question.

Question 5

A small number of candidates were let down by poor powers of expression or knowledge of English.

(a) There was evidence of much confused thinking on this part question. Candidates often muddled emission and absorption, sometimes even referring to both. Both do, of course, happen but this is not a helpful way of considering the situation. There were also contradictory predictions and explanations.

(b) (i) Candidates did well on this part and many scored full credit. Usually a viable experiment was described and some of the features to improve accuracy. However, there were some inappropriate answers, mainly to do with cans being immersed in hot water or water being poured into cans then the cans being emptied.

(ii) Usually candidates realised that the tiles should be placed on top of or below the cans. However, the explanations of why this would improve the experiment were often far too vague. Merely saying that the heat losses would be reduced was insufficient. What was required was definite reference to a method of heat loss, for example "Heat loss by evaporation from the top of the can is prevented" gained full credit.

(c) Candidates were much more confident with this than the emission situation in part **(a)** and there were many good answers gaining full credit.

Question 6

(a) Many candidates gained full credit, but there were many inaccuracies and wild guesses.

(b) This multi-step calculation was answered well by many candidates. A significant number lost some credit, however, because they did not carry forward the appropriate velocity of sound from part **(a)**. Also, as is often found with questions involving the time and distance travelled by sound, many introduced a spurious factor of 2 as if it were an echo question. The diagram made it absolutely clear that no echo was involved. Candidates need to think through the situation not simply write down any vaguely related equation they have learnt.

Question 7

(a) The boxes in part **(i)** for virtual and magnified were generally ticked although a small minority of candidates made wild guesses. The correct distance for the focal length was less often identified.

(b) Many candidates answered very well and gained full credit for what was designed to be a test of using known principles in an unfamiliar situation. In part **(iii)**, many weaker candidates did not think through that the incident ray OP was on the same line as the normal, so the reflected ray at P was drawn with an angle from the normal greater than 0. This made it almost impossible to gain credit for the second marking point in part **(iv)** for accuracy.

Question 8

(a) Good candidates usually gained full credit. However, many answers showed a correct appreciation of the one third factor for length and doubling for cross-sectional area but could not put these together to reach a correct answer.

(b) (i) Good candidates usually answered this correctly. Errors were often seen involving the parallel resistance equation, substitution into this equation, and the final evaluat resistance of the resistors in parallel.

(b) (ii) and (iii) Many candidates produced good answers to score full credit. A significant numbe responses, however, were mutually contradictory. Other common errors were to equate all the currents or voltages or to use Ohm's law relationships.

Question 9

(a) The majority of middle range and good candidates stated that there was a danger of electric shock or the acceptable alternative answer of a short circuit. However, there were very few valid further explanations. What was expected was a clear statement that it was the dampness that caused the current to flow through the switch to the user. Overall, candidates scored poorly on part **(ii)** quoting unacceptable practices like wearing rubber gloves or boots. Very few gave the expected answers of a switch operated by an insulating cord or placed outside the workroom. Most of those who quoted some form of automatic remote actuation did not score because they failed to supply any sort of meaningful detail.

(b) There were many fanciful answers to this question, some related to when the aircraft was flying or taking off or landing or the tanker driving along the road. This is another example of candidates needing to think through a new and unfamiliar situation and not thoughtlessly writing down vaguely related statements.

Many candidates realised that friction was involved in charging up the aircraft but fewer stated that it had to be between the fuel and the hose. Even fewer stated that this caused charges to be on the fuel, which were then transferred to the aircraft. In part **(ii)** there were many correct responses but also many errors and some candidates even thought that the wet tyres helped to insulate the aircraft from the ground.

Question 10

(a) Nearly all candidates recognised the symbol for the AND gate and many had a general idea of how to draw a NOR gate. However, carelessness or lack of knowledge often resulted in accuracies that confused aspects of NAND and NOR gates or had the wrong number of inputs or outputs.

(b) The majority of candidates scored full credit here.

(c) Most candidates correctly circled the transistor.

Question 11

(a) There were many entirely correct answers here but also a wide variety of errors.

(b) Many candidates scored some credit but a significant number ticked a box that did not correspond to their answer to part **(a)(ii)**.

(c) This was well answered with most candidates scoring full credit.

PHYSICS

Paper 0625/33
Extended Theory

Key Messages

The main emphasis of this paper is to test the supplementary section of the syllabus. Many supplementary topics, however, are extensions of the core syllabus material and it is essential for candidates to be utterly familiar with the core content as well.

Candidates should take note of the credit available for each question and the space allocated for the response, as these provide an indication of the type of answer that is expected. For numerical calculations, particularly those involving more than one step, it is important that candidates show their working clearly so that this can be credited even if the final answer is incorrect.

General Comments

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

Similarly, answers which are written sideways in the margin or above crossed out material can be difficult to read or interpret. The amount of space available for written answers should be enough for an answer that obtains full credit, 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 clear reference to the location in the original answer space. Under no circumstances should any answers be written on the front page.

The candidates who produce the highest scores are those who are conversant with the whole syllabus and are prepared to give answers that exactly deal with the question asked. The candidate who has learnt specific answers to questions asked in previous years, might well find that the answer to a rather different question is not going to score well this time. For example**, Question 9(b)(i)** was specifically about the effect of increasing the length of transmission cables and more general points about energy loss were not necessarily credited.

There is some credit to be gained for just remembering and writing down facts, equations and other relationships, but to score well these facts must be understood and be applied in circumstances which are not necessarily familiar. It was pleasing to see that once the expression for a numerical answer had been quoted, the numbers were, generally speaking, accurately substituted and the answer accurately calculated. There were the odd occasions when this was not done or where the correct answer was wrongly rounded off. The majority of candidates gave an appropriate unit with a numerical answer but there remains the rare candidate who repeatedly omits the unit and is penalised more than once in the paper for this.

Comments on Specific Questions

Question 1

(a) (i) This answer was very commonly correct with the overwhelming majority of candidates stating that the spoon is a good conductor of heat or thermal energy just as a metal is. A few candidates wrote that metals are conductors but then added *of electricity*, which in this case is not relevant.

