PHYSICS

Paper 0625/11
Multiple Choice

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

General comments

Candidates found items **1** and **27** to be very straight forward. The most difficult items were items **5, 7, 9, 11, 14, 16, 23, 31, 33, 34** and **38**; of these, item **11** and item **31** were found the most taxing.

Comments on specific questions

The paper started with the simple measurement item **1** which was answered correctly by almost all candidates. Item **2**, on speed/time graphs, also presented few with a problem – the constant speed section between V and W was by far the most popular distractor, candidates probably thinking of the graph as showing distance/time. Item **3** involved a speed calculation, and the only significant mistake was to divide speed by time to arrive at option A. The balance item **4** discriminated well between the candidates. In item **5** on density, just over a third of candidates chose A, being the block with the smallest volume, therefore the most dense material. In the well-answered item **6**, several candidates opted for C, forgetting that a measurement of mass is also needed. Distractor A was very popular in the moments item **7**; it is worth stressing that equilibrium requires no resultant force *or* moment. Perhaps some candidates misread the question in item **8**, choosing C (as the only option with *no* resultant force). Item **9** caused many more problems; a considerable number of candidates thought that the measured length was plotted on the y-axis, despite the fact that the graph line started at zero.

A number of candidates lost a mark in item **10** because they could not recall that the work done by a force depends on the distance moved in the direction in which the force acts. Item **11** showed widespread confusion over the use of a manometer but pressure caused by a solid was much better understood in item **12**. Similarly, evaporation caused little difficulty in item **13**, unlike item **14** in which a large number of candidates chose D, as the only graph with a negative gradient. Item **15** was straightforward recall, whereas item **16** required an understanding of the concept of thermal capacity; this was often lacking, although most candidates did appreciate that the boiling point was not involved. Convection items are generally well received, and item **17** was no exception. All distractors worked well in items **18**, **19** and **20**. In item **21** on refraction, almost one in four candidates chose option C; candidates need to be reminded to look carefully at which material a ray of light is leaving, and which it is entering. In the wave item **21**, almost a quarter chose reflection as the process involved, and in item **22** distractor B (the non-reflected clock face) was popular. In different guises item **23** is very common on this paper, but was not well answered; the experiment to measure the speed of sound would be worth teaching in some detail. Items similar to item **24** on loudness and pitch are also common, but despite this still cause problems to some candidates. Items **25** and **26** were tackled well.

Electrical units were very well known in item **27**. Item **28** concerned a circuit, and a large proportion of candidates believed that moving the lamp to position P ‘before’ the resistor would increase the current in it; this seems to show a basic misunderstanding of the nature of current and a belief that it is ‘used up’ in a circuit. Item **29** was tackled well, and item **30** on resistance worked as intended. In item **31**, nearly half the candidates opted for B, misunderstanding the potential difference variation across each lamp. The physics principles behind a fuse and a relay were well known in item **32**, but not the pattern and direction of the magnetic field lines around a straight wire in item **33**; candidates needed to read the question carefully to note that the current was flowing *out of* the page. Item **34** needed some thought and was generally well answered, distractor A being the most popular. Item **35** demonstrated that the basic materials used in a transformer were not as well known as might have been expected. The next item **36** was also recall, and many chose A, confusing electromagnetic induction with thermionic emission. In item **37**, all three distractors were effective. Although negative statements are avoided in this paper wherever possible, candidates should be advised that they may be used occasionally; this was the case in item **38** and may have caused distractor D to be particularly popular. Items **39** concerning half-life, and item **40**, atomic structure, both caused fewer problems.

PHYSICS

Paper 0625/12

Multiple Choice

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

General comments

Items **2**, **3**, **5**, **6**, **25** and **27** were found easiest by the candidates. The most difficult items were items **11**, **12**, **18**, **24**, **28**, **29**, **33** and **36**; of these, item **12** and item **28** were found the most taxing.

Comments on specific questions

Item **1** on speed/time graphs presented few with a problem – the constant speed section between V and W was by far the most popular distractor, candidates probably thinking of the graph as showing distance/time. Almost all responses to the straightforward measurement item **2** were correct. In item **3**, a number of candidates opted for C, forgetting that a measurement of mass is also needed. In item **4** on density, a quarter of candidates chose A, being the block with the smallest volume and therefore the most dense material. Item **5** involved a speed calculation, and the only significant mistake was to divide speed by time to arrive at option A. A few misread the question in item **6**, choosing C (as the only option with *no* resultant force). Item **7** caused more problems; a significant number believed that the measured length was plotted on the *y*-axis, despite the fact that the graph line started at zero. The balance item **8** was well answered. Distractor A was popular in the moments item **9**; it is worth stressing that equilibrium requires no resultant force *or* moment. Almost one in three lost a mark in item **10** because they could not recall that the work done by a force depends on the distance moved in the direction in which the force acts. Item **11** showed 34% of candidates choosing D, as the only graph with a negative gradient. Item **12** showed widespread confusion over the use of a manometer, a large proportion of candidates not noticing the 20 cm difference in water levels and consequently opting for C. Item **13** on pressure caused by a solid was much better understood, as was the straightforward recall item **14**. All distractors worked well in item **15**. Items **16** and **17**, on evaporation and convection respectively, caused few problems.

Although a great majority of candidates realised that item **18** concerned thermal capacity, more than a quarter chose B, not understanding that a higher thermal capacity is associated with a smaller temperature rise. The reflection item **19** was well answered. In item **20** on refraction, it was distractor C which was popular; candidates need to be reminded to look carefully at which material a ray of light is leaving, and which it is entering. Diffraction was recognised by most in item **21**, with refraction being the popular distractor. A stronger performance was shown in item **22** which required recall of wave types. Item **23** is similar to several previous waves questions, and produced very close to its target facility. However item **24**, despite being very common on this paper in different guises, was not well answered; the experiment to measure the speed of sound would be worth teaching in some detail. Electrical units were very well known in item **25**. Item **26** on resistance also produced many correct answers, as did item **27** on circuits. In item **28** nearly half the candidates opted for B, misunderstanding the potential difference variation across each lamp. Item **29** concerned a circuit, and one in four candidates believed that moving the lamp to position P ‘before’ the resistor would increase the current in it; this seems to show a basic misunderstanding of the nature of current and a belief that it is ‘used up’ in a circuit. The physics principles behind a fuse and a relay were well known in item **30**, and items **31** (77%) and **32** (84%) on magnetism were similarly tackled well. The pattern and direction of the magnetic field lines around a straight wire in item **33** lead a quarter of candidates to choose B, probably failing to notice the direction of the current. In item **34**, the basic materials used in a transformer were not as well known as expected. Item **35** on the a.c. generator needed some thought and was generally well answered, distractor A being the most popular. Although negative statements are avoided in this paper wherever possible, candidates should be advised that they may be used occasionally; this was the case in item **36** and may have caused distractor D to be particularly popular. Item **37** on atomic structure and item **38** on half-life caused far fewer problems. The next item **39** involved recall, and many chose A, confusing electromagnetic induction with thermionic emission. In item **40**, all three distractors were effective.

PHYSICS

Paper 0625/13
Multiple Choice

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

General comments

Items **1**, **4**, **6**, **9**, **10**, **11**, **15**, **17**, **19**, **26**, **28**, **29**, **30** and **39** were found to be the most easy by the candidates. above. Only three items were found particularly challengbing; these were items **13** (particularly badly answered), item **18** and item **32**.

Comments on specific questions

Item **1** involved a speed calculation, and caused little difficulty. This was also true for item **2** on speed/time graphs. In different guises, item **3** is very common on this paper, and was generally well answered, with distractor C being particularly effective. With a high facility, the simple measurement item **4** represented very little challenge, but item **5** lead a significant number of candidates to opt for distractor A, believing that the measured length was plotted on the y-axis, despite the fact that the graph line started at zero. Item **6** concerned resultant force, and this was clearly well understood, although some did choose C (as the only option with *no* resultant force). Many candidates lost a mark in item **7** because they could not recall that the work done by a force depends on the distance moved in the direction in which the force acts. Distractor A was popular in the moments item **8**, and it is worth stressing that equilibrium requires no resultant force *or* moment. The balance item **9** was another well answered question, as was item **10** on pressure due to a solid, and item **11** on equipment to measure density. In item **12** on density, many candidates chose A, being the block with the smallest volume, therefore the most dense material. Particularly challenging to candidates, item **13** showed widespread confusion over the use of a manometer. Item **14** required an understanding of the concept of thermal capacity; most of those making an incorrect choice did at least appreciate that the boiling point was not involved, and opted for B. A high success rate was found in item **15** which concerned evaporation. Although not quite as well known, the knowledge of thermometer fixed points required in item **16** was generally sound. Item **17** was answered well, unlike item **18** in which a high proportion of candidates chose D, as the only graph with a negative gradient. Convection items are generally tackled well, and item **19** was no exception. Items similar to item **20** on loudness and pitch are also common and was quite well answered.

In item **21**, B (the non-reflected clock face) was the principal distractor. Knowledge of wave diffraction was evident in the relatively high success rate for item **22**, naming the effect as refraction being the commonest error. In item **23** on refraction, one in four chose option C; candidates need to be reminded to look carefully at which material a ray of light is leaving, and which it is entering. The pattern and direction of the magnetic field lines around a straight wire was the subject of item **25**; candidates needed to read the question carefully to note that the current was flowing *out of* the page, to avoid choosing B. Items **26** and **27** on magnetism were both answered well, as was the electrical items **28**, **29** and **30**. Item **31** concerned a circuit, and a reasonably large proportion of candidates believed that moving the lamp to position P 'before' the resistor would increase the current in it; this seems to show a basic misunderstanding of the nature of current and a belief that it is 'used up' in a circuit. In item **32**, more than a third of candidates opted for B, misunderstanding the potential difference variation across each lamp. In contrast, the physics principles behind a fuse and a relay were well known in item **33**. Item **34** needed some thought and was well answered, distractor A being the most popular. Although item **35** had a slightly higher success rate, the basic materials used in a transformer were still not as well known as expected. Item **36** showed generally sound understanding of the deflection of charged particles in an electric field, but in the recall item **37**, many chose A, confusing electromagnetic induction with thermionic emission. Item **38** on atomic structure caused fewer problems, as did item **39** on half-life. Although negative statements are avoided in this paper wherever possible, candidates should be advised that they may be used occasionally; this was the case in item **40** and may have caused distractors A and D to be popular choices.

PHYSICS

Paper 0625/21

Core Theory

Key message

To make a success of this paper, candidates need to be competent at all sections of the Core syllabus. The topics of waves, electromagnetism and cathode rays were not well known by a significant number, who might have benefited from more focused revision of these areas.

