PHYSICS

Paper 0625/11
Multiple Choice

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

Comments on Specific Questions

In item **1**, care had to be taken to read the scale units carefully, and several did not do this, opting for **C** as a result. Speed/time graphs were well understood so little difficulty was found with item **2**, but item **3** required some calculation and a large number of candidates opted for **B**, making the classic mistake of forgetting to halve the distance travelled by the sound.

A large majority of candidates clearly knew the difference between mass and weight required to answer item **4**, but item **5** on moments showed a lot of candidates opting for **B**, perhaps simply judging by size. In item **6**, it was distractor **D** which was the most popular, attracting those who simply divided mass by the length of one side of the cube. In item **7**, a large proportion of the candidates did not subtract the original length of the spring and chose **B**.

The preference for option **B** in item **8** suggested that many candidates misunderstood the syllabus term 'internal energy'. There was a widespread lack of knowledge of the process of electrical generation in item **9**, as a large proportion of the candidates opted for **A**. Similarly, in item **10** the popularity of distractor **B** showed that many incorrectly linked work done to time taken.

In item **11**, the choice of **A** was the most popular mistake. Many candidates found difficulty with item **12**, which required them to look carefully at the lower mercury levels. Item **13** was the best answered question on the paper. In item **14**, a significant number of candidates suggested that evaporation caused a temperature increase.

In item **15**, it was evident that many candidates did not have a firm understanding of the term ‘fixed points’, and so opted for **A**. In item **16**, a good proportion of the candidates chose **B**, simply subtracting one temperature from the other. Item **17** was well answered. In item **18**, the common error was to suggest placing the ice packs at the bottom of the box.

Option **A** proved a popular distractor for item **19**. Item **20** worked well, and was slightly better answered.

Many candidates were uncertain of the correct answer in item **21** which required some careful thought, but item **22** and item **23** were much better answered. Item **24** was a simple recall item, with the only complication being the mixture of units Hz and kHz, which caused rather more difficulty than expected. By contrast, item **25** caught out relatively few.

In item **26** on magnetic induction, a significant number of candidates did not look carefully at the diagrams and opted for **B**. The electrical item **27** was better answered. A good proportion could tackle item **28** effectively; distractor **A** was the most popular, these candidates either believing that unlike charges repel, or not reading the stem carefully enough.

It would seem that the topic of capacitors and their uses needs more attention, since all distractors worked well in item **29**. Item **30** was similarly found quite challenging; here many did not realise that lamp Y would light. Although item **31** was rather better answered, the popularity of option **B** indicates widespread uncertainty over the operation of a potential divider.

In item **32**, many candidates seemed unaware of circuit breakers, and opted for **D**. A.C. generators were better known in item **33** which was well answered, as was electromagnetic induction in item **34**. In item **35**, a very significant number of the candidates chose **D**, not realising the significance of the transformer being step-down, despite the primary coil being drawn helpfully on the left of the diagram.

Item **36** concerned a cathode-ray tube and the commonest mistake was to confuse the relative positions of the anode and cathode. In items **37**, **38** and **39** on radioactivity and atomic structure, there were no particularly strong distractors, and similarly this was the case in the final item **40**; this section of the syllabus seems generally well understood.

PHYSICS

Paper 0625/12
Multiple Choice

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

Comments on Specific Questions

Item **1** required some calculation and a large number of candidates opted for **B**, making the classic mistake of forgetting to halve the distance travelled by the sound. In item **2**, care had to be taken to read the scale units carefully, and several did not do this, opting for **C** as a result. Item **3** on waves worked well, as did item **4** on moments, although in this latter item distractor **B** was popular, these candidates perhaps simply judging by size.

A large majority of candidates clearly knew the difference between mass and weight required to answer item **5**, and also understood speed/time graphs well for item **6**. In item **7**, it was distractor **D** which was the most effective, attracting those who simply divided mass by the length of one side of the cube. In item **8**, many simply subtracted one temperature from the other and opted for **B**. A possible lack of understanding of the term ‘fixed points’ led a high proportion of candidates to opt for **A** in item **9**.

Few problems were encountered with item **10**, but in item **11** a lot of the candidates failed to subtract the original length of the spring and chose **B**. Item **12** showed that a high proportion of candidates believed that evaporation caused a temperature increase. Item **13** was the best answered question, but real difficulty was found with item **14**; candidates needed to look carefully at the lower mercury levels.

Item **15** worked as intended, although the preference for option **B** suggested misunderstanding of the syllabus term 'internal energy'. The pressure item **16** was straightforward and worked well, **A** being the most chosen distractor. In item **17** the popularity of distractor **B** showed that many candidates incorrectly linked work done to time taken, and there was a more widespread lack of knowledge of the process of electrical generation in item **18** as a large proportion opted for **A**. Item **19** was well answered, with distractor **A** being the most effective. In item **20**, the common error was to suggest placing the ice packs at the bottom of the box.

Echoes were the topic of the simple recall item **21**, but another recall item **22** caused some problems over the mixture of units Hz and kHz. Many candidates were uncertain in item **23** which required some careful thought. The waves item **24** worked as intended, as did the electrical item **25**.

In item **26** on magnetic induction, a reasonably large number of candidates did not look carefully at the diagrams and opted for **B**. It would seem that the topic of capacitors and their uses needs more attention, since all distractors worked well in item **27**. Most candidates coped well with the magnetism item **28**, but the popularity of option **B** in item **29** indicates widespread uncertainty over the operation of a potential divider.

A good proportion could tackle item **30** effectively; distractor **A** was the most popular, these candidates either believing that unlike charges repel, or not reading the stem of the questions carefully enough. Much greater difficulty was found with item **31**; here many did not realise that lamp Y would light.

Electromagnetic induction was well understood in item **32**, and A.C. generators were also well known in item **33**. In item **34,** almost half the candidates chose **D**, not realising the significance of the transformer being step-down, despite the primary coil being drawn helpfully on the left of the diagram. In item **35**, many candidates seemed unaware of circuit breakers, and opted for **D**, but atomic structure was well known for item **36**.

The radioactivity items **37**, **38** and **39** caused little difficulty. The final item **40** concerned a cathode-ray tube and the commonest mistake was to confuse the relative positions of the anode and cathode.

PHYSICS

Paper 0625/21
Core Theory

Key messages

Questions requiring few words in the answer were generally well attempted, whereas longer question answers need more detail and explanation. Candidates should be guided by the number of marks allocated to each question. It is often beneficial for a candidate to read again through their answer to make sure that the meaning is clear.

Some candidates would benefit from improving the way they lay out their working in numerical questions so that they can gain credit for it.

General comments

To be successful on this component, candidates need to be competent across the whole range of Core topics. There were many candidates who showed this breadth of knowledge. The questions themselves were well subdivided, to help guide the candidate through the question and this assistance frequently had the desired effect.

Most candidates were able to make some attempt at all parts of all questions, and few left many blank spaces. There was no evidence that candidates ran out of time before they had completed the paper.

The mathematics that was involved in **Questions 1, 5** and **8** was well done when the candidate knew the underlying Physics. Where necessary, candidates showed their working, thus enabling credit to be awarded for partially correct solutions, even if the final answer was wrong. A word of warning here, though; many candidates do not use an orderly way of presenting their working, but string things together with "equals" signs, even when things are not equal. This is especially noticeable when equations have to be rearranged and substituted into.

For instance, an answer might contain this string:

$$R = \frac{V}{I} = I = \frac{V}{R}$$

This would not be marked correctly, because the centre "equals" sign makes a nonsense of the string.

