PHYSICS

Paper 0625/11
Multiple Choice

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

General comments

Candidates found **Questions 11** and **29** the easiest, with 89% and 92% of candidates, respectively choosing the correct answer. Candidates found **Question 21** (31% correct) and **Question 40** (35% correct) the most difficult on the paper.

Comments on individual questions

Question 2

Option C was the most popular distractor, with these candidates opting for the highest labelled point on the graph and ignoring the axis label.

Question 4

In this question on comparing masses and weights, 28% believed that balanced scales could indicate the same weight, but different masses revealing a misunderstanding about the relationship between mass and weight.

Question 7

Almost a third of candidates thought the cuboid B to be the most stable, rather than looking for the lowest centre of mass.

Question 8

The main error here was in candidates confusing forces and moments, thus choosing C.

Question 9

A sizeable number of candidates believed that nuclear energy in a power station is first converted into chemical energy, rather than into thermal energy.

Question 10

This question asked candidates which quantity would not affect the work done in lifting a box. Although this question was generally well answered, some candidates may not have appreciated that the question asked for a quantity that would <u>not</u> affect the work done.

Question 12

This question expected the simple recall of the use of a mercury barometer, and rather surprisingly, half of the responses were incorrect.

Question 18

More candidates opted for B or C rather than the correct response, showing confusion over the concept of thermal capacity.

Question 20

Almost a third of candidates chose distractor A, failing to realise that a convection current would not transfer thermal energy sideways to the boy in the open air.

Question 21

Many candidates did not appear to understand what is meant by the term ‘wavefront’ and there was evidence of widespread guessing.

Question 22

Half of the candidates failed to gain the mark in this question, and most of these incorrectly divided the time by the number of waves.

Question 23

More widespread guessing occurred in this recall question about the nature of the image formed by a converging lens.

Question 31

Just over a quarter of candidates opted for C, failing to realise that closing switch 4 would short-circuit the battery.

Question 32

Further guessing was evident in this question on capacitors and relays.

Question 33

Only 43% of candidates could answer this question, suggesting that it would be worth spending some more time on explaining the concept and operation of the potential divider.

Question 34

This question concerned electrical heating of a wire and the most popular error was to believe that thicker insulation would reduce the heating, rather than the use of thicker wires.

Question 38

Knowledge of the relative ionising abilities of β-particles and γ-rays was not secure for many candidates and guessing was evident.

Question 40

In this question on nuclear structure more than half the candidates opted for B, either failing to notice that the question concerned a nucleus rather than an atom, or in the mistaken belief that nuclei contain electrons.

PHYSICS

Paper 0625/12
Multiple Choice

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

General comments

Candidates found **Questions 9**, **12**, **23**, **24** and **27** the easiest on the paper. No question was answered particularly poorly.

Comments on individual questions

Question 3

In this question on comparing masses and weights, a quarter of the candidates believed that balanced scales could indicate the same weight but different masses, revealing a misunderstanding of the relationship between mass and weight.

Question 6

In this question, one distractor proved particularly popular, with a quarter of responses being B. These candidates believed the cuboid to be the most stable, rather than looking for the lowest centre of mass.

Question 9
The calculation of density caused very few problems in this question, in which 92% of responses were correct.

Question 11

A sizeable number confused force and moment in this question, thus choosing distractor C.

Question 12

This concerned transfer of energy from gravitational potential into other forms, and was very well answered.

Question 13

In this question a common misunderstanding led to a belief that nuclear energy in a power station is first converted into chemical energy, rather than into thermal energy.

Question 20

As many candidates opted for B or C rather than the correct response, showing confusion over the concept of thermal capacity.

Question 21

Almost a third of candidates failed to gain a mark in this question, incorrectly dividing time by the number of waves.

Question 23

This question on the cause of reflection was well answered.

Question 24

The majority of candidates could recognise a reflected image.

Question 25

Only half of the candidates showed a good understanding of the term 'wavefront'.

Question 27

Most candidates could identify a beam of electrons as being an electric current, either from knowledge of electrons as the charge carriers in metals, or by deducing that electrons were the only charged particles given.

Question 29

This question required an understanding of the potential divider. Approximately half the candidates chose the correct response, with the rest generally opting for C (the opposite of the correct answer).

Question 33

The fact that an electromagnet can be switched on and off was widely known.

Question 36

Prevention of overheating in a current-carrying wire was understood by the majority of candidates, but nearly half did not gain a mark here, often believing that thicker insulation would keep the wire cooler.

Question 38

More candidates in this question chose option B than the correct response D, suggesting that either they were unaware of the meaning of the term 'nucleons', or that they misread the question and answered as if it concerned an atom rather than a nucleus.

PHYSICS

Paper 0625/13
Multiple Choice

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

General comments

Candidates found **Questions 3**, **11**, **15**, **28**, **30**, **32** and **40** the easiest. **Question 21** (28% correct) and **Question 24** (36% correct) were the most difficult on the paper.

Comments on individual questions

Question 3

A very large majority of candidates understood the significance of the gradient of a speed-time graph.

Question 4

In this question on comparing masses and weights, 24% believed that balanced scales could indicate the same weight but different masses, revealing a misunderstanding of the relationship between mass and weight.

Question 7

This question on stability was well answered, with the most common incorrect answer being B (the cuboid), where candidates have not appreciated that A has the lowest centre of mass.

Question 8

Only 40% of responses were correct here. Most candidates failed to appreciate that, because the parcel was moving at constant speed, the resultant force on it must be zero. Therefore, the two forces mentioned must be equal in size and opposite in direction.

Question 9

Almost a fifth of candidates believed that nuclear energy in a power station is first converted into chemical energy, rather than into thermal energy.

Question 11

The transfer of energy from gravitational potential into other forms was very well understood.

Question 12

This concerned simple recall of the use of a mercury barometer, and rather surprisingly, just over half of the responses were incorrect.

Question 13

Most candidates believed that the water pressure on the larger section of the dam would be greater than that on the smaller section, ignoring the fact that the depth of the water was the same everywhere.

Question 15

Little difficulty was experienced with this question on melting and boiling points.

Question 18

A significant number of candidates opted for distractor A (smallest temperature rise), showing confusion over the concept of thermal capacity.

Question 23

Just over half the candidates knew where to place an object relative to a converging lens in order to produce a diminished image.

Question 24

This question required knowledge that a ray of light travelling from water to a less dense medium (air) would be partially reflected, as well as being refracted. Most candidates did not know that some reflection would occur for angles of incidence below the critical angle.

Question 26

The most common error here was to link small frequency to high-pitched sounds.

Question 27

Just over half the candidates failed to identify iron and steel as ferrous, many believing steel to be non-ferrous.

Question 33

This question on the potential divider showed evidence of widespread guessing, suggesting that the concept and operation was not very securely understood.

Question 40

Very few candidates failed to recognise the neutron as the non-charged particle.

PHYSICS

Paper 0625/21
Core Theory

Key Messages

Candidates can improve their performance by:

- answering the question just as it has been asked
- showing their working clearly

Marks are awarded for the specific answers required. Candidates should avoid the temptation to add comments on related matters or to give general descriptions about the situation presented in the question, as these will not gain credit.

In calculations, candidates must show clear working to support their answers. If unclear or no working is shown by the candidate and it leads to the correct answer, due credit may be given for the numerical answer. However, when a candidate makes an error that leads to an incorrect numerical answer and no working is shown, marks for the method may not be awarded.

General Comments

A high proportion of candidates were well prepared for this paper and it was clear that many candidates had been taught how to apply equations to standard situations. However, some candidates displayed a lack of depth of understanding when it came to applying their knowledge to new situations. Candidates would benefit from more practice in using equations in unfamiliar situations and many struggled when asked to rearrange equation. There remains a tendency for some candidates to think less logically in non-numerical questions compared to numerical questions.

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 undemanding that they would have been better entered for the Extended Theory paper.

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

Comments on specific questions

Question 1

(a) Many candidates failed to recall the term *moment as* the turning effect of a force.

(b) The majority of candidates failed to state that the obvious difference between the forces was that they were in opposite directions. Many candidates scored one mark and simply gave the reverse argument for their second answer.

(c) The majority of candidates scored this mark, but a number were vague in their description of where a lubricant should be applied.

Question 2

(a) Nearly all candidates could state the equation linking density, mass and volume.

(b) (i) Many candidates scored all three marks, but a significant number went astray by trying to use the equation for density in their calculations.

(ii) With credit given for wrong answers from part **b(i)** used in **b(ii)**, the majority of candidates were able to score both marks in this part. The most common source of error was an incorrect rearrangement of the equation.

Question 3

(a) Many candidates scored all three marks. The most common source of error was an incorrect rearrangement of the equation for speed, distance and time.

(b) (i) Most candidates scored both marks. Weaker candidates lost a mark through subtracting reaction time instead of adding it to the answer from part **(a)**.

(ii) Only better candidates seemed able to produce an answer linking starting the timing to an appropriate visual stimulus. Many weaker candidates thought the timekeeper should move closer to the start of the race or that he should 'be more attentive'.

(c) Many candidates scored both marks. Weaker candidates once again deducted the timing error rather than adding it to the time shown on the watch.

Question 4

(a) The majority of candidates scored this mark.

(b) Most candidates scored this mark, but weaker candidates confused elastic potential energy with gravitational potential energy.

(c) The majority of candidates gave the correct answer for this question, but a significant number of candidates interchanged the correct answers to parts **(b)** and **(c)**.

(d) A significant number of candidates seemed to think that the arrow's kinetic energy would increase as it rises. The majority of candidates scored two or three marks in this question.

Question 5

(a) (i) The majority of candidates recognised that atoms in the metal would vibrate faster when heated, but only the better candidates gave a valid second point, with many giving general statements about melting. A common misunderstanding was to state that 'atoms would expand'.

(ii) Only better candidates realised that all three dimensions of the ruler would increase. Weaker candidates insisted that at least one dimension would decrease.

(b) Many candidates scored one mark for realising that the nut would expand, but only better candidates included a comparison with the bolt. The weakest candidates stated that the nut would melt.