General comments

Candidates on this paper usually cope well with the limited mathematics required, and this seemed to be the case on this occasion. There is no penalty applied for weakness in English language skills; if the Examiner can understand an answer to be correct, credit is awarded, however poor the expression or spelling. The same applies to the standard of writing and presentation, but on far too many occasions the answer was written so badly that it simply could not be read. Candidates should not assume that if they write indistinctly, the Examiner will give them the benefit of the doubt. Similarly, many candidates lost marks through careless drawing.

Very few candidates did not attempt **Question 12**, so it would seem that they had enough time, although a sizeable minority left sections unattempted in other parts of the paper – suggesting significant gaps in their knowledge.

Comments on Specific Questions

Question 1

Most candidates could identify the regions of uniform and accelerating motion, but only a tiny minority knew that the distance in the last 15 s was found from the area under the graph, or the average speed x time. The vast majority simply multiplied 5 by 15.

Question 2

(a) A metre rule is not suitable to measure such a long distance, but very few could suggest an alternative.

(b) Most knew that time is measured with a clock, and a good proportion made an understandable attempt at describing how to time the piece of wood's journey. The calculation of the speed posed few problems for most, and nearly all included appropriate units in the answer. On this occasion, the unit was not printed on the answer line, which indicates that the candidate is expected to supply it. Credit for the correct unit was awarded even if the numerical answer was wrong.

Question 3

(a) The use of a plumb-line was only familiar to a small number, and some of these resorted to describing it, rather than naming it (this was marked correct). Appropriate alternatives would have been awarded credit, but by far the most popular answer was metre rule, which was not credited. A pleasing number knew how to find the position of the centre of mass of the triangular card. Even those who received no credit seemed to know it was something to do with drawing lines from **A**, **B** and **C**.

(b) Most candidates knew that **X** should be on the vertical axis of the toy, and gained partial credit, but far fewer knew where exactly on this line to position **X**. Some candidates were too careless to position **X** accurately on the axis and so could not be awarded credit. A few millimetres off the axis was not adequate.

Question 4

(a) A good number knew that something was seen moving. Some of these even indicated randomness in this movement. However, what is seen (notice the bold print in the question) is not molecules, nor even particles, but dark specks or bright specks (depending on illumination).

(b) This was known by the more able candidates.

(c) Very few could actually answer the question. Most simply wrote what they knew about air molecules, whether or not it related to the experiment in the question.

Questions 5 and **6** on waves were both poorly done – this is clearly a topic needing more attention in the future.

Question 5

(a) Very few could find the frequency of the sound produced by the rotating wheel. There seemed to be an overwhelming desire to prove that it was 50 Hz.

(b) Very few knew the range of frequencies heard by the human ear. Some even put the highest frequency lower than the lowest frequency, or put the lowest frequency at 0 Hz.

(c) Many answered this part correctly, even if **(a)** and **(b)** were incorrect.

Question 6

(a) Not many identified ultrasound as the only non-electromagnetic wave.

(b)

(i) Very few could put the radiations in their correct order, although a few gained partial credit.

(ii) Radio waves were rarely identified as having the longest wavelength, with gamma rays being much more popular. Possibly this was a confusion with the fact that, of the three emissions from radioactive substances, gamma has the longest range in air/vacuum.

(iii) Many candidates did not name infra-red, but ultra-violet instead.

(iv) This part was usually answered correctly.

Question 7

Electromagnetism is another topic where candidate understanding needs improving. Frequently there is confusion between charge and magnetism.

(a) A majority realised that the needle should be put into the coil, but some thought that merely being near was sufficient, or that the needle had to be rubbed by the coil. It would appear that a lot of candidates *assumed* that a current was already passing through the coil, and so did not gain credit for current and d.c. Virtually no candidates could describe how to check the polarity of the needle in convincing terms.

(b) About half attempted to draw some sort of magnetic field around the magnetised needle but many were too carelessly drawn to receive credit.

Question 8

(a) Answers were often ambiguous, but many candidates correctly identified the fault. At this stage there was no involvement of a voltmeter, so answers that said that this had been omitted were not credited.

(b) The question clearly said "Using standard symbols.....", though many candidates didn't and so could not be awarded credit.

(c) A good proportion showed the voltmeter correctly connected, but there were some candidates who put it in series.

(d) Unfortunately many candidates could not read the two meters correctly, and very few could work out what happened to the readings when the slider position was changed for **(ii)** and **(iii)**. Candidates needed to stop and think the problem through carefully, rather than simply dashing down a quick answer.

Question 9

(a) A good proportion knew that this symbol showed a transformer, but coils and capacitors were also popular incorrect answers.

(b) Questions on this topic usually require the use of the transformer equation. A lot of candidates made a very good attempt, and calculated the turns ratio at **X** correctly. Fewer earned credit for the turns ratio at **Y** because they got it the wrong way round i.e. 550/1 rather than 1/550.

(c) Virtually no candidates answered this part correctly with most answers unfortunately being irrelevant.

Question 10

(a) It was rare to find a candidate who knew what an electric field was.

(b) Almost all knew that **A** and **B** would be closer together. Unfortunately, once again, careless drawing often meant that credit could not be awarded; the threads needed to be straight and at equal angles to the vertical.

(c) It was pleasing to see how many gained at least partial credit for the forces on **B**. The question only required the directions of the forces, so there was no penalty if the forces did not start from **B**. Forces **E** and **W** were frequently marked correctly, but **T** was often shown coming down from the support.

Question 11

Most candidates did not have sufficient knowledge about this topic to be able to give meaningful answers to the questions.

Question 12

(a) The graph was usually well plotted, and a reasonable curve drawn though the points. The most common point to be mis-plotted was the final one.

(b) Candidates were usually able to take the readings from the graph to an acceptable level of accuracy, but the translation of them into the half-life of the material proved too challenging for many.

PHYSICS

Paper 0625/22

Core Theory

Key messages

To make a success of this paper, candidates need to be competent at all sections of the Core syllabus. The topic of radioactivity was not well known by a significant number, who might have benefited from more focused revision of this area.

Many candidates struggled to give clear definitions of basic terms such as *moment* or *melting point*. Candidates would be advised to learn some simple definitions.

General comments

Candidates on this paper usually cope well with the limited mathematics required, and this seemed to be the case on this occasion. Most candidates were able to make correct use of units. There is no penalty applied for weakness in English language skills; if the Examiner can understand an answer to be correct, credit is awarded, however poor the expression or spelling. The same applies to the standard of writing and presentation, but on far too many occasions the answer was written so badly that it simply could not be read. Candidates should not assume that if they write indistinctly, the Examiner will give them the benefit of the doubt. Similarly care should be taken when drawing diagrams.

Most candidates attempted all the questions; there was no evidence that candidates were short of time.

Comments on Specific Questions

Question 1

(a) Most candidates knew how to calculate density from mass/volume, but a sizeable minority forgot to do the necessary subtraction to find the correct mass.

(b) A large proportion thought incorrectly that the density of olive oil would increase when it was heated.

Question 2

(a) There were some very muddled and ambiguous descriptions of what an echo is. The two key words in the definition are sound (or waves) and reflection and many candidates did not mention the second of these.

(b) Most knew speed = distance/time, but many either could not rearrange it correctly or used 300 m as the distance instead of 12.9 m.

Question 3

(a) (b) The meaning of *moment* proved surprisingly difficult for most candidates. This translated itself to **(b)**, where only a few made any reference to the distance from the hinges/pivot. A small number made an irrelevant reference to the fact that **A** was closer to the edge of the door. Not all were able to work out what happened to the door when the two workers were pushing.

Question 4

(a) As with the previous question, candidates found it difficult to give a precise statement. Most knew the *melting point* to be something to do with solids turning to liquids, but only a few said it was the temperature at which this occurs. The most common answers were in the form “The point when a solid turns to a liquid” (which was awarded credit) or “The point when a substance melts” (which was not awarded credit). Some candidates could only relate their answer to ice, and generally such answers did not receive credit. Candidates need to realise that basic definitions such as melting point and moment are crucial to a proper understanding of Physics, and should make sure they are well known.

(b) A majority of candidates thought that there is a temperature change (up or down) during melting. This is another key misunderstanding.

(c) Only a few knew enough to show a horizontal section on the graph, and not all of these were at -10 °C. Of those that got this far, most showed straight line cooling sections before and after, rather than curves. However, the vast majority of candidates had no idea what the graph should have looked like.

Question 5

(a) Only a small proportion were able to work out that the resistance of **X** decreases, and even fewer could relate that to a thermistor.

(b) The whole idea of calibrating **X** (rather than a liquid-in-glass thermometer) as a thermometer seemed to throw most candidates. A good proportion realised that the resulting thermometer would not be very accurate if resistance did not vary linearly with temperature.

Question 6

(a) Most candidates were determined to show the refracted rays joining directly to the incident rays or to have them changing direction at the centre line of the lens, even if this meant them not passing accurately through the points. The intention was that the rays would follow the real paths through the lens, not what we pretend, for convenience of ray diagrams, namely a path where the bending occurs at the middle of the lens. No doubt this was a completely strange concept to many candidates. It should not be. **F** was rarely positioned correctly.

(b) This part of the question was generally well done. The only serious mistake was to show total internal reflection at **C**.

Question 7

(a) This simple question was generally correctly answered.

(b)

(i) Candidates were about equally divided in their selection of the **R** or **L** side. Most candidates were unable to give a convincing argument for their choice.

(ii) A good proportion could answer this correctly, but a lot of candidates answered in terms other than that of wave spacing. Such answers could not be awarded any credit.

Question 8

(a) This was well answered by most candidates.

(b) Many candidates gained full credit on this part, having worked out that the water at **X** was positively charged. However, the means by which this charge was acquired, when described, was often most imaginative. It was decided not to penalise this, if the candidate knew about the positive charge. It still remains, though, that most candidates probably don’t really understand what is happening at **X**, and teachers should take note of this.

Question 9

(a) Candidates usually knew that the rod would become magnetised and that the steel pin would be attracted to it. What was not understood, however, except by a very small minority, was the momentary nature of the deflections of the millivoltmeter, and the opposite deflections on turning on/off. Most thought that the pointer went one way when switching on and then back to the centre on switching off. This is a misunderstanding that appears often and teachers need to find some way of helping their candidates grasp what is happening.

(b) Diagrams of the electromagnet and circuit usually showed what was required, although some circuits were not well drawn. Not many could state the setting of the variable resistor that gave the strongest magnetism. "Low resistance" or "reduced resistance" was not adequate.

Question 10

(a) Most knew that the instrument was a voltmeter and could show it in the correct position. It seemed that there were fewer than usual who put the voltmeter in series.

