PHYSICS

Paper 0625/12
Multiple Choice (Core)

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

General comments

It is important that candidates read the questions carefully and work through the options in a logical manner. Candidates would benefit from working on problems where solutions are only found after more than one stage in the calculations.

Although there were some strong candidates, it was clear that many candidates had a poor understanding of even the most basic concepts. Most candidates answered **Questions 3**, **6**, **14**, **17**, **22**, and **35** very well. **Questions 12**, **15**, **25**, **26**, **34** and **39** were more challenging for many candidates.

Comments on specific questions

Question 5

Many candidates failed to read the question properly and simply subtracted the mass of the half full bottle of oil from the mass of the full bottle of oil.

Question 10

Many candidates appeared to link the term ‘hydroelectric’ with steam, with many choosing this option. This showed that the majority of candidates did not understand the process of electricity generation from nuclear fuel.

Question 12

Most candidates did not understand the principles involved in this experiment. The key was the least popular choice, and all three other options were considerably more popular.

Question 15

Almost all candidates recognised that when the tape measure was hotter it expanded and that the distance between the divisions on it moved further apart. However, a large majority of these candidates thought that the reading would increase when measuring the distance between two posts.

Question 20

Few candidates understood the term ‘wavefront’. Some candidates confused the term with ‘wavelength’. The most frequently chosen option was the arrow showing the direction of travel of the wave.

Question 24

Each option was chosen in almost equal proportions. Clearly, candidates were not aware of the properties of microwaves or of the fact that all electromagnetic radiations travel at the same speed in a vacuum.

Question 25

Very few candidates realised that the sound had to travel from the boat to the sea bed and back again, making 2000 m in total.

Question 26

It was clear that very few candidates had seen the experiment in which a steel rod (which has been carefully demagnetised) is placed parallel to the Earth’s magnetic field and is hammered. Before hammering, the rod will not attract small pieces of demagnetised iron (e.g. pins), but afterwards it will pick them up.

Question 27

Most candidates recognised that that repulsion meant that a rod is magnetised and many of those who recognised this realised that both rods must be magnetised for this to happen.

Question 32

This question was challenging for many candidates but stronger candidates were able to answer correctly.

Question 34

Most candidates incorrectly assumed that a battery is needed to induce an electromotive force (e.m.f.). However, stronger candidates recognised the basic concept that background count rate needs to be subtracted from the recorded count rate in order to find the count rate due to the course.

PHYSICS

Paper 0625/22
Multiple Choice (Extended)

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

General comments

There were some very strong performances which showed that the syllabus had been fully covered in detail and that candidates had an in-depth understanding of the material. Candidates answered **Questions 3**, **6**, **14**, **33**, **37**, and **38** particularly well. **Questions 2**, **9**, **12**, **20**, **23**, **27** and **30** were more challenging for some candidates.

Comments on specific questions

Question 2

Although the majority of candidates answered this correctly, a significant number thought that deceleration meant that the rate of change of speed was decreasing. Candidates who looked at the phrase carefully saw that the 'rate of change of speed' is the acceleration (or deceleration) and that the phrase referred to the change in the acceleration not the change in speed.

Question 9

The physics of circular motion was challenging for many candidates. Only stronger candidates recognised that an object travelling at a constant speed in a circle is not in equilibrium and has a resultant force towards the centre of the circle acting on it. The most common incorrect answer was **D**, and candidates did not recognise that the downward force of gravity is equal to the upward forces of friction and buoyancy.

Question 20

This question showed whether candidates really understood the cooling of bodies with different coloured surfaces. Although the majority of candidates got the correct answer, there was a significant number who thought that the can with the black surface would cool more slowly than the can with the shiny silver surface.

Question 23

The major confusion in this question was caused by a lack of understanding of the term 'refractive index' of a material. The refractive index refers to the ratio of the speed of light in a vacuum to the speed in the material which is approximately equal to the ratio of the speed of light in air to the speed in the material. In this case the light is travelling in the opposite direction (from the material into the air).

