PHYSICS

Paper 0625/11
Multiple Choice

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

General comments

Questions **1**, **3** and **7** were particularly straightforward with more than 90% of candidates selecting the correct answer. The most difficult questions, with a facility of less than 60%, were questions **6**, **15**, **17**, **21**, **24** (found to be particularly challenging), **25**, **27**, **29**, **31**, **32**, **34**, **36** and **38**. All questions reliably differentiated on grounds of ability.

Comments on individual questions

(Percentages in brackets after an item number show the proportion of candidates choosing the correct response.)

Item **1** (96%) caused little difficulty. Item **2** (65%) on timing was answered quite well, with distractor B attracting one in four candidates; this option gave the smallest final value, but not the smallest *difference* in lap times. Few candidates were unable to score in the straightforward item **3** (91%), and most correctly divided total distance by total time in item **4** (81%). A similar proportion chose correctly in the recall item **5** (81%). Item **6** (50%) caused the first real difficulty; 37% of candidates opted for D, failing to divide the difference in the readings by six, and simply dividing the second reading by two. A much stronger performance was shown in item **7** (95%) and item **8** (85%). Item **9** (66%) required the use of the unloaded spring length as well as the extension, and was found to be more taxing. Item **10** (74%), item **11** (79%), item **12** (78%) and item **13** (79%) all worked well, and the kinetic theory item **14** (84%) was well answered. Item **15** (60%) covered change of state, and one in three candidates gave the response that, after evaporation, the average speed of the remaining molecules would increase. The second question on this topic was item **16** (88%), which caused few problems. In item **17** (39%) the relevance of the ice still remaining after 15 minutes was not appreciated by many. A better performance was given in items **18** and **19** (both 82%), and another recall item **20** (72%) worked as intended.

Just under half the candidates scored in item **21** (48%), with all distractors working well, particularly option A which named the effect involved as diffraction. The facility of item **22** (77%) was very close to the target, and item **23** (71%) also worked well. The worst answered question was item **24** (21%); half the candidates opted for C, being distracted by the increased amplitude of P and so not noticing that the question asked about pitch which like the frequency would be unchanged. Past questions have often referred to pitch and loudness, but candidates should be warned that what is asked might be different, and careful reading is necessary. In item **25** (44%) B was a popular choice, showing the classic mistake of forgetting that the sound travels *twice* the distance to the sea bed. Item **26** (82%) was found far more simple. All distractors were popular in the rather more demanding magnetism item **27** (53%), as they were in the electrical item **28** (67%). Item **29** (45%) concerned current in a series circuit, and was not well answered, with 36% of candidates responding that neither ammeter would show the current in R_2. The recall item **30** (77%) worked as intended, and in item **31** (60%) distractors A and D were the most popular, this latter choice suggesting confusion between parallel and series circuits. Item **32** (40%) concerned a potential divider, and all three distractors were popular, particularly B; this suggests that many candidates were aware that the voltage is shared, but did not understand the relationship between resistance and p.d. There was less difficulty with item **33** (67%), which was quite straightforward, but in item **34** (42%), more than a third of candidates opted for A, failing to appreciate that a current would be prevented from flowing in the metal case because of its plastic support. 65% of responses were correct in item **35**, with B and D being the more popular distractors. In item **36** (52%) many responded that direct current would be used in a long distance transmission system, and in item **37** (72%) the most common incorrect response was to say that the cathode rays were deflected downwards, towards the negative plate. Half-life questions frequently involve information in a graph, but the format used in item **38** (47%), combined with the fact that candidates were required to work backwards in time, caused widespread difficulty. Item **39** (71%) and item **40** (83%) presented fewer difficulties.

PHYSICS

Paper 0625/12

Multiple Choice

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

General comments

Questions **2**, **3**, **6**, **7** and **10** were particularly straightforward, with more than 90% of candidates selecting the correct answer. The most difficult questions, with a facility of less than 60% were items **15**, **22**, **24**, **26**, **29**, **31**, **34** and **40**.

Comments on individual questions

(Percentages in brackets after an item number show the proportion of candidates choosing the correct response.)

In item **1** (64%), 37% of candidates opted for D, the result of not dividing the difference in the readings by six, and simply dividing the second reading by two. Items **2** and **3** (both 97%) caused little difficulty, but in item **4** (75%), the most common error was to opt for B, confusing a barometer with a manometer. In item **5** (75%), the popular distractor was B; this option gave the smallest final value, but not the smallest *difference* in lap times. Item **6** (91%) was well answered, as was the straightforward item **7** (93%), and all distractors worked well in items **8** (85%) and **9** (84%). With a facility of 91%, item **10** presented few problems, but item **11**

(74%) required the use of the unloaded spring length as well as the extension, and was more taxing. Items **12** (86%), **13** (88%) and **14** (86%) showed pressure, change of state and kinetic theory to be widely understood, but in item **15** (49%) the relevance of the ice still remaining after 15 minutes was not appreciated by many. A basic understanding of convection was shown in item **16** (84%), but in item **17** (62%) nearly one in three candidates responded that, after evaporation, the average speed of the remaining molecules would increase. The thermal conduction item **18** (84%) and the reflection item **19** (85%) were strongly answered. Although item **20** (79%) had quite a high facility, a significant number of candidates gave responses which suggested that sound waves are transverse.

Item **21** (72%) worked as intended, the most common mistake being to select 'total internal refraction' as the name of the effect involved. Far more taxing was item **22** (54%) on refraction, with all distractors being popular, especially A which named the effect as diffraction. In item **23** (62%) B was a popular choice, showing the classic mistake of forgetting that the sound travels *twice* the distance to the sea bed. The worst answered question was item **24** (34%); 44% of candidates opted for C, being distracted by the increased amplitude of P and so not noticing that the question asked about pitch which like the frequency would be unchanged. Past questions have often referred to pitch and loudness, but candidates should be warned that what is asked might be different, and careful reading is necessary. Although the recall item **25** (81%) was generally well answered, item **26** (52%) showed that series circuits are not well understood, with almost one in three candidates responding that neither ammeter would show the current in R_2. Item **27** (71**%**) showed each distractor to be effective, but item **28** (85%), a simple recall question on capacitors, was better answered. Understanding of the potential divider was tested in item **29** (48%), and a popular mistake was to opt for B; this suggests that many candidates were aware that the voltage is shared, but did not understand the relationship between resistance and p.d. In item **30** (68%), distractors A and D were the most popular, this latter choice suggesting confusion between parallel and series circuits. Two out if five candidates opted for A in item **31** (36%), having not recognised that a current would be prevented from flowing in the metal case because of its plastic support. In the well-answered item **32** (79%), the most common misconception was that a fuse would reduce the current to the correct value for the appliance. Item **33** (87%) on magnetism was found undemanding, but all distractors were popular in the rather more demanding magnetism item **34** (60**%**). In item **35** (64%) almost a quarter responded that direct current would be used in a long distance transmission system. 65% of responses were correct in item **36**, with B being the more popular distractor. Item **37** (78%) worked well, and the atomic model was well known in item **38** (84%). The popular misconception in item **39** (75%) was that α-particles could penetrate paper. Half-life questions frequently involve information in a graph, but the format used in item **40** (60%), combined with the fact that candidates were required to work backwards in time, caused difficulty.

PHYSICS

Paper 0625/13
Multiple Choice

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

General comments

Candidates scored highly on a large number of questions; items **1**, **4**, **7**, **8**, **9**, **11**, **12**, **14**, **15**, **16**, **23**, **26**, **32**, **34** and **40** showed a facility of 90% or above. Items with a facility of 60% or lower were **18, 21, 27, 28, 31, 35** and **36**.

Comments on individual questions

(Percentages in brackets after an item number show the proportion of candidates choosing the correct response.)

Item **1** (98%) was straightforward and caused little difficulty, and similarly item **2** (85%) on pressure was well answered. In item **3** (76%), the most common mistake was to confuse a barometer with a manometer, thus opting for B. Measuring volume by displacement was clearly thoroughly familiar to candidates, leading to a very high facility for item **4** (99%). Although item **5** (86%) was well answered by many, more than one in ten candidates chose distractor D, the result of not of dividing the difference in the readings by six, but simply dividing the second reading by two. With high facilities, the next two items, **6** (88%) and **7** (90%), showed that candidates were familiar with extension/load graphs and timing. This trend continued in item **8** (93%) and item **9** (98%). Item **10** (80%) required recall, and of the candidates who failed to score here, A was a slightly more popular response than B. A strong performance was also shown in item **11** (96%) and item **12** (92%). In item **13** (89%), it was principally distractor B (a generator) which attracted those unsure of the correct response. Convection was the topic of item **14** (91%), kinetic theory of item **15** (93%) and change of state of item **16** (91%), and once again most candidates showed a good understanding. In item **17** (76%), which also covered change of state, more than one in five candidates gave a response suggesting that, after evaporation, the average speed of the remaining molecules would increase. The first widespread difficulty was seen in item **18** (48%), with almost one in three choosing D and missing the relevance of the ice still remaining after 15 minutes. Candidates performed well in **19** (88%) and **20** (81%), although in this latter item a significant number gave responses suggesting that sound waves are transverse.