(ii) This part of the question could be answered in two ways. The most significant answer concerns the transmission of thermal energy through the free electrons but metals also conduct by atomic vibrations and this description was also credited. A large proportion of the candidates gained partial rather than full credit due to incomplete descriptions, often omitting to actual[illegible] relevant initial difference between the atoms at the two ends.

(b) An appropriate method for determining the density was very widely known and many ex[illegible] answers were produced. It was unfortunate that some good descriptions were spoiled by the [illegible] of imprecise or inaccurate terminology. Measuring cylinders determine the *volume* of a liquid an[illegible] not the *amount*. A very few candidates weighed the spoon with a balance of some sort but then used the term *weight* instead of *mass* in the rest of the description.

Question 2

(a) Whilst many candidates gave the correct answer, a large number of candidates gave the value 2500 either with the unit *newton* or with some other unit.

(b) (i) Although the correct answer was given fairly frequently, there were many candidates who did not know the correct term.

(ii) A significant number of candidates used the gradient to obtain the correct numerical answer but did not state it with a unit. Whilst the omission of a unit from a gradient may be justified, the spring constant certainly has a unit.

(c) (i) This part of the question should have been fairly straightforward, but a significant minority of candidates did not realise that the answer was simply zero or no force.

(ii)1. Rather more candidates gave the correct answer here than in the previous part. There were, however, a few misreadings of the graph, and some candidates read the graph backwards.

(ii)2. This was quite commonly calculated correctly but some candidates were uncertain of the unit for acceleration.

Question 3

(a) This was generally well answered with many candidates giving the correct numerical answer. A few candidates gave the newton as the unit and a few tried to incorporate the 4.0 s into the calculation and so did not obtain full credit.

(b) (i) Many candidates obtained the correct answer but some left out of the calculation the 4.0 s term. This time it was needed.

(ii) There were many good answers here and many candidates scored highly. Where the final answer was not given, the compensation mark could not be awarded for an expression such as *efficiency* = *output* / *input*. The word *energy* or the word *power* was needed in this definition.

(c) The emphasis here was on mechanisms and only a minority of candidates gave an answer in these terms.

Question 4

(a) (i) It was extremely pleasing to see that almost all candidates calculated the correct answer here and also supplied the correct unit. This is clearly well known and well understood.

(ii) This is not the most straightforward of calculations and it was very encouraging indeed to notice the large number of candidates who gave the correct answer here. A common source of error is to quote the correct formula for kinetic energy in symbolic form but then to omit the power of two from the numerical substitution. Candidates might well be reminded of this specific source of inaccuracy every time the formula is mentioned in class.

(b) Many candidates stated that this was due to air resistance or air friction, but a rather smaller number explained how this affected the required launch speed. The question is *Explain why* and candidates need to be aware that rather more is expected when this wording is used.

(c) Despite the reference to constant speed in the very last word of the question, mo... introduced the idea of an increasing kinetic energy into the energy transformation. O... minority scored well here.

Question 5

(a) There was much uncertainty here and only a minority of candidates gave the correct answer *fusion*. Many candidates simply gave the answer *radiation*. The questions do need to be read carefully.

(b) (i) Many candidates scored well here and answered the question in one of a variety of acceptable ways. Whilst changes to the surface colour of the drum or the addition of a lid do have the desired effect, they do not answer the question which refers to the shape of the drum. This is a question which a few candidates needed to read more carefully.

(ii) This question produced responses of a wide variety of standards. Some very brief answers concentrated on the essential elements of the experiment and obtained full credit. Others were less focused and missed some essential points. Some answers were specifically directed at the emission properties of the two types of surface whilst others tried to used Lesley's cube in an absorption experiment; it is more suited for use in an emission experiment, of course.

Question 6

(a) There were two stages to this calculation. Candidates had initially to determine the electrical energy supplied to the kettle and then to use this in the calculation of the answer. This proved tricky for many candidates with a large number of answers directly using the value 2400 W as the energy needed in the second stage. Those candidates who did give the correct numerical answer did not always add the correct unit. It is not a simple unit and perhaps it needs to be learnt as well as understood.

(b) To work out what is happening here is not without complication and, since both the effect and the explanation were required, only the best candidates gave a correct answer that could be rewarded with full credit.

Question 7

(a) Many candidates used the correct formula for refraction but at least half of these candidates used it the wrong way round and gave an angle that suggested the ray refracted towards the normal. Candidates need to think about the meaning of their numerical answers in cases such as this.

(b) (i) The relevant formula was widely known and the correct numerical substitution commonly gave the correct answer here.

(ii) Some candidates were not certain about how to approach this and others simply quoted a known value. The question's wording is important. The word in the question is *Calculate*, and candidates were expected to show their working as with all calculations.

(c) Very few candidates gave answers in terms of the wavefronts but many realised the significance of the light ray being perpendicular to the glass surface. To achieve full credit, however, some explanation of the effect on the refracted ray was needed.

Question 8

(a) (i) Only a minority of candidates obtained full credit here and these tended to be candidates who scored highly elsewhere on the paper. Some candidates omitted the horizontal lines between the half waves that are present.

(ii) There were few correct answers here.

(b) The emphasis here is on the explanation as well as on the effect. Many candidates were able to describe the effect but of these a significant fraction gave no further explanation.

Question 9

(a) Most candidates find electromagnetism one of the more testing parts of the syllabus. Ca should look carefully at the total credit available for a question and judge the amount of de give in their answer accordingly. Those candidates whose answers simply stated that secondary coil consisted of more turns than the primary were unlikely to score fully here. This was part of the answer to the question but an explanation of a transformer was also needed for full credit. There are many common misconceptions about transformers and all of these were seen. These include the idea that one magnetic field is cutting another one and the suggestion that there is a current in the core. The use of the term *induction* to describe the production of the original magnetic field is unusual and might well suggest that electromagnetism is not firmly understood.

(b) (i) Many candidates referred to an increased resistance and obtained some credit here; rather fewer explained how this resulted in an increased energy loss.