(b) It is often the case with candidates for this paper that there is a belief that the current in a circuit gets less and less as you go round the circuit. This didn't seem to be the case on this occasion, as most candidates gave the correct currents for both ammeters.

(c) A good proportion were able to perform the calculation of the resistance successfully. Any error in this calculation was not penalised again in the value for the total resistance. As long as 4 Ω was correctly added to their calculated value, credit was awarded.

(d) Most were able to answer this correctly.

Question 11

Answers to this question showed a somewhat insecure understanding of radioactive decay.

(a) Only a small proportion could suggest an acceptable source for the background radiation.

(b) Alpha and beta particles were widely quoted and rewarded, but any mention of gamma was penalised.

(c) Some candidates seemed to find it hard to estimate the half-life from a table, rather than from a graph. It is an important skill to be able to estimate values from tables such as this.

(d) Candidates who were prepared to stop and think were able to correctly deduce the answers here. A very large proportion thought both values would increase when a larger quantity was used. The half-life, of course, remains unchanged.

(e) Precautions tended to centre on protective clothing – even lead suits were mentioned and this was given the benefit of the doubt. The other common precaution that was given credit was about keeping your distance – using tongs etc.

Question 12

The whole of this question was pleasingly well done by the vast majority of candidates. There was a bit of confusion between mass number and atomic number (where candidates used that terminology), but otherwise most candidates are to be congratulated on having grasped this tricky concept.

PHYSICS

Paper 0625/23

Core Theory

Key message

The topics of Brownian motion, ray optics and electromagnetic induction were not well known by a significant number of candidates, who might have benefited from more focused revision of these areas.

General comments

In general, candidates showed themselves to be competent across much of the Core syllabus. Most candidates attempted all parts of all questions. Numerical work was usually good, and candidates seemed to be able to cope with the correct use of units. Where appropriate, candidates usually attempted to present their work in a clear manner.

Comments on specific questions

Question 1

(a) Most candidates realised that the shaded area represented the 25 km shown on Fig. 1.1.

(b) A few got muddled, but the majority could interpret the graph.

(c) This was correctly answered by most.

Question 2

This section of the syllabus is often poorly understood, and this was the also case on this occasion. Candidates had little idea about the behaviour of the molecules causing the observed movement.

Question 3

This was a slightly different approach to a familiar situation, and candidates generally applied their knowledge well.

(a) Quite a lot of candidates assumed this was a pendulum, and wanted the energy to be gravitational PE, rather than strain/elastic.

(b) Most candidates answered this correctly.

(c) Candidates are often poor at giving definitions or stating meanings, but there were many good attempts at both definitions in **(i)**. It was well known that the amplitude decreases as the total energy of the strip decreases.

(d) This question posed few problems.

Question 4

Apart from a few muddled candidates in **(c)**, the whole of this question was very pleasingly answered.

Question 5

(a) Some tried to use density=mass/volume to find the mass, instead of simply subtracting, but most knew what to do.

(b) Density was well understood and the calculation was usually clearly performed. If a candidate used a value of mass that had been incorrectly calculated in **(a)**, no further penalty was applied provided no further mistake was made. This is a general principle in IGCSE Physics papers, to avoid penalising a candidate more than once for the same mistake. The printed answer line did not contain the unit for the answer. Teachers could explain that this usually indicates that the candidates have to supply the unit themselves (unless the quantity has no unit).

Question 6

(a) Most knew that an echo was reflected sound, but far fewer indicated what it was reflected from. The calculation that followed this was very well done.

(b) Candidates are to be congratulated for being prepared to think about this somewhat unusual graph, instead of just guessing. Many were awarded full credit.

Question 7

(a) Candidates generally struggled with this ray optics question. Some candidates did not realise that the image would be behind the mirror. Those who did, usually positioned it in the correct place, but it was very common to see the image placed on the mirror surface. Many reflected rays did not obey $i = r$.

(b) A good proportion spotted that the only word to look different in reflection was HIS. In fact, the only letter to look different was S, and this was given by a few as the answer. This was given the benefit of the doubt.

(c) Candidates need to spend more time practising drawing ray optics diagrams. A large proportion of candidates incorrectly drew the ray being deflected at the first surface, in both prisms.

Question 8

(a) There were some candidates who seemed to have a confident grasp of the topic, but there were others who appeared to be guessing.

(b) Most knew that the instrument would be a voltmeter, and could show it in the correct position, using the standard symbol. There was a minority who showed it connected in series somewhere.

(c) The wiring on the diagram was completed correctly by most candidates, although some added an extra wire across the bottom, incorrectly creating a short circuit. The calculation was correctly done by most candidates, including stating the correct unit, but candidates were far less sure about the total resistance of the electric fire.

Question 9

(a) Candidates' application of their knowledge of magnetism to this problem needed more thought. Few seemed to realise the significance of whether something attracts or repels.

(b) Most recognised that the balls would attract, but few tackled what would happen after they touched.

Question 10

Candidates were very confused when it came to electromagnetic induction. In particular, candidates did not appreciate the momentary nature of the deflection of **G** – that the needle deflects one way for an instant and then goes back to zero. The most common, incorrect, understanding of candidates is that it deflects one way (and stays there, by implication) when switching on, and then goes back to zero on switching off. As part of the core syllabus this is a difficult topic for most candidates.

Question 11

(a) Candidates were good at realising what gave rise to the 136 count, but surprisingly not so good at realising that the average count rate simply needed a division by 4.

(b) Few could work out that since the count was almost the same (slightly lower, actually) as before, the source must be emitting alpha radiation. Many of the attempts at finding the count rate due to the source alone were spoiled by not subtracting the background value first.

Question 12

Understanding of this topic was good and candidates are to be complimented.

PHYSICS

Paper 0625/31

Extended Theory

Key Messages

Some areas of the syllabus were better known than others; in particular cathode-ray tubes were not well understood.

Whilst candidates had no problems with single step calculations, many got lost when trying to work through more complex questions involving several stages, and would benefit from having more practice at solving these types of problem.

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

General Comments

Varying types of question brought varying qualities of answer. Almost all candidates coped easily with calculations which required recall of a formula, the substitution of numbers and the ensuing work with a calculator. Unfortunately, when numerical questions demanded a step-by-step development, many candidates did not get beyond the early stages. There were three examples of this type of question in this paper.

Other questions required verbal responses of varying degrees of difficulty. The simplest of these required recall of learnt material and many candidates fell short in this area, omitting significant words or detail. The harder questions of this type are those which require the application of recalled material to unfamiliar situations. Only the most able candidates are expected to succeed with all of these, but it is creditable that in many cases apparently weaker candidates unexpectedly produced answers of good quality to such questions, boosting their overall performance accordingly.

Comments on Specific Questions

Question 1

(a) Any statement equivalent to change of velocity or change of speed per unit time was acceptable, either stated in words or using explained symbols. Statements such as velocity or speed divided by time were not rewarded. A good proportion of candidates were successful.

(b)

(i) The correct numerical answer was very frequently given. Partial credit was awarded if a wrong value was calculated but it was clear that an area under the graph was being used.

(ii) The first requirement was to calculate the time of 50 s during which acceleration took place. Many candidates who had been unsuccessful in **(a)** nevertheless found this time correctly. It was not unusual for candidates to use the time of 50 s in their subsequent graphs without showing its calculation. This was entirely acceptable. A majority of candidates gained full credit for their graphs.

Question 2

(a) The intention of the question was for candidates to explain what happened to the water which had already evaporated from the sea. Many spent time and space explaining evaporation. Answers of varying standard were seen, with the majority including enough processes or energy changes to gain at least partial credit.

(b)

(i) All but the weakest candidates gained full credit here. Few unit errors or omissions of units were seen here or in subsequent questions.

(ii) The formula for kinetic energy was in general quoted correctly, but a minority omitted to square the speed in their calculations.

Question 3

(a) Regarding the force aspect, very few candidates gave the simple statement ‘no resultant force’. Many answers seen were insufficiently comprehensive, so upward force equals downward force was not rewarded. A typical acceptable answer was ‘total force in any direction equals total force in the opposite direction’ with several possible alternatives conveying the same idea. As regards rotational equilibrium, the simplest wording would have been ‘no resultant moment’, but this was seldom seen. Many candidates quoted ‘sum of clockwise moments equals sum of anticlockwise moments’, again with alternative wording, which gained credit.

(b)

(i) Perhaps the candidates were put off by the unfamiliar context of the question. Many gained credit for F x 2, but did not identify two opposing moments, or miscalculated the distances of the forces from point P. Totally correct answers were rare.

(ii) Here the task was to recognise the equilibrium of the total upward and downward forces. Few did this successfully. Candidates who had given an incorrect answer to **(i)** were still able to gain full credit for this part if they had worked it through correctly.

Question 4

(a) Surprisingly few candidates gained full credit. The required labels were to indicate the mercury in the dish and the vacuum in the space at the top of the tube. The levels of mercury had to be indicated with the appropriate height labelled *h*.

(b) Most candidates received full credit here.

(c) Answers suggesting reading error or variations in the density of mercury were not rewarded. The most acceptable suggestions referred to a difference in altitude at which measurements were made or the presence of air in the space above the mercury.

Question 5

(a) In **(i)**, most candidates correctly stated that gases expand the most and solids the least. In **(ii)**, fewer could suggest that, in a gas, change in pressure also causes change of volume.

(b)

(i) Several valid statements could have been made, such as uniform expansion, low freezing point, or remains liquid over the required range. Those which were rejected included: has a good range, has a high boiling point, is coloured, is sensitive.

(ii) Candidates in general have a poor idea of what is meant by sensitivity, often suggesting factors about the liquid rather than about the design of the thermometer itself. Factors which would increase the spacing between the scale graduations were required, such as using a capillary with a smaller diameter and using a larger bulb.

(c) Glass is a poor thermal conductor and various reasons based on this point were credited, such as faster flow of heat to the alcohol. Some referred to the fact that thinner glass would absorb less heat and were also rewarded.

Question 6

(a)

(i) 1. A good proportion of candidates could suggest that compressions (or rarefactions) would be closer together or that there would be more of them.

2. This part question proved to be difficult for most candidates, largely because many seemed unfamiliar with the representation of a longitudinal wave shown in the figure. Very few correctly referred to layers of air being closer together at compressions and further apart at rarefactions.

(ii) Candidates who chose to mark the distance between adjacent compressions or rarefactions usually gained credit. Those who chose to show the wavelength other than in this way were less successful, sometimes through carelessness.