Question 27

Most candidates thought that starting the stopwatch on the first clap and stopping it on the eleventh clap meant that the sound had travelled to and from the wall eleven times, not the correct ten times.

Question 30

Many candidates were able to answer the question correctly but other candidates clearly did not understand the term 'electromotive force'. The most common error was to confuse e.m.f. with potential difference. However, almost the same proportion confused it with current.

PHYSICS

Paper 0625/32
Core Theory

Key messages

- In calculations, candidates must set out and explain their working correctly. When a candidate gives a wrong final answer and working is shown, it is often possible for partial credit to be awarded for any parts that are correct.
- Candidates should ensure they are clear and precise when answering questions requiring a description or explanation.
- It is important that candidates read the questions carefully in order to understand exactly what is being asked.

General comments

Many candidates were well prepared for this paper. Most candidates knew the equations used in the paper well but a significant number struggled to recall the equation for balanced moments in **Question 4(c)**. Often candidates were able to apply their knowledge and understanding to fairly standard situations. On occasions, when asked to apply their knowledge to a new situation, some candidates became confused and showed a lack of breadth of understanding. Stronger candidates were able to think through the possibilities and could apply their knowledge when the question asked for suggestions to explain new situations. Less successful candidates found difficulty in applying their knowledge to new situations and did not show the stages in their working.

The questions on conservation of energy, moments, convection, electrostatics and explaining half-life were generally more challenging for many candidates. There were a significant number of candidates who either did not read the questions carefully, or gave answers that were related to the topic being tested, but did not answer the question in enough detail to receive credit.

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

Comments on specific questions

Question 1

(a) The vast majority of candidates answered this correctly. Weaker candidates were equally distracted by the options of volume and weight.

(b) Most candidates answered this question correctly. The most common error was dividing by 1000 instead of multiplying by 1000.

(c) The majority of candidates gained at least partial credit. A common error was to omit or to give the wrong unit. Weaker candidates simply gave the combined mass.

Question 2

(a) Only the strongest candidates answered this question fully correctly but many gained at least partial credit. The most common error was misinterpreting the times in the description of the journey.

(b) The majority of candidates answered this correctly but weaker candidates attempted to use incorrect equations such as distance = speed ÷ time.

Question 3

(a) (i) Most candidates answered this question well. A common incorrect response was resultant force, or simply downwards force.

(ii) The majority of candidates answered this correctly. A common error was to multiply the force by 10 to give 40 N.

(b) Most candidates correctly calculated the resultant force. Weaker candidates added the forces instead of subtracting.

(c) (i) Many candidates correctly stated the principle of conservation of energy, but a significant number of candidates were unable to recall this principle.

(ii) Only the strongest candidates answered this fully correctly. A significant number of candidates attempted to answer the question by describing the forces acting on the load.

Question 4

(a) (i) Most candidates only ticked one box, with only stronger candidates identifying both force and distance.

(ii) The majority of candidates identified the joule as the unit for work done, but weaker candidates were attracted equally to all of the incorrect options.

(b) The majority of candidates only ticked one box, with only stronger candidates identifying both energy transferred and time.

(c) This question proved challenging to many candidates. Only stronger candidates equated moments to give the correct answer. The most common error was to attempt a cross multiplication, giving an answer of 20 000 N.

(d) (i) The majority of candidates answered this correctly.

(ii) Only stronger candidates answered this question correctly. The most common error was to give a vague description about the centre of mass of the bricks moving, but not to state that it had moved closer to the pivot.

Question 5

(a) The majority of candidates gained full credit. A common error was to give just 'light' as the source of energy, rather than the Sun.

(b) (i) Most candidates gained at least partial credit, but there were many vague responses such as 'easy to assemble' which were not precise enough to gain credit.