However, consider the following:

$$R = \frac{V}{I} \quad I = \frac{R}{V}$$

The second equation would be treated as an incorrect transposition of the first equation, which was itself correct. Thus the first equation would be credited with the equation mark, even if the candidate then went on to substitute in the incorrectly transposed version, although this working with incorrect Physics would not earn any further credit. Note that an "equals" sign inserted in the gap in the centre would immediately have lost the candidate credit here.

Presentation is important. Candidates are not penalised for poor writing, for poor language skills or even for poor presentation, but credit cannot be awarded if an answer cannot be read unambiguously.

Comments on specific questions

Question 1

(a)(b) Candidates were clearly familiar with this experiment, and it was rare for a candidate to not gain full credit. Virtually all put a unit with their answer, usually the correct one.

(c) Despite the competent way candidates tackled the first two parts, nearly all candidates demonstrated the misconception that the density of the stone would have changed.

Question 2

(a) There was a good understanding of pressure shown in most answers. Nearly all answered in terms of collisions, although a few stated that the molecules collided with each other to create pressure.

(b) Candidates who labelled the axes correctly did not always mark X correctly, but there was a good proportion who scored gained full credit. There was no requirement that candidates should recognise the shapes of these graphs, merely to know that pressure increases as temperature increases and decreases as volume increases, and to spot which graph showed which trend.

Question 3

A familiarity with the difference between renewable and non-renewable energy sources was shown by most candidates. Sometimes credit could not be awarded because it was not clear what the candidate was trying to say. Candidates should be taught to read again their answers to questions such as this one, and to ask, "Is this actually answering the question, and is it what I wanted to say?" There were some answers which said no more than "A renewable source is one that can be renewed". The quoted sources and the reasons given showed a good insight into the topic.

Question 4

(a) Most answered in terms of cold air falling, or of hot air rising to be cooled. These were each adequate to score credit. "Heat rises" was not acceptable.

(b) The most common acceptable answer was that which indicated that the refrigeration unit itself would give out heat, which was not wanted inside the cold store. Answers along the lines of "To make more room in the store" were not acceptable.

(c) It was rare for a candidate to show understanding of the purpose of insulation. A lot talked about stopping heat getting <u>out</u> or stopping "cold" getting out, or that the insulation prevented the hot/cold <u>air</u> escaping/coming in. There were also a few who muddled thermal and electrical insulation.

(d) Very few showed a clear understanding of the idea that heat gained from the outside would become equal to the heat removed by the refrigeration unit. Some ignored the statement in the stem that the unit was running continuously and assumed that it was thermostatically controlled. As this was not an unreasonable assumption, if it was clear from the answer then credit was awarded for this.

Question 5

(a) Boxes 1 and 4 should have been ticked in order to score full credit. Very few succeeded.

(b) Nearly all knew how an echo occurred.

(c) The measurement of the speed of sound by the echo method is clearly well-known, although quite a few forgot the "there and back" aspect. Most could spot which cliff caused the first echo and there were many good answers to the calculation. There were some very good answers describing what was heard when the cliffs were equidistant, and even those who said they would hear two echoes usually added "at the same time".

Question 6

Ray optics often causes difficulties for candidates. This question tested a standard piece of very basic Physics, but it was rare to find a candidate who answered completely correctly.

(a)(b) Most knew that the direction of the refraction was down at the first surface, but by no means all then showed another downward refraction at the second surface. Some showed the ray going straight on, some showed upward refraction (as would be the case for a rectangular block). Although the light was clearly described in the first sentence as “monochromatic (single colour)”, a large minority indicated dispersion at one or other of the surfaces. Even those who did not show a spectrum frequently said in **(b)** that one would appear on the screen.

(c) A good proportion knew there would be a spectrum (note: “rainbow” was not acceptable), but, for further credit candidates were required to state that red would be at the top and violet (note: not blue) at the bottom. Lots quoted the list of spectral colours, without saying which way up it would be.

Question 7

(a) Most had sufficient understanding of electrostatics to know that the two spheres would move towards each other. Many of the threads were poorly drawn, but this was not penalised on this occasion.

(b)(c) The ability to apply the theory of electrostatics to a real situation was in much shorter supply, but nevertheless some candidates made brave attempts. Most were not sure what was being charged by the action of rubbing, and some seemed to think that like charges attract each other. Credit was given for anything relevant that was written, and many candidates scored partial credit.

Question 8

Candidates were much more comfortable with current electricity than they were with static electricity and there were some good attempts at this question.

(a) Most knew the resistors were in parallel and realised that the p.d. between B and C was the same as between A and D. The calculation was frequently well done, although too many took the risk of not showing the working. If the answer to **(ii)** was quoted incorrectly but then subsequently used correctly in **(iii)**, no further penalty was applied. Only a few used the equation the wrong way up, but some incorrectly gave the answer in ohms. Most had some idea about how current was shared in a parallel circuit.

(b) Nearly all managed to draw a series circuit, with a large proportion drawing a second series circuit, with a different orientation, in the second box. There was a good number, however, who drew a series and a parallel circuit, and scored full credit. Some used incorrect symbols for the resistors, including the lamp symbol, but the aim of this question was not to test knowledge of symbols, but to see if the candidates knew how to get equal currents in the components. There was a small but noticeable minority who attempted a parallel circuit, but added a 4^{th} branch to the circuit, consisting of a wire that shorted out the other three branches. This tendency has been seen on previous occasions, and teachers would help their candidates by pointing out that this makes the circuit incorrect (and would do nasty things to the battery).

Question 9

(a) In a sense, **8(b)** led into this part of this question, and there were many intelligent attempts. In this case, the important thing was to have each of the lamps in the car getting the full battery voltage. A series circuit would not achieve this.

(b) The question then moved to the behaviour of a flashing warning lamp in the car, and clearly became a heat/expansion question. Most candidates made the transition successfully. The reason for expansion was known by most, although not always expressed unambiguously. It is likely that questions about the movement of molecules will reappear on future papers, so it would be good for candidates to practise writing answers until they can express themselves clearly. In this case, it is the fact that the molecules move further apart that is relevant, not that they “need more space”. When describing the behaviour of the bimetallic strip, it was again imprecise wording that caused candidates to not gain credit. There was a small proportion of very good answers, where the candidates clearly knew what was happening and set their answers down in an orderly manner, step by step.

Question 10

(a) Virtually all candidates realised that Figs. 1 and 3 were the appropriate ones, but a sizeable minority chose them the wrong way round.

(b) Candidates were familiar with the idea of a sine wave. Such a curve is difficult to draw accurately, and the wording was specific that it should be for two complete rotations of the coil. Most managed to comply with this restriction, although the Examiners allowed a small amount of "overshoot" or "undershoot". Some candidates would be well advised to take more care over their diagrams. In this case the need would be to take more care to keep the amplitudes equal and the spacing equal. A certain amount of drawing inaccuracy was accepted, and most candidates scored at least partial credit here.

Question 11

(a) This was known by a good proportion of candidates.

(b) Most knew which switch should be closed to make the cathode become hot, but after that, even though the choices were extremely limited, many candidates did not select the correct order.

(c) Very few could answer this clearly. It could have been that there were more who knew what they wanted to say, but their answers were not clear enough to be awarded credit. Phrases like, "turn the battery the other way round" (but which battery?) or "change the cathode and the anode" (the labelled anode and cathode, or the horizontal plates?) or "put V_2 in the top" (but which way round?), and others of a similar style, were not thought good enough for credit to be awarded.

Question 12

(a) Even with the sentence started for them, most candidates could not complete the definition in an adequate manner. The definition of half-life regularly appears in one form or another in this paper, so it is worth candidates taking the trouble to memorise it. In fact it is always worth candidates memorising basic facts or equations, as credit will always be available for recalling or using them.