Question 6

Many candidates failed to use a ruler when drawing rays in this question.

(a) (i) Only better candidates were able to correctly identify the angle of refraction and use the required letter to identify it.

(ii) The majority of candidates scored two marks, with only the best candidates realising that the ray would be refracted upwards at both surfaces of the second prism.

(iii) Only better candidates recognised that P would be at the point where the red light entered the prism on the left of the diagram.

(b) (i) The majority of candidates scored two or three marks. Weaker candidates ignored labels and started a new ray for blue light, or drew the ray refracting upwards at the second surface.

(ii) The majority of candidates scored this mark.

Question 7

(a) Most candidates scored the mark for this question. However, many weaker candidates misread the question and drew an arrow pointing to the north-seeking pole of the compass.

(b) Most candidates scored both marks, but a significant number only scored one mark by merely stating that the two poles would repel each other.

(c) Only better candidates recalled that a current flowing in a wire would produce a magnetic field.

Question 8

(a) The majority of candidates scored one mark, with only better candidates stating that 1.5 V was the electromotive force of the cell.

(b) Many candidates scored full marks for this calculation. The most common source of error was an incorrect rearrangement of the equation, and the most common loss of one mark was failing to write down the correct unit for current. Many candidates were able to score 2 marks by correctly stating that V= I x R and by giving the correct unit for electric current,

(c) (i) Many candidates scored full marks for the circuit diagram. The most common source of error was the addition of a short circuit across the parallel combination of resistors. Weaker candidates drew the resistors connected in series.

(ii) Many candidates scored both marks, with weaker candidates thinking that one or both of the quantities should be halved.

Question 9

(a) The majority of candidates scored this mark, but a significant number of candidates failed to label the diagram at all.

(b) (i) Many candidates scored this mark, but a significant number thought that the charge in the circuit would increase.

(ii) Most candidates scored one mark, but only the best candidates realised that the voltage would increase slowly.

(c) Only better candidates recalled that a capacitor stores charge, and that its voltage would only decrease slowly.

Question 10

(a) Most candidates scored this mark. Weaker candidates thought that the coils should also be made from iron.

(b) Only better candidates seemed able to recall the name of the part of the transformer made of soft iron.

(c) Many candidates scored full marks for this calculation. However, many scored zero through simply giving an incorrect answer with no working. Candidates should be encouraged to show their working in all calculations.

(d) Many candidates scored both marks in this section, but some candidates tend to use rather exaggerated descriptions, for example 'explode' for part **d(ii)**, which teachers should discourage in favour of more appropriate descriptions.

Question 11

A significant number of candidates did not give answers to the three parts of this question, perhaps showing a lack of knowledge or understanding of the properties of radioactive emissions.

(a) Of those that answered this part, many candidates scored both marks.

(b) Of those that answered this part, many candidates scored one or two marks.

(c) Of those that answered this part, many candidates scored one or two marks.

Question 12

(a) (i) Many candidates scored this mark, with weaker candidates confusing the nucleon number with molecular mass or the number of neutrons.

(ii) Many candidates scored this mark, with weaker candidates confusing the proton number with mass number or the number of neutrons.

(b) (i) Only the best candidates scored this mark.

(ii) Only the best candidates realised that the –1 would indicate a negative charge.

(c) (i) Many candidates identified the correct nuclide.

(ii) Many candidates scored this mark, but weaker candidates failed to carry out the calculation accurately and chose the wrong nuclide.

PHYSICS

Paper 0625/22

Core Theory

General comments

This paper requires candidates to have a sound knowledge and understanding of all sections of the Core syllabus. It would appear that all candidates 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.

Examiners look to give credit for correct responses even if presentation, spelling, punctuation and grammar are not good. There is no penalty for weaknesses in English language skills. However, candidates would be well advised to take care with the presentation of their work and to check their written responses so as to ensure that they are able to gain the full benefit of the marks available. Similarly, examples of careless and untidy drawing prevented marks being awarded to some candidates.

The questions on the mechanics and electricity 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 significant number of candidates missed out on obtaining maximum marks on numerical questions through not including an appropriate unit alongside their correct responses, where required.

The questions on the heat, light 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 contradictory responses or a choice of possible answers to a question. In such cases, an incorrect response alongside a correct response does not gain any credit.

Comments on specific questions

Question 1

Many candidates had a good understanding of speed. A significant number were unable to convert the time in minutes into a time in hours. A number of candidates failed to recognise that the straight line on the graph was an indication of the constant speed of the bus travelling to the football ground.

Question 2

This question resulted in high marks for many candidates. However, a significant number of candidates incorrectly measured the length of the plastic sheet, with common errors being 0.8 cm, 8.1 cm and 80 cm. This error was carried forward so that the majority of candidates were able to gain full credit for subsequent calculations. There were a significant number of incorrect responses to part **(c) (ii),** with the most common being ‘weighing machine’.

Question 3

(a) About half of candidates provided the correct response with nearly all others indicating that the pressure was greater.

(b) The vast majority answered this question correctly.

(c) About a third of candidates gave a correct response to this question. A common error was to divide 752 by 123, rather than subtract the 123 from the 752.

(d) A number of candidates did not attempt a response to this question. Of those that did attempt it, very few gave the correct answer. Of those that did not gain a mark for their answer, half suggested that the mercury level would increase and half, that it would decrease.

Question 4

This question was poorly answered by many candidates.

(a) Very few candidates scored the first two marks, with the majority of candidates believing that the image would appear to be on or in front of the mirror rather than behind the mirror.

(b) (i) There were many examples of careless and untidy drawings. In some cases it was unclear which of the many lines drawn was intended to be the normal. Many candidates did not attempt this part.

(ii) Very few candidates were able to draw correct incident and reflection rays to and from the mirror to justify whether or not the two people would be able to see each other. Those that had produced correct diagrams often failed to realise that the position of the rays striking the mirror could be between the mid-point of the mirror and the end, P.

Question 5

(a) Many candidates were confused about the amounts of kinetic energy at the highest and lowest points of the swing. Some candidates suggested answers above the 150J indicated.

(b) This question was generally well answered with many of the more able candidates obtaining full credit for this question.

Question 6

This question was poorly answered by many candidates.

(a) (i) There were many incorrect responses to this question with common misconceptions including a reference to diffusion or to Brownian motion.

(ii) Following on from their responses to the previous part, many candidates gave responses in terms of the passage of the crystal through the water as a result of the collisions between particles, and many failed to mention the fact that warm rises and cooler water falls. There were also a significant number of candidates who gave answers to this part in terms of air rising and falling, which did not receive credit.

(b) Just over a third of candidates were able to give an acceptable response to this question.

Question 7

This question was generally well answered by those that had effectively revised this topic. There were many candidates that left sections blank, without attempting an answer. In some cases, much of the question was left without any responses at all.

Question 8

Many candidates obtained high marks for this question. Candidates were able to correctly identify the ammeter and voltmeter in most cases. Many candidates were also able to correctly calculate the value of the resistance, but a small number forgot to include the unit, which had not been given. There were also many creditworthy responses for the last parts to this question.

Question 9

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

(b) This question was not well answered with only a very small number obtaining full credit for their responses to both parts of the question. The majority of candidates obtained only one of the marks available and this was invariably picked up in the second table for lamps L2 and L3 having partial brightness.

Question 10

Parts of this question were well answered by many candidates. Generally those candidates who obtained the correct response to part **(a)** then went on to score a further mark in part **(b)**. Part **(c)** was not well answered. In part **(c) (ii)**, a small proportion of candidates correctly identified that motors make use of the effect, with the most common misconception being that the effect is used by generators or electromagnets. Parts of this question were not attempted by some candidates.

Question 11

This question was very poorly answered by the majority of candidates – it is clearly a topic that needs more attention in the future.

(a) Candidates were generally unable to explain the term 'radioactive decay'. The weaker responses included the use of the same wording as in the question, for example 'the decay of radioactivity'. Of those that did attempt an explanation, many gave an explanation for half-life. There were very few candidates who were able to explain radioactive decay in terms of the break-up of unstable particles and the emission of alpha, beta or gamma radiation.

(b) This part of the question was poorly answered by the majority of candidates with many omitting it altogether. A high proportion of those who attempted part **(a)** read the highest count rate as 2400 rather than 2200. Although a few candidates did show the count rates being halved, they did not then go on to link the values with times. There were very few correct responses to part **(ii)** of this question. Those that answered gave a value based on an estimation of between 200 and 300 counts per minute rather than as a result of a calculation.

Question 12

Many candidates did not attempt parts of this question.

(a) Generally well answered by many candidates.

(b) Few candidates made valid responses to this question.

(c) A small, but significant number of candidates gave the correct response, the most common misconception being a reference to a charge or voltage being applied.

(d) A small number gave the correct response, with the common misconception being that the plates were used to accelerate the electrons into a beam.

(e) Many candidates were able to give the correct response to this question.

PHYSICS

Paper 0625/23

Core Theory

General comments

This paper requires candidates to have a sound knowledge and understanding of all sections of the Core syllabus. It would appear that all candidates 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.

Examiners look to give credit for correct responses even if presentation, spelling, punctuation and grammar are not good. There is no penalty for weaknesses in English language skills. However, candidates would be well advised to take care with the presentation of their work and to check their written responses so as to ensure that they are able to gain the full benefit of the marks available. Similarly, examples of careless and untidy drawing prevented marks being awarded to some candidates.

The questions on the mechanics and energy 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 significant number of candidates missed out on obtaining maximum marks on numerical questions through not including an appropriate unit alongside their correct responses, where required.

The questions on radioactivity were not well answered by candidates who might have benefited from further revision.

Comments on specific questions

Question 1

The majority of candidates gave good responses to this question and demonstrated a good understanding of calculating speed using the equation 'distance ÷ time'. A small number of candidates lost a mark for not including a correct unit for speed. Part **(c)** of the question was not as well answered, indicating that candidates were unsure of how acceleration altered the speed of the vehicle.

Question 2

This question resulted in high marks for most candidates.