(ii) This was not as well answered as the previous part and not all candidates referred to a reduced resistance. Some candidates referred to an increased cost but did not make it clear exactly what would cost more and why.

Question 10

(a) (i) There were candidates who did not realise what was required here and so produced answers of many different sorts. Some candidates had an idea of what was expected but scored less than full credit for answers which were carelessly drawn and unclear. In particular, candidates who drew patterns in which field lines were crossing were usually unable to gain full credit. In some cases the crossing was due to a clear attempt at a three-dimensional diagram but this is difficult to produce and more frequently the effect was a lack of clarity.

(ii) Many candidates gave answers which were correct but some candidates referred to the solenoid rather than the pattern of the magnetic field.

(b) This was usually answered correctly although a few candidates omitted any explanation at all. A misunderstanding here was the suggestion from some candidates that the magnetic field was causing the current and that increasing the resistance influenced this process.

(c) (i) Many candidates scored full credit here but drawing the curve in the wrong direction or drawing a curve which was a straight line for far too long after entering the field prevented some candidates from achieving full credit.

(ii) Some candidates scored well here whilst others were less certain about what was required. In particular, rather few candidates offered an explanation of the cause of the reversed deviation. It is unclear whether answers such as *the direction of the α-particle is reversed* represents a genuine misunderstanding or if it is an inaccuracy due to less than careful language.

Question 11

(a) Many candidates did not appear to understand what was required. Sometimes, when an incorrect answer was offered, the scale of the graph was misinterpreted. The unit here was important and although the word *counts* could be omitted, *per minute* was essential.

(b)(i)(ii) Many candidates gave the correct values here and of those that did not many scored partial credit by supplying the values *84 counts / minute* and *21 counts / minute*, which were the values read from the graph before subtracting the background radiation.

(c) This was poorly answered even by candidates who had a usable set of values in **(b)**. A not infrequent misunderstanding led candidates to halve the time between the two readings (9 minutes) and then to halve it again. There were also others who simply divided the time difference by the ratio *72/9* or by *84/21*.

PHYSICS

Paper 0625/04
Coursework

General comments

The general standard of coursework produced has once again reached a high level. Coursework candidates were given many different opportunities to demonstrate their practical skills using a range of tasks from different areas of the syllabus. Clearly a large amount of good work has been completed by teachers and candidates. The samples illustrated clear annotated marks and comments, which was helpful during the moderation process.

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 Moderator 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 to the task as well as to the criteria in the syllabus and should
a slight rewording of the assessment criteria.

PHYSICS

Paper 0625/51

Practical Test

Key messages

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

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 of the concept of results being equal within the limits of experimental accuracy,
- dealing with possible sources of inaccuracy,
- control of variables,
- accurate measurements,
- choice of the most effective way to use the equipment provided.

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.

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 '*make sure the pins are vertical*', applied to a lens question, show learning of mark scheme instructions rather than understanding of the questions.

Comments on specific questions

Question 1

(a) Most candidates recorded the unstretched length of the spring correctly but some gave an answer that was not in mm. A minority of candidates indicated the distance measured insufficiently clearly to gain full credit. The table was filled in correctly by most candidates with the correct force values and accurate calculations of the extension.

(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 credit available for the graph line, 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. The question required candidates to 'show clearly on the graph how you obtained the necessary information'. Candidates who did not follow this instruction lost some of the available credit. Some credit was still available, however, if the calculation showed that at least ... had been used.

Question 2

(a) Most candidates successfully recorded a realistic temperature for the hot water.

(b) - (d) Most candidates correctly recorded the units, s, °C, °C. Some, however, missed this completely whilst others gave a wrong unit e.g. C°. Sensible values of θ_H were usually stated, being lower than the original value. Most recorded steadily decreasing temperatures giving the values to at least the nearest 1 °C. The final mark in the table was awarded for the temperatures recorded for the thermometer in position **B** showing a greater decrease than those for the thermometer in position **A**.

(e)(f) Some very sensible suggestions were offered by candidates, showing that they were familiar with discussing their practical work and reflecting on accuracy and control of variables. A significant number of candidates, however, appeared to be unaware of what was being asked here. In part **(e)** answers that conveyed no more than '*I would do it carefully*' gained no credit. Reference to viewing the thermometer scale at right angles, or reference to a strategy for taking the thermometer reading as close to the correct time as possible, were credited. In part **(f)** some candidates made sensible suggestions but others confused the control of variables with precautions to be taken to improve reliability. This may be due to attempting to learn answers from the mark schemes of past papers.

Question 3

(a) Most candidates completed the current and potential difference readings correctly and to a suitable number of decimal places, reflecting the precision of the meters. Some recorded current or potential differences that were clearly much too large. This was probably due to misreading an unfamiliar meter. The power calculations were successfully completed by most candidates.

(b) Candidates were expected here to consider their results carefully and make a judgement about the value of P_T when compared with the sum $P_1 + P_2 + P_3$. Some candidates appeared to answer this without reference to their results and may have been trying to remember something from a mark scheme of a past paper. The most confident candidates were able clearly to express a judgement that either the results were within the limits of experimental accuracy, beyond those limits or exactly equal depending on the results obtained. The exact wording '*limits of experimental accuracy*' was not required but the concept had to be clearly expressed. Some candidates appeared to have learned the words but did not know how to apply them, for example stating that the results were within the limits of experimental accuracy when they were either exactly equal or too different.

(c) A significant number of candidates drew an inaccurate diagram. Common errors were drawing the lamps in series, placing the voltmeter in series with the lamps, including a voltmeter across each lamp and drawing the wrong symbol for the variable resistor. A thermistor symbol was used by many and others drew a symbol that was a cross between the variable resistor symbol and the thermistor symbol.

(d) A large number of candidates did not know that the purpose of the variable resistor was to vary the current. Many of these candidates confused the variable resistor with a fuse and some answers described something that seemed to be a mixture between a variable resistor and a fuse.

Question 4

(a)(b) Most candidates performed the calculations correctly. However a significant number of candidates appeared to have had little or no experience of this type of experiment, or had forgotten what they did during the IGCSE course. These candidates gave values for the image distance *v* that were outside the tolerance allowed and could not have produced an image on the screen.