(b) Not all candidates knew how to obtain the half-life from the graph, but a high proportion were able to answer both **(i)** and **(ii)** correctly. The decrease from 10 counts/s to 5 counts/s was a half-life, so the answer to **(iii)** was the answer to **(ii)** plus a half-life. Regardless of the actual values obtained in **(i)** and **(ii)**, if the candidate added these two values, credit was scored.

PHYSICS

Paper 0625/22
Core Theory

Key messages

Questions requiring few words in the answer were generally well attempted, whereas longer answers often lacked clarity. It is often beneficial for a candidate to read again through their answer to make sure that they are fully addressing the question and that the meaning is clear.

Candidates need to make sure that they have revised the entire content of the Core syllabus.

General comments

To be successful on this component, candidates need to be competent across the whole range of Core topics. In this examination, many candidates were competent, even very good, on the topics covered by **Questions 1-9**, but not as successful on the topics of **Questions 10, 11** and **12**. Many candidates, especially on these last three questions, did not seem to know the basic facts, and could not apply what they did know to the questions presented to them. It was often the case that the response given did not answer the question or that the answer was just a repeat of the question. However, there were some candidates who performed well in all questions, even in the “difficult” last three questions.

Most candidates attempted all parts of all questions, and few left many blank spaces. The mathematics that was involved in **Questions 4** and **8** was well done when the candidate knew the underlying Physics. There was no evidence that candidates ran out of time before they had completed the paper.

Presentation is important. Candidates are not penalised for poor writing, for poor language skills or even for poor presentation, but credit cannot be awarded if an answer simply cannot be read unambiguously. This applies to candidates’ numerical working as well as to written answers.

Comments on specific questions

Question 1

It is well-recognised that most candidates find it difficult to use their own words to describe a procedure, so this question was designed to help them round this problem. This had the desired effect, except in **(b)** and **(d)**, where the candidate had to say what was read from the scale. Most said nothing about where the reading was taken from, and made no reference to water level or volume or meniscus. However, once penalised in **(b)**, if a candidate used the same vague terminology in **(d)** or **(e)**, appropriate credit was given.

Question 2

All possible combinations of conduction, convection and radiation appeared, but mostly candidates had a good understanding of this topic.

Question 3

Many candidates scored full credit here. A sizeable minority suggested that the purpose of a solar panel was to protect the house from the heating of the Sun, either as insulation or as a reflector. A few suggested that they picked up signals from satellites.

Question 4

Nearly all candidates scored well on this question. The information deduced from the graph for **(a)** and **(b)** was usually correct. Very few did not gain full credit for **(d)**, but only a handful knew how to find the distance needed in **(c)**. There was virtually no evidence of the formula for the area of a triangle, or even a mention that the area under the graph would give the distance. There are very few things that, at this level, candidates can be asked to find from a speed-time graph, and this is highly likely to be asked again in the future.

Question 5

(a) Candidates struggled with this question. The vast majority incorrectly showed the image on the mirror. Some of the more able candidates drew appropriate rays from the eye to the bottom of the mirror and then reflected down to the girl. A few of these then did not indicate what part could not be seen. Most candidates unfortunately indicated that the region below the bottom edge of the mirror was what could not be seen.

(b) Very few candidates gained full credit here. A good proportion showed waves reflected at the correct angle, even if the spacing was not correct. It was almost universal that the reflected waves were not actually continuations of the first two waves - they did not start where the incoming portions met the wall.

Question 6

(a) This was one of the questions where answers often bore no relation to the questions, and if candidates stopped to think about what they had written, they would realise this. For instance, "the vibrations expand" is not an appropriate answer to **(i)**. There were a lot of good answers, but also quite a few where the parts were not consistent with each other, for instance where the candidate correctly had the molecules moving further apart, but then had the density of the iron staying the same.

(b) Most candidates successfully understood that this question was about expansion, but there were some who answered in terms of pressure or the ease of making road repairs and even to stick the sections together. An interesting, but wrong, variant was that the pitch was there to stop the concrete expanding.

Question 7

(a) A few missed the point of this question and answered in terms of an electric circuit, but a pleasing number realised that a current involves charges of some sort. Many of these answers involved electrons, in amongst other sorts of charges, but here the knowledge that a charge of some sort was involved earned credit. Very few however gained further credit, for stating that the charge was moving.

(b)(c) Answers to these two parts were usually quite competent.

Question 8

All parts of this question were pleasingly well answered, with the exception of **(e)**, where very few realised that it would be the battery that would be damaged. The circuit symbol in **(c)** was sometimes identified as a thermistor, a switch, a fuse or simply as a resistor, but a good number made a correct identification.

Question 9

Answers to this question seemed to be either very good or full of guesswork. Most candidates gained at least partial credit, but the impression is of a topic that is not well understood. Candidates' difficulties with electromagnetism have been seen in many examinations in the past, a fact that teachers could well address when planning their teaching.

Question 10

The topic of X-rays appears to have been taught in most Centres, because most candidates seemed to have some knowledge. Very few, however, showed a secure grasp of the topic.

(a) Very few knew that X-rays are electromagnetic, and equally few that they have short wavelengths.

(b) Virtually none knew how X-rays are detected. The most popular answer was "an X-ray machine".

(c) A majority seemed to have some idea about X-rays going through things, but only a small proportion grasped the idea of "passes through flesh but stopped by bone". Many answers were too vague to be awarded credit.

(d) All sorts of precautions were suggested, but most were too vague or too trivial to be awarded credit.

Question 11

This is another topic where the level of understanding needs significant improvement. The concept of electron movements is difficult, so this is a question aimed at grade C candidates, but very few good answers were apparent.

(a) There was a 50 % chance of getting the correct answer by guesswork.

(b) A few candidates were awarded credit for saying that there would be a current on closing the switch. There was rarely any mention of heating in the filament cathode, or what this did to the electrons. The term "thermionic emission" was rarely seen.

(c) There was a lot of confusion evident here. Candidates should know how electrons are made to move across the tube.

Question 12

Answers to this question showed a lack of ability to apply knowledge. In **(a)**, a lot of candidates clearly knew about the weak penetrating ability of alpha particles, but could not adapt that knowledge to say that they would not even get through the carton, let alone indicate anything about the level of the liquid. In **(b)**, similarly, a lot of candidates said that gamma rays would pass right through the carton of drink, but did not go on to say that they would be virtually unaffected whatever the level of the liquid. Lots of answers were in the form of "it's very dangerous" or "it will contaminate the drink/make it radioactive" or "it is too strong/weak for this application".

In **(c)**, the choice of source was fairly evenly divided. Those who opted for the barium often thought that the short half-life was an advantage, missing the fact that this would mean the factory would have to repeatedly change sources. Those who liked the long half-life of the strontium could rarely say convincingly why this would be a good thing. Answers to **(d)** were rarely correct. Boxes seemed to have been ticked almost randomly.

PHYSICS

Paper 0625/31

Extended Theory

Key messages

When writing explanations, a sequence of short statements is often clearer that trying to convey ideas in unnecessarily long sentences. It is often beneficial for a candidate to read again through their answer to make sure that the meaning is clear.

Some candidates would benefit from improving the way they lay out their working in numerical questions so that they can gain credit from it.