Question 3

This question was generally well answered. A small number of candidates ticked more than the required number of boxes in each column and consequently marks were lost for including incorrect responses.

Question 4

(a) Many candidates scored high marks for calculating the volume and then the density of the aluminium rod. A small number of responses did not include an acceptable unit. A small number of candidates did not attempt the density calculation.

(b) The majority of candidates scored the first mark. A smaller proportion of candidates were then able to obtain the final two marks for describing a different method for finding the density of the cylinder, realising that the base was circular. A common misconception by those attempting this question was to use the equation 'length x width x height'. A small number of candidates did not attempt part **(b) (ii)**.

Question 5

This question resulted in high marks for over half of the candidates. A small proportion of candidates lost marks for a lack of accuracy when drawing the rays or for poor positioning of the mirror in part **(b)**. A very small number of candidates did not attempt parts of this question.

Question 6

This question was poorly answered by many candidates.

(a) There were few correct responses to this question with many candidates incorrectly using terminology associated with the heat section of the syllabus. A small number of candidates did not attempt the last part of this question.

(b) There were no correct responses to this question, the misconception being that the water was boiling at 80 ^{o}C.

(c) There were many correct responses to the first part of this question, but a common misconception was that the water was evaporating. About half of the candidates responded correctly to the second part of the question with incorrect responses being chosen in equal measure.

Question 7

This question was generally well answered by those that had effectively revised this topic. There were a small number of candidates that left sections without attempting an answer. In part **(b)** a common error by a small number of candidates was the use of distances that were too small. In part **(c)** a significant number of responses included answers that were too vague, for example, candidates gave responses of 'distance' and 'time"' without clarifying which distance and time was to be measured. Very few candidates obtained the last mark where they were required to recognise that the distance needed to be doubled (or the time halved) to take account of the sound travelling towards the obstacle before being returned.

Question 8

In parts, this question was well answered by some candidates.

(a) There were some very poorly presented circuit diagrams. In future, candidates may lose marks for careless or untidy diagrams that are not drawn with accurate symbols.

(b) There were some very good responses by those that had revised the equation V = IR. A small number of candidates did not attempt this question.

(c) There were many correct responses, but a common error involved candidates explaining that the fuse had blown rather than the lamp.

(d) This question was not well answered with very few candidates scoring all three marks. Candidates did not appreciate that a blown fuse would prevent the lights from working.

Question 9

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

(b) This question was not well answered with only a small number of candidates obtaining full marks for the completion of the table. A greater number of candidates did, however, know that soft-iron is required for an electromagnet and that the advantage of an electromagnet is that the magnetism can be switched on and off.

Question 10

This question was well answered by those candidates that had revised this section of the syllabus carefully. There were many good responses resulting in candidates obtaining high marks.

Question 11

This question was well answered by more able candidates.

(a) There were very few candidates that were able to complete correctly the table, a common misconception being that a neutron has no mass.

(b) There were very few candidates who were able to correctly identify the number of particles in the atom. Despite making responses, a significant number of candidates did not score any marks for this question.

Question 12

A significant number of candidates did not attempt parts of this question. Radioactivity is a topic that needs to be given more attention.

(a) Very few candidates gave an acceptable answer to this question. Candidates that did give responses often lacked the required accuracy.

(b) A small number of candidates gave the correct response to this question.

(c) A very small number of candidates gave a response within the allowed tolerance.

(d) This question was not attempted by most candidates. Those that did give a response often started their own curves from the same starting point as used on the original graph.

PHYSICS

Paper 0625/31

Extended Theory

Key messages

Candidates must be careful in their use of the words 'it' or 'its' in an answer involving a description or explanation. In a question there is often more than one word or term or component in a circuit, say, to which the words 'it' or 'its' could apply. Sometimes an Examiner can judge from the further context of an answer what the candidate meant and reward the answer appropriately. However, this is not always the case and as a consequence credit may have to be withheld.

It has previously been suggested that the use of bullet points in writing longer descriptive answers is to be encouraged. This technique can help to focus the thinking and keep answers brief and to the point.

General comments

The most able candidates were able to look at a question, evaluate its requirements, and write succinct answers in appropriate scientific language. Their numerical work tended to be accurate and often faultless with steps clearly explained.

Candidates of lower ability had more difficulty in seeing the main point of a verbal question and sometimes gave the impression of beginning to write without having thought through the essential point that they were trying to make. Such answers sometimes began with a rephrasing of the question, costing time and leaving little of the given space to make that point. If a numerical question demanded the use of a formula, the substitution of data and a subsequent calculation, few errors were made. However, more difficulty was apparent if question required a step-by-step approach and an intermediate numerical answer was involved.

The weaker candidates were only on firm ground in questions that followed a pattern that they had previously encountered. They tended to be puzzled by those questions which demanded fresh thinking. Because it fits in with the knowledge which they have actually acquired, they appeared sometimes to answer a different question from the one that actually faced them. In longer descriptive answers they often lost the thread of what they were trying to explain. Nevertheless, creditable work on at least parts of several questions was frequently seen.

Comments on specific questions

Question 1

(a) This question allowed a large majority of the candidates to get off to a good start on the paper. Mistakes in both parts **(i)** and **(ii)** were fairly uncommon. Where credit was lost, it was usually because of a misreading of the maximum speed from the graph.

(b) The good work in **(a)** was, in general, continued here.

(c) This was a particularly testing question that proved difficult for even the very able candidates. Some appreciated that during the constant speed phase of the motion there was no resultant force. The further step to write down 'driving force = friction (or air resistance)' followed fairly readily. 'Driving force – friction (or air resistance) = resultant force' was not rewarded.

Question 2

(a) Most candidates know how a vector quantity is identified.

(b) An error in the direction of an arrow on one or more of the vectors was the main reason for a penalty in drawing the vector diagram. The candidates who chose to obtain the resultant as the diagonal of a rectangle, rather than the third side of a triangle, were less likely to incur this type of penalty. In general, the accuracy of the numerical values obtained was good. For those obtaining the values by using the given scale, rather than by calculation, some tolerance was allowed.

Question 3

(a) Since the conditions for equilibrium of forces is a Core item in the Curriculum Content, it is surprising how few candidates could state them. For the Extended paper, the word ‘moment’ is a preferred alternative to ‘turning effect’.

(b) (i) A common error, and in many cases the only error, in calculating the force *F*, was the use of 380 mm, instead of 500 mm, in writing down the moment of the 20 N force about H.

(ii) With the benefit of the error from **(i)** carried forward frequently needed, there were many successful calculations of the pressure. The unit N/m^2 was accepted as an alternative to Pa.

Question 4

(a) A good proportion of candidates gave an acceptable meaning of ‘centre of mass’.

(b) Having answered **(a)** successfully, it was anticipated that more candidates could identify *h* in the formula g.p.e. = *mgh* as the height through which the centre of mass of the body rises.

(c) This was an example of the sort of answer highly suitable for a bullet point approach, matching each change of energy to a stage in the pole-vaulting process. In some cases the energy changes were identified correctly, but the matching aspect was unclear. The most frequent errors were in referring to the chemical energy in the body as potential energy, and not appreciating that the pole, when bent, contains strain energy. On the whole, however, the question was answered well, with most candidates gaining at least half of the available credit.

Question 5

(a) (i) The point required was that gas molecules exert a force when they collide with a solid surface. Many candidates, having made this point, added detail here that was only required in the answer to **(ii)**.

(ii) Most candidates gained most of the available credit. The point most frequently omitted was that a greater force is exerted

(b) A majority of candidates quoted a formula consistent with Boyle’s Law and calculated the new volume of the air, which was quoted as the final answer. A small of minority of these candidates, who had read and understood the question more thoroughly, subtracted the volume of air remaining in the cylinder.

Question 6

(a) The most common error in defining specific latent heat of fusion was the omission of a reference to 1 kg or 1 g or unit mass.

(b) (i) Errors in converting mm to metres were a common source of error resulting in some loss of credit.

(ii) There were two approaches to this two-step calculation. One approach was to find 60% of 250 and multiply the answer by 0.25. The other was to multiply 250 x 0.25 and find 60% of the answer. The majority of candidates made an error in one or other of the steps. Some used the 60% incorrectly. Others divided rather than multiplied by 0.25. The expected unit was J, but J/s and W were also accepted.

(iii) For many candidates this question proved as problematical as **(i)**. Most could be rewarded for quoting Q = mL, but fewer could calculate the mass of ice melted. Only a small minority were then able to calculate the time taken, again with errors carried forward taken into account.

Question 7

(a) Most candidates wrote an acceptable explanation of the cooling of a liquid as a result of evaporation. References to hotter and colder molecules in some explanations were not rewarded.

(b) In **(i)**, many answers revealed a serious misconception in the explanation as to why B takes longer to cool than A. Few candidates compared the emission of radiation from the dull and shiny surfaces, referring instead to reflection. Some answers were apparently on the right track but had to be rejected because the candidate had written 'it is a better emitter of radiation'. In **(ii)**, **(iii)** and **(iv)**, a large majority offered the correct explanations.

Question 8

(a) (i) Some candidates drew a glass block rather than a single refracting surface, but could be rewarded nevertheless if the correct detail was present. In some drawings one angle required to be marked was with the normal and the other with the surface. This seemed to be evidence of carelessness rather than lack of knowledge.

(ii) Little difficulty was apparent in the calculation of the refractive index. A large majority gained full credit.

(b) Most answers referred to total internal reflection and gained some credit. Credit for explaining this in terms of the angle of incidence being greater than the critical angle was less frequently awarded.

Question 9

(a) (i) Many candidates clearly failed to read the question with sufficient care. The significance of the words 'larger' and 'opposite direction' had to be taken into account. Only partial credit was possible for a large number of answers.

(ii) This question proved to be too demanding for most candidates. Very few of even the most able candidates appreciated that opposite and equal voltages would be induced in the two halves of the rod, with no resultant voltage therefore occurring.