(c) In this part candidates were required to think carefully about the experiment and make sensible suggestions and decisions as a result of their considerations.

(i) Candidates who obtained a focused image were able to make a realistic assessment of the range of *v* values that appeared to give an image of the same quality.

(ii) Considering the range quoted in **(i)**, and other uncertainty factors, the average valu length should have been given to 2 or 3 significant figures.

(iii) Successful candidates made relevant suggestions from their experience. Others made suggestions that only amounted to writing that they would follow the instructions carefully. This not gain the available credit. The question asked for two precautions. There are more than two possible correct answers but candidates should be warned against offering more than the number requested as they run the risk of effectively asking the Examiner to choose the correct answers from a list – it is the candidates' task to select two precautions and credit is awarded accordingly.

PHYSICS

Paper 0625/52
Practical Test

Key Messages

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

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,
- accurate measurements,
- choice of the most effective way to use the equipment provided.

Candidates entering this paper scored the full range of marks. They 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. Work was generally neat, legible and well expressed. 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. The gathering and recording of data presented few problems for any candidates. Units were well known, 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. There was evidence of some candidates not having the use of a calculator.

The ability to quote an answer to an appropriate number of significant figures, or to an appropriate number of decimal places, still causes difficulty for many candidates. Data should be recorded so as to reflect the precision of the measuring instrument. The number of significant figures given for calculated quantities should be appropriate to the least number of significant figures in the raw data used and show a candidate's appreciation of how precise their answer is likely to be.

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 credit for it. Candidates should be encouraged to cross out completely and to re-write their answers so that there is no ambiguity. Weaker 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) – (d) All candidates wrote down values for the time *t* for 20 complete oscillations of the 30.0 cm and the 60.0 cm pendulum. The calculation of the periodic time of the pendulum for both these lengths was usually performed correctly, but the values quoted were often not to a consistent number of significant figures.

(e) Most candidates were able to use their results to state, correctly, that doubling the length of a pendulum does not double the periodic time. Only the more able candidates were able to justify their statement by referring to their results. The better candidates correctly stated that the result for the period of the longer pendulum was too different from the value which would be double, or that the difference was too large to be explained by inaccuracies in experimental procedure.

(f) This part was better attempted, with most candidates stating that the line should be straight, although far fewer candidates mentioned that the line would also pass through the origin.

(g) Most candidates obtained a value for the time of 20 oscillations of the 30.0 cm pendulum with the heavier bob, which was within 1 s of the value obtained of the 30.0 cm pendulum with the lighter bob. Those candidates who had taken more care with their timing of the oscillations obtained values which, if not identical, were very close to each other, and thus obtained credit for the accuracy mark that was available here.

(h) Only a minority of candidates obtained credit for their answer. Many candidates did not even refer to their results. The expected answer was that doubling the mass of the pendulum had no effect on its periodic time. Most candidates would not commit to the answer '*no effect at all*'. They used statements such as '*very little effect', 'no significant effect'*, which did not gain credit.

Question 2

(a) - (c) Candidates found the four cooling experiments easy to perform, and it was rare to see any omissions in the spaces left on the question paper for the recording of the initial temperatures, final temperatures and the fall in temperature of the water in each case. Units are expected to be given for physical quantities, but occasionally there was no evidence of the °C unit anywhere in this question – this incurred the loss of some credit.

(d) A number of candidates, despite having correctly calculated the four temperature drops of the water in the experiments, were unable to list them in order correctly, with the greatest temperature drop first.

(e) Most candidates made sensible suggestions and gave one condition that needed to be kept constant in order to provide reliable results.

(f) This part was harder, and many candidates merely repeated the condition given in the previous part. Only the more able candidates realised that cooling the water for the same time in each experiment was needed.

Question 3

(a) (b) The first measurement made by candidates was that of the current in the circuit. In many cases the current was written to too few decimal places or its unit was missing.

The table was almost always completed, with candidates giving complete sets of values for *x*, *V* and *R*, but it was rarer to see use of a consistent number of significant figures in each column of values. The calculation of the resistance *R* of the wire was sometimes incorrect because candidates did not round the value of their calculated ratio correctly.

(c) There was a marked improvement in the standard of graph plotting this year. Most candidates chose horizontal and vertical scales which made use of at least half of the given grid. There was little use of scales which increased in inconvenient increments, such as 3 or 7. Choosing such scales makes the points much harder to plot and more difficult for the Examiner candidates' plotted points.

A significant number of candidates lost credit by presenting graphs where the points were dot-to-dot. When best fit lines were attempted, they were often biased to one side, or even fo through the origin. The concept of a best-fit line is clearly still not well understood by all.

(d) Most candidates were able to read the graph and give a value for the length which was correct to ±½ of one small grid square. Credit was often lost, however, because candidates ignored the given instruction to indicate clearly on the graph evidence of how they had obtained the necessary information.

(e) Many methods, some ingenious, were adopted by candidates to predict the resistance of 1.5 m of the resistance wire and most candidates arrived at a sensible answer. On the other hand, the values quote by some candidates were clearly obviously incorrect, and so far from the values shown by their tables and graphs. Candidates should spend a moment looking at the value of any prediction they make, and ask themselves if this value is realistic.

Question 4

(a) Only the more able candidates measured and recorded a value for the image distance v which was within the generous tolerance allowed here for accuracy. The calculations of uv and $u + v$ were nearly always done correctly and a value for the focal length f_1 which was correct for the candidates' results was usually calculated. The value of the focal length was often written to more significant figures than was consistent with the data in the question, and the unit was frequently omitted.

(b) Candidates were required to move the lens towards the screen to produce another sharp image of the object. The ensuing measurements that had to be made were the same as those in **(a)**, and the same comments apply here, as they did above.

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

(d) Most candidates responded well to this question and could list sensible precautions to take in this type of experiment.

(e) Most candidates sketched the inverted triangle image correctly.