General comments

A high proportion of candidates had clearly been well taught and prepared for this paper. There remains the tendency to think less rigorously and logically in non-numerical questions than in numerical questions. Equations were generally well known and many of the more able candidates wrote out the equation that they were to use before they started. With several questions involving more than one stage this appeared to help candidates think more systematically and produce successful answers and is to be encouraged. Setting out of working by weaker candidates, especially on harder questions, was sometimes very confused and broke the rules of algebra. Examiners do their best in these situations to reward candidates for progress they have made but can only do so when it is clear that this has been achieved. Generally candidates used the correct units but even the most able candidates made occasional errors or omissions with units, probably needlessly through forgetfulness or carelessness.

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

The English language ability of the vast majority of the candidates was adequate for the demands of this paper.

Comments on Specific Questions

Question 1

(a) Generally the points were correctly plotted. Examiners tried to be tolerant where candidates drew blobs for points but sometimes the blobs were just too large. Similarly, where candidates had drawn a line that obscured points, benefit of the doubt was given where possible but Examiners did require some evidence that the points themselves had been correctly plotted. It is recommended that candidates plot points as crosses or as dots in circles. A significant number of candidates included the origin as one of their points.

(b)

(i) Most candidates gained credit but a few did not give the unit. A number of candidates did not extend their line to the force axis and gave their answer as 4 N.

(ii) This was generally answered correctly but a few candidates gave two answers, one right and one wrong, and so no credit could be awarded.

(c) Not all candidates seemed to realise that, as the gradient was quoted in the question, no credit would be awarded for its value. In cases where graphs were not drawn through the correct points, many candidates used data from the table rather from their line.

(d) Although **(i)** was almost always correctly answered, very few candidates followed through in **(ii)** to deduce that *m* would equal *F/a* and therefore have the same value as the gradient of the graph.

(e) Generally well answered.

Question 2

(a) Some answers did not give one each of time, distance or load, whilst others suggested that the load was the weight of the man himself. Weaker candidates could not distinguish between the quantity, the unit and the instrument. A fair number of candidates gave the impression that their colloquial expression for a metre rule was "a metre", which was not acceptable, particularly if the spelling meter was used, which could mean an unspecified instrument or a distance.

(b)(c) A lot of good work was seen on these questions, which were found difficult even by many strong candidates. There were an appreciable number of correct answers, especially to **(b)**. The successful candidates almost invariably set out information and the equations to be used in tackling the problem in a systematic and organised manner.

In **(b)** candidates often appeared to calculate a distance, 3.3 m, or a time, but could not then relate this to the number of rungs. The formula for efficiency was rarely quoted explicitly in **(c)** and was sometimes quoted wrongly as energy in / energy out. Often a factor of 15% was applied in such a confused manner that Examiners were unable to follow how the candidate had meant to apply it.

Question 3

(a) Many candidates did not give a reason for their answer, as required by the question, in either part.

(i) Only a very small proportion of candidates suggested that the force decreases due to the decrease in area. It was likely that candidates had not noticed the drop in cross-sectional area as the pond empties.

(ii) Many answers correctly stated that the pressure decreases due to a decrease in depth but weaker answers merely stated that there was less water on top, which was an insufficient explanation as the area decreases as well.

(b)

(i)(ii) The equation for the relationship between pressure and depth was very well known as was the unit of pressure, although a number of candidates missed out the unit in either **(b)(i)** or **(ii).**

(iii) Although a significant number of candidates could recall the correct equation, they often could not apply it correctly. The most frequent error was to confuse pressures at the top and bottom.

(iv) Candidates' responses to this part question were disappointing as they often merely stated that a bubble expands as it rises from the bottom, rather than expands as it is heated. The more able candidates made explicit the difference between their answer to **(b)(iii)** and the actual volume of the bubble.

Question 4

The basic understanding of d.c. electricity and the application of the equations was encouraging.

(a) Most candidates stated that the component was a variable resistor. The more able candidates stated that this was to control the current in the circuit, some even going further to explain that this could control the temperature of the heater.

(b) It was unusual to find an answer which did not include the equation $P=VI$ in **(i)** or the $R=V/I$ in **(ii)**. However, the vast majority of answers in **(ii)** used 3.6 V or 6 V as the p.d. in the equation, rather than the p.d. across the component X.

(c) The majority of answers suggested that resistance had increased but some candidates suggested that this had been caused by altering the value of the variable resistor or even of the connecting wires, rather than the resistance of the heater.

(d) Both parts were generally well answered.

Question 5

(a) This was generally well answered but weaker candidates often gave the unit instead of the quantity.

(b) Answers here were often weak in that the part of the heater quoted to be earthed was sometimes vague, such as "the metal part", or was not inside the heater itself, such as "the plug". Surprisingly many stated that the live wire should be earthed. Many candidates stated that electric shock is the hazard reduced by proper earthing but then did not explain that this was caused when the live wire touches the case. Weaker candidates confused the action of earthing with the action of a fuse.

(c) Circuit diagrams were generally correct although a significant number of candidates produced circuits containing a shorting wire or omitted a power source.

Question 6

Answers showed a good background knowledge and sensible understanding of radioactivity.

(a) This was generally well answered.

(b)

(i) Most candidates appeared to use 3 half-lives in the calculation and more able candidates had little trouble in working through to the correct answer, although the unit was forgotten quite often. Weaker candidates found many unusual wrong ways of doing the calculation, such has halving the half-life three times.

In **(ii)** and **(iii)**, simple, straightforward answers were all that were required such as "the proton number has changed" or "it takes a long time to decay" and it was encouraging to find these often expressed adequately.

Question 7

This question was answered well in all parts.

(a) Whilst many good answers were seen, a significant number of candidates did not realise that there was more to the question than the standard experiment with a glass block to find angles of incidence and refraction. Other candidates gave answers written in terms of an impractical method of timing the passage of light through a glass block.

(b)

(i) The equation $v = f\lambda$ was well known. Answers sometimes showed an inability to deal with powers of ten on a calculator or omitted the unit of the answer.

(ii) The majority of candidates successfully calculated the time of 240 s, sometimes not realising that this is the time taken for the shock wave to arrive and not the warning time. Sometimes the value of 240 s was unexplained and buried in a confused mass of other working, which made it very difficult for Examiners to give credit for correct work. Those candidates who realised that the data given in the stem of the question to **(b)** should also be used, calculated the two times and subtracted them successfully.

Question 8

(a) Answers obtained appeared better than in previous years.

(i) Total internal reflection was often mentioned. Many of the reasons given for this reflection were too vague, such as "the ray is larger than the critical angle" but overall the answers were good.

(ii) In this part question, candidates often clearly knew the physics but drew the rays without sufficient care and accuracy. Many did not try to draw an accurate diagram but just drew a zig-zag line down the length of the fibre.

(b) In this part on the other hand, the answers appeared to lack a real grasp of the practical situation. Simulations and pictures of the use of endoscopy are easily found on the Internet and in text books and these might provide candidates with a more practical understanding of the use of optical fibres.

(i) In this part good answers such as "the fibre is flexible" or "it provides an image with a lot of detail" were rare. It may be that candidates do not know that each fibre provides one pixel in the final image.

In **(ii)** and **(iii)** answers often did not indicate that light travelled along the fibres and candidates invented light sources outside the stomach that appeared to travel into or out of the body directly. Many mentioned that a camera is passed into the stomach, which was not relevant to this question, which clearly states that the detecting equipment is outside the body.

Question 9

Candidates often find questions involving the left- and right-hand motor and generator rules difficult. They should realise that merely learning the rules is insufficient for the type of searching question likely to be asked in this Extended Theory paper. They need to have had some experience of applying the rules to a variety of practical situations.

(a) Competent candidates performed well here but weaker candidates frequently displayed the above-mentioned confusion.

(b) Stronger candidates, who may have had practical experience of making a motor, recognised that the motor continues to turn. Many candidates, however, thought the coil would stop or even reverse its direction. Good answers made use of their understanding that an object will continue with the same motion in the absence of a force, or state that the inertia or momentum of the coil was responsible for the coil continuing to turn.