The most taxing item in the paper was item **21** (34%); more than half of candidates chose option C, not noticing that the pitch *and* the frequency would be unchanged. Past questions have often referred to pitch and loudness, but candidates should be warned that what is asked might be different, and careful reading is necessary. In item **22** (61%) B was a popular choice, showing the classic mistake of forgetting that the sound travels *twice* the distance to the sea bed. Item **23** (91%) was answered well. Nearly two thirds of responses were correct in item **24** (64%), with all distractors working well, particularly option A, which named the effect involved as diffraction. Confusing refraction with reflection caused 13% of candidates to choose option D in item **25** (79%). The first magnetism item **26** (93%) showed a good response, but item **27** (57%) suggested that many believed steel to be a softer magnetic material than iron, so opting for D. In item **29** (78%) distractors A and D were the most popular, this latter choice suggesting confusion between parallel and series circuits. Item **30** (76%) worked well; A and D were the more popular distractors. A potential divider was the topic of item **31** (53%); distractor B was particularly popular, suggesting that many candidates were aware that the voltage is shared, but did not understand the relationship between resistance and p.d. Recalling that a capacitor can store energy and be used in a time-delay circuit was straightforward for most in item **32** (91%), but in item **33** (65%) waveform B was commonly chosen, this representing a full-wave rectified output, and not that for the apparatus shown in the diagram. Recall was again required for the well-answered item **34** (90%), but in item **35** (40%) just over a third of candidates opted for A, not realising that a current would be prevented from flowing in the metal case because of its plastic support. In item **36** (57%) many believed that direct current would be used in a long distance transmission system, and in item **37** (81%) the most popular mistake was to believe that the cathode rays would be deflected downwards, presumably because they were thought to have a positive charge. Item **38** (87%) showed quite a sound knowledge of the penetrating power of the three types of radiation, but rather more mistakes were made in item **39** (69%). Half life questions frequently involve information in a graph, but the format used here, combined with the fact that candidates were required to work backwards in time, caused some difficulty. Item **40** (91%) on the atomic model presented far fewer difficulties.

PHYSICS

Paper 0625/21

Core Theory

General comments

This paper covered a range of topics, one or two of which were those which candidates often find challenging, and one or two which were in a slightly different form from usual. In general, candidates coped well with these questions, and it was gaps in knowledge in all parts of the syllabus that let them down. Good candidates were able to make some attempt at all parts of all questions, and most candidates left few, if any, sections unanswered. Candidates seemed to have had enough time to attempt all questions.

Numerical work was competently performed, and usually set out in an understandable manner, although some candidates risked losing all the marks on a question by not showing any working, but simply writing down the answer. Of course, in such situations, if the answer were to be wrong, the Examiner can only award zero marks. Generally, though, any problems with numerical questions seemed to be related to poor understanding of the underlying Physics, rather than lack of facility with numbers. Ability with units is only tested, on this paper, where no unit is printed on the answer line. Candidates in general seemed to have a competent ability with units.

The problems associated with answering an exam paper, in a language which may be the candidate's second or even third language, are well understood at CIE. As long as the meaning is clear and unambiguous, poor spelling or poor grammar is never penalised. Even poor handwriting, if it can be deciphered, is not penalised, trying though it might be for the Examiner. However, there seemed to be more instances than usual this time, of candidates whose handwriting in places was simply illegible. Marks cannot be awarded if the answers are undecipherable.

Comments on specific questions

Question 1

(a) The question clearly stated, "....giving your answers in cm.", and the answer lines had "cm" printed on them. Nevertheless, a large proportion still gave their answers in mm, and lost marks. Some attempted to convert to m. The calculation of volume was usually correctly done, although some candidates omitted to involve the thickness. Any error, carried over from the previous part, was not penalised further.

[6 cm, 5 cm, 60 cm^3]

(b) A few candidates multiplied mass and volume, but most knew how to find the density of the block. A small number of candidates used the volume from part **(i)**.

[2.65 g/cm^3]

Question 2

(a) The calculation of the average speed was well done, with some even going to the trouble of converting from m/min to m/s, or even km/hr.

[120 m/min]

(b) There was some confusion about the force against which the work was done, but a majority realised it was some kind of friction.

Question 3

(a) Very few candidates could name three energy resources involving water. Many simply quoted three types of energy such as PE, KE and heat.

(b) Candidates who showed a poor understanding of what is meant by an energy *resource* in **(a)** struggled with this part also. Interestingly, though, quite a few still ended up trying to describe hydroelectric power, and thereby usually earned at least one mark. Candidates describing hydroelectric power rarely mentioned the significance of the reservoir being at high level, and most thought the turbine and the generator are the same thing.

Question 4

(a) (b) Candidates frequently find ray optics challenging. Very few identified PF as the focal length, and whilst most showed the rays converging on F, the majority showed the refraction occurring at the first surface only. For the second of the two marks it was expected that either the refraction be shown at the mid-line of the mirror (following the usual ray-drawing convention) or that refractions be shown at both surfaces. The standard of care taken over the drawing of the four rays was poor, with the rays often missing F by a substantial amount.

(c) (d) Most candidates had little idea what to expect on the screen in either case.

Question 5

Many candidates showed good recall of the properties of the listed radiations.

Question 6

The question demonstrated that many candidates find the concepts of thermal energy transfer challenging, particularly when asked to apply their knowledge to an unfamiliar situation.

(a) Convection was a more popular answer than conduction, even when convection was also given as the answer to the next part.

(b)(c) Answers to these question parts were often insufficiently clear, with candidates writing about something going up and/or down, but rarely being worth any marks.

Question 7

(a) A large proportion of candidates could not mark the angle of incidence correctly. The angle with the surface was a common mistake, but other angles too were marked by some.

(b) (i) Most showed the ray going in something like the correct direction, but the second mark was for accuracy, as indicated by the wording of the question, and fewer scored this mark. Of the incorrect attempts, refraction towards the normal was popular, as was reflection off the normal.

(ii) Few candidates showed a secure understanding of total internal reflection.

Question 8

(a) Most candidates could state what the boy would hear, even, in a handful of cases, to the extent of saying that he would hear nothing for a short time and then hear the bang. Some candidates seemed to be using the word “echo” to mean any sound. Answers to the calculation generally fell into one of two categories: those who applied the correct equation correctly, and those who used distance = speed/time.

[495 m]

(b) It was very pleasing to see how many could clearly explain why the girl hears two sounds. Many of the times were both correct, too. Candidates usually quoted 1.5s for the first sound, but 3s was often given as the answer for the second sound.

[1.5s,4.5s]

Question 9

(a) The poles of the magnet were usually correctly marked, but very few could state what happens to the unmagnetised iron or the charged plastic. It was common for the candidate to think that nothing would happen to the iron because it was unmagnetised, and that the charged plastic would be attracted.

(b) Whilst many candidates knew that a current should be passed to magnetise the core, they did not make it clear that the current should be in the coil (it is a common misconception that the current is passed through the core). It should be noted that steel is not suitable for the core.

Question 10

(a) "Series" was at least as popular as "parallel", with many candidates not realising the significance of the fact that the lamps were 100V lamps run from a 100V generator.

(b) A significant proportion of candidates could not apply I=V/R correctly, with many using I=VxR or not quoting the equation and with an incorrect answer appearing from a jumble of numbers.
[0.4A]

(c) Incorrect values from **(b)** were not penalised again, provided they were otherwise correctly-used in this part.
[12A]

(d) Again "series" and "parallel" were about equally popular.

(e) Answers that followed correct logic from parts **(a)** and **(d)** were rewarded.

Question 11

(a) A lot of the circuits linked the bell to the ends of the reed switch, but did not include a battery. Such attempts were not rewarded. A few candidates thought that the magnet had to be wired into the circuit.

(b) Although this is not an entirely new application for IGCSE Physics, candidates often find questions difficult when they have to apply their knowledge in a real situation. It was pleasing, therefore, to see how many answered well both parts **(i)** and **(ii)**. Most realised that M and S would have to be positioned adjacent to each other, one on the door and one on the frame, and most of these realised that it was more appropriate for the magnet to be in the door. Some suggestions for the application simply restated the question or were too vague to be worth the mark, but most answers were very intelligent.

Question 12

(a)(b) Mostly well-answered.

(c) The points were accurately plotted, with the exception sometimes of the last point, which appeared in these cases to have been plotted as 90.9, not 99. The curves were usually of acceptable accuracy and quality. Graph plotting skills have improved over the years, and teachers are to be complimented on this. Most candidates followed the style used with the printed points, of using a dot in a circle. This usually means the points are plotted more accurately, and it is helpful to the Examiner. The numerical parts were by no means as good as the graph plotting. It was rare to find a correct time for the decrease from 800 to 200 counts/min, and only a handful realised that this was 2 half-lives. Despite being told to "<u>use your answer from **(c)(ii)**</u> to determine the half-life.....", some clearly found the value independently. The only answer to be awarded the mark for **(c)(iii)** was half the value in **(c)(ii)**.
[100 ± 2 min]

(d) The decay corresponded to a decrease of 2 half-lives, so the answer should have been the same as **(c)(ii)**, or twice **(c)(iii)**. Many candidates were unable to apply this logic.
[100 ± 2 min]

PHYSICS

Paper 0625/22

Core Theory

General comments

There were one or two questions on this paper that introduced Physics in what for some would have been new situations. In general, candidates coped well with these questions, and it was gaps in knowledge in all parts of the syllabus that let them down. Good candidates were able to make some attempt at all parts of all questions, and most candidates left few, if any, sections unanswered. There was no evidence that candidates were short of time to attempt all questions.

Numerical work was competently performed, and usually set out in an understandable manner, although some candidates risked losing all the marks on a question by not showing any working, but simply writing down the answer. In such situations, if the answer were to be wrong, the Examiner can only award zero marks. Generally, though, any problems with numerical questions seemed to be related to poor understanding of the underlying Physics, rather than lack of facility with numbers. Ability with units is only tested, on this paper, where no unit is printed on the answer line. Candidates in general seemed to have a competent ability with units.

The problems associated with answering an exam paper, in a language which may be the candidate's second or even third language, are well understood at CIE. As long as the meaning is clear and unambiguous, poor spelling or poor grammar is never penalised. Even poor handwriting, if it can be deciphered, is not penalised, trying though it might be for the Examiner. However, there did seem to be more instances than usual this year of candidates whose handwriting in places was simply illegible. Marks cannot be awarded if the answers are undecipherable.