PHYSICS

Paper 0625/53
Practical Test

Key messages

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

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 of the concept of results being equal within the limits of experimental accuracy,
- dealing with possible sources of inaccuracy,
- control of variables,
- accurate measurements,
- 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 are answered much more effectively by candidates who clearly have had regular experience of similar practical work.

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

It is expected that numerical answers will be expressed to a number of significant figures which is appropriate to the data given in the question or a measurement carried out by the candidate. This was demonstrated in many good responses to **Questions 1** and **3**. 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, must be avoided.

Responses to **Question 1(d)** and **4(k)** often mentioned the term '*parallax*' without explaining what this means or how inaccuracy in the reading of scales could be avoided.

Comments on specific questions

Question 1

Good responses to this question were seen from many candidates, although later sections pro challenging for some.

(a) The majority of candidates recorded a sensible mass. The resulting volume was generally calculated accurately although the unit was sometimes missing or given incorrectly. A unit of g/cm^3 was the most common error.

(b) A volume within 10% of V_1 was generally recorded.

(c) The straightforward measurement of lengths was usually carried out correctly with reasonable values being recorded.

While the average value of diameter was calculated correctly by the majority, $(d_1 - d_2)/2$ or $(d_1 + d_2)$ were both seen.

The value of V_3, expected to be greater than V_1 and V_2, was generally appropriate but often with a number of significant figures in excess of the acceptable 3. Candidates need to be aware of the limited precision of the measurements they make.

(d) For Method 2, reference to the possibility of water remaining in the cup or being spilt on transfer to the measuring cylinder was common, as was the need to read the scale on a line perpendicular to the bottom of the meniscus. Credit was given to candidates who described the meniscus without knowing the correct scientific term. It should be noted that the presence of a meniscus is not, in itself, a source of error and that use of the word '*parallax*' will not be given credit unless avoidance of error in the reading of a scale is explained.

Many candidates identified that the diameter at the MAX level rather than the top of the cup should have been measured in Method 3 and that it was difficult to measure the height to the MAX level because of the sloping side. Responses referring to the use of an average diameter as being inherently inaccurate in an equation were not given credit.

Use of 'more accurate apparatus', not available in a normal laboratory, is unlikely to be an acceptable response to this type of question.

(e) A large number of candidates recognised that the mass of the empty cup would be the most obvious additional measurement in Method 1. '*Weight of the cup'* was not allowed.

Question 2

This was the question which was the most well done by candidates across the whole ability range.

(a) Decreasing thermometer readings were recorded by the majority of candidates. Candidates should be advised to estimate temperatures to 0.5 °C if possible, rather than record integer values, to avoid the risk of a succession of identical readings. This is especially true of temperatures which are decreasing slowly.

It was usual to see the units and column *t* values inserted correctly, although headings were sometimes left blank by otherwise good candidates, who had presumably not read the question carefully.

(b) Many candidates correctly identified that the rate of loss of thermal energy was greater for beaker **A**, as evidenced by a greater temperature change for this beaker. Full credit was gained by those who also stated that the changes for each beaker had taken place over the same time interval, or who calculated a comparative overall rate of decrease in temperature. It should be noted that a lower final temperature for beaker **A** was insufficient evidence without reference to the starting temperatures. If it was justified by the temperature changes having a difference of less than 10%, a response of 'no significant difference' was acceptable.

(c) Good responses to this question were generally seen, with '*initial temperature of the ho* the most common correct answer. Although not strictly a condition, the frequently seen *the hot water'* was also allowed as it was a valid comparative factor.

(d) This was the most challenging aspect of the question, requiring a careful description of the cha and its effect. The most straightforward answers were often the best, with a number of candidates referring to the need for an identical lid on both beakers so that the only difference was the effect of the insulation around beaker **B**. Although not such a good practical solution due to the significant convection, the removal of the lid from beaker **B** was also acceptable.

Question 3

Although many excellent responses to this question were seen, there were some fundamental errors in graphs.

(a) Sensible values, recorded to at least 1 decimal place for potential difference and 2 decimal places for current reflecting the precision of the meters, were seen in the work of most candidates. Where candidates had apparent problems with the apparatus, the readings they had recorded made their subsequent graph work more difficult. In these cases, candidates should be encouraged to seek help from the Supervisor.

(b) Some good skills were seen in graph work, with clearly labelled axes and accurate plots shown with fine crosses or circled small points. 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 credit 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 which allowed plotted points to occupy at least half of the grid on each axis, often achieved with a non-zero origin, were seen in the better responses. Quite a number of candidates lost credit here with plots occupying a smaller section of, usually, the *y*-axis, or with odd intervals based on 0.3 or 0.15. Candidates should be aware of the difficulties of determining accurate plots when unusual intervals are used. Plotting was generally good and a fine, best-fit straight line was attempted by many. Credit was lost by a number of candidates who showed lines which joined plots together or joined the first and last points, ignoring the distribution in between. Well judged curves were acceptable if the plots indicated this.

(c) Many showed a clear triangle method on the graph for determining the gradient, but 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.

The value of R was often less than 2.0 Ω, as expected, and was expressed to an appropriate 2 or allowable 3 significant figures, with a correct unit. The negative value of M was sometimes incorrectly transferred to R.

Question 4

This question was the least well done by a whole range of candidates. A small number of candidates carried out the ray-trace drawing on Fig. 4.1 rather than using the separately supplied ray-trace sheet; the mistake should have been realised as they were unable to carry out the instructions in **(a)** and **(b)**. Most of the credit was still available to them, but no credit could be given for the skills which were assessed by the completion of those parts of the diagram which were already drawn on the paper.

(a)–(i) Ray-trace:
The normal was usually correct but pin positions were often too close together. 5.0 cm is the recommended minimum separation but candidates should space the pins as far apart as possible. Lines had generally been drawn carefully and neatly although some thicker lines clearly led to inaccurate measurement later. It was rare to see incorrect values of α.

Table:
θ measurements were often within the expected tolerance but some showed greater discrepancies and there were cases of the wrong angles being identified.