(b) Most candidates found it difficult to take the appropriate steps to calculate the speed in steel, with some showing no coherent steps. Some successfully gained credit by calculating the time taken by the sound travelling in air. Many of these then added, rather than subtracted, the time delay. The final answer achieved depended on how many significant figures were used in the calculation; good practice would be not to apply rounding until the final answer stage of a multi-step calculation, but no penalties were applied.

Question 7

(a)

(i) The definition of 'monochromatic', in the context of physics, is 'radiation of a single frequency or wavelength'.

(ii) In general there was sound recall of the formula and correct calculations of the angle.

(iii) Most candidates could be awarded credit for showing refraction of the ray towards the normal. In some cases it was not clear that the emerging ray was parallel to the incident ray.

(b)

(i) As in **(a)(ii)**, most candidates could choose and apply the formula correctly. It was surprising how many candidates wrote the answer using all the digits from their calculators; this was not penalised, although it is good practice for the final answer to reflect the precision of the data from which it was calculated.

(ii) Candidates had to be aware that a violet ray refracts more than a red ray, and that, for a common angle of incidence, the emerging red and violet rays are parallel to each other.

Question 8

(a) Most candidates could identify three changes to the system that would increase the induced current. Weaker candidates often suggested changes implying that there was a voltage source or current in the circuit other than the induced ones.

(b)

(i) Almost all candidates were able to recall and successfully use the relationship between the voltages and the numbers of turns.

(ii) Candidates who equated the power in the primary and secondary circuits were most successful. Those who attempted to apply a relationship between currents and numbers of turns often were not successful. The latter may have made a better attempt if they were able to recall that if voltage is stepped down by a transformer, the current is stepped up.

Question 9

(a)

(i) Few candidates could be awarded full credit. Many candidates clearly based their decisions about the way the resistances vary simply by looking at the shape of the graphs, incorrectly relating the resistance to the gradient rather than looking at the ratio V/I. In relation to the curve for the lamp, some correctly suggested that the resistance rises, but added that it subsequently falls.

(ii) The correct answer was usually stated.

(b) Most candidates could be awarded credit for a statement of a version of the parallel resistance formula. Fewer went on to correctly calculate one or both of the resistances at 4.0 V. Of those who got this far, mistakes in using the parallel resistance formula were frequently seen. The exact answer arrived at by this approach depended on the number of significant figures used for the resistors.

The alternative but mathematically simpler approach was seldom seen. Adding the currents at 4.0 V gives the current from the supply. Dividing the given e.m.f. by this current gives the required resistance.

Question 10

(a)

(i) Many weaker candidates did not identify component B as a thermistor.

(ii) No credit was given for stating that as temperature rises the resistance of B falls, this having been suggested in the question. Candidates were not expected to give details of the function of the transistor, beyond expressing the idea that it operates as a switch. Credit was available for stating that the p.d across B is high at low temperature, and low at high temperature, or that the p.d across B falls as its temperature rises. Further credit could be awarded for a statement as to how the change in p.d of B affected the potential of the base or the base current. A complete answer went on to state that the lamp is on at low temperature and off at high temperature.

(b) Answers such as ‘fire alarm’ or ‘street lights’ or ‘in a refrigerator’ were not rewarded. Minimal but relevant detail was expected; for example, to switch on a lamp when the temperature of a process or appliance, not necessarily named, becomes too high, or off when it becomes too low.

Question 11

(a) Many answers to this question were disappointedly weak. It was not unusual for weaker candidates to suggest that it is light that travels through the CRO in order to produce a light spot on the screen. Other serious misconceptions were also apparent.

Very brief answers would have sufficed, but many candidates, unsure of the actual purposes of the components, wrote unnecessarily long and often contradictory responses.

(b)

(i) The required statements were that a p.d had to be applied, and the top and bottom plates made positively and negatively charged respectively. The first of these points was rarely seen.

(ii) Parallel lines from upper to lower plate were required, with arrows pointing downwards. Many answers showed only the path electrons would take, suggesting lack of care in reading the question.

PHYSICS

Paper 0625/32

Extended Theory

Key Messages

Some areas of the syllabus were better known than others; in particular logic gates and logic circuits were not well understood.

Most candidates were proficient in applying equations to standard situations. However, when asked to apply their knowledge to a new situation, they could become confused and display a lack of breadth of understanding of the use of the equation. More practice in applying equations in unfamiliar situations would deepen candidates' understanding and thus improve their overall performance in the examination.

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

General Comments

A high proportion of candidates had clearly been well taught and prepared for this paper which is to be commended. However, there remains the tendency to think less rigorously and logically in non-numerical questions than in numerical questions. Equations were generally well known by many candidates. Setting out of working by weaker candidates was sometimes very confused, even breaking the rules of algebra. Examiners do their best in these situations to reward candidates for progress they have made but can only do so when it is clear that this has been achieved. Generally candidates used the correct units but there were occasional errors or omissions with units.

It is essential that candidates are secure in their knowledge of left and right. In **Question 6(a)** a small minority of candidates confused left and right. In this question the rest of their answers could still be valid so Examiners were able to give appropriate credit. However, candidates should be aware that this might not always be the case.

Comments on Specific Questions

Question 1

(a) A high proportion of candidates used the expression gain of gravitational PE = $mg\Delta h$ and often made a good attempt at substitution. The most common error was to use one of the two heights given for the centre of mass not the difference between them. There were also many errors in converting the mass to kilograms.

(b) The common error here was to not link the change in KE to the change in gravitational PE. Some candidates, including some of the stronger candidates, used $v^2 = u^2 + 2as$. This gives the correct answer but the physics is incorrect in this situation, so no credit could be awarded.

(c)

(i) Many candidates gained full credit, but there were a significant number of errors in changing cm to m, and ms to s. Candidates should be made aware that the paper only uses standard SI multiples and sub-multiples, as a number of candidates seem to think that ms was an abbreviation for minutes and tried to calculate a time in seconds by dividing by 60.

(ii) The most commonly seen correct answer was an appropriate mention of energy lost to air resistance or heat. More was expected than the insufficient comment "Some of the KE was transferred to other forms." It would also have been acceptable to make a correct and specific reference to experimental error. Almost all candidates who answered in this way were far too vague. Answers such as "mistakes were made in measuring" were not awarded credit.

Question 2

(a) Most candidates correctly calculated the acceleration, but a significant number incorrectly quoted the unit of acceleration as m/s.

(b) This was generally well done although weaker candidates struggled with calculating the stored energy and efficiency. In **(i)** a few candidates quoted the energy wasted rather than energy stored. In this part question in particular it was felt that those candidates who struggled to gain any credit would have been better entered for the Core paper.

(c) There were many correct responses, but quite a few made no response or named some inappropriate devices such as springs, which would only work for a model car. Flywheels are used to store energy in public service vehicles as well as racing cars so would have been quite acceptable as an answer. Candidates who chose a correct device very often did not come up with the correct change that occurs as energy is stored. For example, thermal or heat energy was often quoted as the change in a capacitor.

Question 3

(a) The expression ρgh was widely seen and most able candidates substituted correctly. The incorrect value for h was often used i.e. 7 cm instead of 0.07 m.

Although the depth of the brick below the surface was not part of the question, an appreciable number of candidates thought it was involved. For example, they would evaluate the correct value for pressure difference, then use ρgh again with an inappropriate h and subtract the two pressures. This indicates that these candidates were not secure in applying the expression in a new situation.

(b) Many candidates were able to gain credit for using $F=PA$ but a significant number chose to use a numerical value indicating volume instead of area or used an area in cm^2 instead of m^2.

(c) Nearly all candidates, including some strong candidates, did not realise that a resultant force was involved. Usually candidates just took their value from **(b)** and divided by the mass, gaining only partial credit for this part.

Question 4

Most candidates gained partial credit in each of the two parts, with many well-reasoned answers. Some candidates did not answer in terms of atoms or molecules moving or spoke about collisions without being more specific that the collisions were with the walls. Weaker candidates were more interested in external pressures and bursting balloons rather than concentrating on the helium pressure, and a surprising number deduced that the helium pressure would rise in one or both cases.

(a) Candidates who appreciated that the KE would be less needed to progress this by saying that the speed of the atoms would decrease. Many candidates appreciated that a lower frequency of collisions would lead to a fall in pressure.

(b) More space or increasing volume were popular answers but were not sufficient to gain credit as this was in effect merely repeating the question. Many candidates appreciated that fewer collisions with the walls was the key point.

Question 5

Stronger candidates gave a good account for all three methods of heat transfer. Some candidates seemed confused as to how to answer the question. They tried to describe thermal energy transfer through the copper rod, fins and the black surface all in **(a)**. Some answers to **(b)** and **(c)** just talked about the tube and vacuum.

(a) Many good descriptions of conduction were seen, with the majority of candidates being awarded full credit. The most common omission was not mentioning that copper was a good conductor of heat, instead merely stating that copper was a conductor of heat. Many candidates mentioned electrical conduction, which is a wrong answer to this question. This did not receive any credit but it was condoned as irrelevant if added on to a correct reference to thermal conduction.

(b) The majority of candidates were awarded only partial credit due to confusion between convection and radiation. Many candidates did not link the large surface area to the fact that this allows greater contact with the air or more air particles to be in contact with the fins. Many described convection in general terms and did not apply it to this situation. Good answers described enhanced convection currents through the gaps between the fins.

(c) The confusion between radiation and convection was again apparent here. A statement that a black surface was a good absorber of radiation did not receive credit. This was condoned as an irrelevant extra if there was also a correct mention that a black surface is a good emitter. Despite the stem clearly asking about thermal energy transfer, an appreciable number of answers attempted to describe X-ray production and X-ray radiation.

Question 6

Most candidates produced accurate ray diagrams and scored very well in this question. Weaker candidates did not always appreciate the difference between reflection and refraction and many found themselves unable to apply their knowledge to what was clearly a new situation, and gave no response to all or nearly all of the question.

(a) The most common error was to measure the angle of incidence from the ray to the tangent to the surface at A. Rays from the right were condoned in this instance and those not incident at A could receive credit in other parts of the question.

(b)

(i) Virtually all candidates gained full credit in this section. Those not receiving any credit often did not use sines of angles at all.

(ii) Candidates successful in **(a)** often received credit here too.

(c) Usually there were few problems with this, but there were some attempts that did not produce a reflected angle equal to the incident angle or drew an unrealistic normal making it impossible to award credit for a good reflected ray.

(d) The emergent ray was usually correctly drawn, with only few candidates drawing a ray refracted nearer to the normal.

Question 7

(a) The speeds of sound and light were usually correctly quoted, with the most common errors being incorrect units or the incorrect power of 10.

(b) Most candidates carried out a correct calculation with errors in the rearrangement of the wave equation, or the use of the speed of the wrong type of wave, accounting for the vast majority of mistakes.