Comments on specific questions

Question 1

(a) Not all candidates could take the reading off the digital stopwatch. Fortunately, this reading was not a problem for most.

(b) Most obtained the correct answer, although some multiplied by 40.

[0.34s]

(c) Most had some idea about increasing accuracy.

(d) It was pleasing to see how many made an intelligent attempt at this part. There was not an exact number of intervals, so anything between 4 and 5 intervals was acceptable, together with the appropriate calculation.

[1.36 – 1.7s]

(e) Some candidates responded that the spacing was to do with air resistance or pressure or "gravity gets bigger nearer the ground", but quite a few realised that the answer was as simple as acceleration.

Question 2

(a) Most, but not all, could identify the extension.

(b) (i) Graphs were almost always well drawn. Graph plotting has improved enormously over the years, and teachers are to be complimented on this. The use of dots in small circles to plot the points led to improved accuracy of plotting, and was a great help to the Examiner.

(ii) Some candidates did not know the appropriate word to complete the sentence. Answers like "similar", "equal" and "close" were common and wrong.

(iii) The meaning of N was well known, and most could use the graph to get 26 cm or something close. Unfortunately this value is the extension so only a small number scored the second mark for the length.

[75 – 76 cm]

Question 3

(a) This part was well done, showing good understanding.

(b) This was also well done, except by those who thought distance = speed/time. A good proportion of candidates made an intelligent attempt at **(ii)**, usually along the lines of friction being less or having a tailwind.

[800 km/hr]

Question 4

Many candidates scored well on this question. If answers were wrong, it was usually the words in spaces 1 and/or 4.

Question 5

Heat and temperature are topics which candidates often find challenging, so it was pleasing to see some candidates scoring well on this question.

(a) Many scored all 3 marks, and very few scored nothing at all.

(b) Most candidates will not have seen this apparatus, and its description in the question was quite long. Most candidates read the question thoroughly, because there were some good attempts. The most common mistake was to write in the top right hand box that the *glass* expands.

Question 6

(a) Most candidates could answer this correctly, with very few giving the usual alternative of the angle with the surface.

(b) Probably the majority of candidates showed the reflected ray at 40° to BC, but anything bigger than this scored the mark for **(i)**. Not many answered **(ii)** correctly, but if their value was used correctly in **(iii)**, no further penalty was incurred.

[60°, 20°]

(c) It had been thought that this would be the easy part of the question, but a surprisingly large number displayed a weakness here. Not all realised that the height would be the same, and whereas a good number of candidates seemed to know that the image distance was the same as the object distance, not all that many answered the question by giving the object-image distance.

[2 cm, 10 cm]

Question 7

(a) Most candidates knew refraction, and a good proportion could identify dispersion, although some confused this with diffraction or diffusion.

(b) The majority of candidates knew this, with just a few putting red at the bottom.

(c) It was pleasing that most could identify at least one other part of the electromagnetic spectrum, with many scoring both marks.

Question 8

(a) Most candidates could identify distance *b*, but far fewer knew that distance *a* was the amplitude of the wave. A common incorrect answer for this was “peak” or “crest”.

(b) Very few could describe how the string causes the sound. Some answered that the air vibrating caused the string to vibrate. Similarly, in part **(ii)**, only a minority recognised that the loudness would decrease. Quite a few responded that the effect would be a change of pitch or frequency.

Question 9

(a) Most circuits were quite good, and used conventional symbols. The most common mistake was to show the voltmeter in series. The equation was usually quoted correctly, although a few gave their version of the transformer equation. A good proportion could identify two properties on which the resistance depends. As would be expected, “voltage” and “current” were common wrong answers.

(b) Very few managed to find the resistance per metre of the wire. Most got as far as using 6.0V and 1.5A to find the circuit resistance, but many proceeded no further. Candidates must expect the occasional calculation requiring 2 or more steps.

[0.5Ω/m]

Question 10

(a) Many candidates find questions on electromagnetic induction challenging. All the parts of **(a)** were poorly answered, with many not realising that induction was involved. Some thought it was to do with the magnets attracting or repelling each other. Some answered that the magnets were deflecting the millivoltmeter. Of candidates who did write answers relating to induction, many did not include the idea of the pointer deflecting *and returning to the centre*, and most thought it was the wheels, not the axle that were the reason for the deflection. In general, a very poor grasp of this topic was shown overall.

(b) In contrast to **(a)**, a good number of candidates answered this part correctly. It is perhaps worth pointing out that it is the *pointer* that moves, not the *millivoltmeter*, as many stated (although this was not penalised).

Question 11

The circuit symbols drawn were frequently correct, although a few resistor symbols were also seen. Not many candidates were able to correctly describe how a fuse works, and in particular very few talked about the fuse wire *melting*. Most talked about it breaking or blowing or blowing up, none of which were acceptable for the second mark. A good number knew that the fuse was inserted into the live wire.

Question 12

(a) This was a slight variant on the usual question, and many candidates found it challenging.

(b) Candidates on this paper usually tackle nuclear equations very well. On this occasion, most stated the mass number correctly, but gave 96 for the proton number, not having taken the minus in -1 into account.

[250, 98]

PHYSICS

Paper 0625/23

Core Theory

General comments

There were one or two questions on this paper that introduced Physics in what for some would have been new situations. In general, candidates coped well with these questions, and it was gaps in knowledge in all parts of the syllabus that let them down. Good candidates were able to make some attempt at all parts of all questions, and most candidates left few, if any, sections unanswered. There was no evidence that candidates were short of time to attempt all questions.

Numerical work was competently performed, and usually set out in an understandable manner, although some candidates risked losing all the marks on a question by not showing any working, but simply writing down the answer. In such situations, if the answer were to be wrong, the Examiner can only award zero marks. Generally, though, any problems with numerical questions seemed to be related to poor understanding of the underlying Physics, rather than lack of facility with numbers. Ability with units is only tested, on this paper, where no unit is printed on the answer line. Candidates in general seemed to have a competent ability with units.

The problems associated with answering an exam paper, in a language which may be the candidate's second or even third language, are well understood at CIE. As long as the meaning is clear and unambiguous, poor spelling or poor grammar is never penalised. Even poor handwriting, if it can be deciphered, is not penalised, trying though it might be for the Examiner. However, there did seem to be more instances than usual this year of candidates whose handwriting in places was simply illegible. Marks cannot be awarded if the answers are undecipherable.

Comments on specific questions

Question 1

(a) Not all candidates could take the reading off the digital stopwatch. Fortunately, this reading was not a problem for most.

(b) Most obtained the correct answer, although some multiplied by 40.

[0.34s]

(c) Most had some idea about increasing accuracy.

(d) It was pleasing to see how many made an intelligent attempt at this part. There was not an exact number of intervals, so anything between 4 and 5 intervals was acceptable, together with the appropriate calculation.

[1.36 – 1.7s]

(e) Some candidates responded that the spacing was to do with air resistance or pressure or "gravity gets bigger nearer the ground", but quite a few realised that the answer was as simple as acceleration.

Question 2

(a) Most, but not all, could identify the extension.

(b) (i) Graphs were almost always well drawn. Graph plotting has improved enormously over the years, and teachers are to be complimented on this. The use of dots in small circles to plot the points led to improved accuracy of plotting, and was a great help to the Examiner.

(ii) Some candidates did not know the appropriate word to complete the sentence. Answers like "similar", "equal" and "close" were common and wrong.

(iii) The meaning of N was well known, and most could use the graph to get 26 cm or something close. Unfortunately this value is the extension so only a small number scored the second mark for the length.

[75 – 76 cm]

Question 3

(a) This part was well done, showing good understanding.

(b) This was also well done, except by those who thought distance = speed/time. A good proportion of candidates made an intelligent attempt at **(ii)**, usually along the lines of friction being less or having a tailwind.

[800 km/hr]

Question 4

Many candidates scored well on this question. If answers were wrong, it was usually the words in spaces 1 and/or 4.

Question 5

Heat and temperature are topics which candidates often find challenging, so it was pleasing to see some candidates scoring well on this question.

(a) Many scored all 3 marks, and very few scored nothing at all.

(b) Most candidates will not have seen this apparatus, and its description in the question was quite long. Most candidates read the question thoroughly, because there were some good attempts. The most common mistake was to write in the top right hand box that the *glass* expands.

Question 6

(a) Most candidates could answer this correctly, with very few giving the usual alternative of the angle with the surface.

(b) Probably the majority of candidates showed the reflected ray at 40° to BC, but anything bigger than this scored the mark for **(i)**. Not many answered **(ii)** correctly, but if their value was used correctly in **(iii)**, no further penalty was incurred.

[60°, 20°]

(c) It had been thought that this would be the easy part of the question, but a surprisingly large number displayed a weakness here. Not all realised that the height would be the same, and whereas a good number of candidates seemed to know that the image distance was the same as the object distance, not all that many answered the question by giving the object-image distance.

[2 cm, 10 cm]

Question 7

(a) Most candidates knew refraction, and a good proportion could identify dispersion, although some confused this with diffraction or diffusion.

(b) The majority of candidates knew this, with just a few putting red at the bottom.

(c) It was pleasing that most could identify at least one other part of the electromagnetic spectrum, with many scoring both marks.

Question 8

(a) Most candidates could identify distance *b*, but far fewer knew that distance *a* was the amplitude of the wave. A common incorrect answer for this was "peak" or "crest".

(b) Very few could describe how the string causes the sound. Some answered that the air vibrating caused the string to vibrate. Similarly, in part **(ii)**, only a minority recognised that the loudness would decrease. Quite a few responded that the effect would be a change of pitch or frequency.

Question 9

(a) Most circuits were quite good, and used conventional symbols. The most common mistake was to show the voltmeter in series. The equation was usually quoted correctly, although a few gave their version of the transformer equation. A good proportion could identify two properties on which the resistance depends. As would be expected, "voltage" and "current" were common wrong answers.