(b) Candidates in general showed a lack of knowledge of the details of the components and use of an oscilloscope. In **(i),** many referred to Y-terminals rather than Y-plates. In **(ii)**, very few could relate the motion of the spot on the screen to the motion of XY. In **(iii)**, there was minimal realisation that the time-base would be off.

Question 10

(a) Some candidates, apparently not appreciating the significance of the word 'quantity' in the question, quoted formulae for resistors in series and parallel.

(b) Usually when candidates see two resistors in series, they add their values to find the total resistance. In this case, few did this, perhaps because one was a thermistor rather than a resistor, or because the voltmeter was connected across one of them. Without that starting point little progress was possible, and no credit was gained. Of those who found the combined resistance, some went on to calculate the current and the voltmeter reading. Very few gained full credit.

(c) A bullet-point approach such as the following may have been advantageous for some candidates.

- When heated the resistance of the thermistor decreases.
- The current in the circuit containing the relay coil rises.
- The magnetic field of the relay coil closes the switch and the bell rings.

Many candidates were awarded most of the available credit.

Question 11

(a) Most candidates were awarded full credit.

(b) (i) An idea of repulsion, not reflection or deflection, between the positive charges of a gold nucleus and an α-particle, was required.

(ii) It was fairly common to find no response offered to this question. Those who gave an answer most frequently referred to the positive charge of the nucleus. Less common were references to the small size of the nucleus relative to the size of the atom, and its large mass relative to the total mass of an atom. References to neutrons in the nucleus were ignored.

PHYSICS

Paper 0625/32
Extended Theory

Key Messages

- Candidates must not try to maximise their chances by giving more than one answer to a question. If two answers are given, one correct and the other incorrect, the candidate will almost always score no credit. Candidates must follow the rubric of the question. 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 asked. Credit is only awarded for the specific answers required, not for comments on related matters.

- 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 poor, or no working. If this leads to the correct answer, the Examiner may be able to give some credit due to the merit of the work. When an error is made in the middle of such work, it is usually impossible for credit to 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 the more able candidates. 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 in the examination. Many candidates, when asked to apply their knowledge to a new situation, become confused and unable to use what knowledge they do have. Often candidates had been taught well how to apply equations to fairly standard situations, but displayed a lack of breadth of understanding of their use in other contexts.

A significant minority of candidates found the subject matter and level of some questions inaccessible and would, therefore, have been better entered for the Core paper. However, the 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. Others gave the impression of not being able to understand some questions. The English language ability of the vast majority was adequate for the demands of this paper.

Overall the use of units by candidates was very good. Instances of forgotten units were rare and wrong units were seen even more rarely. Normally answers are required to two significant figures. Fractions should not be used in final answers.

Comments on specific questions

Question 1

(a) The majority of candidates gave good answers, although some weaker candidates failed to convert kilojoules to joules.

(b) Better candidates scored full credit. Nearly all the weaker candidates knew the appropriate equation but made mistakes in application. This was possibly due to reading the question carelessly or not thinking about it. Often 160kJ or 40kJ was used as the gain of gravitational potential energy rather than subtracting 40kJ from 120kJ.

(c) Only the best candidates scored full credit for this part. Most lost credit through imprecise answers, e.g. stating that the kinetic energy of the car had been transferred to kinetic energy or gravitational potential energy but not specifying "of the water". A significant number seemed to think that friction was a form of energy.

Question 2

(a) Many candidates failed to realise that this part of the question only asked for the resultant force, and attempted to draw vector diagrams on top of the airliner. This produced a mixture of actual forces as well as the resultant force, and unless labelled accurately, resulted in the loss of credit.

(b) A significant proportion of better candidates produced clear accurate diagrams. Candidates should be able to add vectors by graphical representation. They need plenty of practice to be able to do this in a range of situations. Very few of the weaker candidates were able to set about this task correctly. Common errors were failure to choose a suitable scale for the forces and apply it consistently. Often the vectors of the two forces 1.20×10^6 N and 1.39×10^6 N were drawn the same length. Many incorrect angles between the vectors were used. When a parallelogram was used, more often than not the wrong diagonal was drawn as the resultant vector.

(c) This question differentiated clearly between good and weak candidates. Many good candidates scored full credit, but weaker candidates were unable to give any sort of meaningful answer, or thought that as the speed was constant, so was the velocity.

Question 3

(a) The majority of candidates scored most of the available credit. The most common error was to think that a sensitive thermometer was one that reacts quickly to change of temperature.

(b) (i) The majority of candidates scored full credit. Some credit was lost through forgetting to label different metals for the wires in the thermocouple and/or showing some form of unlabelled dial or meter, which was therefore meaningless. Many weaker candidates produced diagrams of liquid-in-glass thermometers. This was possibly due to a weakness in their knowledge of English and they may have thought that the word 'thermometer' meant a liquid-in-glass device.

(ii) The majority of candidates linked a thermocouple's ability to measure high temperatures to the high melting point of the metal wires. Virtually none realised that its ability to measure rapidly changing temperatures was linked to its small thermal capacity.

The performance of candidates in the past has also suggested a weakness in showing an understanding of the term thermal capacity.

Question 4

Candidates generally gave good answers to all parts of this question and seemed well-practised in applying kinetic theory to this sort of situation. Some of the answers were confused, suggesting that candidates were trying to cover every possible point, relevant or irrelevant. Where possible, scoring points were identified but it was sometimes unclear as to what was meant. Often the spurious information was contradictory to a valid point made so negated any credit that might have been awarded.

(a) The vast majority of candidates full, or nearly full credit for this question. Only the weakest candidates failed to answer in terms of molecular movement.

(b) Again, this part was very well answered, with the vast majority of candidates scoring well.

Question 5

This question was generally well answered and candidates scored highly. Even weaker candidates appeared to understand the physics, but their answers were often let down by poor powers of expression or knowledge of English.

(a) Almost all candidates scored some credit for this question. Better candidates were able to link the lower external temperature of the double cup to a reduction in thermal energy transferred across the air gap. A few weak candidates seemed to think that there was a vacuum between the cups. Possibly this was confused thinking related to a vacuum flask.

(b) Most candidates scored some credit for this question. Careless graphical work was the most common error. For example, many cooling curves became horizontal, often after eight or nine minutes.

(c) Better candidates gave two clear reasons why energy loss from the cup was reduced when fitted with a lid. Weaker candidates only gave one reason, and sometimes there was confusion with the double cup of part **(a)**.

Question 6

(a) The majority of candidates scored all the available credit. Typical errors made by weaker candidates were a muddling of the equation or the substitution of 15 °C or 65 °C as the temperature rise instead of the difference between them. This was one of the few part questions in the paper where a significant number of answers were penalised for an incorrect unit or no unit at all.

(b) Strong candidates did well on this part but not as many middle range or weaker candidates scored full credit as in part **(a)**. They did not always realise that the value of 170 W/m^2 needed to be multiplied both by the area and by the number of seconds in an hour.

(c) This part differentiated clearly between candidates. Many of the weakest candidates could not recall the efficiency equation. Of the better candidates, many substituted the values for input and output energy into the correct equation, but the wrong way round.

(d) The vast majority of candidates scored credit here, but answers were often poorly expressed. The "it is never over" was given in many cases. This appears to be a colloquial expression meaning "it will not be used up". Candidates should learn carefully what expressions are colloquialisms and avoid using them in examinations.

Many candidates made the incorrect statement that solar energy can be re-used or replaced, which on its own cannot earn credit. If written down alongside an acceptable answer, such as "the Sun's energy will not run out", the candidate was given the benefit of the doubt and the wrong statement was ignored as irrelevant. On another occasion, the two parts could have been regarded as two attempts at the answer. One is correct and the other incorrect; it would, therefore, be marked as wrong.

(e) Again, the vast majority scored credit, with the most common response being that the solar panel would not produce any heat at all when the Sun was not shining or only shining weakly.

Question 7

(a) There were many correct and well drawn ray diagrams. The question was designed for the diagram to be drawn full-scale. Other scales were acceptable as long as quoted on the diagram. Where a different scales were used but not quoted, it was impossible for the Examiner to know whether or not the work was correct, and so credit could not be awarded. Weaker candidates also often lost credit through carelessness or using a scale that made the drawing of the diagram difficult.

(b) (i) The majority of candidates scored credit here, although some responses were again poorly expressed. The weakest candidates had very little idea of what was meant by a virtual image.

(ii) Better candidates found this part easy, but again the weakest candidates seemed to have little knowledge of the situation.

Question 8

(a) A high percentage of candidates showed a good understanding of the mechanism of charging by friction and scored full credit. The most common error was to state that the candidate's hair was positively charged and therefore attracted electrons from the balloon.

(b) A high percentage of candidates scored full credit here.

(c) Many candidates produced good answers to score full credit. Many responses included details of how a charge was induced in the stream of water.

(d) The majority of candidates found this difficult and only the best were able to state that the metal is an electrical conductor, or contains free electrons.

Question 9

(a) The majority of middle range and good candidates displayed a good understanding of the properties of alpha particles and gamma rays, and most or all of the available credit.

Many weaker candidates, and even a few better ones, failed to follow the rubric of the question, even though it was stated in bold. There was often more than one tick in each column, and sometimes the ticks were contradictory, e.g. a tick in the box for 'no deflection' as well as in one or more of the boxes describing a deflection. A number of candidates put multiple ticks in each column, perhaps hoping to ensure the correct box was ticked. Candidates should be made aware that mark schemes are always designed so that such an approach will score no credit.

(b) A number of candidates found this difficult. The most common error was, having explained the effect on alpha particles, to completely ignore the effect on the gamma rays.

(c) Again, many candidates lost credit for thinking that stating the purpose of the lead cylinder was all that was needed, without any explanation.

Question 10

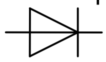
(a) A high percentage of candidates scored all full credit. Only the weakest candidates failed to use a correct expression for calculating the parallel combination of resistors.

(b) (i) The majority of candidates scored full credit here. The most common errors were to connect the ammeter so that it measured the total current through both resistors or to short circuit the resistors.

(ii) Many candidates scored full credit in this part, the most common error being to use the wrong value for the second resistor in their calculation of current.