(c) Again, most calculations were carried out correctly. More able candidates gained credit for clearly stating that their calculation assumed that light had arrived instantaneously. Many candidates simply stated that light travels faster than sound or made statements about the situation that were too vague to gain credit.

Question 8

(a) The majority of candidates gained full credit, but incorrect names such as contractions and refractions were seen. Examiners try to be as tolerant as possible with minor spelling mistakes e.g. rarefraction. However, as many terms in physics and in this question in particular, are fairly similar words, it is not possible to condone an incorrect spelling which could mask incorrect terminology.

(b) This was often poorly answered, with the majority of candidates merely describing regions of high and low pressure. Very few candidates correctly explained how these were formed by the movement of the loudspeaker cone as asked by the question.

(c) Candidates generally showed a good knowledge of pitch and loudness.

Question 9

This was a well answered question. Candidates had learnt the material and were able to apply it to this reasonably standard situation.

(a) Most candidates could quote the correct equation and then apply it. The most common mistake was in setting the parallel combination equal to R_p instead of $1/R_p$. Only the weakest candidates treated the combination as resistors in series.

(b)

(i) Most candidates gained credit here, but a considerable number incorrectly drew the voltmeter in series with the parallel resistors.

(ii) A significant number of candidates used $V = IR$ but some decided to add in the 1 Ω resistance and ended up with a value of 4 V, the voltage across the whole resistor network.

(c) The vast majority of candidates correctly stated that increasing the value of the series resistor would decrease the current through it. However, a significant number thought the ammeter reading could not change as the ammeter was connected in series.

Question 10

There was some evidence that this topic had not been learnt by many candidates because of the disproportionate number of no responses to much of the question.

(a) This was usually answered correctly.

(b) The vast majority of candidates gained at least partial credit here, although a surprising number did not answer the relatively straightforward **(ii)** correctly.

(c) Mostly well answered.

(d) Mostly well answered.

(e) This part was found difficult by all but the strongest candidates. Good answers invariably described correctly the whole logical sequence – both inputs A and B high, output of AND gate high, transistor switches on and buzzer sounds.

Question 11

The main issue throughout the question was that many candidates wrote about a current being produced and did not realise that it is voltage that is induced or that, in this circuit with a high resistance voltmeter, effectively no current can flow.

(a) Most candidates were able to explain how the conductor cutting across a magnetic field induced an emf across the conductor. However, a significant number of candidates were trying to answer by simply recalling the words electro-magnetic induction and not applying the concept to the situation in the question. Some confusing answers were seen, such as indicating that copper is magnetic or that the field from the copper rod cuts another field.

(b)

(i)(ii) Many candidates gave a correct increase in deflection for both parts and an appropriate reason. However, there were a significant number of answers which tended to use the word ‘faster’ for the deflection, which might well have suggested an oscillating pointer. The word ‘stronger’ is also not clear in this context.

(iii) Most candidates correctly stated that the deflection would be zero as the conductor was no longer cutting any magnetic field lines. But a number simply spoke about the field being parallel to the rails, which is an incomplete argument.

Question 12

Candidates had, in general, learnt this topic well and answered appropriately.

(a) Most candidates showed a good understanding of the notation used to describe a nucleus, with most candidates gaining the maximum credit available.

(b) The vast majority of candidates had a good understanding of isotopes. Weaker candidates thought that isotopes have different numbers of protons or electrons, and not all recognised the need to quantify the number of extra neutrons.

PHYSICS

Paper 0625/33

Extended Theory

Key messages

Candidates are advised to read carefully through their responses to make sure that what they have written has the intended sense. Concise explanations are often the best.

When performing calculations, the best candidates always show their full working. It is good practice to first write the full equation, then rearrange if necessary, rewrite with correct numerical substitutions, before finally evaluating. Candidates who work in this way rarely make errors, and when they do they can usually be awarded partial credit. Calculators are always allowed for this paper, but candidates must make sure that they understand how to use them properly.

General comments

Although there were a small number of candidates scoring comparatively low marks on this paper, the overwhelming majority produced convincing and accurate answers to the nearly all the questions. It was clear that the majority of candidates were well prepared to face this examination and were sufficiently well acquainted with the subject to produce answers that were either largely accurate or at the very least showed a decent understanding of what was being tested and asked for. Inevitably some questions proved more straightforward than others and from time to time a candidate who had performed well on the more challenging questions made unfortunate errors in questions that other candidates found less testing.

The total range of marks that candidates scored on this paper did extend from very high indeed to the very low but far more candidates did well than the reverse. The most able candidates scored very high marks indeed and sometimes the marks that were lost were for making careless errors or even for writing down the opposite of what was intended or for contradicting what has just been written – it is easy to write *scalars have a direction whereas scalars do not* and to lose a mark. Very commonly, the very few candidates who scored the lowest marks had left a significant number of questions unanswered.

There were almost no language issues with the candidates and even when the answer offered was not completely correct, it was almost universally the case that the question had been understood and the meaning of the answer was clear.

The examination techniques of the candidates are to be commended with very few lost marks caused by units or working out omitted. Although neither a serious nor a widespread problem, there were rather more marks lost due to inaccurate rounding of significant figures. For example the answer to **11(c)(ii)** can be expressed as 17 000, 17 200 or 17 190 years but not as 17 100 years even though 1, 7 and 1 are the first three figures that appear on the calculator screen.

The format of the examination is clear and candidates understand that an answer should be written in the dedicated space on the paper. There is always enough space to write or draw the expected answer even for those candidates whose writing is larger than average. It can, however, be necessary on occasion, to cross out an answer and to replace it elsewhere on the paper – at the bottom of the page or on a blank sheet. When this is done, candidates are advised to make a simple reference to the location of the new answer in the original answer space.

This is a paper where all of the questions are compulsory and candidates did not seem to find any difficulty in completing it in the allocated time.

Comments on specific questions

Question 1

(a) This was almost invariably correctly answered by the candidates with just an occasional *kilogram* as the unit for weight or some other similar confusion.

(b) Many candidates did not realise what was expected on the second line and wrote a variety of other answers; *gravitational field* was one example.

(c) This was, again, very commonly correct with just the occasional confusion between mass and weight.

Question 2

(a) (i) The lines drawn were often of the right overall shape but marks were lost when candidates drew an excessively long horizontal section or allowed the trajectory to become vertical before hitting the water.

(ii) Some candidates found this challenging and drew the arrow along the path drawn in **(a)(i)**.

(b) Many candidates stated that the times taken were the same as air resistance is negligible in this case, but some who wrote that there was a difference between the two times still scored full marks by explaining why this conclusion was reached in this example.

(c) Nearly all candidates were able to calculate the time taken for the stone to reach the sea and some went on to calculate the velocity with which the stone hits the water from this value. Other candidates, however, needed to see that there were two stages in reaching the answer and that the second stage was the application of the formula $v = at$.

Question 3

(a) (i) This distinction was well understood and very often well expressed. There was, however, some confusion in writing down the answer and some candidates should realise that a statement such as *a vector has direction and magnitude* might be taken to imply that a scalar has only direction. The precise difference between the two is only made clear by the second half of the comparison.

(ii) Most candidates wrote down one of the vector quantities referred to in the syllabus.

(b) This proved to be one of the more challenging parts of the paper. There were some candidates who simply redrew Fig. 3.1 and added some labels, others calculated the answer without including the correct diagram and were unable to score full marks as a result. When candidates drew unlabelled diagrams it was not always clear how the answer had been obtained and this would have forfeited some marks. Many candidates must be congratulated for drawing the correct diagram very carefully and obtaining encouragingly accurate values for the tension.

Question 4

(a) (i) This was very commonly correct and it is clear that this formula is very widely known. Since the question asked for a formula used to find the pressure, those who simply wrote F/A were allowed the mark but it was not possible to treat other rearrangements of the equation which omitted the subject – for example PA – in the same way.

(ii) This part was usually answered correctly but the few candidates who did not score the mark had mainly either omitted to double the area of contact or had halved it instead.

(b) Very many candidates scored both marks here but those who only scored one of the two omitted to explain why less pressure is an advantage when crossing a sandy desert.

(c) This part was very well answered indeed; the overwhelming majority of the candidates suggested a way in which the soldier could reduce the pressure caused by his weight.

Question 5

(a) (i) Almost all candidates obtained the correct answer by stating and using the correct formula. Full marks were very commonly awarded here.

(ii) Although a significant majority of the candidates explained carefully what was happening in this case, other candidates did reveal some misunderstandings in the sequence of energy changes that occur. Some candidates seem to have been confused as to which form of energy was kinetic and which potential. Although the hammer at rest on the ground might well be said to have some potential energy, it is wrong to imply that it has been produced from the kinetic energy that the hammer had previously possessed.

(b) (i) This part was commonly correct but there were candidates who confused and exchanged the numbers even though the formula produced was correct.

(ii) This part proved extremely challenging indeed. Only a minority of candidates obtained the correct answer and the majority calculated and gave as the answer a value of 12% of **(b)(i)**.

Question 6

(a) (i) This part of the question was really rather testing and only some candidates scored full marks. Many candidates who might well have produced the correct circuit for an electrical question omitted either one or both of the meters here. It is possible to use a joulemeter here but it is neither connected in parallel nor in series with the usual circuit and this was only infrequently understood. Those candidates who described a method that involved some form of the method of mixtures rarely included both liquids or the liquid and a solid in the diagram.

(ii) This part was amongst the most testing on the paper; those candidates who did not score full marks here should have suggested rather more measurements than they did. Few candidates suggested that both the ammeter and voltmeter should be read and those using a method of mixtures rarely stated that the specific heat capacity of the added solid or liquid needed to be known. There were also other common omissions.

(b) (i) This part of the question was very well answered indeed by very many candidates; a significant fraction of the candidates scored full marks here. Other candidates should be aware, however, that in the expression $mc\theta$, the symbol θ represents the change in temperature (88.6 °C) and not the initial temperature of the water (12.0 °C).

(ii) This part was well answered with the majority of candidates dividing their **(b)(i)** value by 620 to obtain an answer in seconds. Many candidates then converted the answer to minutes or minutes and seconds. This is perfectly fine but not necessary as the SI unit of time is the second.

Question 7

(a) (i) The correct answer was offered by only a minority of candidates; other common suggestions included 6 V and 12 V. Candidates who do this are probably a little uncertain about the rather difficult concept of potential difference.

(ii) This part was more accessible to most candidates but there were candidates who gave the answer 4 V or 6 V.

(b) (i) A very large number of candidates were able to state the answer here – just a few tried to apply the formula for resistors in parallel.