(b) Very few managed to find the resistance per metre of the wire. Most got as far as using 6.0V and 1.5A to find the circuit resistance, but many proceeded no further. Candidates must expect the occasional calculation requiring 2 or more steps.

[0.5Ω/m]

Question 10

(a) Many candidates find questions on electromagnetic induction challenging. All the parts of **(a)** were poorly answered, with many not realising that induction was involved. Some thought it was to do with the magnets attracting or repelling each other. Some answered that the magnets were deflecting the millivoltmeter. Of candidates who did write answers relating to induction, many did not include the idea of the pointer deflecting *and returning to the centre*, and most thought it was the wheels, not the axle that were the reason for the deflection. In general, a very poor grasp of this topic was shown overall.

(b) In contrast to **(a)**, a good number of candidates answered this part correctly. It is perhaps worth pointing out that it is the *pointer* that moves, not the *millivoltmeter*, as many stated (although this was not penalised).

Question 11

The circuit symbols drawn were frequently correct, although a few resistor symbols were also seen. Not many candidates were able to correctly describe how a fuse works, and in particular very few talked about the fuse wire *melting*. Most talked about it breaking or blowing or blowing up, none of which were acceptable for the second mark. A good number knew that the fuse was inserted into the live wire.

Question 12

(a) This was a slight variant on the usual question, and many candidates found it challenging.

(b) Candidates on this paper usually tackle nuclear equations very well. On this occasion, most stated the mass number correctly, but gave 96 for the proton number, not having taken the minus in -1 into account.

[250, 98]

PHYSICS

Paper 0625/31

Extended Theory

General comments

The Extended paper is targeted at candidates expected to achieve grades A –C. There were a number of candidates who evidently found this paper very challenging, and who might have found the Core paper more accessible.

For a large proportion of the other candidates, recall of facts and formulae was generally sound, suggesting that thorough learning had taken place. A large majority also achieved a good deal of success with calculations requiring substitution in formulae, with few penalties having to be applied for arithmetic errors or wrong or missing units.

Greater variation of performance was shown in questions requiring the application of knowledge to provide explanations. Sometimes it was clear that candidates had not read a question with sufficient care or studied a circuit in sufficient detail, and this is an essential skill that should be impressed upon them. It is often apparent that candidates have some knowledge of the physics, but fail to communicate it successfully. The writing of shorter sentences is to be encouraged, as candidates often lose clarity when writing long and complicated sentences, and sometimes lose marks by contradicting themselves.

It was a fairly common feature of many answers attempting an explanation that a candidate only succeeded in rewording the question. Examples of this will be referred to in the comments on specific questions which follow.

A very large proportion of the candidates completed the paper with only very few part questions not attempted. A small minority of candidates whose earlier marks showed that they were finding the paper very challenging, failed to submit answers to all or most of the last two questions; it is possible that such candidates were finding the paper too demanding and ran out of time.

Comments on specific questions

The numerical answers given are the most common correct answers given by candidates, but answers to at least two significant figures are acceptable.

Question 1

(a) Most of the candidates made a good attempt at drawing the required vector triangle or parallelogram, using their chosen scale with good accuracy. Some omitted an indication of which line indicated the resultant. Very few made the mistake of repeating the triangular shape shown in Fig. 1.1.

(b) A numerical value for the resultant outside the acceptable range was unusual, but candidates who wrote down the length of the line they had measured did not score. A calculated value of the resultant using Pythagoras was acceptable.

[98 – 102 N]

(c) In most cases the resultant drawn in the candidate's vector diagram was not a vertical line. Reference to Fig. 1.1 and knowledge of equilibrium was therefore required to state the direction of the resultant as vertically upwards, but 'north' was not an acceptable alternative. Many candidates simply gave the direction of the resultant in their vector diagram.

(d) The mark was given for the correct value of the weight, or a repeat of the value given in **(b)**, provided this was a force. Those who gave the mass of the object did not gain the mark.

Question 2

(a) Answers such as 'constant velocity must be in a straight line' or 'the direction of the motion is changing' were required. It was not sufficient to state the difference between a scalar and a vector quantity. The most simplistic answer, 'because a car travelling around a circular track does not have a constant velocity', or words to that effect, was occasionally seen, but gained no credit as it simply restates the question.

(b) (i) A general point and a specific point about this particular motion were required. The first mark could have been given for stating what a force can do to a body according to Newton's 1^{st} law, and the second for stating that the car is changing its direction of its motion, or its velocity, or is accelerating. Candidates attempted various ways of making such statements, with varying degrees of success. However, the answer 'because circular motion requires a force to be applied' was unrewarded as it simply restates the question.

(ii) Candidates had to express in some way the idea that the force acts towards the centre of the circle. Even the single word 'inwards' sufficed. It was surprising to see so many answers such as 'in the direction of the car' or the opposite, with candidates appearing unaware of the concept of centripetal force.

(iii) Friction and an indication of where it acts were required. Many other suggestions were offered including gravity, the engine and the steering wheel.

Question 3

(a) (i) Candidates appeared to be on more familiar ground with this question, with few losing any marks. For the few candidates who got no further, a mark was given for quoting P = F/A.

[100 000 Pa or N/m^2]

(ii) The formula in **(i),** in the form F = PA, was clearly used by a large majority of candidates. The answer in **(i),** with the benefit of any error carried forward, multiplied by 0.02 and by 4 enabled many candidates to gain the 3 marks. If the multiplication by 4 was omitted, 2 marks were gained.

[8000 N]

(b) In contrast to **(a),** far fewer candidates scored the marks here. The fact that the 8000 N force was opposed by the weight of the two supports was entirely missed by even many of the most high-scoring candidates. Many answers simply worked out the mass of one or both of the supports.

[600 kg]

Question 4

(a) Accurate definitions of specific heat capacity were the norm.

(b) It was pleasing to see so may correct statements of the formula, either $c = Q/m\Delta\theta$ or $Q = mc\Delta\theta$, and the correct units of the answer. Other recognisable symbols were acceptable for the equation, as was the use of words instead. Working in grams with the correct unit could also gain full marks.

[907.5 J/(kg K) or J/(kg ^{o}C)]

(c) (i) A repeat of the working in **(b)** with the new temperature difference was nearly always successful.

[1212.9 J/(kg K) or J/(kg ^{o}C)]

(ii) One mark was for expressing the fundamental reason for the higher second value - that more energy or heat had been lost to the surroundings. This idea was missing from all but a few answers. The other mark was much more frequently awarded. One approach was to give a reason for the greater loss of energy: e.g. that the initial temperature or that the overall or average temperature in the second experiment was higher. The other was to give a result of the greater loss of energy: e.g. that the temperature rise was lower.

(d) Acceptable answers had to address the idea of minimising heat loss from the apparatus, or making sure that all the energy calculated as delivered by the heater was actually used in heating the block. Providing insulation, ensuring good thermal contact between the heater and the block, and making sure the heater was fully warmed up before recording data, were the expected ideas.

Question 5

(a) (i) It was rare to see wrong answers for this part, and even these usually gained a mark for the correct formula.

[0.15 m/s]

(ii) Most candidates quoted the formula for gravitational potential energy and proceeded to the correct numerical answer and unit. Use of g = 9.8 or 9.81 N/kg was allowed on this occasion, although candidates are expected to use 10 N/kg as quoted on the front of the question paper.

[100 J]

(iii) Many candidates failed to link this calculation to the previous one. They often wrote down P = W/t and used this wrongly, presumably not equating work with the increase in potential energy.

[2.5 W]

(iv) Many correct statements were offered, clearly showing understanding of efficiency.

Question 6

(a) For the 3 marks, three conditions for total internal reflection were required. Many candidates only stated one condition, with few achieving all three. This was a case where the statements would have been better made separately in short sentences or bullet points, rather than in an over-complicated continuous paragraph.

(b) Fairly accurate drawing was required, which was not achieved in many cases. The reflected ray at Q, drawn with care, left the fibre at the end R without further reflection. One reflection at the lower surface resulted in the loss of a mark. A reflection at the upper surface meant that no marks were awarded.

Question 7

(a) This part of the question required recall of Core syllabus material. There were numerous examples of candidates who gained up to a quarter of the marks on the whole paper but gained only one or none of the 3 marks here. In **(iii)**, the missing region was sometimes identified as α or β radiation, or even water waves.

(b) Candidates who had been unsuccessful in **(a)** tended to make mistakes here also, usually through failure to state the correct equation. The infrequent error by better candidates was to omit the unit.

[1.2 m]

Question 8

(a) A good proportion of candidates did not recognise the symbol as the one for a capacitor.

(b) (i) There was reasonable success in choosing the 5 Ω resistor as being the only resistor involved.

(ii) The answer of 20 Ω was not uncommon, candidates not having studied the circuit carefully enough to realise that two resistors were now in parallel. There was a compensation mark simply for using the 5 Ω and 20 Ω values. Proceeding to the final answer involved the correct choice of the equation, often successful, and then its correct arithmetic use, with frequent slips being made here.

[4 Ω]

(c) This question proved to be beyond the scope of many candidates, who do not understand the function of a capacitor, assuming it had been identified as such. Very few could state that the ammeter gives a reading which falls to zero as the capacitor charges. An alternative answer, more frequently offered, that the ammeter reads zero, was acceptable, but few could suggest an appropriate reason for this.

(d) There was a mark for quoting an equation to calculate the current, and another for an equation relating the energy, the power and the time. These marks were often gained. Successful calculations frequently followed.

[400 s]

Question 9

(a) (i) Almost all the candidates could place the correct signs at X and Y.

(ii) A significant issue here was to know that free electrons in a conductor can move, and that positive ions do not. Consequently, after gaining a mark for 'the positive charge of A attracts negative charges of B' or simply 'unlike charges attract', many candidates got no further. The ones who went on to say 'electrons move to X' and 'positive charges, or ions, are left at Y' were in a small minority.