(j) It was expected that candidates would recognise that a small difference between 2 within the limits of experimental accuracy and so the results supported the suggestio number did give that response but fewer backed it up with values from the table. A si number of answers stated that one set of results supported the suggestion and one did not, the values were different and therefore did not support the suggestion. Where errors had be made with the measurement and there were discrepancies of greater than 10% between θ and 2α, few candidates gave the acceptable justification that the values were 'too different' to support the suggestion.

(k) Many good answers focused on the need for thin lines drawn with a fine pencil, reading the scale of the protractor perpendicularly, having well separated pins and viewing pins from their bases. Repeating results was accepted only if the need to calculate an average was also stated.

PHYSICS

Paper 0625/61
Alternative to Practical

Key messages

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

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 of the concept of results being equal within the limits of experimental accuracy,
- dealing with possible sources of inaccuracy,
- control of variables,
- accurate measurements,
- choice of the most effective way to use the equipment provided.

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.

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 examination, 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 inappropriately applied to the current examination have not gained credit. 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

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 difficulties encountered in this type of experiment.

(a) To gain credit, candidates needed to comment on balancing the rule on the pivot and ... would then be at the centre of mass.

(b) This part described a common problem when carrying out this type of moments exper... Candidates could either suggest taking the readings from the 50.2 cm mark or suggest addin... small weight at one end of the rule so that it balances at the 50.0 cm mark.

(c) Most candidates correctly completed the column headings in the table and calculated the clockwise and anticlockwise moments.

(d) Candidates could draw on their experience of the experiment here to suggest a suitable method for locating the centre of mass of the load, or suggest estimating between the two best positions at which the rule most nearly balances on the pivot.

Question 2

(a) Most candidates successfully recorded the temperature.

(b) (i) Most candidates correctly recorded the units, s, °C, °C. Some, however, missed this completely whilst others gave a wrong unit e.g. C°.

(ii)(iii) Most candidates realised that position **B** gave the greater rate of cooling but credit was only awarded to those candidates who related this to a greater temperature difference. A theoretical explanation was not required and did not gain any credit.

(iv)(v) Most candidates correctly calculated the temperature differences. Many gave a sensible estimate for room temperature based on the readings in the table but others gave answers that were clearly impractical.

(c) Answers that conveyed no more than '*I would do it carefully*' gained no credit. Reference to viewing the thermometer scale at right angles, or reference to a strategy for taking the thermometer reading as close to the correct time as possible, were credited.

(d) Some candidates made sensible suggestions but others confused the control of variables with precautions to be taken to improve reliability. This may be due to attempting to learn answers from the mark schemes of past papers.

Question 3

(a) Most candidates completed the current and potential difference readings correctly. The power calculations were successfully completed by most candidates.

(b) Candidates were expected to consider the results carefully and make a judgement about the value of P_T when compared with the sum $P_1 + P_2 + P_3$. Some candidates appeared to answer this without reference to the results and may have been trying to remember something from a mark scheme of a past paper. The most confident candidates were able clearly to express a judgement that the results were within the limits of experimental accuracy. The exact wording '*limits of experimental accuracy*' was not required, but the concept had to be clearly expressed. Some candidates appeared to have learned the words but did not know how to apply them.

(c) A significant number of candidates drew an inaccurate diagram. Common errors were drawing the lamps in series, placing the voltmeter in series with the lamps, including a voltmeter across each lamp and drawing the wrong symbol for the variable resistor. A thermistor symbol was used by many and others drew a symbol that was a cross between the variable resistor symbol and the thermistor symbol.

A large number of candidates did not know that the purpose of the variable resistor was to vary the current. Many of these candidates confused the variable resistor with a fuse and some answers described something that seemed to be a mixture between a variable resistor and a fuse.

Question 4

(a)(b) Most candidates measured accurately and performed the calculations correctly.

(c) A significant number of candidates lost some credit here by giving *f* to more than 3 figures, which could not be justified by the precision of their measurements, or missing the u

(d) Candidates who could draw on their experience were able to make a realistic assessment of range of *v* values that would give an image of the same quality.

(e) Successful candidates made relevant suggestions from their experience. Others made vague suggestions that only amounted to writing that they would follow the instructions carefully and did not gain credit. The question asked for two precautions. There are more than two possible correct answers but candidates should be warned against offering more than the number requested as they run the risk of effectively asking the Examiner to choose the correct answers from a list – it is the candidates' task to select two precautions and credit is awarded accordingly.

Question 5

(a) Most candidates recorded the unstretched length of the spring correctly but some gave an answer that was not in mm.

(b) The table was filled in correctly by most candidates with accurate calculations of the extension.

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 credit available for the graph line, 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. The question required candidates to 'show clearly on the graph how you obtained the necessary information'. Candidates who did not follow this instruction lost some of the available credit. The second marking point awarded credit to those candidates who obtained a *G* value within the tolerance allowed.

PHYSICS

Paper 0625/62
Alternative to Practical

Key Messages

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

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,
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- 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,
- accurate measurements,
- choice of the most effective way to use the equipment provided.

Candidates entering this paper scored the full range of marks. They 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, many candidates seemed less able to derive conclusions from given experimental data and justify them.

The ability to quote an answer to a sensible, consistent number of significant figures, or to an appropriate number of decimal places, still causes difficulty for many candidates. Data should generally reflect the precision to which the measurement has been made. The number of significant figures given for calculated quantities should be appropriate to the least number of significant figures in the raw data used and show a candidate's appreciation of how precise the answer is likely to be given the limits of experimental measurement and accuracy.

Comments on specific questions

Question 1

(a) Most candidates measured the required length correctly to the nearest millimetre, but a minority of candidates were up to 2 mm out.

(b) The calculation of the period of the pendulum caused little difficulty, but a common omission was to forget to complete the column headings in the table, despite the instruction to do so being given.

(c) Most candidates stated that the results showed that doubling the length of the pendu double the periodic time *T*. Far fewer candidates were able to justify this statement by re the results. The more able candidates used ideas that the result for *T* was too different fro which would be double, or that the difference was too large to be explained by inaccuracies experimental procedure.