(ii) Given that arithmetical errors are commonly made when this formula is used, it was very pleasing indeed to see that so many candidates not only knew the formula but were able to use it to obtain the correct answer rather than its reciprocal.

(c) This was well answered with most candidates scoring full marks by using the correct formula to obtain the correct answer. The unit was almost invariably correct here.

(d) (i) Most candidates realised that this action would not affect the ammeter reading and scored this mark by stating this.

(ii) This part was more testing but many candidates were able to deduce what was happening and to get the correct change.

Question 8

(a) (i) A significant fraction of the candidates marked an arrow on the coil that suggested that the current was anticlockwise when viewed from above. It was unfortunate that there were candidates who drew an arrow on the diagram that was not on the coil as asked for; to draw the arrow on B_1 or B_2 is rather more straightforward and did not of itself score the mark.

(ii) Whilst many candidates realised that the coil would rotate in an anticlockwise sense when viewed as stated, some candidates talked about only one side of the coil and gave answers such as *upwards*. An answer of this type fell short of what was needed.

(b) The answers to the three sub-sections – **(i)**, **(ii)** and **(iii)** - of this part of the question were all the same – *faster*. Many candidates realised this and had the confidence to give three consecutive identical answers. Others gave different answers to all three parts or to at least one of them.

(c) This part produced very few correct answers and candidates found it to be the most challenging question in the paper. Very few candidates understood the role played by induction here and it is clear that electromagnetic induction is very poorly understood by many candidates.

Question 9

(a) Many candidates gave the answer of *a single colour* or something similar. Colour is quite a vague term, and a more technically precise answer such as *single frequency* or *single wavelength* is more appropriate at this level.

(b) The calculation needed here is not entirely straightforward and it was extremely encouraging indeed to see that a very significant majority of candidates were able to handle this calculation with facility and to obtain the correct answer and consequently to score full marks. A few candidates forfeited a mark because the calculator had been left in the radian mode or because a bracket had been left out. Candidates are strongly advised to watch out for these points when using calculators.

(c) Very many candidates gave the correct answer here and scored the mark. There were a very few who tried to apply the Snell Law inaccurately here and who obtained an answer that was less than 26°.

(d) Many candidates were clear as to what was meant and simply wrote down the words *less* and *more* and scored both marks. A small number of candidates used the answer line to turn the phrase given into a sentence. These candidates were more likely to get the comparison reversed.

Question 10

(a) The answers to both **(i)** and **(ii)** were very commonly although not universally correct.

(b) Many candidates were able to work their way through this to obtain the correct answer in both **(i)** and **(ii)**.

(c) This part was found rather challenging and only a minority of candidates were able to show that they understood why it is necessary to use a relay in such a circuit.

(d) This part was also something of a test and only a small fraction of the candidates were able to score a mark here. In a case like this, candidates should ensure that both conditions (the darkness and the heat) are addressed. An answer such as to *light a lamp in the dark* only dealt with one of the conditions and did not score the mark.

Question 11

(a) This was quite a challenging part of the question and candidates tackled it in an encouragingly convincing fashion. Many candidates were able to describe fairly concisely the way in which the paper can be used to distinguish between the two sources and were also able to write something relevant concerning the use of the magnet. The experiment using a magnet, however, was rarely as well explained as the other experiment and hence some candidates' descriptions were complicated and confused.

(b) (i) Many candidates were able to write down the correct proton number and the correct nucleon number here. A few candidates gave the neutron number instead of the nucleon number and a very few included the number of electrons.

(ii) Many candidates obtained the correct answer here and remembered to include the correct unit. Other candidates need to be clear that it the number of radioactive nuclei that halves and that repeatedly halving the half-life is not going to produce the correct answer. A few candidates had difficulty in determining the number of half-lives that had elapsed and both 2 × and 4 × 5730 years were suggested as the age of the skeleton.

PHYSICS

Paper 0625/04

Coursework

Key message

Centres are reminded that teachers may not enter candidates for this Paper until they have been accredited. Accreditation can be gained using the distance training materials obtainable from Cambridge. These materials give teachers thorough guidance in the skills that are to be assessed, how to devise suitable tasks for assessments, how to mark their candidates' work, and how to organise and submit their coursework sample for external moderation.

General Comments

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 and clearly a large amount of good work has been completed by teachers and students.

The majority of samples illustrated clearly annotated marks and comments, which was helpful during the moderation process.

PHYSICS

Paper 0625/51
Practical Test

Key message

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. To make a success of this paper, candidates need to have the experience of carrying out a good range of experimental work.

General Comments

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

- graph plotting,
- drawing ray diagrams,
- tabulation of readings,
- manipulation of data to obtain results,
- drawing conclusions,
- dealing with possible sources of error,
- control of variables,
- accurate measurements,
- choice of the most effective way to use the equipment provided.

The general level of competence shown by the candidates was sound. Very few candidates did not attempt all sections of each of the questions and there was no evidence of candidates suffering from lack of time. However some candidates seem to have had little practical experience during their course to draw on when attempting the questions. Many candidates, who appeared to have had a good level of practical experience, dealt well with the range of practical skills tested.

Comments on Specific Questions

Question 1

(a) Most candidates filled in the table accurately and recorded realistic values for *x* and *y*.

(b) Candidates needed to set up the graph axes so that their plots would make best use of the grid both vertically and horizontally. A significant proportion chose a poor vertical scale, but almost all labelled the axes correctly. 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) Here candidates were required to show clearly, on the graph, the triangle method used for the gradient and then take accurate readings from the graph line.

(d) Candidates gained credit if they calculated *W* correctly, giving the answer to two or three significant figures with the unit N. Further credit was awarded to those candidates who had obtained a value within the tolerance allowed.

Question 2

(a) Most candidates successfully recorded realistic temperatures with the correct unit, ^{o}C, consistently used. Fewer candidates were able to suggest two suitable precautions in **(iv)**.

(b) The majority of candidates recorded the second set of temperatures and correctly calculated the average temperature.

(c) Most candidates made a correct statement that matched their results. Candidates who were familiar with this type of experiment were able to justify their answer using the idea of results being within (or beyond) the limits of experimental accuracy.

(d)(e) Here candidates needed to consider carefully the aspects of good experimental technique that they had discussed and used during their IGCSE course and apply them to these specific questions.

Question 3

(a) Most candidates gave the current values correctly, although some did not give their values to at least two decimal places and others missed the unit. In some cases the readings showed that the candidate had not changed the position of the ammeter as instructed.

(b) Most candidates successfully completed the calculation and went on to make a correct statement, but few justified it by commenting that the difference was within (or beyond) the limits of experimental inaccuracy (or words to that effect). Some attempted a theoretical explanation which was not asked for.

(c) Most candidates gave a sensible value for the potential difference. To gain credit for the resistance, candidates needed to give the value to two or three significant figures with the unit, Ω.

(d) Many candidates drew the correct symbol for a voltmeter and placed it correctly on the circuit diagram.

Question 4

(a)(k) 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 lines as instructed and measured the angles correctly (to within 2°), then full credit was awarded. The most common error was placing the pins too close together. Candidates need to realise that for good accuracy the pins should be placed as far apart as is practical. In this case the minimum separation to gain credit was 5.0 cm. The most competent candidates placed their pins with a separation well in excess of 5.0 cm.

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

PHYSICS

Paper 0625/52

Practical Test

Key message

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. To make a success of this paper, candidates need to have the experience of carrying out a good range of experimental work.

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.

Many candidates showed a sound level of competence with practical work and most were able to finish the paper, leaving very few answers to questions blank. Questions which focused on more effective techniques or the reasons for their importance, revealed a lack of experience by some candidates.

Comments on Specific Questions

Question 1

(a) The majority of candidates gained credit for this straightforward measurement and most gave a suitable unit. The calculation was generally done correctly, with only a few responses reversing x and y, and the appropriate unit, g, was employed in the majority of cases.

(b) It was usual to see correct measurements and calculations, with a significant number of candidates obtaining a value of (m_2 + m_3) within 2 g of m_1 from **(a)**.

(c) This was the least well done section of the question. While many candidates stated that clay might be left on the knife or board after cutting, very few realised that the smaller masses could produce greater inaccuracy in balancing or that the additional calculations might introduce further rounding errors. There were a number of references to the possibility of mistakes being made, ignoring the assumption in the question that 'the experiment has been carried out with care'.

(d) This question tested a detailed knowledge of technique and many were able to explain how the centre of the lower edge of the block was marked or that half the width of the block was measured either side of the 10.0 cm mark.

Question 2

(a) Only a very small minority of candidates were unable to record sensible values of hot and cold water temperature.

(b) An appropriate range of temperatures was usually recorded. Where errors occurred, it was generally in the recording of the total volume present rather than that which had been added, producing a systematic error of 100 cm^3.

(c) Overall, the graphical work was not done as well as in previous years. Only a minority of candidates used a suitable scale which allowed the plots to occupy at least half of the grid, and some based the scale on an interval of 15 which made plotting difficult. Plotting was generally accurate, the main error being to omit the θ_h value at $V = 0$. A number of candidates drew poor lines, attempting to fit a straight line to plots which clearly indicated a curve or producing a curve which joined the plots rather than ran smoothly through them. A majority of candidates did produce thin lines and plotted with neat, clear points. Some lines were too wide, however, or were drawn to plots which were indicated by large dots. The advice is that plotted points should, preferably, be marked with a small fine cross. Small dots are acceptable, but are often obscured when the line is drawn through them, making it more difficult to award credit for correctly plotted values.

(d) At least partial credit was gained here by the large majority of candidates. There was some confusion between conditions, such as the initial temperature of the hot water, and apparatus or procedures. It was common for candidates to give more than the required number of answers and they should be aware that additional wrong answers could result in credit not being awarded.

(e) This question focused on techniques employed in taking readings accurately and was not well done. Although some mentioned the need to avoid parallax, few explained how this might be done. A number of candidates did realise that time should be allowed for the thermometer reading to stabilise.

Question 3

(a) Voltage values were generally recorded correctly, to at least one decimal place and with suitable units. In some cases, there did appear to have been alterations made to ensure that (V_A + V_B) would equal V_C. This was not necessary, provided that there was a reasonable correlation.

(b) Many calculated (V_A + V_B) correctly and appreciated that the difference between that and the measured V_C was small. The stronger candidates recognised that the small difference was within the limits of experimental accuracy and the result therefore supported the theory. When large differences were encountered, generally because of errors in measurement, it was acceptable to indicate that the theory might not be supported, provided the values were identified as ‘too different’ rather than merely ‘different’.

(c) Suitable values of I were generally recorded and the subsequent calculations were often correct although a number of responses contained rounding errors. Very few answers showed four or more significant figures, most having the expected two or three.