(c) There were many possible correct answers to this part. The majority of candidates could suggest one correct change to increase the speed of the motor.

Question 10

(a) The basic idea behind thermionic emission, that a heated metal surface emitted electrons, was generally known.

(b) The answers to this part illustrated yet again that the candidates who answered well, had not merely memorised a fairly complicated diagram but also had a good understanding of the subject matter. The question did not ask about the grid but it was included by many candidates, who often confused it with one of the anodes. Similarly, although the question did not ask about the vacuum in the tube, many candidates appeared not to appreciate the need for a vacuum as they drew an open tube.

The X- and Y-plates were often the only recognisably correct features in the diagram of the oscilloscope. It was expected that candidates would also draw either a cylinder or a plate with a hole as the anode, with everything enclosed in a closed, flared tube.

(c) The most common acceptable answer was to adjust the temperature or the heat incident on the cathode or filament. The majority of candidates did not gain any credit as they were too vague with answers such as "change the voltage" or "add a variable resistor".

(d) It was encouraging to see many correct answers to **(i)** and **(ii)** although the change in the time from 5.0 s to 20 s between **(i)** and **(ii)** was a confusion for some candidates.

Question 11

(a) A good proportion of candidates produced the correct answer to this demanding question, usually with excellent setting out of their working. Sadly, a few of these candidates then gave an incorrect unit or no unit at all. Many candidates were confused between evaluating specific latent heat and specific heat capacity so tried to force temperature into their calculation often, perhaps because of the similarity of symbol, using a time value.

The use of power as joules/minute in this question was not found difficult by most candidates, who readily obtained the energy by multiplying the power by 9 minutes, although 2, 11 or 13 minutes were sometimes used and obtained some credit.

As a general point, which was highlighted in this question, candidates do need to be aware that the same letter of the alphabet can be used as the symbol for different quantities.

(b)

(i) This was generally correctly answered.

(ii) The answers required were straightforward with molecular explanation being possible in various ways, such as faster movement, spreading apart, evaporation, change of state or even involvement in a convection current. Candidates who took the time to give some detail usually gained full credit. As has been the case in similar questions for many years, a number of candidates incorrectly stated that the molecules expand.

PHYSICS

Paper 0625/32

Extended Theory

Key messages

When writing explanations, a sequence of short statements is often clearer that trying to convey ideas in unnecessarily long sentences. Candidates need to avoid giving an answer which is simply a restatement of the question. Candidates should be guided by the number of marks allocated to a question and also the amount of space provided, although it is not usually necessary to use all of the space. It is often beneficial for a candidate to read again through their answer to make sure that the meaning is clear.

Some candidates would benefit from improving the way they lay out their working in numerical questions so that they can gain credit from it.

General comments

The questions on this paper allowed candidates of all abilities to show their strengths to maximum effect.

Most of the numerical work required the knowledge of a formula, the substitution of data and a calculation of the final answer, with few complicating issues. On such questions the performance was particularly good, including a high proportion of those of lower overall ability. This means that weaker candidates have learnt and could recall important basic formulae. There is no reason why many of these candidates, with sufficient encouragement and motivation, should not also be able learn and recall definitions and meanings of physical terms and words, an area in which much of their under-performance lies.

The parts of questions requiring verbal explanations and descriptions are areas where significant problems arise for candidates whose skills in English are limited. Sometimes in such questions candidates give the impression that they think they must fill the space available. They try to convey their ideas in unnecessarily long sentences when a sequence of short statements would suffice.

It is likely that candidates are advised to read the whole of a question before setting out to write the answers to the separate parts. However, it is sometimes apparent that the initial reading introduces unnecessary ideas into a candidate's mind, and leads to answers to the early parts of questions including points which are only relevant to later sections of the question. They should be reminded that they can answer early parts of questions on the basis of what they have read so far and the learning they have achieved in the topic concerned.

With few exceptions, candidates wrote answers to all the questions, suggesting that teachers had managed to achieve comprehensive coverage of the syllabus, for which great credit is due. Also it was encouraging to note that very few errors over units were made in this paper, and more often by omission than by writing down the wrong one.

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Question 1

(a) Sound knowledge of the classification of quantities as scalars or vectors was generally evident. The quantity most often wrongly classified was kinetic energy.

(b)

(i) This was almost invariably answered correctly, as was **(ii)**.

(iii) Most candidates identified friction or air resistance as a slowing factor. A small minority suggested the idea that the force or acceleration provided by the kick persists after the ball loses contact with the foot.

(iv) Candidates had been told that the average speeds between **A** and **B** and between **B** and **C** were the same, and had to remember that velocity is a vector quantity. A minority of candidates missed one or other of these points.

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(a) Most candidates correctly quoted kinetic energy, heat/thermal/y internal energy, and sound energy. Strain energy was rejected on the basis that this was gained by the belt as a consequence of loss of potential energy by the package.

(b) The vast majority quoted *mgh*, and arrived at the correct answer with the right unit.

(c) Most were successful. A few wrote down $P = W/t$ and calculated a different value for W than had been calculated in **(b).**

(d) Three points were required, each for a mark. Most candidates gained credit for saying the speed of the belt was lower or that it took a longer time to raise the package. Many also referred to the greater increase in P.E. of the package or of the need for the motor to do more work. Fewer made the connection between power, work and time by quoting $t = W/P$ or the equivalent.

Question 3

(a) A large majority did not include all the necessary detail. 'Force multiplied by perpendicular distance from the point' was required. The words 'perpendicular' and 'from the point' were usually missed.

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(i) A downward pointing arrow at the centre of the bar was usually drawn, but surprisingly many placed the arrow at the pivot or the right-hand end of the bar. Some showed the arrow in the correct place but pointing upwards.

(ii) Many did not use the given dimensions correctly to calculate the distance.

(iii) The fact that the question used the words 'total' and 'forces' should have suggested to candidates that more than one moment was involved. However, the great majority did not include the moment due to the weight of the bar.

(iv) With the benefit of any error from **(iii)** carried forward, full credit was usually awarded.

(v) Either by analysing the previous numerical work, or by knowing how a crowbar works, many candidates gave the correct answer.

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(a) This question effectively asked for a definition of specific latent heat of fusion. Unfortunately, a majority of candidates did not include the words 'at constant temperature', 'at 0 ^{o}C' or 'at freezing point'.

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(i) Most candidates clearly understood the information conveyed by the graph, but some did not take note of the words 'what is taking place' and wrote freezing or melting point, instead of ice melting, for **B** to **C**, and boiling point instead of water boiling for **D** to **E**. The word evaporating was not rewarded.

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(i) Almost all candidates arrived at the correct answer. Many candidates wrote down an expression of Boyle’s law and substituted the correct values. Others simply saw that the volume was halved, applied Boyle’s law mentally, and wrote down the correct answer. Candidates are advised to show their working, however, since credit can be given for correct working even in the final answer is incorrect.

(ii) The answer required a mention of collision of molecules with the walls and that these collisions occurred with greater frequency, or words to that effect. Omission of the reference to frequency suggested incomplete understanding of the ideas, so no credit was awarded. A substantial number of candidates implied that increase of pressure leads to an increase in the speed of the molecules.

Question 6

(a)

(i) Candidates needed to suggest in their answer that the free end of the rope had to be moved repetitively. Most answers succeeded in this requirement.

(ii) Most candidates know a definition of wavelength and attempted to show the distance on the figure. Many were successful, but some of the attempts to indicate its length on the figure were less precise than required. A majority did not know the meaning of amplitude and labelled the peak-to-peak distance.