Question 11

(a) The majority of candidates scored credit here, although often the symbol given was not quite correct. Only a small minority used the approved symbol for a diode.



An enclosing circle is optional, and was acceptable. The version most commonly seen had no horizontal line through the triangle. This was accepted on this particular occasion.

(b) Many candidates scored full credit, but a significant number thought that the diode could conduct in both directions.

(c) Good candidates showed the required half wave rectification. Weaker candidates indicated that it would either be a full wave or a steady d.c. voltage, or even that the frequency changed. For full credit candidates needed to draw flats at 0 V between the half waves and realise that the two resistors acted as a potential divider. The peak voltage of each half wave should have been shown as 3 V.

(d) The majority of candidates correctly identified component Z as a transistor. Only better candidates were able to give the correct condition of the lamps for the given switch positions.

Many candidates put ticks or crosses in the boxes, or wrote yes or no. These answers were unclear and so scored no credit.

PHYSICS

Paper 0625/33
Extended Theory

Key Messages

This paper consists of questions based on the Extended (Core plus Supplement) syllabus content with a quarter of the marks available based on the Core syllabus material. It therefore follows that the candidates who scored well on this paper, had studied the entire syllabus and were thoroughly familiar with it. Some parts of questions tested factual recall and there are some facts, definitions and formulas that candidates needed and recall accurately. Some of the other parts of the paper tested the application of the fundamental ideas in areas which had not necessarily been studied during the course. The candidates who excelled on these parts were those who were not only familiar with specific facts, but who also understood the implications of the basic ideas and had a sound and thorough grasp of them. Many of these candidates were able to apply them in the particular cases asked for.

In some cases, a question involved the use of a known formula and the substitution of values given in the question. These questions usually offer some credit to the candidate who is able to give the correct formula or to show how the numbers are to be manipulated but full marks are only awarded to candidates who obtain the correct numerical answer and who supply with it, a suitable unit. Candidates should be advised that fractions are not acceptable in a final answer and that final answers given to only one significant figure are only credited where the full calculation produces no subsequent significant figures. It was noticeable that, after several years where it is rare for a candidate to lose more than a couple of marks through unit and significant figure omissions, candidates were less meticulous this time.

It is inevitable that a certain level of basic mathematical manipulation is required in a paper like this one. Some candidates are able to recall correct formulas, but often they are unable to rearrange them correctly. This happens most often after the numerical substitution but it sometimes seen with the formula itself. In this paper, marks were lost for this reason in **Question 6(a)(ii)** and **8(a)(i)**.

General Comments

Some candidates are clearly writing out their answers in pencil and tracing over them in ink. This is not only a waste of the candidate's time, but it can lead to an answer which is less legible than it would otherwise be. This should be strongly discouraged.

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

Comments on Specific Questions

Section A

Question 1

(a) These three times were quite commonly correct and most candidates knew what was required and understood how to interpret the graph. The three parts of the question each asked for a single time and candidates who gave a range of times were only credited when all times in the given range were acceptable. The candidates who were least likely to forfeit a mark were those whose times were clearly in the correct region of the graph and not near to a time the acceleration passes from one stage to another.

(b) This was the most difficult part of the question and few candidates scored all four marks. Surprisingly few candidates referred to the weight of the brick and the fact that the air resistance is increasing as the brick speeds up was commonly omitted. There were no marks available for explaining the behaviour of the brick after 14.0 s.

(c) This was more often correct than not, but a surprisingly significant number of candidates gave the answer 'downward'.

Question 2

(a) This was usually correct, but a very few candidates gave the 'kilogram' as the unit or a numerical value such as 0.54.

(b) (i) This was poorly answered with rather more candidates describing the elastic limit than those who described the limit of proportionality.

(ii) This was quite well answered with many candidates scoring all three marks and others obtaining two in part **1**. Some candidates needed to be aware that the extensions should have been calculated from information given and that it was the total lengths that were given in the question. It was noticeable that some candidates obtained the correct answer in **2**. without obtaining the correct answer in **1**.

(iii) Although this was very well answered, either by using the correct values or as a result of carrying forward a previous error, there were still a few candidates who calculated the reciprocal of density or who multiplied the mass by the volume.

(c) This was generally well answered.

Question 3

(a) This was also generally well answered with many candidates obtaining both correct answers.

(b) (i) This was well answered with nearly all the candidates scoring both marks.

(ii) This was less well answered. Some candidates simply gave one of the forms of energy already mentioned.

(iii) This was well answered by only a minority of candidates.

(c) Very few candidates revealed an understanding of the need for a centripetal force. It was unfortunate, therefore, that some of those who did, did not give a sufficiently precise answer. That the force is perpendicular to the direction of motion is true, but is not sufficiently detailed to score the mark in this case.

Question 4

(a) (i) Almost all candidates were aware that the molecules collide with the inner surface of the cylinder and scored the first two marks and many of these candidates realised and stated that the collision caused a force to act. Those who made no reference to a force did not score full marks here.

(ii) Many candidates gave both points required here but of those who did not, the majority omitted to mention the reduction in the number of collisions and only mentioned the reduction in the number of molecules.

(b) This relatively straightforward calculation was very usually correct. However, some candidates did not add on the atmospheric pressure and in a few cases used the value as *g* in *hρg*. The value of *g* is given on the front cover sheet.

Question 5

(a) (i) Credit was given here for a variety of thermal energy transfer mechanisms, but convection is primarily a mechanism that occurs within a single medium. Candidates who only suggested 'convection' as their answer did not, as a result score highly here.

(ii) Very few candidates offered the straightforward explanation of a reduced temperature difference here, but many did score the mark in other allowable ways.

(b) Many candidates supplied both clear diagrams and detailed and accurate descriptions of appropriate experiments. It was especially encouraging to see how many candidates made a point of emphasising the need to keep other variables the same. There was a certain amount of confusion with the absorption properties of the surfaces referred to and many candidates suggested heating their water vessels with an external radiant heater. Fortunately, some of these then allowed the water to cool and in some cases were able to score full marks.

Question 6

(a) (i) Many candidates scored this mark, but others suggested the speed of sound or confused the power of ten required. The value 3.8×10^8 m / s was very commonly suggested.

(ii) Many candidates were able to produce the correct answer although some found difficulty when dividing by a number with a negative index in the power of ten. Some candidates simply treated it as a positive index. Those who quoted the formula using the conventional symbols usually did so accurately. Candidates who quoted the formula using other symbols, were much more likely to write a version of the formula which was unclear and difficult to interpret, for example $v = w\lambda$ was typical.

(b) (i) The correct answer to this straightforward part of the question was very commonly given by candidates although 35° was given by some.

(ii) Most candidates understood what was required and were able to calculate the correct answer here. A few simply divided 55° by 1.5. There were also those who, having written *sin 55° / 1.5* then divided 55° by 1.5 in order to obtain their answer.

Question 7

(a) (i) Many candidates were able to draw the correct ray diagram using two of the rays whose paths are known and so form an image. Of those who did not score full marks, some candidates drew rays without taking into account the location of the two focal points and some positioned the image anywhere along a ray and not where two rays cross.

(ii) Many candidates were able to state two features of the image in **(a) (i)**.

(b) (i) This was measured from the candidate's diagram and most candidates, with a properly drawn image were able to do this with the required accuracy.

(ii) Only a minority named this device correctly.

Question 8

(a) (i) This was almost always correct. The errors that were made tended to be mathematical.

(ii) This question, which involves the direct application of syllabus material, was usually correctly answered. The use of inappropriate units (mainly the joule) spoiled the otherwise perfect answers of a small number of candidates.

(b) Only a minority of candidates scored this mark. More commonly, the answer given was twice or half that of **(a) (i)**.

Question 9

(a) (i) It was encouraging to see how many candidates were sufficiently familiar with electromagnetic induction to score either one or two marks here. This is a topic which many candidates find challenging.

(ii) There was some confusion here with some candidates stating that there would now be no deflection at all or that the deflection would actually be larger. Many candidates, however, were able to explain what was happening and to score both marks.

(iii) Only a minority of candidates stated that the needle would deflect in the opposite direction. A more common answer was that the there would be no deflection.

(b) There were candidates here who only described the use of a transformer and did not describe or explain its operation. Very few candidates suggested how the iron core effected the operation of a transformer.

Question 10

(a) (i) This factual recall was very often correct.

(ii) This was well answered with many candidates expressing clearly what was happening and how the relay functioned here. For those candidates who clearly understood what was happening, the most common reason for not scoring full marks was the omission of any reference to the role of magnetism in the explanation of the operation of the relay. Some candidates stated that it was the current in the first circuit that, by transferring to the second circuit, operated the bell.

(c) The majority of candidates answered this part correctly.

Question 11

(a) Although some candidates scored full marks here, there were two common reasons for not doing so. Some candidates used the numbers 4 and 2 for the β-particle and gave the numbers that the correctly balanced equation for α-emission would have produced. More commonly, candidates who correctly used the numbers 0 and –1 for the β-particle, gave the proton number 89 for the protactinium. This suggests that the subtraction of a negative number presents an arithmetical difficulty for some candidates.

(b) (i) Most candidates drew an acceptable curve that showed the correct direction of deviation. Only a minority drew the curve downwards or drew a straight line. A small number of candidates drew in the electric field lines instead.

(ii) Most candidates stated that the negative β-particle was attracted to the positive plate or repelled by the negative one in some way.

PHYSICS

Paper 0625/04

Coursework

General comments

Only a small number of Centres were moderated, but the candidates were given many opportunities to demonstrate their practical skills using a range of tasks from different areas of the specification. Clearly, a large amount of good work has been completed by teachers and candidates. The majority of samples illustrated clear annotated marks and comments, which was helpful during the moderation process.

PHYSICS

Paper 0625/51

Practical Test

Key Messages

To do 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, the precautions taken to improve reliability and the 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 or 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 and answers such as ‘statement to match readings’ or ‘justified by reference to the readings’ show learning of mark scheme instructions rather than understanding of the questions.