(d) This part was better attempted, with most candidates stating that the line should be straight, although far fewer candidates mentioned that the line would also pass through the origin.

(e) Only a very small minority of candidates obtained credit for their answer. Many candidates did not refer to the given values at all. The expected answer was that doubling the mass of the pendulum had no effect on the periodic time. Most candidates would not commit to the answer '*no effect at all*'. They used statements such as *'very little effect', 'no significant effect'* which did not gain credit.

Question 2

(a) - (c) Most candidates gained full credit for the skills assessed here. Where the thermometer was misread, the most common incorrect answer was 82 °C. Only a small minority of candidates did not include a unit or gave an incorrect unit.

(d) A surprising number of candidates, despite having correctly calculated the four temperature drops, were unable to list these in order correctly, greatest temperature drop first.

(e) Most candidates made sensible suggestions of the conditions that needed to be kept constant in order to provide reliable results. Quite frequently, however, candidates effectively gave the same answer twice, and therefore only scored partial credit – e.g. '*use the same volume of water each time*' and '*use the same mass of water each time'*.

(f) This part was harder, and most candidates repeated points they had stated in part **(e)**. Only the more able candidates realised that cooling the water for the same time was needed.

Question 3

(a) The reading of the ammeter and voltmeter scales presented no difficulty to the majority of candidates. A sizeable minority of candidates forgot to include the unit of current and were penalised for this omission. In part **(iii)**, the division of the voltmeter reading by 0.3 to calculate the resistance of the wire surprisingly produced many incorrect answers.

(b) There were many good graphs drawn. Most candidates chose horizontal and vertical scales which used at least half of the given grid. There was little use of scales which increased in inconvenient increments, such as 3 or 7. Choosing such scales makes the points much harder to plot and difficult for the Examiners to check the plotted points

A significant number of candidates lost credit by presenting graphs where the points were joined dot-to-dot, and even the straight lines were often biased to one side, or even forced through the origin. The concept of a best-fit line is clearly still not well understood by all.

(c) Most candidates were able to read the graph and give a value for length which was correct to ±½ of one small grid square. Credit was often lost, however, because many candidates ignored the given instruction to indicate clearly on the graph evidence of how they had obtained the necessary information.

(d) There were some interesting predictions of the resistance of 1.5 m of the resistance wire. Many methods, some ingenious, were adopted by candidates, and most arrived at a sensible answer. On the other hand, some of the values quoted by candidates were clearly obviously incorrect, and so far from the values shown by their graphs. Candidates should spend a moment looking at the value of any prediction they make, and ask themselves if this value is realistic.

Question 4

(a) Although most candidates were able to measure the distances *u* and *v* correctly, there was minority of candidates who were unable to measure a given distance to within 1 mm. The pr *uv* and the sum *u* + *v* were calculated correctly, but the ratio of these quantities, although usu arithmetically correct, was quoted to too many significant figures. The same comments apply to part **(b)**, which tested the same skills as part **(a)**.

(c) Because, in the majority of cases, the answers to **(a)(v)** and **(b)(iii)** were the same, candidates had little difficulty justifying the given suggestion.

(d) Most candidates responded well to this question and could list sensible precautions to take in this type of experiment.

(e) Most candidates correctly drew an inverted triangle, but a surprising number of images were not inverted. It is possible that these candidates had not done this sort of experiment in class. A minority of candidates treated the triangular object as a prism and drew diagrams showing the dispersion of a beam of white light through it.

Question 5

(a) Only a very small number of candidates correctly wrote 7.<u>0</u> cm for the length of the block, although almost all wrote 3.<u>3</u> cm for its width. Some candidates lost credit by the omission of a unit in either answer.

(b) The value of the weight was usually read correctly as 6.5 N from the forcemeter scale. The most common incorrect answer was 7.5 N, where candidates had read the scale backwards. The magnitude of the pressure exerted by the block on the bench was usually calculated correctly, but the unit given was almost invariably incorrectly given as Pa instead of N/cm^2.

(c) Candidates struggled to suggest an acceptable practical source of inaccuracy to explain why the value of their calculated pressure would be slightly too small. Correct responses, such as the outline would be larger than the block, or a zero error on the forcemeter, or the precision with which the forcemeter could be read, were only given by the most able candidates.

PHYSICS

Paper 0625/63
Alternative to Practical

Key messages

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

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 of the concept of results being equal within the limits of experimental accuracy,
- dealing with possible sources of inaccuracy,
- control of variables,
- accurate measurements,
- 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. 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 **Questions 2(c)** and **4(d)**, which required references to results rather than theory, and in the clear practical details given by some candidates in **Question 1(d)**.

It is expected that numerical answers will be expressed to a number of significant figures which is appropriate to the data given in the question or a measurement carried out by the candidate. This was demonstrated in many good responses to **Questions 1** and **3**. 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, must be avoided.

Responses to **Question 1(d)** and **4(e)** often mentioned the term '*parallax*' without explaining what this means or how inaccuracy in the reading of scales could be avoided.

Comments on specific questions

Question 1

Good responses to this question were seen from many candidates, although the sections involving pract considerations proved challenging for some.

(a) The majority of candidates recorded the mass correctly but some lost credit by not including the unit. The resulting volume was generally calculated accurately although the unit was sometimes missing or given incorrectly. A unit of g/cm^3 was the most common error. Credit was given if candidates converted the mass correctly to kg but this often led to confusion in the subsequent calculation of volume.

(b) The correct volume was generally recorded but values of 174 or 70 were seen.

(c) The straightforward measurement of lengths from the paper was usually carried out correctly, with tolerance being applied to some values. However, there were common errors such as d_1 being recorded as 7.9 or 7.5 cm. While the average value of the diameter was calculated correctly by the majority, $(d_1 - d_2)/2$ or $(d_1 + d_2)$ were both seen. The value of V_3 was generally appropriate but often with a number of significant figures in excess of the acceptable 3. Credit was given in later parts of the calculation for errors carried forward from measurements.