(iii) Most answers conveyed in some way that the rate of moving the rope, compared with the answer to **(i)**, had to be increased, thus showing their awareness that a reduction in wavelength required an increase in frequency.

(b) A complete answer needed recognition of the reduced wavelength in the shallower water, the fact that the frequency is constant, and a statement of the relationship between speed, wavelength and frequency. A commendable number made the appropriate points and achieved full credit. The factor most often missed was the constant nature of the frequency. Those who stated that speed is proportional to wavelength also had to mention the constant frequency in order to make sense of the proportionality.

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(a) The fact that the focal length is the distance between a principal focus or focal point and the centre of the lens, or simply the lens, is not well known. Many took no note of the word ‘length’ and wrote about a point instead.

(b)

(i) Many misconceptions were apparent in the candidates’ ideas about a real image. Acceptable answers referred to an image which can be formed on a screen or other surface or an image formed by rays of light meeting. The answer ‘not virtual’, often quoted, was not accepted.

(ii) The rays drawn had to start at **A** and finish, or pass through, **B**. Most candidates were correct in drawing ray 1 as a straight line from **A** to **B**, but many of these did not place the lens line at the intersection of this the ray and the principal axis. Some of those who drew ray 2 correctly did not show **F**, the principal focus, at the appropriate point. Ray 3 posed a problem for many, with some not showing it at all; any ray starting at **A**, bending at the lens and passing through **B** would suffice.

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(a)

(i) The rule was applied correctly in the majority of cases.

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PHYSICS

Paper 0625/33
Extended Theory

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PHYSICS

Paper 0625/04
Coursework

General comments

It is once again pleasing to see that points made from previous reports were noted. Although the following points are still relevant to some of the Centres and potential new Centres:

- It is advisable that a maximum of two skill areas should be assessed on each practical exercise.
- It should be noted that although Moderators do not expect to see written evidence of Skill C1, they do expect to be provided with details of how candidates achieved the marks awarded.

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

PHYSICS

Paper 0625/51
Practical Test

Key messages

Candidates should make sure that they come equipped with a calculator and a sharp pencil.

Where candidates are asked to draw conclusions from their results, it is essential that their conclusion is consistent with their data and that they refer to their data when justifying their conclusion.

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 were well prepared and it was pleasing to see that the range of practical skills being tested proved to be accessible to the majority of the candidature. Work was generally neat, legible and well expressed. The majority of candidates demonstrated good practical skills and understanding, and were able to use their practical expertise in carrying out the different tasks. All parts of every practical test were attempted and there was no evidence of candidates running short of time. The majority of candidates were able to follow instructions correctly, record observations clearly and perform calculations accurately and correctly. Units were well known and were invariably included, writing was legible and ideas were expressed logically. However, many candidates seemed less able to derive conclusions backed up by evidence, or to present well thought out conclusions.

All questions provided opportunities for differentiation, but particularly good, were **Questions 3** and **4**, where the conclusions and the justifications in support of them allowed the more able 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 figures, 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 had overwritten their first answer. This often made it difficult for the Examiner to see what the reading was, and sometimes the Examiner was unable to award credit. Candidates should be encouraged to cross out completely and to re-write their answers so that there is no ambiguity. Candidates still find difficulty in choosing an appropriate scale to plot their graphs and in drawing a best-fit line to display their data.

Comments on specific questions

Question 1

(a) The majority of candidates measured and recorded the lengths of the sides of the triangle, and a large proportion of these achieved the desired accuracy. There was evidence that in some Centres the prescribed card size had not been supplied to candidates. In these cases, the Examiner checked each candidate's diagram individually to ensure that they were not disadvantaged.

(b) – (e) Candidates followed the detailed instructions to enable them to locate the centre of mass of the lamina, but a significant minority of candidates ignored the instruction to label their circles with the appropriate letter. The crosses were invariably correctly placed, but candidates often joined these crosses to the vertices of the triangle and not to the circles, as instructed.

(f) The position of the centre of mass was usually judged to be within the tolerance allowed; for many candidates the three lines crossed exactly at the same point. The instruction to draw a line from the centre of mass to the right angled corner of the card was sometimes ignored – the line being drawn to one of the sides instead.

(g) This part proved to be a very effective discriminator, with only the most able of candidates giving a sensible suggestion for minimising the given cause of inaccuracy. Even when the problem of parallax error was appreciated, it was very seldom made clear how this could be achieved in practice.

Question 2

(a)(b) The table was almost invariably completed correctly, with only the occasional candidate starting the table with room temperature. Temperatures were always expressed to 1 degree Celcius or better. Where credit could not be awarded it was usually because the units at the head of the table were missing, or occasionally were incorrect.

(c) The temperature drop in **(i)** was evaluated correctly by the majority of candidates, but many derived the temperature change in **(ii)** by subtracting from the initial temperature and not following the instruction to give the temperature fall in the last 30 seconds of cooling. The units of temperature were frequently omitted from candidates' answers.

(d) Only a minority of candidates chose scales which made best possible use of the grid provided. The *y*-axis scale chosen was usually much too small, and this resulted in the graph being squeezed into a very small area of the total space available. Points were plotted correctly, but best-fit curves/lines were rare, many candidates contenting themselves with a point to point line. The line quality was usually good – most candidates drawing neat, thin lines/curves.

(e) Most candidates were able to use their answers to **(c)** to compare the rates of cooling over the two given time periods, but fewer were able to express clearly how their graph line confirmed what they had just written. Candidates who knew from theory that the initial cooling should be quicker, answered accordingly even if the results they had obtained did not show this. In many cases there was little difference between the rates of cooling, so that sensible interpretations were difficult to make.

Question 3

(a)(b)(c) The units of potential difference, current and resistance were well known and the readings of potential difference and current were sensible and expressed to an appropriate number of decimal places. The values of the resistances of the lamps were usually calculated correctly and were expressed to a sensible and consistent number of significant figures. Very few rounding errors were encountered and only occasionally were there straight copies of the calculator display written down for the value of resistance.

(d) Values for the voltmeter and ammeter readings were almost always present, and were usually correct. In some cases, candidates had clearly manipulated their results so as to make R_T the same as R_S.

(e) Candidates almost all disagreed with the given statement, but only a very small minority tried to justify this by using an argument based on the limits of experimental accuracy. Most candidates invoked the use of theory to try to explain the discrepancy between the two answers rather than using their data. In many cases, the difference between the values of R_S and R_T was so great that candidates may not have felt the need to comment, but needed to do so.

(f) Most candidates attempted to answer this part with reference to theory, instead of following the instruction given, namely to state one piece of evidence that they had observed whilst carrying out the experiment to show that the temperature of the lamp filament had changed. All that was expected here was some reference to a change in the brightness of the filament/lamp.

Question 4

The ray diagrams were, in the main, neat, complete and generally accurate, although the trace was not always drawn as well as those in previous years. Where neatness was an issue, candidates also tended to lose the credit for accuracy awarded for the drawing of the trace. Candidates should be advised to equip themselves with sharp pencils for drawing ray traces, where they are being awarded credit for the accuracy of their drawing. Some candidates did not repeat the steps as instructed, and did not complete the incident and reflected rays from both edge **A** and edge **B** of the card. The angles of incidence and reflection were measured accurately, with most candidates quoting their measured values within the tolerance allowed.

Creditworthy answers to the final, more demanding part, **(k)**, of this question were rare. Candidates did not always realise that they were being asked about unavoidable errors, and gave answers that implied carelessness in following the procedure. Scarcely any candidates mentioned that the thickness of the mirror could be one such cause of inaccuracy, although when it was mentioned, it was clear that the Centre had taught this, because several candidates from the same Centre would come up with this suggestion.