Comments on Specific Questions

Question 1

(a) (i) Most candidates successfully measured the distance d_0 and recorded it in mm. Some recorded the reading in cm and this lack of attention to the instructions lost them a mark.

(ii) Candidates needed to show clearly the distance measured. This could be to the bottom or top of the loop, but where the position was not clear candidates were penalised. A minority of candidates appeared to have carelessly missed this part of the question.

(iii)-(v) Most candidates entered correct values into the table.

(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 mark for the line, usually by drawing a dot-to-dot line rather than a best-fit line.

(c) Candidates were awarded the first mark for clearly showing on the graph that they had used the triangle method to determine the gradient. The second mark was for using at least half of their graph line. Some candidates made no attempt to indicate the triangle on the graph and many used a small triangle.

Question 2

(a) Most candidates successfully recorded a realistic room temperature.

(b)-(d) Most candidates correctly recorded the units in the table (s, ^{o}C, ^{o}C). Some candidates recorded room temperature at time t = 0 s instead of the initial hot water temperature. Most recorded steadily decreasing temperatures giving the values to at least the nearest 1 ^{o}C.

(e) The statement here had to match the readings to gain the mark. Similarly, the justification had to relate to the readings. Candidates who wrote a theoretical response without reference to the readings did not score this mark.

(f) Most candidates could offer at least one relevant condition, usually room temperature. The initial temperature of the hot water is another important condition to control but vague references to the temperature of water did not gain the mark.

Question 3

(a) Most candidates knew the correct circuit symbols. Only a few drew a picture of the circuit rather than a circuit diagram. Many candidates correctly positioned the voltmeter, but a significant number lost a mark by drawing an ammeter with three terminals.

(b) (c) Many candidates successfully recorded all the values to appropriate numbers of decimal places and with the correct units.

(d) Here the statement had to match the candidate's values of V_A and V_B and the justification follow logically, expressing the idea that the values were the same, within the limits of experimental accuracy, or that they were not because they were beyond the limits of experimental accuracy. Many candidates lost this mark because they attempted a theoretical explanation of series and parallel circuits.

Question 4

(a)-(g) Most candidates drew a neat, accurate ray-trace, following the instructions with care. Relatively few, however, scored the marks for placing their pins as far apart as possible which is a precaution that should be taken to obtain an accurate result. The most competent candidates used a large pin separation, well in excess of the minimum of 5 cm required for the marks.

(h)-(j) Most candidates accurately recorded the angles and correctly calculated the ratios.

(k) Relatively few candidates realised that from their evidence the suggestion was supported within the limits of experimental accuracy. Some attempted to use the relationship 'sin*i*/sin*r*', which was not part of the question.

PHYSICS

Paper 0625/52
Practical Test

Key Messages

To do 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, the precautions taken to improve reliability and the 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
- tabulation of readings
- manipulation of data to obtain results
- drawing conclusions
- dealing with possible sources of error
- control of variables
- accurate measurements
- choice of the most effective way to use the equipment provided.

Candidates were well prepared and it was pleasing to see that the range of practical skills being tested proved to be accessible to the majority. 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. Units were well known and were invariably included, writing was legible and ideas were expressed logically. However, many candidates seemed less able to derive conclusions backed up by evidence, or to present well thought out conclusions.

Questions 1 and **2** particularly allowed the better candidates to demonstrate their ability. The gathering and recording of data presented few problems for any candidates. There was evidence of some candidates not having the use of a calculator.

The ability to quote an answer to a given number of significant places, or to an appropriate number of decimal places, still causes difficulty for many candidates. There were also many examples of instances where a candidate had repeated a measurement and overwritten their first answer. This often made it difficult for the Examiner to read, and sometimes credit could not be awarded. Candidates should be encouraged to cross out completely and to re-write their answers so that there is no ambiguity. Candidates still find difficulty in choosing an appropriate scale when plotting graphs and in drawing a best-fit line to display the data.

Comments on specific questions

Question 1

(a) Most candidates were able to measure and record the length of the given pendulum and arrive at a value which was within the tolerance allowed.

(b) Many candidates described an acceptable method of judging that the centre of the pendulum bob was vertically above the 50.0 cm mark of the metre rule. The use of a set square was not seen as often as might have been expected. A significant number of candidates misread the question and thought that the vertical distance was supposed to be 50.0 cm.

(c) Almost all candidates completed the table, but it was often evident that the five values of *t* written down were for nine and not ten complete swings of the pendulum. Some candidates quoted the values of *t* and *T* to an unrealistic number of significant figures. Many candidates misunderstood the question and multiplied the numbers in the first two columns together. The unit for the period *T* often caused problems, with cm / s being frequently given.

(d) Few candidates stated correctly that the distance did not affect the period, and many stated, from a correct table of values, that the two quantities were directly proportional. These candidates appear not to have a clear understanding of proportionality, and considered that any positive correlation, however slight, means that the two quantities are directly proportional. Of those candidates who did realise that there was no effect, relatively few were able to proceed and state that the results in the table were all the same, within the limits of the experiment.

(e) The most common method of gaining credit was to state that a mean value for the period could be found. Most candidates simply stated that it was easier or more accurate, without any justification, which was insufficient. The small number of more able candidates who explained about spreading the human reaction time error and thus reducing the (percentage) uncertainty, were, of course, rewarded, but they were very much in the minority.

Question 2

(a) Virtually all candidates scored credit here for recording a sensible value for the room temperature.

(b) Most candidates recorded realistic temperatures, and carried out the required subtractions correctly. Credit was occasionally lost because the unit °C did not appear anywhere in **(a)** or **(b)**.

(c) As in **(b)**, the required calculations of temperature change were usually done correctly.

(d) Many candidates were penalised here, because they failed to calculate the ratio, despite the instruction to refer to the results. An understanding that their two values were too different to be explained by uncertainties in the measurements, or that the values were close enough to be considered to be within the limits of experimental error, was seen relatively rarely.

(e) Most candidates could find at least one condition that should be controlled, but many answers were too vague, e.g. water temperature, rather than hot / initial water temperature, to score full credit.

Question 3

(a) The required current and potential difference values were usually recorded and the combined resistance of the lamps presented no problems. Credit was occasionally lost because the value of the resistance was incorrectly rounded.

(b) Most candidates had a full set of recorded results of current and potential difference for the rearranged circuit. Candidates are expected to give units for the quantities that they measure or calculate, but these units were often missing or incorrect.

(c) It was pleasing to see that the majority of symbols drawn for the variable resistor were correct. Some candidates confused the symbol for a variable resistor with that of a thermistor; a considerable number put the correctly drawn symbol in the wrong place, however, such as in series with only one branch of the circuit.

Question 4

(a) (b) Most candidates submitted completed tables of results, with all five *v* values present, and correctly calculated values of *uv* and *d*.

(c) There were few very good, well drawn graphs. Many candidates chose a horizontal scale which did not permit the points they plotted to occupy at least half the grid. A significant number, possibly in an attempt to make the points fit the whole grid, chose scales which increased in very inconvenient increments, such as 3, 7 and even 33. Choosing scales such as these, makes the points very difficult to plot with accuracy, and very difficult for Examiners to check.

There were many graphs where the points were joined dot-to-dot, and even the straight lines were biased to one side, or forced through a (false) origin. Too many candidates plotted their points with large 'blobs' rather than the accepted small cross or tiny dot surrounded by a circle, and the lines of best fit were often thicker than they should have been.

(d) The gradient question should have given candidates the opportunity to pick up some credit relatively easily. To obtain full credit, the gradient triangle needed to be clearly shown on the (straight) line and should have been at least half the length of the line. Despite the clear instruction being given in the question to show clearly on the graph how the necessary information to calculate the gradient was obtained, many candidates gave no indication at all on the grid, and thus were not awarded any credit.

Very few candidates realised that part **(ii)** required a simple transcription of the gradient from part **(i)**. Of those values for the focal length given that were within the correct range, many were quoted to an unrealistically large number of significant figures, or had the unit omitted.

PHYSICS

Paper 0625/53

Practical Test

Key messages

To do 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, the precautions taken to improve reliability and the 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
- tabulation of readings
- manipulation of data to obtain results
- drawing conclusions
- dealing with possible sources of error
- control of variables
- accurate measurements
- choice of the most effective way to use the equipment provided.

Candidates' experience of sound practical technique has considerable influence on how well they perform in the examination.

Numerical answers need to be expressed to the correct number of significant figures and, generally, have an appropriate unit.

Where a justification or explanation requires reference to experimental results, answers usually need to include numerical data in order to achieve full credit.

Candidates should be aware that, as this paper tests practical work, explanations need to be based on data from the question or the implications of observations rather than theoretical considerations.

Comments on specific questions

Question 1

(a) The large majority of candidates were awarded credit for the measurements and found the calculation of extension straightforward.

Determination of the value of k was usually achieved, although some candidates inverted the equation. The unit was less well answered, g / cm or g / mm being the expected responses.

(b) The first part of this section tested candidates' knowledge of good experimental practice and required a reference to, for example, marking the centre of the mass so that it could be aligned with the 40 cm graduation, or ensuring that the mean value of readings taken at the edges of the mass was 40 cm. Some candidates referred to checking that the edges of the mass were equal distances from the 40 cm mark without going on to give the practical details of how this might be done.

Measurement of l_2 and l_3 with subsequent calculation of e_2 was done correctly by the majority. The value of *M* was generally accurate but was often shown with an excessive number of significant figures, typically four.

(c) This was the least well done section of the question. It was expected that answers would be based on the assumption that the experiment had been carried out with care, and focus on what the candidates experienced when using this particular method. Suitable responses might have referred to the difficulty in placing the mass accurately or the possibility that the mass could move on the sloping rule during the experiment. Other possible practical causes of inaccuracy may be that the end of the rule resting on the bench could slip and that the spring might not have uniform extension.

Question 2

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

(a) Indication of the correct units was largely correct and, where credit was lost, it was generally due to omitting the time unit; this shows the importance of reading the question carefully. Units attached to the data values in the columns, rather than at the head of the table, were accepted, but candidates should be aware of the increased possibility of contradictory answers in this case.