A source of error in the calculation was the use of (V_A + V_B) rather than the measured value of V_C as required.

Where Centres had provided candidates with milliammeters, there was often much confusion with units and it may be that clear instructions would avoid this.

(d) Most were able to draw the correct symbol for a voltmeter connected in parallel with the combination of resistors.

Question 4

(a) The normal was drawn correctly by most candidates.

(b)(h) Completion of the diagram with neat, fine lines was seen in many cases. Thicker lines were less frequent here but were drawn by a significant minority.

Very few gained full credit on this section, the most usual error being the pin spacing, expected to be 5 cm or more. The most competent candidates placed their pins with a separation well in excess of 5.0 cm. A less frequent mistake was incorrect positioning of AB and the pin positions on it.

A significant number of candidates seemed to have difficulty with the use of optical pins and this could indicate that further opportunities to practice the technique are needed.

Where candidates had produced sensible diagrams, angles were generally measured accurately, with good correlation between *i* and *r*.

(i) This question tested recognition of difficulties which are experienced in this type of experiment. It was expected that candidates would mention aspects such as measuring angles from thick lines or the inaccuracies introduced by large pin holes. Many, wrongly, suggested problems such as small pin separation or mistakes in lining pins up, which are not significant in an experiment 'carried out with reasonable care'.

PHYSICS

Paper 0625/53
Practical Test

Key message

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. To make a success of this paper, candidates need to have the experience of carrying out a good range of experimental work.

General comments

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

- graph plotting,
- tabulation of readings,
- manipulation of data to obtain results,
- drawing conclusions,
- dealing with possible sources or error,
- control of variables,
- accurate measurements,
- choice of the most effective way to use the equipment provided.

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

All questions provided opportunities for differentiation, but particularly good were **Questions 2** and **3**, where the conclusions and the justifications in support of them allowed the better candidates to demonstrate their ability. The gathering and recording of data presented few problems for any candidates. There was evidence of some candidates not having the use of a calculator.

The ability to quote an answer to an appropriate number of significant figures, or to an appropriate number of decimal places, still causes difficulty for many candidates. There were also many examples of instances where a candidate had repeated a measurement and had overwritten their first answer. This often made it difficult for the Examiner to see what the reading was, and sometimes the Examiner was unable to award the mark. Candidates should be encouraged to cross out completely and to re-write their answers so that there is no ambiguity. Candidates still find difficulty in drawing a best-fit line to represent the trend in their data.

Comments on specific questions

Question 1

(a) The height, width and depth of the cube of modelling clay were almost always measured and recorded, and the majority of candidates recorded their answers to the nearest millimetre. Candidates found little difficulty using the given formula to calculate the volume of the block, and usually proceeded to determine the density of the block to obtain an answer within the accepted range.

(b) Most candidates followed the instructions provided and used the measuring cylinder correctly to find the volume of the modelling clay and to calculate its density. The value of the density was often quoted to too many significant figures, and the unit of density was sometimes missing or was incorrect.

(c) It was pleasing to observe that the majority of candidates were able to compare the values of the density of the modelling clay that they had obtained from the two different methods and make sensible suggestions as to why they were not the same. A common incorrect suggestion was that they had used different volumes of clay in methods 1 and 2, so the densities should be different.

Question 2

(a) Candidates found little difficulty following the instructions given and measuring the initial temperatures of the hot and cold water and also the temperature of the mixture.

(b) The calculations of the gain of thermal energy of the cold water and the loss of thermal energy of the hot water were usually correctly performed. The unit of energy was sometimes omitted and there was sometimes a lack of consistency in significant figures when quoting the answers.

(c) Correct answers to this more demanding part were only given by the more able candidates. Very few candidates stated that the very small difference between their values of energy lost by the hot water and energy gained by the cold water might be attributable to experimental error. More candidates were able to state that heat lost to the surroundings and the heat gained by the beaker were also contributory factors.

(d) Candidates still find difficulty in deciding which quantities to keep constant in order to make readings repeatable when the experiment is done again. Full marks in this part were obtained by the better candidates, but most answers appeared to be due to guesswork. It was not uncommon to see ticks opposite each suggested quantity.

Question 3

(a) The required readings of current and potential difference were taken by the majority of candidates, but they were not always recorded to the appropriate number of decimal places consistent with the resolution of the meter that they had used. The resistance values of the different lengths of wire were usually calculated correctly, but not always to an appropriate or consistent number of significant figures.

(b) Most candidates attempted to deduce a relationship between the length of the wire and its resistance, but the instruction to show their working was ignored by some. Although many candidates suspected that the relationship between length and resistance was directly proportional, many did not explicitly say so because when using their results, the ratio of resistance to length did not give an exact constant. All that was required here was for candidates to state that within the limits of experimental accuracy, the ratios calculated were close enough to be considered equal.

(c) Candidates had little difficulty in using their results to predict the resistance of a 1.500 m length of the same wire, and almost all gave an answer which was within the allowed tolerance.

Question 4

(a) Candidates were required to measure image distances of an object placed at various distances from a convex lens. The overall impression of the results obtained by candidates, was that the focusing of the image for each object distance was not carried out with enough care and precision. Image distances were sometimes not given to the nearest millimetre and the calculated values of $1/u$ and $1/v$ were not written in the table to a consistent number of significant figures. This made the plotting of the points and the drawing of the best-fit line more difficult.

(b) The standard of graph plotting and drawing continues to improve and most candidates used the given scales on the axes to produce thin best-fit lines using small, neat plots. Occasionally candidates crossed out the scales on the axes (which had been given to help them) and decided to use their own. This inevitably led to graphs which did not make best use of the space available on the grid and this incurred a subsequent penalty.

(c) The reading of the axes, and the recording of both intercepts, was done well by almost all candidates.

(d) Most candidates stated an acceptable precaution to be made whilst carrying out optics experiments in order to obtain reliable measurements. It is worth pointing out here that if candidates use the avoidance of parallax as a precaution, they must state how parallax is avoided. The mere phrase 'avoid parallax', does not earn credit.

PHYSICS

Paper 0625/61
Alternative to Practical

Key message

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.

General Comments

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

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

Clearly, some of the skills involved in practical work can be practised without doing experiments. These include graph plotting and tabulation of readings. However, there are parts of this examination in which the candidates are effectively being asked to answer from their own practical experience. Questions on experimental techniques were answered much more effectively by candidates who clearly had experience of similar practical work and much less successfully by those whose responses revealed that they had not. These candidates found **Questions 2** and **5** particularly difficult.

Manipulation of data to achieve a final value was handled much more confidently by those who seemed to have tackled such activities in a previous practical situation.

Many candidates will have prepared for the examination (very sensibly) by working through some past papers. However, some candidates gave answers that would have been correct in a similar question from a previous session, but were not appropriate to this question paper. Revision from past papers is only effective where candidates fully understand the answers given, rather than simply learning them.

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

Comments on Specific Questions

Question 1

(a) Candidates needed to set up the graph axes so that their plots would make best use of the grid both vertically and horizontally. A significant proportion chose a poor vertical scale, but almost all labelled the axes correctly. 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.

(b) Here candidates were required to show clearly, on the graph, the triangle method used for the gradient and then obtain a value that was within the tolerance allowed.

(c) Candidates who calculated the value correctly, gave it to two or three significant figures and included the unit (N) gained credit.

(d) Candidates who were used to carrying out these types of moments experiments were able to concisely explain the relevance of balancing the rule on the pivot (with no loads) and how to make the necessary adjustment for the centre of mass being a few millimetres from the 50.0 cm mark (either by taking readings to the actual centre of mass, or adding a small load at one end so that the centre of mass was at the 50.0 cm mark). Unfortunately, such candidates were in the minority.

Question 2

(a) Most candidates successfully recorded the correct temperature with the correct unit, ^{o}C.

(b) The majority of candidates correctly calculated the average temperature.

(c)(f) Here candidates needed to consider carefully the aspects of good experimental technique that they had discussed and used during their IGCSE course and apply them to these specific questions.

Question 3

(a) Most candidates gave the current value in **(i)** correctly. In **(ii)** most candidates made a correct statement but few justified it by commenting that the difference was within the limits of experimental inaccuracy (or words to that effect). Some attempted a theoretical explanation which was not asked for.

(b) Candidates needed to know that a variable resistor is used to vary the current. A significant number of candidates made other suggestions which would indicate lack of personal experience of using a variable resistor.

(c) Many candidates drew the correct symbol for a voltmeter and placed it correctly on the circuit diagram. Most candidates read the value (2.2 V) correctly. A minority gave 2.1 V. To gain full credit for the resistance, candidates needed to give the value to two or three significant figures with the unit Ω.

Question 4

(a)(b) 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 lines as instructed and measured the angles correctly (to within 2°), then full credit was awarded.

(c) Here the candidate needed to notice that the question stated that the experiment had been done with care. Many candidates treated the question as though it read ‘how would you exercise care when carrying out the experiment?’ and so were not awarded credit. Candidates who understood what was being asked made sensible comments, for example about the thickness of the mirror or lines.

(d) This part required candidates to have a firm understanding of precautions that may be taken in the experiment. If boxes 1, 3 and 5 only were ticked the candidate gained full credit.

Question 5

The syllabus requires candidates to be able to describe an experiment for determining the speed of sound in air. The answers seen appear to suggest that this straightforward method has not been discussed with candidates and few have had the opportunity to take part in the experiment which requires only a stopwatch and a tape measure.

(a) Candidates familiar with the experiment suggested a suitably large distance (a minimum of 200 m was accepted).

(b) A metre rule is not a practical solution here, so candidates who suggested a tape measure, ‘clicker’ wheel or other suitable device gained credit.

(c) Many candidates completed the calculation successfully.

(d) To gain credit here, candidates had to show that they realised that the inaccuracies involved in the readings (time and/or distance) make anything more than three significant figures inappropriate.

PHYSICS

Paper 0625/62
Alternative to Practical

Key message

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.

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 suitable apparatus.

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

Those aspects of the paper which tested a general knowledge of approaches to practical work were tackled competently by most candidates, suggesting that they had been given some direct experience of experimental practice. However, some candidates were less confident in handling questions which focused on detailed techniques and this may reflect the extent of their experience.

Most candidates were able to finish the paper and very few left answers to questions blank.

Comments on Specific Questions

Question 1

(a) The majority of candidates gained credit for this straightforward measurement and confusion with units was the most common source of error.

(b) Conversion of the lengths to actual size and calculation of the mass, with a suitable unit were generally done well.

(c) The vast majority gained credit for this calculation.