PHYSICS

Paper 0625/52
Practical Test

Key messages

Candidates should make sure that they come equipped with a calculator and a sharp pencil.

Where candidates are asked to draw conclusions from their results, it is essential that their conclusion is consistent with their data and that they refer to their data when justifying their conclusion.

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,
- drawing ray diagrams,
- 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.

The general level of competence shown by the candidates was sound. Very few candidates did not attempt all sections of each of the questions and there was no evidence of candidates suffering from lack of time.

Many candidates appeared to have had a good level of practical experience and dealt well with the range of practical skills tested. However, some candidates seem to have had insufficient practical experience through their course to draw on when attempting the questions.

Comments on specific questions

Question 1

In **(a)**, **(b)** and **(c)** most candidates displayed their measurements of F and the values of m well, but some gave the F values to a mixture of one and 2 significant figures rather than giving them all to the nearest 0.1 N. A few candidates gave F values that were clearly far too large or far too small; they may have been unfamiliar with using and reading a forcemeter.

(d) The graph was usually set up with sensible, labelled axes and the plotting was generally correct. However, some candidates drew a line that was either not the best fit-line or was too thick.

(e) Some candidates did not follow the instruction to 'show clearly on the graph' how they obtained the result, although the value often showed that they knew what to do.

(f) Many candidates showed a good awareness of the apparatus and correctly suggested that the mass of the metre rule was involved here.

Question 2

(a) Most candidates successfully recorded room temperature.

(b) – (e) The column headings were usually completed correctly by all candidates who attempted this. A few candidates gave their value of room temperature as the temperature of the hot water at time 0s. Most candidates had two suitable ranges of temperatures. A few candidates quoted the wrong times.

(f) Most candidates correctly identified the first experiment. In the few cases where the readings gave a different result, any award of credit was based on the candidate's results. The justification produced fewer correct responses. Many attempted a theoretical explanation, rather than referring to their data, and so were not awarded credit. Some candidates answered well, making it clear that they had considered the temperature ranges over the same time interval and calculated the relevant differences.

(g) Many candidates made sensible suggestions here but some wrote about precautions rather than variables and so could not be awarded credit. It may be that they had learned answers from previous examinations during revision sessions without fully understanding the questions.

Question 3

(a) Most candidates calculated the *R* values correctly and expressed them consistently to either two or three significant figures. The units were also usually correct. To gain full credit candidates needed to give their current values to at least two decimal places and the potential difference values to at least one decimal place. The length values were usually correct. The first *R* value was close to half the third *R* value if the candidate had carried out the experiment correctly.

(b) Most candidates made a correct statement but fewer justified it correctly by commenting that the variation was within the limits of experimental inaccuracy (or words to that effect). Some attempted a theoretical explanation which was not asked for.

(c) Many candidates needed to realise that this was not a question about controlling room temperature or insulating the wire. Candidates who wrote sensibly about switching off between readings or limiting the current gained credit.

Question 4

(a) – (j) This question required candidates to work with care and to be familiar with drawing ray traces in this type of experiment. Most ray traces were drawn neatly with the angle of incidence and normal correctly drawn. However many candidates did not gain the credit available for placing the pins at least 5 cm apart. The two distances were usually correctly measured. A very few candidates did not attach their ray trace to the examination booklet.

(k) Candidates who expressed their value of *n* to two or three significant figures and with no unit were awarded credit here. Further credit was given to those candidates who had carried out the experiment with care and accuracy and obtained a value for *n* within the tolerance allowed.

(l) Here the candidates needed to notice that the question stated that the experiment had been done with care. So answers that were effectively answering the question 'how would you exercise care when carrying out the experiment?' did not score. Candidates were being asked about unavoidable errors, and many did make sensible comments referring, for example, to the thickness of pencil lines or the thickness of the ray emerging from the block.

PHYSICS

Paper 0625/61
Alternative to Practical

Key messages

Candidates should make sure that they come equipped with a calculator and a sharp pencil.

Where candidates are asked to draw conclusions from results, it is essential that their conclusion is consistent with the data and that they refer to the data when justifying their conclusion.

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,
- drawing ray diagrams,
- 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.

Clearly, some of the skills involved in practical work can be practised without doing experiments. These include graph plotting and tabulation of readings. However, there are parts of this examination in which the candidates are effectively being asked to answer from their own practical experience.

Questions on experimental techniques were answered much more effectively by candidates who clearly had experience of similar practical work and much less successfully by those whose responses indicated that they had not. Manipulation of data to achieve a final value was handled much more confidently by those who seemed to have tackled such activities in a previous practical situation.

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

It was pleasing that most candidates, across the mark range, were able to finish the paper and that very few candidates left answers to questions blank.

Comments on specific questions

Question 1

(a) Many candidates drew the straight lines required with care and precision. Some could not receive credit as the lines were too thick to be precise. There were candidates whose responses showed that they were not familiar with this standard experiment (which is required by the syllabus and does not require use of a laboratory or any but the simplest of apparatus). Such candidates drew a selection of lines joining the crosses in a variety of ways and did not gain credit.

(b) Here candidates were required to mark a suitable position for the centre of mass within the triangle formed by their drawn lines and then draw a line to the corner at **B** and measure the length of the line. Conscientious candidates who showed attention to detail were able to score full credit.

(c) Some candidates realised that the practical skill here involves viewing the plumb line perpendicularly to the card (in order to avoid a parallax error). Others made a variety of suggestions (for example, repeating the experiment) that did not address the problem.

Question 2

(a) Most candidates successfully recorded the correct temperature.

(b)

(i) The column headings were often completed correctly. A minority of candidates seemed to miss the instruction and wrote nothing.

(ii)(iii) The majority of candidates correctly calculated the temperature differences.

(c) Candidates needed to set up the graph axes so that their plots would occupy at least half of the grid both vertically and horizontally. A significant proportion chose a poor vertical scale. The plotting was usually correct. Candidates then needed to draw a line that was a good attempt at the best-fit line and not too thick.

(d)

(i)(ii) Most candidates spotted that T_1 was greater than T_2 although few expressed the fact as succinctly as they might have done. The more able candidates usually write their answers concisely.

Question 3

(a) Most candidates calculated the values correctly and expressed them consistently to either two or three significant figures. The units were also usually correct.

(b)

(i) To gain full credit here candidates need to draw the voltmeter, ammeter and lamp symbols correctly. The voltmeter had to be drawn in parallel with the power source. Meters or lamps that were drawn over the top of existing lines so that they had a line through the middle were judged to be incorrect symbols.

(ii) Most candidates calculated the value of resistance correctly although a significant number gave twice the correct value and some answers contained rounding errors.

(c) Most candidates made a correct statement but few justified it correctly by commenting that the difference was outside the limits of experimental inaccuracy (or words to that effect). Many attempted a theoretical explanation which was not asked for.

(d) Candidates needed to realise that the student would be able to see the change in brightness of the lamps.

Question 4

In **(a)**, **(b)** and **(c)** candidates were required to work with care and to be familiar with drawing ray traces in this type of experiment. Most ray traces were drawn neatly and if the candidate drew the lines as instructed and measured the angles correctly, then full credit was awarded.

(d) Here the candidate needed to notice that the question stated that the experiment had been done with care. So answers that were effectively answering the question 'how would you exercise care when carrying out the experiment?' did not gain credit. Candidates who realised that they were being asked about unavoidable errors made sensible comments referring, for example, to the thickness of the mirror or lines.