The *t* values were almost invariably inserted correctly and a complete set of increasing values of θ were generally seen, with the temperatures for black card rising at a greater rate.

(b) Most calculated the temperature changes correctly.

There were some good, clear responses to part **(ii)**, stating that the black card absorbed thermal radiation more effectively and citing the greater temperature change as evidence of this. Some identified the correct surface but, inaccurately, referred to the higher final temperature of the black card, rather than the temperature change. Theoretical explanations based on the absorption properties of black surfaces were not credited.

In part **(iii)**, many candidates correctly identified that the results supported the suggestion. Fewer obtained credit for the justification, which required figures from the table to be quoted.

(c) This part of the question related to practical considerations and required an explanation of how the particular precaution suggested by the candidate might affect the experiment. A considerable number of responses included a valid precaution, but the reason for the choice was not always clear.

The most straightforward answers were often the best. A number of candidates referred to the importance of keeping identical distances between the card and the lamp so that both surfaces would receive the same intensity of thermal radiation. Other correct responses mentioned using cards of the same dimensions so that the surface areas available to absorb radiation would be comparable, or referred to the suggestion in part **(b)(iii)** as a reason for ensuring that starting temperatures were equal.

Question 3

(a) Most candidates were able to draw a correct symbol for a voltmeter connected in parallel with the lamp.

(b) Suitable values of *V*, to at least one decimal place, and *I*, to two decimal places, were recorded by most.

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

There were few errors in the calculation of the *R* values, with the most common reason for loss of credit being inconsistent or excessive significant figures.

(d) While many candidates recognised that differences in resistance values were too great to support the suggestion, fewer gave examples of the calculated values as evidence for this opinion. A full response also required reference to the candidates' observations concerning the brightness of the lamp and the link to its temperature. Only a minority obtained credit here.

Question 4

(a) Most candidates measured the *v* distances appropriately. It was expected that the significant figures of these recorded readings should be consistent with those already given in the *u* column.

(b) Values for 1/*v* were generally calculated accurately, with only a small number of rounding errors.

(c) Some good skills in graph work were seen, with clearly labelled axes and accurate plots shown with fine crosses or 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 plots and line so that accurate drawing may be achieved and errors easily corrected.

As the origin was indicated on the grid and it was stated that the extended line should cross both axes, only one scale ($2\,\text{cm} = 1\,\text{m}^{-1}$) was feasible if the plots were to occupy as much of the grid as possible. The majority of candidates used this scale but valid alternatives were allowed if warranted by the results obtained. It was not acceptable for candidates to extend the grid to accommodate a line produced with an inappropriate scale.

A fine, best-fit straight line was attempted by many and intercepts within the grid were generally seen, although scale errors sometimes made this unachievable.

(d) Where intercepts had been produced, the values were usually determined accurately, with only a minority of candidates misreading the points on the axis or reversing *p* and *q*. Any values read correctly from the graph were accepted.

(e) Errors in determining z and calculating a value for the focal length of the lens were rare. Only a small number of candidates expressed the answer to more than two or three significant figures.

PHYSICS

Paper 0625/61
Alternative to Practical

Key Messages

To do 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, the precautions taken to improve reliability and the control of variables.

General Comments

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

- graph plotting
- understanding the significance of the best fit graph line
- determination of the gradient of a straight graph line
- drawing ray diagram
- 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 or inaccuracy
- control of variables
- accurate measurements
- choice of most suitable apparatus.

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 practical work.

Some of the skills involved in practical work can be practised without doing experiments. These include graph plotting and the tabulation of readings. However, there are parts of this examination in which the candidates are being asked to answer from their own practical experience. Questions on experimental techniques were answered much more effectively by candidates who evidently had experience of similar practical work. Candidates who were less successful in these questions appeared to lack personal experience of practical work.

Many candidates will have prepared for the examination (very sensibly) by working through some past papers. However, in some cases candidates appeared to give answers that would have been correct in a similar question from a previous session, but were not appropriate to this question paper.

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

It was pleasing that most candidates, across the mark range, were able to finish the paper in the time available.

Comments on Specific Questions

Question 1

(a) Most candidates successfully measured d_0. Some carelessly recorded the value in cm.

(b) Most candidates recorded D_0 correctly although some divided d_0 by 10.

(c) Most candidates recorded the values correctly in the table. Extension values correctly calculated from candidates' incorrect D_0 values were allowed.

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

(e) Candidates were awarded the first mark for clearly showing on the graph that they had used the triangle method to determine the gradient. The second mark was for using at least half of their graph line. Some candidates made no attempt to indicate the triangle on the graph and many used a small triangle.

(f) Candidates familiar with practical work and with good understanding of the techniques were able to comment on the line of sight being at right-angles to the rule.

Question 2

(a) Most candidates correctly read the temperature. Some recorded 20.4 °C.

(b) (i) Most candidates correctly completed the column headings with s, °C, °C.

(ii) Candidates familiar with this type of experiment realised that the rates of cooling were about the same. Not all of these candidates, however, were able to express the idea of the rates being the same within the limits of experimental accuracy.

(c) Most candidates could offer at least one relevant condition, usually room temperature. The initial temperature of the hot water is another important condition to control, but vague references to the temperature of water did not gain the mark.

Question 3

(a) Most candidates knew the correct circuit symbols. Only a few candidates drew a picture of the circuit instead of drawing a circuit diagram. Many candidates correctly positioned the voltmeter, but a significant number lost a mark by drawing an ammeter having three terminals.

(b) (i)(ii) Most candidates correctly recorded the values with the appropriate units.

(iii) A significant number of candidates placed the pointer at 0.7 instead of 0.65. To gain the mark, the pointer had to be sufficient to reach as far as the graduations on the scale.

(c) (d) Here, the statement had to match the values of V_A and V_B and the justification follow logically, expressing the idea that the values were the same, within the limits of experimental accuracy, or that they were not because they were beyond the limits of experimental accuracy (if the candidate had made an error in calculation). Many candidates lost this mark because they attempted a theoretical explanation of series and parallel circuits.

Question 4

(a) Most candidates successfully drew the normal in the correct position and the angle of incidence at 30°. A few drew the incident ray at 60° to the normal.

(b) (i) Relatively few candidates showed an understanding that greater accuracy is achieved by placing the pins as far apart as possible. A minimum separation of 5 cm was allowed to gain the mark.

(ii)(iii) Most candidates completed the line drawing neatly and accurately.

(c) (i) Candidates who had completed the drawing correctly and measured the angle accurately were awarded the mark.

(ii) Whilst many candidates successfully calculated the ratio, some lost the mark by leaving it as a fraction.

(b) (i) This mark was awarded to candidates who had the ratio calculations correct and had expressed them to 2 or 3 significant figures, with no unit.

(ii) Relatively few candidates realised that from their evidence the suggestion was supported within the limits of experimental accuracy. Some attempted to use the ratio 'sin*i*/sin*r*', which was not part of the question.

Question 5

(a) The most commonly seen error here was use of the barometer to measure the pressure of the laboratory gas supply. Whilst a metre rule could be used to measure a distance of 50 m, the most suitable apparatus from the list is the tape measure.

(b) (i) To gain the mark, candidates needed to make it clear that the line of sight must be perpendicular to the rule. Vague responses referring to looking down, looking from above, looking straight, looking along, etc., were not allowed.

(ii) Candidates who had personal experience of lens experiments were able to write clearly about moving the lens back and forth to find the sharpest image. Other responses about use of a darkened room, ensuring the object and lens are at the same height from the bench or ensuring the object, lens and screen are at right angles to the bench, were all accepted.

PHYSICS

Paper 0625/62
Alternative to Practical

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
- tabulation of readings
- manipulation of data to obtain results
- drawing conclusions
- dealing with possible sources or error
- 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, candidates seemed less able to derive conclusions from given experimental data and justify them.

All questions provided opportunities for differentiation, but particularly good, were **Questions 2 (d)** and **5 (e)**, where the conclusions and the justifications in support of them, allowed the better candidates to demonstrate their ability.

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. Within a given question, candidates should be consistent in the number of significant figures to which they quote their answers.

Comments on specific questions

Question 1

(a) Very few candidates failed to score this mark. In the few instances where the mark was not awarded, it was evident that the candidate did not have access to a ruler.

(b) The normal to the line was, in most cases accurately drawn. The normal was occasionally constructed by candidates, presumably because they did not have access to a protractor or a set square.

(c) The majority of candidates measured their angles correctly from the normal. Of those who did not, the wrong scale on the protractor was used, marking a 60° angle as 30°.

(d) The positions of the majority of the pins drawn by candidates were too close together. There were many pins with a spacing of exactly 50 mm, suggesting that candidates had learned this figure without understanding why it is better to have the pins even further apart than this, if possible. A spacing of 50 mm should be considered to be the minimum spacing that optics pins should have.

(e) Candidates found this part of the question to be more demanding than the rest of the question. A majority of candidates found some fault with the method or the candidate, despite being told in the stem of the question that this was not the case. Of those candidates who scored this mark, the thickness of the lines or pins was far more common than mentioning the precision of the protractor.

Question 2

(a) Most candidates scored full marks here. Where a mark was lost, it was usually for either an incorrect unit for temperature or the omission of the unit altogether.

(b) The required subtraction of the temperatures to find the temperature difference was done correctly by almost all candidates.

(c) The required subtractions were almost always carried out correctly.

(d) In this, more demanding part of the question, a majority of candidates were penalised by failing to calculate the ratio, despite the instruction being given to refer to the results. An understanding that the two ratios calculated were too different from each other to be explained by uncertainties in the measurements was seen relatively rarely.

(e) Most candidates were able to state one condition that should be controlled, but many answers were too vague to score the second mark, for example 'water temperature', rather than a clear reference to hot water or initial water temperature.

Question 3

(a) It was pleasing to note an increase in the number of correctly drawn and positioned voltmeter symbols, although there were still far too many voltmeters drawn in series. This is a fundamental issue of understanding regarding the nature of potential difference and the use of voltmeters to measure it.