(iii) The idea that Y was initially uncharged and that no charge had been taken from or given to it, was the basis of many answers**,** and gained the mark.

(b) Candidates had to appreciate that conductor A was still in place.

(i) It was often correctly stated nothing happens to the charge at X.

(ii) Less success was achieved here. Only a few stated that the charge at Y was neutralised, and fewer identified this as due to electrons flowing from earth.

Question 10

(a) Answers to this question revealed serious misconceptions about ideas of radioactivity. The expected answer, referring to background radiation and its random nature, was seldom seen. A fairly frequent idea was that when a source is removed, its activity remains in the space for some time, and for some candidates this time is a function of the half-life of the source. These ideas were not infrequently expressed by candidates gaining well over half the marks available on the whole paper.

(b) Further irrelevant ideas were expressed here. Some candidates based their answers on the ability of the different radiations to penetrate the lead screen or to travel different distances through air. Others concentrated on the relative values of the count rates in the first table.

Among those answers which showed some understanding of the situation, few realised that the counts measured at A were due to background. They tended to give their most complete answers about the counts at B at C, identifying the radiations and giving some of the correct reasons for their choice.

Question 11

(a) Correct traces were basically graphs of how the voltage across the resistor varies with time, and a large majority of the candidates clearly appreciated this idea. The marks they were awarded varied from 1 to 6, depending on their appreciation of the different circuits and their components. Below are the common errors seen in the traces for the three arrangements.

Circuit with battery: The horizontal line was sometimes along the middle horizontal grid line rather than above or below it.

Circuit with a.c. supply: Any recognisable shape for an alternating voltage was acceptable. A few traces were drawn entirely in the top half of the grid and lost a mark.

Circuit with a.c. supply and diode: The gaps between the 'humps' of voltage were sometimes too narrow.

PHYSICS

Paper 0625/32

Extended Theory

General comments

A high proportion of candidates had clearly been well taught and prepared for this paper. In non-numerical questions most middle as well as upper range candidates applied good Physics, including the correct use of appropriate terms, and applied logical thought to give well-worded answers. There does still remain a tendency, however, to think less rigorously and systematically in these questions than in numerical questions. Better candidates generally set out their working to numerical questions well, although some still give little or no working so cannot be given credit for possibly correct intermediate progress when producing incorrect final solutions. Also, especially on harder part questions, setting out of working was sometimes very confused, often breaking the rules of algebra. Examiners do their best in these situations to reward candidates for progress that they have made, but can only do so when it is clear that this has been achieved. Generally candidates used the correct units.

The majority of candidates indicated, by their knowledge and skills, that they were correctly entered for this Extended Theory paper. Only a small minority of candidates found the subject matter and level of questions so challenging that they could not do justice to their abilities and might have been better entered for the Core paper. The questions on the Extended Theory paper are mostly targeted at grades A to C, and candidates expected to achieve the lower grades might find the style of the Core paper more accessible.

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

Comments on specific questions

Question 1

(a) Generally the points were correctly plotted but in a few cases the origin was also included, incorrectly. It was not easy to draw a smooth curve for this graph but most candidates made a very good attempt. Straight line sections are incorrect but Examiners were tolerant where this only occurred in the relatively long distance between the points at 250 m and 350 m.

(b) Most candidates gave good answers to both parts, restricting themselves to answering the question asked. A significant proportion of answers, however, used imprecise terms or qualified the original answer so as to make it invalid. Statements such as, ‘the acceleration decelerates’ in part **(i)** were unacceptable. Similarly in part **(ii)** a statement that there is acceleration is merely repeating information in the stem.

(c) There were many good answers by candidates who had thought through the situation and answered in terms of forces as stated in the question. Candidates needed to be careful not to compare a force and an acceleration, and especially not to think that the word gravity, without qualification, refers to a force. Many good answers correctly used the term ‘force of gravity’.

(d) This was generally well understood and answered.

(e) The majority of answers correctly applied $F = ma$, but a significant minority did not apply this basic equation. Also quite a few answers went on to spoil a good start by bringing in $F = mg$ in a variety of incorrect ways.

Question 2

(a) There was a general awareness and correct use of the expression mgh. Despite the instruction on the front of the paper to use 10 m/s^2 as the value of g, a significant number of answers used 9.8 or 9.81. Although this disregard of instructions was not penalised on this occasion, future candidates should be aware that this may not always be the case.

(b) (i) Most candidates realised that the kinetic energy gained was equal to the potential energy lost with a significant number of excellent answers correctly identifying and applying the correct change of height. However, there were far more answers using a whole variety of incorrect height differences, many of which simply quoted the answer from part **(a)**.

(ii) Most candidates correctly evaluated their energy value from part **(i)**.

(iii) Most candidates correctly realised that the bob swinging to the left will return to the same height as before.

(iv) Only a very small proportion of candidates realised that when swinging to the left the string must stay straight over its whole length. The majority of the diagrams showed the swing to the left as a mirror image of the swing to the right, as if the bob was swinging round a non-existent second peg, and thus few answers scored more than 1 mark out of 3 on this part. It would seem that candidates were concentrating so much on the direct application of the Physics they knew, that they lost an appreciation of the whole of the situation.

Question 3

(a)(i) and (ii) Most candidates had the right idea about moments but there were very many unit errors, especially a confusion between metres and centimetres, and incorrect distances from the pivot.

(iii) and (b) Nearly all candidates showed a knowledge of the law of moments and most went on to calculate correctly the required force and position. The most common error in both parts was in determining the correct distance from the pivot.

Question 4

(a) This was a question where most candidates may well have known the correct Physics but failed to think carefully enough about the wording of their answers. In parts **(i)** to **(iii)** good candidates stated good conductor, good absorber and reduce heat losses. Weaker answers were often too vague, or were incorrect such as ‘heat conductor’, ‘heat absorber’ and ‘prevents heat losses’. In part **(iv)** only the very best candidates scored; most answers were very vague or referred to heat being trapped.

(b) Most candidates made a really good attempt at this question, generally scoring 3 marks out of 4 for reaching the intermediate answer of 2.31×10^7 joules. Only the very best answers correctly applied the factor of 25% to score full marks.

Question 5

(a) and (b) Most candidates correctly identified in part **(a)** that the racing car was more stable. The reason often given in part **(a)** showed a confusion between the width of the car and the width of the tyres, which was the correct answer to part **(b)**.

(c) Nearly all candidates correctly applied the equation P = F/A, but a significant minority failed to consider the area of all four tyres. There were a very small number of confusions between mass and weight.

Question 6

(a) Most answers showed an awareness of the meaning of digital, even if the mark was sometimes lost by poor wording. Very few answers showed any sort of correct explanation of analogue.

(b) Candidates almost always correctly identified the function of an AND gate and generally answered the question well, normally in the form of a truth table.

Question 7

This question was answered well in all parts with most candidates scoring more than half the available marks.

(a) Generally candidates were on the right track here but marks were often lost for uncertainty about which time units to use and inconsistency between the time unit chosen and the unit quoted with the answer.

(b) Again there were a significant number of high scoring answers. Often candidates who had confused their units in part **(a)** worked on consistently so produced the correct answer.

(c) This was correctly answered by the vast majority of candidates.

Question 8

(a) There was a wide disparity in the quality of answers to this part. There were six alternative scoring points available towards the total of three marks and many strong candidates could have scored the three marks twice over. They described the process of electromagnetic induction in this case using precise terms and good Physics. As usual many weaker candidates when faced with a descriptive question abandoned the good logic and use of Physics that they had shown in calculation questions. Answers which talked vaguely or incorrectly around the question could score few marks if any.

(b) This was generally very well answered.

(c) Better candidates chose the appropriate equation and answered this part correctly. There was often confusion with the turns ratio among weaker answers.

(d) Nearly all candidates scored one mark for the reduction of energy losses. Strong candidates recognised that this meant thinner cables could be used but most answers effectively repeated with different words their first statement so failed to score the second mark

Question 9

(a) Most competent candidates scored the first two marks for refraction in an appropriate direction but very few gave a valid explanation such as change of speed, optical density or refractive index.

(b) (i) Nearly all candidates correctly extended all three rays to pass through F_1 but only a minority showed the refraction occurring at both surfaces of the lens or, what was also acceptable in accordance with convention, at the centre line of the lens.

(ii) This was almost always correctly answered.

(c) (i) Better candidates placed the X to denote the object position between F_1 and F_2. Many less strong answers had the X on F_1 and this was the only part question in the whole paper where a significant minority did not answer the question at all.

(ii) The quality of answers was very variable. Many of the better answers were entirely correct but weaker candidates did not give more than one of the required three points correctly so did not score any marks.

Question 10

(a) Again the quality of answers was very variable. Many of the better answers were entirely correct but less good answers often correctly showed the paths of one or two particles, so were able to score some of the marks.

(b) (i) Only a few answers gained the mark for knowing the significance of a large deflection.

(ii) Many candidates realised that the sign of the charge on the core was positive. Incorrect numerical information about the size of the charge was condoned.

(iii) Most answers showed one of the correct options but a significant minority of candidates showed a lack of understanding of atomic structure by answering 'air'.

Question 11

Most parts of this question were well answered by the majority of candidates. The exception was part **(c)** where many candidates seemed to identify the word isotope with a radioactive nuclide and failed to answer the question about chemical properties.

PHYSICS

Paper 0625/33

Extended Theory

General comments

The average standard reached by the candidates who took this paper was encouragingly high. There were very few candidates who were unsure about tackling all of the questions and very few candidates indeed produced scripts where a significant number of the answer spaces were left blank.

In the more descriptive sections of the paper, the majority of candidates were able to communicate their ideas clearly.