Question 5

This question required candidates to demonstrate their skills in estimating and their awareness of normal values of current obtained in common classroom experiments. Relatively few candidates gained full credit, with the third and fourth responses causing the most difficulty.

PHYSICS

Paper 0625/62
Alternative to Practical

Key messages

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General comments

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

- graph plotting
- tabulation of readings
- manipulation of data to obtain results
- drawing conclusions
- dealing with possible sources of error
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Clearly, some of the skills involved in practical work can be practised without doing experiments. These include graph plotting and tabulation of readings. However, there are parts of this examination in which the candidates are effectively being asked to answer from their own practical experience.

Questions on experimental techniques were answered much more effectively by candidates who clearly had experience of similar practical work and much less successfully by those who, apparently, had not. Manipulation of data to achieve a final value was handled much more confidently by those who seemed to have tackled such activities in a previous practical situation.

It was pleasing that most candidates, across the mark range, were able to finish the paper and that very few left answers to questions blank.

Comments on specific questions

Question 1

The question was the most successful of the paper for candidates across the whole range of marks.

(a) The vast majority of candidates gained the mark for this simple tabulation.

(b) Graphical work was generally well done, particularly in terms of labelling axes correctly, using appropriate scales and plotting values. However, a number of, even better, candidates lost marks through poor lines. Although a majority produced thin, well judged best-fit straight lines, there were a significant number of lines which were not best-fit or attempted to join plotted points together.

Some lines were too wide or were drawn to plotted points which were indicated by large dots. Both contributed to losing a mark for what was often an otherwise perfect response.

The advice is that plotted points should, preferably, be marked with a small fine cross. Small dots are acceptable but are often obscured when the line is drawn through them, making it difficult to award the mark for correctly plotted values.

(c) Responses to this question were usually good. Where marks were lost, it was because of omission of the unit or lack of a clear indication on the graph of how the result was obtained. There was considerable leeway given to this latter mark but the best responses showed accurate straight lines drawn vertically from the x-axis to the best-fit line and then horizontally to the y-axis.

(d) This was the least well done section of the question. It seemed clear that candidates with experience of practical work of this kind appreciated that the metre rule had weight which would cause a reading on the forcemeter.

Question 2

The majority of responses to this question gained well over half marks.

(a) Only a very small minority of candidates were unable to record the appropriate temperature. The most common errors were to read the thermometer as 20.3 °C or 26 °C rather than 23 °C.

(b) Recording of the correct units for temperature seemed to show a great improvement over previous years and, where marks were lost, it was generally in the omission of, particularly, the time unit or the values in the time column.

(c) A majority of candidates gained at least one mark here by choosing the correct cooling experiment or stating that there was no significant difference between them. However, justifying the choice was much less well done. It was expected that there would be an explanation involving comparisons of <u>temperature difference</u> in the <u>same time</u> for each experiment. There were a number of justifications which fell short of this or ignored the instruction on the paper to refer to the readings and attempted to explain the choice by theoretical considerations of the properties of insulation.

(d) At least one mark was gained here by the large majority of candidates although there was some confusion between factors to be controlled and experimental techniques. Candidates should be aware of the need to choose conditions which would make a significant difference to the experiment in question if they were not controlled. It is presumed that measuring equipment will be calibrated accurately and that use of the same thermometer or stopwatch would not be significantly important.

(e) Although appropriate responses were frequent, selection of alternative insulation proved difficult for some candidates. It was an important consideration that the material should be capable of being wrapped around the test-tube.

Question 3

Many candidates, across the mark range, found aspects of this question difficult and only a few gained full marks for it.

(a) Calculations were often correct although a number of responses contained rounding errors. Another source of error was the number of significant figures recorded. Pleasingly, few answers showed four or more significant figures and many had the expected two or the acceptable three. However, there often were inconsistencies in these. Usually, the resistances of AB and AC were recorded to three significant figures while the accompanying value for AD was recorded to two. Candidates should be mindful that 8.5 expressed to three significant figures is 8.50.

Headings were generally correct with omission, not recognising the given lengths to be in cm or recording quantities rather than units being the main sources of error.

(b) This was often well done with the majority of candidates recognising that the suggestion was correct and justifying this with reference to results that were 'within the limits of experimental accuracy', or words to that effect. Correct explanations often showed an implication that candidates had been used to making this kind of judgement in practical situations. Again, some lost the mark by not referring to the results for resistance but using theory to indicate that a doubling in length would produce a doubling in resistance. Candidates should be aware that this examination is not a test of theoretical knowledge but, as here, may call for accurate interpretation of results.

(c) Many candidates thought that the change in temperature of the wire would primarily affect environmental conditions and could be reduced through the use of, for example, air conditioning. Few realised that the resistance would be altered, although this was stated in the question, and that the current should be limited or the circuit switched off between readings.

(d) The symbol for the variable resistor and its location in the circuit were well recognised. A number of candidates confused the variable resistor symbol (a rectangle with a diagonal arrow through it) with that for a potentiometer or a thermistor.

Question 4

(a) The angle of incidence was measured correctly by all but a small number of candidates.

(b) Accurate completion of the diagram with neat, fine lines was seen in the majority of cases. Thicker lines were less frequent here than in **Question 1** but were drawn by a significant minority. It should be recognised that accurate measurement is difficult with wider pencil lines.

However, the measurements of GH and HF were generally well done and many gained full marks for this section of the question.

Calculations of refractive index were good and only a minority attributed a unit or used more than three significant figures.

(c) This was less well done. Although many correctly stated 5 cm or over as an appropriate separation for the pins, they failed to suggest that it would produce greater accuracy. A common mistake was to indicate that it had been scaled up from the diagram in the question. Some impossibly large separations implied a lack of experience in lining up pins in a practical situation.

(d) This was by far the least well done section of the question and gave a real indication of the lack of good experimental practice.

Question 5

The question was the least well done by candidates across the range of marks for the paper.

(a) Many, particularly the above average, candidates were able to suggest appropriate headings for the columns and identify the correct units from the values provided. Common errors were to use 'mass' for the first column or fail to realise that the length and extension values were in metres.

(b) This part of the question tested an understanding of factors which should be kept constant when another specified factor is changed. Few obtained two marks here but as many did suggest the length of the wire to be an important control variable. A minority correctly identified the other dimensions of the wire or the ambient temperature as factors which would influence results.

PHYSICS

Paper 0625/63
Alternative to Practical

Key messages

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Some lines were too wide or were drawn to plotted points which were indicated by large dots. Both contributed to losing a mark for what was often an otherwise perfect response.

The advice is that plotted points should, preferably, be marked with a small fine cross. Small dots are acceptable but are often obscured when the line is drawn through them, making it difficult to award the mark for correctly plotted values.

(c) Responses to this question were usually good. Where marks were lost, it was because of omission of the unit or lack of a clear indication on the graph of how the result was obtained. There was considerable leeway given to this latter mark but the best responses showed accurate straight lines drawn vertically from the x-axis to the best-fit line and then horizontally to the y-axis.

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Question 2

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(b) Recording of the correct units for temperature seemed to show a great improvement over previous years and, where marks were lost, it was generally in the omission of, particularly, the time unit or the values in the time column.

(c) A majority of candidates gained at least one mark here by choosing the correct cooling experiment or stating that there was no significant difference between them. However, justifying the choice was much less well done. It was expected that there would be an explanation involving comparisons of <u>temperature difference</u> in the <u>same time</u> for each experiment. There were a number of justifications which fell short of this or ignored the instruction on the paper to refer to the readings and attempted to explain the choice by theoretical considerations of the properties of insulation.

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Many candidates, across the mark range, found aspects of this question difficult and only a few gained full marks for it.

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