(d) From their responses to this part of the question, it was clear that many candidates had carried out similar basic practical work. For Method 2, reference to the possibility of water remaining in the cup or being spilt on transfer to the measuring cylinder was common, as was the need to read the scale on a line perpendicular to the bottom of the meniscus. Credit was given to candidates who described the meniscus without knowing the correct scientific term. It should be noted that the presence of a meniscus is not, in itself, a source of error and that use of the word '*parallax*' will not be given credit unless avoidance of error in the reading of a scale is explained.

Many candidates identified that the diameter at the MAX level rather than the top of the cup should have been measured in Method 3 and that it may be difficult to measure the height to the MAX level because of the sloping side. Responses referring to the use of an average diameter as being inherently inaccurate in an equation were not given credit.

Use of 'more accurate apparatus', not available in a normal laboratory, is unlikely to be an acceptable response to this type of question.

(e) A large number of candidates recognised that the mass of the empty cup would be the most obvious additional measurement in Method 1. '*Weight of the cup'* was not allowed.

Question 2

This was the question which was the most well done by candidates across the whole ability range.

(a) The thermometer readings were recorded correctly by the majority of candidates. Very occasionally, values of 97, 98, 80.7 and 80.8 °C were seen.

(b) It was usual to see the units and column *t* values inserted correctly, although they were sometimes left blank by otherwise good candidates, who had presumably not read the question carefully.

(c) Many candidates correctly identified that the rate of loss of thermal energy was greater for beaker **A**, as indicated by the greater temperature change for this beaker. Full credit was gained by those who also stated that the changes for each beaker had taken place over the same time interval, or who calculated a comparative overall rate of decrease in temperature. It should be noted that the lower final temperature of beaker **A** was insufficient evidence if the different starting temperatures were ignored.

(d) Good responses to this question were generally seen, with '*initial temperature of the hot water*' being the most common correct answer. Although not strictly a condition, the frequently seen '*volume of the hot water*' was also allowed as it was a valid comparative factor.

(e) This was the most challenging aspect of the question, requiring a careful description and its effect. The most straightforward answers were often the best, with a number of referring to the need for an identical lid on both beakers so that the only difference was the the insulation around beaker **B**. Although not such a good practical solution due to the sign convection, the removal of the lid from beaker **B** was also acceptable.

Question 3

Although many excellent responses to this question were seen, there were some fundamental errors in graphs.

(a) The majority of responses included a correct symbol for a single voltmeter connected in parallel across **X** and **Y** or equivalent points on the circuit. However, incorrect symbols showing a square rather than a circle, or with a line through the circle were evident. Pairs of voltmeters and series connections were also seen. A significant number of candidates made no response, perhaps indicating that they had not read the question thoroughly.

(b) Some good skills were seen in graph work, with clearly labelled axes and accurate plots shown with fine crosses or circled small points. 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 credit 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 which allowed plotted points to occupy at least half of the grid on each axis, only achievable with a non-zero origin, were seen in the better responses. Quite a number of candidates lost credit here with plots occupying a smaller section of, usually, the *y*-axis or with odd intervals based on 0.3, 0.15 or even 0.13. Candidates should be aware of the difficulties of determining accurate plots when unusual intervals are used. Plotting was generally good but with the particular difficulty of the 1.13 I value being plotted as 1.03. A fine, best-fit straight line was attempted by many. Credit was lost by a number of candidates who showed lines which joined plots together or joined the first and last points ignoring the distribution in between. Well judged curves were acceptable if incorrect plots indicated this.

Many showed a clear triangle method on the graph for determining the gradient, but 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. The value of R was often determined correctly and expressed to an appropriate 2 or allowable 3 significant figures, with a correct unit. The negative value of M was sometimes incorrectly transferred to R.

Question 4

This question was the least well done by a whole range of candidates.

(a) The normal was usually correct but pin positions were often too close together or shown below the mirror and not on **LN** as instructed. 5 cm is the recommended minimum spacing, but candidates should know from their practical experience that it is best to space the pins as far apart as possible.

(b)(c) Many candidates gained the full credit here, with mostly accurate drawing and measurement. Some seemed tempted to make θ exactly equal to 2α at this stage, in spite of correctly drawn lines, and lost at least some credit.

(d) It was expected that candidates would recognise that a small difference between 2α and θ was within the limits of experimental accuracy and so supported the suggestion. A good number did give that response but fewer backed it up with values from the table. A significant number of answers stated that one set of results supported the suggestion and one did not, or that the values were different and therefore did not support the suggestion. Where errors had been made with the measurement and there were discrepancies of greater than 10% between θ and 2α, few candidates gave the acceptable justification that the values were 'too different' to support the suggestion.

(e) Many good answers focused on the need for thin lines drawn with a fine pencil, reading the scale of the protractor perpendicularly, having well separated pins and viewing pins from their bases. Repeating results was accepted only if the need to calculate an average was also stated. Some responses ignored the nature of this particular practical and declared the need for the procedure to be carried out in a dark room, presumably remembered from a list of precautio[illegible] experiments.

Question 5

Many candidates were able to gain at least half of the credit available for this question.

(a) Most responses showed a suitable table with clear headings. Where temperature units had been incorrect in **Question 2**, they were not penalised again here. The tables were often ordered by increasing or decreasing temperature. Correctly ordered times were accepted although it was probably more difficult to see a pattern.

(b) This was a challenging question and the values needed to be studied carefully to see the reading which did not fit the pattern. Many candidates incorrectly chose 50 °C, the temperature at which the time increased after previously falling as temperatures increased. However, it was the earlier set of readings, with a lower time than expected, which did not fit the general pattern of a decrease of 36 s for an increase of 10 °C. This could be seen between 20 °C and 30 °C as well as 50 °C and 60 °C. The interval of 72 s between 30 °C and 50 °C confirmed the pattern.

Many candidates suggested that the readings could be plotted on a graph of time against temperature, often recognising the need for a best-fit line to be drawn. This would show the reading which did not fit the pattern as an anomaly, or outlier, away from the line. Less good responses, attracting only partial credit, suggested a graph but with a dip or bump when the points were joined together. It was necessary for candidates to explain how the point would stand out as not fitting the general pattern, rather than merely stating that it would.