In questions that require a calculated numerical solution, the best method is one that a very large proportion of candidates already adopt. It is to state the appropriate equation, rearrange it where necessary and then to substitute into it the numbers from the question. The candidate should then write down the calculated answer to an appropriate number of significant figures, including the correct unit. Candidates who do not include any working and those who leave units out may lose marks.

Occasionally, it proves necessary for a candidate to cross through one answer and to substitute a second attempt. This should be done as neatly as possible and where there is not enough room for the new answer, it is recommended that candidates write down the location of the new answer in the original answer space.

In this paper, all the questions are compulsory and so the marks awarded vary from question to question and candidates should be aware of this when considering the detail required for a particular question or part question.

Comments on specific questions

Question 1

(a) (i) This part of the question was very frequently answered correctly. Only a very small number of candidates calculated something other than the acceleration or put in an incorrect unit. It should be noted that the answer $8/3\ m/s^2$ was not awarded the second mark and, in general, answers should not be given in the form of a fraction.

(ii) This part was correctly answered by most candidates. The two most common misunderstandings were the use of the formula $F = mg$ rather than $F = ma$ and the use of *420 N* as the athlete's mass.

(iii) This part of the question was really quite tough and it was most pleasing to see that a significant number of candidates set about it in the correct manner and that many of these obtained the correct answer as well. Inevitably, there were those who were uncertain about the procedure to follow and incorrect answers were obtained from calculations such as *100/14.2* or *100/11.2* or *88/11.2*.

(b) There were many candidates who were able to suggest two appropriate differences here. The simple statement *the speed decreases* was not accepted; the athlete does not have a single speed and the graph in the question includes a region where her speed is decreasing in the absence of the strong opposing wind.

Question 2

(a) It was realised by many that three missing forces had each to equal *40 N* and this mark was commonly scored. The determination of the direction of these forces was more problematic and some candidates omitted this section altogether.

(b) (i) Many realised that the application of the principle of moments was required in order to obtain the weight of the workman. This turned out to be quite testing and there were many different ways in which the candidates tried to take account of the width of the blocks. As an example, some multiplied *160 (N)* by the correct *0.78 (m)* but *0.72*, *0.75* and *0.81* were also used.

(ii) The first mark was commonly scored by candidates who added 160 N to their answer to **(b)(i)** and many realised that all the remaining forces were equal to zero.

Question 3

(a) (i)(ii) This part of the question was often well answered but candidates who wrote generically about the random movement of air molecules were in danger of losing marks by not answering the specific question asked. Lower-scoring candidates did not always make a sufficiently clear distinction between the smoke particles and the air molecules. In **(i)**, some stated that the particles moved in random directions at varying speeds without referring to the cause. In part **(ii)**, it was stated by some that the mass of air molecules was large or even larger than that of the smoke particles because they cause the smoke particles to move.

(b) (i) The increase in the pressure was recognised almost without exception.

(ii) This was also well answered; many candidates scored 3/3 here. There were some candidates who made no reference to the collision of the molecules being against the container walls.

Question 4

(a) (i) The majority of candidates correctly named this process.

(ii) This question generated both convincing and less convincing answers. Most candidates had some idea about the molecules colliding and that this leads to further collisions. The better and higher-scoring answers made it clear that there was increased vibration at the end where the temperature was raised and that it was energy that was being passed on in the collisions. In a metal, the electrons are responsible for transferring most of the energy. Unfortunately, some candidates who wrote about electrons suggested that the electrons had fixed positions.

(b) This part was very frequently correctly answered.

(c) This testing part of the question was worth four marks; many of the answers offered here did not go into sufficient detail. The question presents an experiment that compares two ostensibly similar arrangements and so the best answers compared the two cases and highlighted the differences that caused the different behaviours. Some candidates who were unclear as to the true explanation referred to the flame being conducted through the iron gauze.

Question 5

(a) This was quite often correctly defined, although some candidates did not refer to a 1 °C or 1 K rise in temperature. There were some who defined the *specific latent heat*.

(b) (i) Whilst very many candidates produced answers that were fully correct, some answers did not address the point being tested with sufficient precision to score the mark. Answers such as *surfaces of different colours can affect the amount of energy absorbed* or *different coloured surfaces absorb solar energy to differing extents* were insufficient to score the mark.

(ii) 1. This was usually correct although *1400 J* was quite common.

2. Although this was also quite often correct, there were candidates who gave 7 800 kg.

3. This calculation caused problems for some candidates. Many candidates including those who obtained the correct numerical answer did not state the formula used as asked for in the question and some stated the wrong one: $Q = mL_f$ was both stated and used by some. There were candidates who used the correct formula but who rearranged it inaccurately. As a result, many different answers were offered here.

Question 6

(a) A very large proportion of the candidates scored both marks here. The commonest incorrect answer was where the candidate multiplied the mass by the distance whilst leaving out *g*. Another error was to substitute the weight *5.0 N* instead of the mass; in effect multiplying by *g* twice.

(b) (i)(ii) The numerical calculation was commonly answered correctly and it was encouraging to see that so many candidates realised that the energy lost on collision was equal to the difference between the two potential energies. In part **(ii)**, the most common suggestion was that friction with the ground was responsible for the energy loss and this was not awarded a mark. A few candidates correctly referred to the energy losses associated with the deformation of the ball. It was very pleasing to note, from time to time, the word *hysteresis* used in an answer, although this answer is beyond the scope of the syllabus and not an expected answer.

(c) In this calculation, only the candidates who scored the highest marks over all tended to gain full marks. Many candidates did not include the 9.0 J of energy already possessed by the ball before calculating its speed from $K.E. = ½mv^2$.

Question 7

(a) The question asks for the change in the resistance to be described, and so those candidates who explained *why* it changes were going beyond what was asked for, and in some cases the actual marking points were completely omitted from the explanation. There were those who used the expression *directly proportional* simply to mean that the two quantities increase together. These candidates could not go on and be awarded the second mark for stating that the resistance increases at an increasing rate.

(b) (i) This value was almost invariably read off correctly.

(ii) The potential difference was very frequently correct but the use of the value *0.7* rather than *0.07 A* was by no means unusual.

(iii) The correct formula was widely known and understood but a few candidates rounded off incorrectly to 0.13 W.

(c) (i) Many different incorrect answers were offered, including values such as *3.5 V* or *0.875 V*.

(ii) Most candidates knew the correct formula to use and calculated the correct value of the resistance of the circuit.

Question 8

(a) Although, candidates frequently find electromagnetic induction very testing, this direct question was well answered. An encouragingly small number of candidates ignored the effect of relative motion and based the answer solely on the motion of the magnet but a very few did. A common error was to state that the deflections in the second and third parts were in opposite directions.

(b) Most candidates were able to give three changes that would increase the magnitude of the deflection. Candidates who simply wrote *the speed*, *the number of turns* and *the strength of the magnet* had not answered the question asked.

Question 9

(a) (i)(ii) Part **(i)** was almost always correct and part **(ii)** was very frequently correct.

(b) Nearly all candidates realised that the answer could be obtained from the two figures given in the question and many obtained the correct answer. Some candidates multiplied 1.48 by 3.00×10^8 but the most common reason for lost marks was the omission of the unit from the final answer.

(c) Most candidates drew the correct reflected ray but occasionally the ray was drawn at right angles to the incident ray. Some drew a refracted ray. The candidate's angle of refraction was not always sufficiently close to the angle of incidence.

Question 10

(a) (i)(ii) This question produced a wide variety of answers. Not all candidates put the dot R in the correct location and many left the dot unlabelled. A very common misunderstanding was to draw a mirror image of the wavefronts to the right of the reflecting surface. Some of the diagrams presented were very poor; in particular, the wavelength of the reflected waves was often extremely variable and not especially close to the value in the diagram.

(b) Many candidates produced good, well-drawn diagrams. The easiest way of producing a convincing diagram, with accurately reflected rays, is first to locate the image by measurement. The reflected rays and construction lines can then be added to the diagram. Candidates who first drew the reflected rays and traced them back to locate the image, tended to produce angles of reflection and images that, even to the unaided eye, were not accurate and hence the virtual image was drawn in a variety of locations.

Question 11

(a) This very standard question can easily be answered by the appropriate use of the word *random* or at least *unpredictable*. Many candidates did exactly this and scored the mark.

(b) (i)(ii) Many candidates scored the first mark; the only acceptable answer was *background (radiation)*. In the second part there were candidates who might well have known possible sources but who gave answers that were too general to be accepted. The simple answer *radioactive isotopes* was not credited. X-rays, though ionising, are not a source of radioactivity.

PHYSICS

Paper 0625/04

Coursework

General comments

It is pleasing to see that points made from previous reports were noted. The following points however are still relevant to some of the Centres:

- 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.
- Consistent use of 'units', in both results tables and on the axes of graphs, should be checked.
- It is advisable that a maximum of two skill areas should be assessed on each practical exercise.

The candidates at all the Centres 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 clearly annotated marks and comments, which was helpful during the moderation process.

PHYSICS

Paper 0625/51

Practical Test

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.

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 dealt well with the range of practical skills tested with each question differentiating in its own way. The majority of candidates showed evidence of preparation for the different types of question in the examination but some seemed less than fully aware of the demands of the paper.

Comments on specific questions

Question 1

(a) Most candidates recorded their measurements and the calculation well. Very few gave *d* values above 50 cm which lost a mark.

(b) The graph was usually set up with sensible, labelled axes and the plotting correct. Candidates needed to draw a line that was a good attempt at the best-fit line and not too thick.

(c) A large number of candidates did not follow the instruction to 'show clearly on the graph' how they obtained the information necessary to calculate the gradient, although the calculation often showed that they knew what to do. Candidates using a triangle that included at least half of their line showed that they were aware of the greater accuracy that can be obtained by using a large triangle.

(d) Candidates who had followed the experimental procedure with care obtained a *z* value within the tolerance allowed. Those who also expressed their answer to 2 or 3 significant figures and included the unit g scored full marks.