(ii) Most candidates gained credit for this question but vague responses such as 'expensive' could not be credited.

(c) Almost all candidates answered this correctly.

Question 6

(a) (i) Many candidates failed to apply their knowledge and understanding of convection to the situation of the electric oven.

(ii) Only stronger candidates gained full credit. Many candidates incorrectly described particles expanding and particles becoming less dense.

(iii) Almost all candidates gained credit for this question.

(b) The majority of candidates suggested suitable positions for the smoke detector in the kitchen. A common error was to state that it should be placed near a window.

Question 7

The majority of candidates scored at least partial credit on this question. A common error was to link very high frequency sounds to amplitude.

Question 8

(a) The majority of candidates gained full credit. A common error was to transpose infrared and microwaves. Weaker candidates used names such as 'ultrasound' in parts of the spectrum.

(b) Most candidates gave a suitable use for ultraviolet radiation. Weaker candidates seemed to mistake ultraviolet for ultrasound when stating a use.

Question 9

(a) The vast majority of candidates correctly identified the circuits.

(b) The majority of candidates were able to give one or two disadvantages of the series circuit.

(c) There were many well drawn circuits with switches correctly drawn in both arms of the parallel circuit. Weaker candidates usually failed to add a switch to turn lamp X on and off.

(d) The majority of candidates gained full credit by correctly identifying the effect on the lamps of the different switch positions.

Question 10

(a) Most candidates answered this correctly. The most common error was to only identify one conductor and one insulator.

(b) Many candidates gained partial credit by describing how to give the polythene strip a negative charge, but then failed to explain that the negative charge was the result of electrons moving onto the polythene strip.

(c) Many candidates gained partial credit by describing how a positively charged object would attract a negative charge on the polythene strip. Only stronger candidates gave a full description in terms of repulsion between the negatively charged strip and a negatively charged object.

Question 11

(a) The operation of the electromagnetic relay was well understood.

(b) Most candidates recognised iron as the material used as the core to an electromagnet, but only stronger candidates were able to explain that it is used because it can be magnetised and demagnetised easily.

Question 12

(a) The majority of candidates answered this question fully correctly. The most common error was in calculations of the numbers of neutrons and protons in the nucleus.

(b) (i) Many candidates gained full credit here. The most common error was to draw a straight line from the count rate axis to the time axis.

(ii) Only the strongest candidates gained full credit for this question. Many candidates seemed to think that if the half-life of astatine-210 was eight hours, the astatine-210 would have completely disappeared after 16 hours.

PHYSICS

Paper 0625/42
Extended Theory

Key messages

Candidates should record the formulae to be used in answering a question carefully, taking care not to transpose part of the formulae.
Candidates should be reminded to include the correct unit in their final answer to questions.

General comments

The strongest candidates demonstrated very thorough knowledge in most aspects of the paper. Most other candidates performed well and all candidates were able to show their knowledge of the subject in answering the questions on this paper.

Comments on specific questions

Question 1

(a) References to speed or velocity were both acceptable in answering this question. A common error was to simply describe acceleration as an increase in speed rather than to define it as rate of change of speed. Some candidates wrote 'change of speed per unit time' and this was credited. However, 'change of speed over time' could not be credited as the amount of time was not specified. The formula (v – u)/t was accepted.

(b) (i) There were many completely correct answers relating to all three sections of the graph. Statements referring simply to motion rather than speed were too vague. Some candidates clearly interpreted the graph as referring to speed or velocity, rather than distance against time and thus failed to recognise the constant speed section of the graph.

(ii) **1** Most candidates successfully used average speed = total distance / total time and gave the correct answer.

2 Far fewer candidates correctly found the maximum speed. Many candidates did not realise that they needed to find the gradient of the straight section of the graph. Others used the correct approach but misread data from the graph

Question 2

(a) Several possible advantages and disadvantages were accepted. Many candidates referred to 'no pollution' as an advantage without specifying a type of pollution such as 'of air' or 'of water'. Some candidates gave 'cheap' or 'expensive' as an advantage but needed to expand on what aspect was expensive (e.g. to set up or build) or cheap (e.g. because no fuel is needed).