(d) This was the least well done section of the question. While many stated that clay might be left on the knife or board after cutting, very few realised that the smaller masses could produce greater inaccuracy in balancing or that the additional calculations might introduce further rounding errors. There were a number of references to the possibility of mistakes being made, ignoring the information in the question that ‘the experiment has been carried out with care’.

(e) This question tested knowledge of technique and many were able to explain how the centre of the lower edge of the block might be marked or half the width of the block might be measured either side of the 10.0 cm mark.

Question 2

(a) Only a very small minority of candidates were unable to record the appropriate temperature. The most common errors were to read the thermometer as 80.6 ^{o}C or 81 ^{o}C rather than 86 ^{o}C.

(b) Indication of the correct units was largely correct. Where errors occurred it was generally in the recording of the total volume present rather than that which had been added, producing a systematic error of 100 cm^3.

(c) Overall, the graphical work was not done as well as in previous years. Only a minority of candidates used a suitable scale which allowed the plots to occupy at least half of the grid and some based the scale on an interval of 15, making plotting difficult. A number of candidates drew poor lines, attempting to fit a straight line to plots which clearly indicated a curve or producing a curve which joined the plots rather than ran smoothly through them. A majority of candidates did produce thin lines and plotted with neat, clear points. Some lines were too wide, however, or were drawn to plots which were indicated by large dots. The advice is that plotted points should, preferably, be marked with a small fine cross. Small dots are acceptable but are often obscured when the line is drawn through them, making it more difficult to award credit for correctly plotted values.

(d) At least partial credit was gained here by the large majority of candidates. There was some confusion between conditions, such as the initial temperature of the hot water, and apparatus or procedures. It was common for candidates to give more than the required number of answers and they should be aware that additional wrong answers could result in credit not being awarded.

(e) This question focused on techniques employed in taking readings accurately and was not well done. Although some mentioned the need to avoid parallax, few explained how this might be done. A number of candidates did realise that time should be allowed for the thermometer reading to stabilise.

Question 3

(a) The vast majority correctly read V_A as 0.8 V.

(b) Many calculated ($V_A + V_B$) correctly as 2.2 V and appreciated that the difference between that and the measured V_C was small. It was the stronger candidates who recognised that the small difference was within the limits of experimental accuracy and supported the theory.

(c) Calculations were often correct although a number of responses contained rounding errors. Very few answers showed four or more significant figures, most having the expected two or the acceptable three.

The most significant source of error was the use of ($V_A + V_B$) rather than the measured value of V_C as required.

(d) Most were able to draw the correct symbol for a voltmeter connected in parallel with the R_2/R_3 combination. However, a number were shown incorrectly in series.

(e) This was the least well done part of the question. It was expected that candidates should refer to the value of the voltage being measured and deduce that the 1 V scale would be more appropriate for V_A of 0.8 V. It was also acceptable to indicate that use of the 10 V scale might be suitable as V_B and V_C were both greater than 1.0 V. This approach would avoid having to change scales during the experiment.

Question 4

(a) The normal and point **C** were drawn correctly by most candidates.

(b) Accurate completion of the diagram with neat, fine lines was seen in the majority of cases. Thicker lines were less frequent here but were drawn by a significant minority. Some candidates made adjustments to ensure that the line P_2P_3 passed through **N**. The question asked for the line to join P_2 and P_3, and continue to meet the normal line at some point, and this was occasionally compromised by the adjustments.

Many omitted 'cm' from the column headings or showed the degrees symbol incorrectly but measurement of the angles was usually done competently.

(c) This question tested knowledge of difficulties which might arise in this type of experiment. It was expected that candidates would mention aspects such as measuring angles from thick lines or the inaccuracies introduced by large pin holes. Many, wrongly, gave problems such as small pin separation or mistakes in lining pins up, which would not be significant in an experiment 'carried out with reasonable care'.

(d) Candidates were able to suggest precautions such as increasing pin separation, using a sharp pencil or avoiding parallax (although often lacking explanation) with the angle measurement. Some clearly picked incorrect answers from a learned list, including 'carrying out the experiment in a dark room'. Candidates should be made more aware of the need to consider the situations in which such answers apply.

Question 5

(a) Many candidates were able to suggest appropriate headings for the columns and identify the correct units from the values provided. Common errors were to use 'l_0' for the first column or not realising that the length and extension values were in millimetres.

(b) The spring extensions were often calculated correctly, the most common identifiable mistake being to subtract the preceding length rather than the unstretched length of 16 mm.

(c) Although there were some good explanations of why the figures did not show that extension was directly proportional to load, a significant number of candidates seemed unclear as to the criteria which indicate proportionality. Many thought, incorrectly, that increasing extensions produced by greater loads was sufficient. The best answers included calculation of the changing ratio of load to extension.

(d) A large number of candidates gained credit here although there were many small, freehand diagrams with excessive gaps between ruler and spring. Sometimes springs were confused with forcemeters and clamp stands were drawn in great detail but with very small springs. Candidates need to practise producing clear diagrams which show the significant aspects of experimental arrangements accurately.

PHYSICS

Paper 0625/63
Alternative to Practical

Key message

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.

General comments

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

- graph plotting,
- tabulation of readings,
- manipulation of data to obtain results,
- drawing conclusions,
- dealing with possible sources or error,
- control of variables,
- accurate measurements,
- choice of the most effective way to use the equipment provided.

Candidates entering this paper scored the full range of marks. They were well prepared and it was pleasing to see that the range of practical skills being tested proved to be accessible to the majority of the candidature. The majority of candidates demonstrated that they were able to draw upon their own personal practical experience to answer the questions. No parts of any question proved to be inaccessible to candidates and there was no evidence of candidates running short of time. The majority of candidates were able to follow instructions correctly, record observations clearly and perform calculations accurately and correctly. Units were well known and were invariably included, writing was legible and ideas were expressed logically. However, candidates seemed less able to derive conclusions from given experimental data and justify them.

All questions provided opportunities for differentiation, but particularly good, were **Questions 2 (c)** and **3 (b)**, where the conclusions and the justifications in support of them allowed the better candidates to demonstrate their ability.

The ability to quote an answer to a sensible, consistent number of significant figures, or to an appropriate number of decimal places, still causes difficulty for many candidates. Generally speaking, all readings taken with the same measuring instrument should be recorded to the same precision; the number of significant figures for calculated quantities should reflect the precision of the data from which it is calculated.

Comments on specific questions

Question 1

(a) The normal to the glass block at point A was usually drawn in the correct position and also at right angles to the block. Candidates had little difficulty marking the positions of the pins on the given rays, but often ignored the instruction to mark suitable positions of the pins. The locating pins P_3 and P_4 were often drawn far too close together. It is good practice when conducting optics experiments of this type to position the pins as far apart as possible; 5 cm was the minimum separation for which credit was given.

(b) The angles of incidence and refraction between the respective rays and the normal were measured accurately by the majority of candidates. Occasionally, candidates ignored the instruction to measure the angles between the rays and the normal, and measured the angles to the surface of the glass block.

(c) This more demanding part required candidates to apply their practical knowledge to suggest how they could ensure that the positions of the locating pins P_3 and P_4 were accurate if a set square was not available. Only the more able candidates were able to offer sensible, workable solutions, such as viewing the bases of the pins when aligning, or keeping the line of sight low.

Question 2

(a) Most candidates read and recorded the temperature of the hot water from the given diagram of a thermometer. When the thermometer was read incorrectly, the common incorrect responses were 80.3°C and 97°C.

(b) The gain in thermal energy of the cold water and the loss in thermal energy of the hot water were usually calculated correctly. Candidates experienced little difficulty in substituting their temperature values in the given equations.

(c) A large proportion of candidates were able to suggest that the thermal energy lost by the hot water was not equal to the thermal energy gained by the cold water because of heat loss to the surroundings during the transfer, or that the container would gain some of this energy. Only a minority of the more able candidates were able to supply a satisfactory justification of the statement that they made in **(c) (i)** by comparing their calculated values of heat loss and heat gain and stating that they were too far apart to be considered to be equal.

Question 3

(a) The column headings were usually inserted into the table correctly. Occasionally, the unit for the length column was given as centimetres instead of metres. The resistance values were invariably calculated correctly, but were very often not quoted to enough or to a consistent number of significant figures. As a general rule, candidates should not quote their answers to more or less significant figures than those provided in the data, and be consistent in the number of significant figures that they use.

(b) Many candidates ignored the instruction given in the rubric of the question and did not use numbers from their table of values to suggest and justify a relationship between length and resistance. Relationships between the length of the wire and its resistance were suggested, but not justified. Of those candidates who suggested that the resistance and the length were (directly) proportional, only a very small minority of the more able candidates appreciated and stated that their calculated ratios were close enough and within the limits of experimental accuracy.

(c) Most candidates were able to use their tabulated values of resistance and length to make a prediction of the resistance of a 1.50 m length of the same wire.

(d) Candidates were able to suggest at least one sensible effect of replacing the 2V power source with a 12V power source. The facts that the wire would get hot and overheat and that the metre readings would increase were appreciated by many candidates. Far fewer candidates realised that the resistance of a given length of the wire would also increase due to the heating effect.

Question 4

(a) Most candidates were able to state a sensible precaution to take whilst carrying out an experiment involving the formation of images with lenses.

(b) The standard of graph plotting continues to improve and many excellent graphs were seen. Sensible scales were mostly used, although some candidates ignored the given instruction of where to start and end their axes, and were penalised for not using a suitable scale. The best-fit lines were well judged and, in the main, were neatly drawn with thin lines and plotted with small, neat plots.

(c) Candidates experienced little trouble in reading and recording the intercepts on the *y*-axis and the *x*-axis. Occasionally, careless reading of the axes scales resulted in the loss of one of the two available marks.

Question 5

(a) There was much evidence of careless measurement of the height, width and depth of the cube-shaped block. Candidates are expected to be able to take measurements from a given diagram to the nearest millimetre. The consequent calculations of the volume and the density of the modelling clay presented no problems to the majority of candidates.

(b) There was the occasional careless error in the reading of the scales from the diagrams of the measuring cylinder. There were many references to avoidance of parallax, as a precaution to take so that the measuring cylinder would be read correctly. Unfortunately few candidates stated <u>how</u> they would avoid parallax. Far fewer candidates stated that the reading should be taken from the bottom of the meniscus of the water in the cylinder. The density of the modelling clay was usually calculated correctly, but correct arithmetic was often spoiled by the inability to quote the answer to an appropriate number of significant figures. The unit of density was often incorrect or missing from the final answer.

(c) It was pleasing to see many sensible suggestions as to why the two different methods of determining the density of the modelling clay produced different answers. A common incorrect answer was that the densities were different because different volumes of modelling clay had been used in the two experiments.