Question 2

(a) – (d) A pleasing proportion of candidates scored full marks (or close to full marks) for the readings in the table. This showed good attention to detail. Only a minority missed the units. Very few quoted a value for room temperature that was clearly wrong.

(e) Here candidates needed to realise that a long time was required (minimum allowed was 300s). Since an estimate was required the answer must be given to no more than the nearest 10s.

(f) Most candidates were able to make a correct statement based on their results but to score the mark candidates needed to justify their answer by reference to the readings as requested in the Question. A theoretical approach did not attract a mark.

(g) The most confident candidates correctly suggested two variables to be controlled. Some, however, seemed to have learned answers from previous questions of this type and made suggestions that are not relevant in this case. Others wrote about precautions to improve accuracy rather than control of variables. Some even had one of each.

Question 3

(a) It was pleasing to see many candidates drawing a correct circuit diagram.

(b) Most candidates were able to record the current although some clearly misread their ammeter.

(c) Many candidates correctly gave the units in the column headings, gave all the currents to at least two decimal places and showed by the way that the currents decreased down the table that they had used the circuit correctly.

(d) Many candidates found this part difficult. The first mark was awarded for calculating $0.5I_o$ and the second mark for estimating the resistance in relation to the results in the table. As this is an estimate only, it is sufficient to give the value to the nearest ohm.

Question 4

(a) – (h) This question required candidates to work with care and to be familiar with finding images in this type of experiment. Most ray traces were drawn neatly and if the candidate drew the normal, the incident ray at the correct angle (within 2°), labelled point **E** and showed an initial pin separation of at least 5 cm with all the lines drawn suitably thinly then full marks were scored.

(i) – (l) Here correct angle measurements and calculations were required and finally a conclusion based on candidates' own readings.

Unfortunately, **Question 4(b)** contained an error; the question should have read, 'so that the normal is 2.0 cm from **D**'. The Examiners were made aware of this error after the paper had been sat. They amended their marking to ensure that no candidate would be disadvantaged.

PHYSICS

Paper 0625/52

Practical Test

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.

The general level of competence shown by the candidates was pleasing. 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.

Most candidates dealt well with the range of practical skills tested with each question differentiating in its own way. The majority of candidates showed clear evidence of preparation for the different types of question in the examination.

Comments on specific questions

Question 1

(a) Most candidates recorded their measurements of *a* and *b* correctly and performed the calculation well. Very few gave *a* and *b* values that totalled above 50 cm (this lost a mark).

(b) To score full marks here candidates needed to take their lead from the wording of the question and give more than two values for *w* and *t*. Unfortunately many gave only one value for each. Most carried out the calculation correctly and those who had proceeded with care gained marks for a density value within tolerance given to two or three significant figures and with the unit (g/cm^3).

(c) Many candidates were able to gain this mark by realising that the assumption is that the centre of mass is at the centre of the rule. Any wording that made this point attracted the mark.

Question 2

(a) – (d) A pleasing proportion of candidates scored full marks (or close to full marks) for the readings in the table. This showed good attention to detail. Only a minority missed the units. Very few quoted a value for room temperature that was clearly wrong.

(e) Most candidates were able to make a correct statement based on their results but to score both marks candidates needed to justify their answer by reference to the readings giving a clear comparison of changes in temperature. A theoretical approach did not attract the second mark.

(f) The most confident candidates correctly suggested two variables to be controlled. A few, however, seemed to have learned answers from previous questions of this type and made suggestions that are not relevant in this case. Others wrote about precautions to improve accuracy rather than control of variables.

Question 3

(a) Most candidates were able to record the potential difference although some clearly misread their voltmeter.

(b) Most candidates filled in the column headings with the appropriate units, gave all the potential difference values to at least one decimal place and had readings that showed they had used the circuit correctly.

(c) The graph was usually set up with sensible, labelled axes and the plotting correct. Candidates needed to draw a line that was a good attempt at the best-fit curve and not too thick.

(d) Many candidates extended the line suitably, following the trend of the line, to the *y*-axis. They were then able to read off the required value to an accuracy of half a small square.

Question 4

(a) – (e) This question required candidates to work with care and to be familiar with using an illuminated object and screen in this type of experiment. Most recorded the correct *x* values and went on to record *s* values that increased down the table. The values of s^2 were mostly calculated correctly and candidates then needed to give this consistently to a sensible number of significant figures (2, 3 or 4 significant figures were accepted but every entry had to be to the same number of significant figures). Candidates who had carried out the instructions with care were awarded the mark for achieving a final s^2 value that was within 10% of the first.

(f) and (g) Here a statement based on candidates' own readings was required followed by a justification that expressed an understanding of the idea of results being within (or beyond, depending on the results) the limits of experimental accuracy. Any wording that expressed this concept was rewarded.

(h) Most candidates were able to make a suitable suggestion of a precaution to be taken.

PHYSICS

Paper 0625/53

Practical Test

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.

The general level of competence shown by the candidates was pleasing. 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.

Most candidates dealt well with the range of practical skills tested with each question differentiating in its own way. The majority of candidates showed clear evidence of preparation for the different types of question in the examination.

Comments on specific questions

Question 1

(a) Most candidates recorded their measurements of *a* and *b* correctly and performed the calculation well. Very few gave *a* and *b* values that totalled above 50 cm (this lost a mark).

(b) To score full marks here candidates needed to take their lead from the wording of the question and give more than two values for *w* and *t*. Unfortunately many gave only one value for each. Most carried out the calculation correctly and those who had proceeded with care gained marks for a density value within tolerance given to two or three significant figures and with the unit (g/cm^3).

(c) Many candidates were able to gain this mark by realising that the assumption is that the centre of mass is at the centre of the rule. Any wording that made this point attracted the mark.

Question 2

(a) – (d) A pleasing proportion of candidates scored full marks (or close to full marks) for the readings in the table. This showed good attention to detail. Only a minority missed the units. Very few quoted a value for room temperature that was clearly wrong.

(e) Most candidates were able to make a correct statement based on their results but to score both marks candidates needed to justify their answer by reference to the readings giving a clear comparison of changes in temperature. A theoretical approach did not attract the second mark.

(f) The most confident candidates correctly suggested two variables to be controlled. A few, however, seemed to have learned answers from previous questions of this type and made suggestions that are not relevant in this case. Others wrote about precautions to improve accuracy rather than control of variables.

Question 3

(a) Most candidates were able to record the potential difference although some clearly misread their voltmeter.

(b) Most candidates filled in the column headings with the appropriate units, gave all the potential difference values to at least one decimal place and had readings that showed they had used the circuit correctly.

(c) The graph was usually set up with sensible, labelled axes and the plotting correct. Candidates needed to draw a line that was a good attempt at the best-fit curve and not too thick.

(d) Many candidates extended the line suitably, following the trend of the line, to the *y*-axis. They were then able to read off the required value to an accuracy of half a small square.

Question 4

(a) – (e) This question required candidates to work with care and to be familiar with using an illuminated object and screen in this type of experiment. Most recorded the correct x values and went on to record s values that increased down the table. The values of s^2 were mostly calculated correctly and candidates then needed to give this consistently to a sensible number of significant figures (2, 3 or 4 significant figures were accepted but every entry had to be to the same number of significant figures). Candidates who had carried out the instructions with care were awarded the mark for achieving a final s^2 value that was within 10% of the first.

(f) and (g) Here a statement based on candidates' own readings was required followed by a justification that expressed an understanding of the idea of results being within (or beyond, depending on the results) the limits of experimental accuracy. Any wording that expressed this concept was rewarded.

(h) Most candidates were able to make a suitable suggestion of a precaution to be taken.

PHYSICS

Paper 0625/61
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.

Clearly, some of the skills involved in practical work can be practised without doing experiments – graph plotting, tabulation of readings, etc. However, there are parts of the examination in which the candidates are effectively being asked to answer from their own practical experience. The answers given by some candidates in this examination suggest a lack of practical physics experience. Some candidates had a good overall understanding of what was required, backed by personal practical experience, and therefore scored high marks. Others, obtaining lower marks, appeared to have limited experience. Many candidates had prepared for the examination (very sensibly) by working through some past papers. However if this was done with little understanding, candidates gave answers that would have been correct in a similar question from a previous session, but were not appropriate to this question paper.

Most candidates dealt well with the range of practical skills tested with each question differentiating in its own way. Many candidates showed clear evidence of preparation for the different types of question in the examination.

Comments on specific questions

Question 1

(a) Many candidates recorded the calculation well. However some did not give the values consistently to either two or three significant figures.

(b) 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.

(c) A large number of candidates failed to follow the instruction to ‘show clearly on the graph’ how they obtained the information necessary to calculate the gradient, although the calculation often showed that they knew what to do. Candidates using a triangle that included at least half of their line showed that they were aware of the greater accuracy that can be obtained by using a large triangle.

(d) Candidates who had followed the procedure with care obtained a *z* value within the tolerance allowed. Those who also expressed their answer to 2 or 3 significant figures and included the unit g scored full marks.

Question 2

(a) Most candidates read the thermometer correctly although some quoted 20.6°C in place of 26°C.

(b) (i) Most candidates gave the correct units s and °C in both tables.

(ii) Candidates needed to realise that a long time was required (minimum allowed was 300s). Since an estimate was required the answer should be given to no more than the nearest 10s.

(c) Here candidates needed to justify their statement (Table 2.2) by comparing two temperature differences and realising that the times are relevant.

(d) The most confident candidates correctly suggested two variables to be controlled. Some, however, seemed to have learned answers from previous questions of this type and made suggestions that are not relevant in this case. Others wrote about precautions to improve accuracy rather than control of variables. Some even had one of each.

Question 3

(a) Most candidates read the value correctly (values from 0.3 to 0.31 were allowed).