(b) (i) **1** Many correct answers were seen. A small minority of answers showed mistakes in using the formula relating density, mass and volume.

2 Most candidates stated and used the formula for kinetic energy correctly. However, a significant number failed to square the speed when using the numbers.

(ii) Only the strongest candidates answered this question correctly. Candidates could not be awarded credit for vague answers mentioning friction or air resistance or heat generated. Answers that were credited referred to air passing through the turbine without striking the turbine blades.

Question 3

(a) Most candidates could identify acceleration and deceleration or equivalent statements as effects of a force. However, fewer could also identify change of direction.

(b) This question proved challenging for many candidates. However, many candidates gained partial credit for the scale used and, less often, for showing the *T* forces at right angles to each other on a vector diagram.

Question 4

(a) (i) A few candidates stated that the space S above the mercury contained air.

(ii) Most candidates used the appropriate formula and calculated *h* correctly.

(iii) Many candidates identified that the vertical would not change, but very few could give an acceptable explanation stating that in the formula $P = hdg$, h is measured vertically.

(b) Only the very strongest candidates answered this question correctly. Most candidates attempted an explanation in terms of differences in the diameter of the tube, or a change in pressure from one part of the room to another.

Question 5

(a) This was usually answered correctly, but some candidates did not include the unit.

(b) (i) **1** The idea of the requirement for uniform expansion was usually expressed adequately.

2 Rather than referring specifically to the capillary tube having a uniform bore, many candidates referred to ‘it’, or ‘the thermometer’, and so could not be awarded credit.

(ii) In general, candidates chose to mention the capillary tube needing to be wider or the bulb needing to be smaller.

(iii) Many candidates successfully identified the need for a narrower capillary tube or a larger bulb.

(c) (i) Many of the diagrams of a thermocouple thermometer drawn by candidates lacked important details. The meter shown was often not identified by an appropriate symbol or a name. Labels for the metals of the wires were frequently confused or missing. However, credit was frequently awarded for showing the labelling wires of two different metals meeting at a junction.

(ii) Most candidates were able to suggest a reason for using a thermocouple thermometer rather than a liquid-in-glass one.

Question 6

(a) Most candidates identified convection as the main process for transferring thermal energy.

(b) (i) Many candidates completed the two stages of the calculation of the time needed. However, in some cases the conversion of kW to W was not carried out.

(ii) Choices of reasons for the time being greater than the value calculated in **(i)** were often vaguely described or lacked the required detail. Some choices, such as wrong readings or faults in the heater, could not be credited.

Question 7

(a) This was nearly always answered correctly.

(b) Most candidates gained at least partial credit for this question but very few gained full credit. The greater force of attraction between solid molecules than between gas molecules was seen in most answers. The fact that it is therefore easier to increase the separation of gas molecules was almost always missed.

(c) Boyle's law was often applied correctly to find the expanded volume of the gas. Only stronger candidates subtracted of the volume of gas left in the cylinder.

Question 8

(a) (i) Most candidates gained partial credit for showing the refracted wavefronts parallel to each other and meeting the incident wavefronts at the boundary. Fewer drew the wavefronts at an acceptable angle to the boundary.

(ii) Many candidates correctly drew an arrow perpendicular to the refracted wavefronts and pointing in the correct direction. Most of the others drew their arrows on the wavefronts themselves.

(iii) Some candidates correctly marked the acute angles between the wavefronts and the boundary. Others treated the refracted wavefronts as rays and usually marked the wrong angles.

(b) In spite of quoting a correct formula, the wrong transposition of this formula led to a number of candidates calculating a speed greater than the speed of light. A number of candidates omitted a unit for the speed.