(b) Nearly all candidates completed the voltmeter diagram, although many had pointers which were too short to indicate clearly if they were pointing to the correct reading.

(c) The majority of candidates were able to read the scales of the given ammeters correctly, although many omitted the unit and consequently lost the mark. Only a small number of the most able candidates were able to score the mark in part **(iii)**. Very few candidates realised that this part was about the limitations of the instrument. What was even more disappointing was the number of candidates who thought that the current had been used up, or had 'escaped'.

(d) It was pleasing to see that most candidates were able to draw the correct symbol for a variable resistor, although some candidates did lose a mark by confusing the symbol with that of a thermistor. A large number of candidates put the correctly drawn symbol in the wrong place in their circuit, such as in series with only one branch of the circuit.

(e) Although there were many sensible and creditworthy suggestions for this more demanding part, many candidates lost marks by missing out steps in their procedure, such as 'remove one lamp and see if the other one lights up', possibly meaning to short-circuit the place where the lamp had been, but failing to mention it explicitly.

Of those candidates who used a voltmeter method, the majority felt that the voltmeter across the faulty lamp would read zero, whereas in fact, the voltmeter across the faulty lamp would read the battery voltage.

Question 4

(a) Most candidates could complete the table, although some added extra, unjustified, significant figures. Some candidates did not read the question and produced numbers calculated in some other way, while a few apparently copied down the numbers in the final column (thus ensuring their graph would be a straight line). Many candidates correctly spotted that the heading in the *uv* column should be cm^2, but far too many did not.

(b) There were disappointingly few good graphs. Very many candidates, possibly the majority, chose a horizontal scale which did not permit the points to occupy at least half the grid. A significant number, possibly in an attempt to make the points fit the grid exactly, chose a scale which increased in very inconvenient increments, such as 33, or 60.2 and these are unacceptable, as are multiples of 3 and 7. Choosing scales like these makes the points almost impossible to plot with any hope of accuracy, and also impossible for Examiners to check. There were also far too many graphs where the points were joined dot-to-dot, and even the straight lines were often biased to one side, or even forced through a (false) origin. Thus, the concept of best-fit is clearly not well understood. Had candidates read **(c) (i)** immediately below the grid they would have seen that a gradient was required and that therefore a straight line was to be expected. Far too many candidates plotted the points with large blobs rather than the accepted small cross or tiny dot surrounded by a circle, and lines were generally thicker than they ought to be.

(c) The gradient question should have been an easy two marks, but the triangle needs to be clearly shown on the (straight) line and it must be at least half the length of the line, preferably more. Despite the instruction to show clearly on the graph how the information was obtained, given in the stem of the question, many candidates gave no indication at all on the grid, and thus lost both marks. Having said this, there were many excellent attempts at this from the more able candidates, and the graph was clearly marked with the triangle on which they based their calculations.

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

Question 5

(a) The length of the pendulum was almost invariably measured correctly.

(b) Surprisingly, a significant number of candidates divided by 5 rather than multiplied by 5 to determine the actual length of the pendulum.

(c) Many candidates came up with an acceptable method, although the use of a set-square was not seen as often as might have been expected. A significant number of candidates misread the question and thought that the vertical distance was supposed to be 50 cm.

(d) Most candidates could complete the table correctly, although, as in other questions, some quoted an unrealistic number of significant figures. A surprising number of candidates misunderstood the question and simply multiplied the numbers in the other columns together, but they were still able to access the significant figure mark.

(e) Far too few candidates stated correctly that the distance did not affect the period, and very many stated, from a correct table of values, that the two quantities were directly proportional. Clearly these candidates have no proper understanding of proportionality and consider that any positive correlation, however slight, means that the two quantities are proportional. Of those that did realise that there was no effect and thus scored the first mark, relatively few could go on to state that the results in the table were all the same within the limits of the experiment.

(f) The most common way of scoring the mark was to state that the mean could be found. Simply saying it was easier or more accurate, without any justification, was insufficient. Those very few candidates who explained about spreading the human reaction time error and thus reducing the percentage uncertainty were, of course, rewarded, but they were very much in the minority.

PHYSICS

Paper 0625/63
Alternative to Practical

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
- tabulation of readings
- manipulation of data to obtain results
- drawing conclusions
- dealing with possible sources of error
- control of variables
- accurate measurements
- choice of most suitable apparatus.

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 practical work.

Candidates' experience of experimental work appears to have considerable influence on how well they respond in those questions which focus on detailed practical techniques.

Numerical answers need to be expressed to the correct number of significant figures and generally, have an appropriate unit.

Where a justification or explanation requires reference to experimental results, answers usually need to include numerical data in order to achieve full marks.

Candidates should be aware that, as this paper tests an understanding of practical work, explanations will need to be based on data from the question or the implications of reported observations rather than theoretical considerations.

Comments on specific questions

Question 1

This was found to be the most challenging question on the paper for candidates across most of the achievement range.

(a) The majority of candidates gained the mark for the measurements and found the calculation of extension straightforward.

Determination of the value of *k* was usually achieved, although some candidates inverted the equation. Many candidates did not gain the mark for the unit.

(b) The first part of this section tested candidates' knowledge of experimental techniques and required a reference to, for instance, marking the centre of the mass so that it could be aligned with the 40 cm graduation, or ensuring that the mean value of readings taken at the edges of the mass was 40.

Some candidates referred to checking that the edges of the mass were equal distances from the 40 cm mark without going on to give the practical details of how this might be done.

In part **(ii)**, e_2 was calculated correctly by the majority of candidates. The value of M was generally correct but was shown too often with an excessive number of significant figures, typically four.

(c) This was the least well answered part of the question. It was expected that answers would be based on the assumption that the experiment had been carried out with care, and focus only on aspects of the particular method described. However, many candidates gave answers that were far too general. Suitable responses referred to the difficulty in placing the mass accurately or the possibility that the mass could move on the sloping rule during the experiment. Other possible practical causes of inaccuracy may be that the end of the rule resting on the bench could slip and that the spring might not have uniform extension.

Question 2

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

(a) Only a very small minority of candidates were unable to record the appropriate temperature. When errors occurred they were most commonly a reading of the thermometer as 20.3 ^{o}C or 24 ^{o}C, or to omit the value all together.

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

Most calculated the temperature changes correctly.

There were some good, clear responses to part **(iii)**, stating that the black card absorbed thermal radiation more effectively and citing the greater temperature change as evidence of this. Some identified the correct surface, but inaccurately referred to the black card's higher final temperature, rather than the temperature change. Theoretical explanations based on the absorption properties of black surfaces were not accepted for the mark.

In part **(iv)**, many candidates correctly identified that the results supported the suggestion. Fewer obtained the mark for the justification, which required figures from the table to be quoted to show comparison of temperature rise in equal intervals of time.

(c) This was the least well answered part of the question, by candidates across the achievement range. The question related to practical considerations and required an explanation of how the particular precaution suggested by the candidate might affect the experiment. A pleasing number of responses included a valid precaution, but the reason for the choice was not always clear.

The most straightforward answers were often the ones that scored the most marks. A number referred to the importance of keeping identical distances between the card and the lamp so that both surfaces would receive the same intensity of thermal radiation. Other correct responses mentioned using cards of the same dimensions, so that the surface areas available to absorb radiation would be comparable, or referred to the suggestion given in part **(b)(iv)** as a reason for ensuring that starting temperatures were equal.

Question 3

This question was reasonably well answered by many candidates.

(a) Most candidates were able to draw a correct symbol for a voltmeter connected in parallel with the lamp, but some diagrams showed a series connection.

(b) Correct units were generally given, although it was clear that some candidates were not used to the conventions employed in tables, responding with the quantity rather than the unit, e.g. 'voltage' rather than 'V'.

There were few errors in the calculation of the *R* values, with the most usual reason for loss of marks being inconsistent or an excessive number of significant figures.

(c) This was the least well answered part of the question. While many candidates recognised that differences in resistance values were too great to support the suggestion, fewer gave examples of the calculated values as evidence for this opinion. A full response also required a reference to the observations concerning the brightness of the lamp and the practical link to likely temperature. Only a minority of candidates obtained this third mark.

Question 4

This was often the best question for those candidates who performed well overall on the paper.

(a) Most candidates measured the distances correctly and proceeded to determine the full size values. It was expected that the number of significant figures of these answers should be consistent with those already given in the *u* and *v* columns.

(b) Values for $1/u$ and $1/v$ were generally calculated accurately, with only a small number of rounding errors.

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

As the origin was indicated on the grid and it was stated that the extended line should cross both axes, only one scale (2 cm = 1 m^{-1}) was feasible if the plots were to occupy as much of the grid as possible. The majority of candidates used this scale. It was not acceptable for candidates to extend the grid to accommodate a line produced with an inappropriate scale.

A fine, best-fit straight line was attempted by many candidates and intercepts within the grid were generally seen, although plotting or scale errors sometimes made this unachievable.

(d) Where intercepts had been produced, the values were usually determined accurately, with only a minority of candidates misreading the points on the axis or reversing *p* and *q*. Any values read correctly from the graph were accepted.

(e) Errors in determining *z* and in calculating a value for the focal length of the lens were rare. Only a small number of candidates expressed the answer to more than 2 or 3 significant figures.

Question 5

(a) Many candidates realised that the mean value of the readings was appropriate here although some did not go on to explain how it could be calculated. A number of candidates identified the anomalous reading (53 cm) and indicated that it should be discarded before calculating the mean of the remaining four values. A calculation was not expected, but was accepted if the correct method was shown clearly.

(b) This part of the question was well answered, with most candidates calculating the percentage efficiency correctly. As the equation had been given, a value of 0.75 was not accepted.

(c) A large number of candidates realised that the efficiency of the concrete floor was the greater. There were some clear and concise explanations relating the lower release height of the ball on the concrete floor to the fact that the ball bounced to the same height on both floors. More complicated explanations often missed that important point and a calculation alone, without a valid explanation, was not acceptable for the second mark.