(b) Most candidates gave the correct units and calculated the final value of resistance correctly.

(c) Many candidates found this part difficult. The first mark was awarded for calculating $0.5I_0$ and the second mark for estimating the resistance in relation to the results in the table, giving the value to the nearest ohm.

(d) To score full marks here candidates need to draw the voltmeter symbol correctly and then draw the voltmeter connected in parallel to the resistor. The final mark was awarded for drawing in the two resistors, in parallel, between **A** and **B**.

Question 4

(a) 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 and if the candidate drew the two lines as instructed, labelled point **G**, showed an initial pin separation of at least 5 cm, measured the angle correctly (to within 2°) and calculated (θ – 2i) successfully, then full marks were scored.

(b) Here correct angle measurements and calculations were required and finally a conclusion based on candidates' own readings. Candidates were expected to convey the idea of 'within (or beyond) the limits of experimental accuracy'. This was judged according to the candidate's own quoted values. Any wording that successfully expressed the correct idea gained the mark. Unfortunately many candidates did not seem familiar with this concept.

(c) Here candidates needed to understand that viewing the bases of the pins overcomes problems due to the pins being either bent of not vertical.

Question 5

(a) Many candidates were able to select three suitable possible variables that should be kept constant. Candidates did need to avoid vague reference to, for example, 'temperature' and to be more specific suggesting room temperature or temperature of ice cubes or water.

(b) Many candidates were successful in naming three items of apparatus along with the quantity that each measures. Some unfortunately gave a unit in place of the quantity.

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 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 – graph plotting, tabulation of readings, etc. However, there are parts of this examination in which the candidates are effectively being asked to answer from their own practical experience.

It is recognised that there can be difficulties in arranging a significant amount of individual practical experience and, in this case, the teaching of the experimental method is of great importance.

There were clear differences in responses from those candidates who seemed to have been exposed to a thorough background in practical work and those who had more limited experience. This was most apparent in the recording of data and in the interpretation of experimental results. A large disparity was found in the treatment of significant figures, units and graphical scales and in the knowledge of the factors influencing the outcomes of experiments.

It is sometimes difficult for the Examiner to see very fine points when plotted on a graph, particularly if these lie under the best-fit line. It is recommended that candidates use small fine crosses, or a small point within a circle, so that their plotting is clear.

There was no evidence that candidates were short of time; most candidates were able to finish the paper and very few questions were left questions blank.

Comments on specific questions

Question 1

(a) Most candidates measured the distances correctly.

(b) Scaling of the measured distances to full size was achieved by the majority of candidates although some divided the answers from **(a)** by 10 rather than multiplying. The mass of the metre rule was generally calculated correctly but the use of an inappropriate number of significant figures negated some potentially correct answers. Although the number of significant figures was not penalised in this part of the question, a greater number of significant figures increases the opportunity to record an incorrect value.

(c) The most usual answers in parts **(i)** and **(ii)** involved the recording of one value for each quantity. Credit was given, though not often gained, for showing that several measurements had been taken for each quantity and an average calculated. This is an example of where a good understanding of the experimental method would allow candidates to score well. It was pleasing to see the use of the correct unit for density in so many answers to part **(iv)** with the value expressed to an appropriate number of significant figures.

(d) Many realised that the centre of mass of the rule was at the 50 cm mark but a significant number incorrectly interpreted the question as referring to the centre of mass of the system, located above the pivot.

Question 2

(a) This was generally well done with the main loss of marks being the careless writing of the unit for ^{0}C.

(b) The correct temperature change was almost invariably obtained.

(c) An encouraging number of candidates recognised that the initial rate of heating was greater than the initial rate of cooling and were able to justify this using data from the first 30 seconds of each phase. However, many ignored the word 'initial' and came to the wrong conclusion by using data from the full 180 seconds of each part of the experiment.

(d) This was well answered although some candidates gave responses that appeared to be standard answers, learned previously, but which did not apply particularly to this question. Candidates should be taught to assess such answers critically in respect of their likely effect on the experiment under consideration.

Question 3

(a) The vast majority of candidates obtained the correct answer for the value of potential difference.

(b) Headings were, for the most part, correct although a small number were left blank or gave the quantity rather than the unit (for example: *V*/voltage rather than *V*/V). The majority of candidates calculated the resistance value correctly.

(c) It was pleasing to see the number of responses to the graphical question which obtained full marks or close to that. Errors included the use of inappropriate scales or axes labels, failure to obtain a 'best fit' line and the use of thick lines or, particularly, large plotted points, sometimes covering most of a square.

(d) Most were able to extend the line and judge a value for the intercept on the V axis. Some, however, forced the extension to go through the 2.0/2.1V point, mistakenly thinking that the value from part **(a)** was needed here.

Question 4

(a) The majority of candidates calculated the value for magnification correctly and realised that there were no units for this quantity.

Many obtained some marks from part **(ii)** of this question although full marks were proportionately rare. Answers generally included a correctly scaled diagram as it was shown on the question paper but many failed to realise that the image would be inverted.

(c) There were a number of appropriate arrangements shown in response to this question but many failed to recognise the need to clamp the metre rule if it was immediately above the lens or mark the centre of the lens on the block if the rule was below it. A correct solution to this practical question would be more easily obtained if candidates had experienced measurement in such circumstances at first hand.

(d) Most were able to gain at least one mark here with what are fairly standard precautions for optics experiments. The avoidance of parallax was often quoted but in order to gain this mark candidates need to describe how this would be achieved in practice.

Question 5

(a) Responses to this question were mixed, many failing to identify the appropriate variables in the experiment.

(b) Only about half of candidates were able to distinguish a quantity from a unit and thus achieve good marks here. Among those, a common mistake was to identify weight rather than mass as the quantity measured with an electronic balance.

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 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. Most were evidently 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 were often challenged when asked to derive conclusions from given experimental data and justify them.

All questions provided opportunities for differentiation, but particularly good, were **Questions 1 (b)(ii)**, **3 (c)(iii)** and **4 (d)(ii)**, where the conclusions, and the justifications in support of them, allowed the better candidates to demonstrate their ability. There was evidence that some candidates did not have the use of a calculator.

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 final answers.

Comments on specific questions

Question 1

(a) The graph of force against acceleration was plotted accurately and neatly by the majority of candidates. Most candidates chose scales which made good use of the grid provided. The line of best fit was usually well drawn in relation to the plotted points. Some candidates lost credit by drawing very thick lines of best fit.

(b) The idea of direct proportionality was understood by only a minority of the candidature. Most candidates incorrectly stated that because the line of best fit was straight, then the acceleration was directly proportional to the force. Only the most able candidates stated that the quantities were directly proportional because the line was straight <u>and</u> it passed through the origin. Candidates who had not included the origin in their choice of scales, rarely scored this mark.

(c) Marks were lost needlessly in this part because candidates ignored the instruction given in the stem of the question to <u>show</u> clearly how they obtained the information that they used to calculate the mass. The expected unit for the answer, kilogram, was often omitted or answers were wrongly expressed in grams.

Question 2

(a) Most candidates read the thermometer scale correctly and wrote down 27^{o}C. If the scale had been read incorrectly, the answer given was either 20.7^{o}C or 33^{o}C.

(b) The column headings were usually filled in correctly and most candidates deduced that the rates of cooling of the water under the different conditions were about the same. Fewer candidates were able to produce convincing justifications for their deductions. All that is required, is for candidates to state that the temperatures are similar, within the limits of experimental accuracy.

(c) Most candidates were able to suggest one condition that should be controlled in order to make the experiment a fair test. Far fewer avoided duplication and gave two different conditions.

Question 3

(a) The symbol for a voltmeter, and its method of connection into a given circuit to measure the potential difference across a resistor, was very well known. Surprisingly, a sizeable minority of candidates did not recognise the given component as a variable resistor. Answers such as thermistor, fuse, and diode frequently appeared.

(b) It was rare to see the pointer of the voltmeter drawn incorrectly.

(c) The table headings were usually correctly inserted; where errors were made it was usually due to candidates writing in the meanings of the symbols V, I and R instead of their units. The resistance values were calculated correctly by the majority of candidates, although there was often an inconsistency in the number of significant figures used for each value.

Although the calculated values of R should have elicited the deduction that R was constant, allowing for experimental inaccuracy, a large number of candidates stated the opposite.

Question 4

(a) This straightforward measurement was carried out accurately by the majority of candidates.

(b) Most candidates multiplied their answer in **(a)** by 3 to obtain the actual distance between the light source and the screen. A minority of candidates did not understand the scale diagram, and divided their answer by 3 instead.

(c) The diameter of the object card was usually measured correctly but many candidates did not repeat their measurement and average, despite the clue given in the stem of the question.

(d) The values of s^2 were usually calculated correctly, but were not always quoted to a suitable and consistent number of significant figures. Most candidates' results supported the suggestion that the value of s^2 when x = 10.0 cm was twice the value of s^2 when x = 2.0 cm, and they stated this, but many of these candidates could not produce a convincing justification of their statement.

(e) One sensible precaution was given by most candidates, but many of these were unable to give a second. It is worth repeating the comment made in previous reports, that the phrase 'avoid parallax', on its own, does not get credited; candidates must explain how parallax is avoided.

Question 5

(a) Most candidates were able to suggest one or two variables which should be kept constant in the investigation. Only the better candidates could suggest three different and relevant variables. One common, incorrect suggestion was to ensure that the temperature of the room remained constant.

(b) This was well done by the majority of candidates. The mark was sometimes lost due to imprecise and vague indication on the given diagram as to exactly which distances would need to be measured.

(c) The expected answer to this practical problem of measuring the length of a spring when it is not possible to position the ruler immediately next to it, was to use a fiducial aid, such as a set square. Many other, often ingenious methods were suggested by candidates. If the method was sensible, and would work in practice, then candidates were awarded credit.