Question 9

(a) Some candidates did not calculate the resistance correctly. Any wrong values were usually the result of misreading data from the graph.

(b) More candidates ticked the wrong box for the resistor than for the thermistor. There were cases of candidates ticking two boxes on one line of the table which meant they could not be awarded credit.

(c) (i) In situations where resistors in parallel are concerned, there was an automatic reaction on the part of many candidates to calculate their combined resistance. Mistakes in using the formula led to a considerable number of wrong values for the resistance and therefore of the current. Those candidates with better understanding followed the straightforward route of adding the two equal currents in the two components.

(ii) Most candidates wrote down a correct formula and calculated the transferred energy correctly.

Question 10

(a) Only the strongest candidates answered this question fully correctly. Other candidates sometimes did not recognise that for a given power, a large voltage produces a low current, and some suggested that high resistance is the cause of low current. Some candidates omitted the fact that low current causes low thermal energy generation or low power loss. In some cases there was no mention that low current means that thinner or lighter or cheaper transmission cables would be needed or that fewer, lighter or cheaper pylons would suffice.

(b) (i) Most candidates were able to use the correct formula and could calculate the number of turns in the secondary coil. However, some candidates incorrectly copied the numbers given in the question.

(ii) A small minority of candidates quoted steel or copper as a suitable material.

Question 11

(a) (i) The decay equation was correctly completed by a large majority of candidates.

(ii) Many correct values for the count-rate were seen. There were sometimes cases of multiplying by two twice rather than dividing, or dividing by two once instead of twice.

(b) Most candidates stated two correct ways in which the emissions differed.

PHYSICS

Paper 0625/52
Practical

Key messages

- Candidates need to have had a thorough grounding in practical work during the course, including reflection and discussion on the precautions taken to improve reliability.
- Candidates should read questions carefully and draw conclusions from the results obtained rather than from theoretical considerations.
- Numerical answers should be expressed clearly, to the appropriate number of significant figures and with a correct unit, where applicable. These techniques will be tested at some point in the paper.
- Candidates should be ready to apply their practical knowledge to designing an investigation. Papers will contain a planning question which can be answered by developing a solution from standard experimental techniques.

General comments

The aim of the examination is to enable candidates to display their knowledge and understanding of practical physics techniques, including the following:

- plotting graphs
- tabulating readings
- manipulating data to obtain results
- drawing conclusions
- dealing with possible sources of error
- controlling variables
- handling practical apparatus and making accurate measurements
- choosing the most suitable apparatus.

It is assumed that, as far as possible, the IGCSE course will be taught so that candidates undertake regular practical work as an integral part of their study of physics.

Questions on experimental techniques were answered much more effectively by candidates who showed evidence of having regular experience of similar practical work. This was demonstrated in the practical details given by some candidates in **Questions 1(g)** and **1(h)**.

There will be questions in which candidates will be asked to devise approaches to investigations which may or may not be familiar to them. Candidates are able to answer these by carefully reading the brief and with logical application of good experimental practice. A number of candidates showed good practical knowledge when answering **Question 2(d)**, **3(f)** and **4**.

Comments on specific questions

Question 1

Most candidates were able to obtain satisfactory data from the ray-trace in order to plot the graph.

(a) to **(d)** Many candidates showed good skills in constructing the diagram, using small crosses as far from point **N** as possible. Others were less precise with thick pencil lines.

(e) Most candidates obtained a set of values within the expected range and expressed to the nearest mm. Where this was not the case, it was generally because of measuring line **NH** rather than **LH**.

(f) There were many well-drawn, accurate graphs with clearly labelled axes. Scales were usually chosen sensibly. Only a few candidates used impractical scales which almost always meant they had difficulty in plotting some points.

Plotting was mostly careful and many candidates indicating the plots with fine crosses. Small dots were acceptable but were often obscured when the line was drawn through them. The large dots used by some candidates were not acceptable as the intended value could not be determined clearly. A sharp pencil should be used for the plots and for the line so that accurate drawing may be achieved and errors easily corrected.

Many candidates produced a well-judged curve as indicated by their accurate plots. However, some candidates joined points together or tried to fit a straight line to them.

A very small number of candidates equally spaced the *a* values from the table on the vertical axis, producing an inconsistent scale and made errors in the scale and also in the plots as their positions could not be determined correctly.

(g) Many candidates answered well and discussed the difficulty of achieving precision with a ray of finite, possibly increasing width or the large effect on the value of *a* by small variations in angle θ. The difficulty in placing the mirror's reflecting surface on line **EF** was also mentioned. However, some candidates incorrectly quoted examples of poor practical procedure, despite the reference in the question to the experiment having been carried out carefully.

(h) This question was about the reliability of data and the most common correct answers referred to repeating readings and calculating average values or taking further values of θ. A few candidates suggested that the same values of θ could be measured below line **NL** and averages calculated from the resulting *a* values.

Question 2

Many candidates were able to carry out this practical well and only the supplementary questions proved difficult for some candidates.

(a) and **(b)** Most candidates obtained a clear, continuous fall in temperature in both beakers, showing a difference between the beaker with insulation and the beaker with a lid. Only a few recorded room temperature as θ_0 or did not wait for the temperature to reach a maximum value before starting the timing. Some candidates did not include the unit marks when completing the table.

(c) Many candidates produced good conclusions based on the readings in the table. Where the expected pattern between the beakers was not obtained, a number of candidates concluded from theory rather than their experimental work and could not be credited.

Justifications correctly based on the difference in temperature change over the full 180 s of the experiment were frequently seen.

(d) Many candidates realised that an additional experiment without insulation or lid, or with both, could be used as a comparison with the results from beaker **A** or beaker **B** in order to show the effect of each of these factors individually.

(e) Many candidates recognised the importance of keeping the initial temperature the same but fewer were able to relate that to the lower cooling rate produced by a lower starting temperature or the converse for a higher starting temperature. Only a few candidates gave good responses regarding the use of cooling rates at different temperatures from beaker **A** readings.

Where constant temperature changes had been obtained over each 30 s period, it was expected that candidates would state that uniform initial temperatures were not important as differences apparently did not affect cooling rates. This was only seen in responses from stronger candidates.

Question 3

Many candidates produced strong responses to this question and a good deal of careful practical work was seen.

(a) There was a lot of good practical skill shown with many candidates obtaining good readings and recording them well. However, some candidates expressed the potential difference values to less than 1 decimal place and the current values to less than 2 decimal places.

(b) The majority of candidates completed the column headings correctly. Some omitted the units with only a small number giving incorrect units.

(c) Accurate calculation was generally seen with good attention paid to correct rounding. Some sets of R values were expressed to an inconsistent number of significant figures.

The quality of practical work behind many responses was evident in the correlation between the values of resistance per unit length.

(d) The most usual method of calculating R_{25} was to multiply one R / l value by 25 cm. Some candidates took a more rigorous approach by first calculating an average value of R / l. Other candidates used proportion from an R value, with some doing this for each length and finishing with an average. All of these methods were credited.

(e) Few candidates recognised the difficulty of achieving a precise contact with a crocodile clip or measuring an accurate length in these circumstances. Many talked of the heating effect of current but this would be the same for all students carrying out the experiment and did not explain differences.

The difficulty of interpolating meter readings between marked values was rarely mentioned.

(f) The most straightforward answers to this question involved reproducing **Fig. 3.1** with a variable resistor connected in series in the upper section of the circuit.

Many candidates were able to draw an accurate symbol for a variable resistor. Some, however, showed it connected in such a way that the voltmeter would measure the potential difference across the variable resistor as well as the resistance wire. Other candidates omitted the voltmeter or the variable connection of the crocodile clip.

Question 4

Stronger candidates answered this question well. The question required the design to be developed from a standard experiment rather than being a practical that was likely to have been experienced in this form. However, it was possible to obtain credit for aspects of good practice and planning.

The strongest responses showed a logical approach, structured as suggested by the bullet points in the question, with concise sentences which communicated ideas well. Weaker candidates sometimes missed straightforward points as planning was not approached in a sequential way.

Most candidates were able to identify the need for a stopwatch or metre rule to measure the dependent variable such as time for a number of oscillations or amplitude at a particular point in the process.

It was expected that the apparatus would be modified by fixing the card to the rod to provide air resistance as the pendulum moved. Few candidates suggested this and instead most talked about waving the card to create an air stream. This gained credit only if it was described as being done as the pendulum swung towards the card. When swinging away from the card, the action would assist the pendulum rather than resist its motion.

A number of candidates ignored the use of the card and gained credit by suggesting variations to the shape of the bob to provide different amounts of air resistance. However, it was difficult to suggest an independent variable in this case.

It was important that candidates described the steps of the experiment rather than just implying the release of the pendulum and measurement of the dependent variable. It was also necessary to state that it should be repeated with a different value of independent variable such as the area of the card.

The length of the pendulum or mass of the bob were generally identified as control variables. Constant angle of release was common and was accepted, even if too large.

Many well thought-out tables were seen, containing clear columns for readings of independent and dependent variables, with appropriate units. Some candidates omitted units or gave units to variables which had not been measured as part of the described method (e.g. N for air resistance).

A comment on the analysis of results was expected. The most straightforward responses suggested that if a change in the independent variable produced a change in the measured dependent variable, this showed that air resistance affected the swing of the pendulum. Many candidates incorrectly predicted a conclusion instead, often quoting theory to support this.

Mention of a graph, with suitable axes clearly stated was sufficient to gain credit for analysis. Candidates needed to recognise that the use of a bar chart was not appropriate for a continuous variable such as area of card or period of oscillation.

Many candidates gained credit for an additional point, suggesting a means of ensuring a reliable experiment.

Some of the most common responses stipulated the timing of a number of oscillations before calculating a mean for each value or taking at least five sets of data. Other candidates mentioned further examples of good practice such as releasing the bob from a small angle or the use of a fiducial mark to aid counting of oscillations.

PHYSICS

Paper 0625/62
Alternative to Practical

Key messages

Candidates need to have had a thorough grounding in practical work during the course, including reflection and discussion on the precautions taken to improve reliability.
Candidates should read questions carefully and draw conclusions from results rather than from theoretical considerations.
Numerical answers should be expressed clearly, to the appropriate number of significant figures and with a correct unit, where applicable. These techniques will be tested at some point in the paper.
Candidates should be ready to apply their practical knowledge to designing an investigation. Papers will contain a planning question which can be answered by developing a solution from standard experimental techniques.

General comments

The aim of the examination is to enable candidates to display their knowledge and understanding of practical physics techniques, including the following:

plotting graphs
tabulating readings
manipulating data to obtain results
drawing conclusions
dealing with possible sources of error
controlling variables
handling practical apparatus and making accurate measurements
choosing the most suitable apparatus.

It is assumed that, as far as possible, the IGCSE course will be taught so that candidates undertake regular practical work as an integral part of their study of physics. This examination should not be seen as suggesting that the course can be fully and effectively taught without practical work. Some of the skills involved in experimental work, including graph plotting and tabulation of readings, can be practised without doing experiments. However, there are parts of this examination in which the candidates are asked to answer from their own practical experience.

Questions on experimental techniques were answered much more effectively by candidates who showed evidence of having regular experience of similar practical work. This was demonstrated in the practical details given by some candidates in **Questions 1(b)**, **1(e)** and **1(f)**.

It is expected that numerical answers will be expressed to a number of significant figures which is appropriate to the data given in the question. A set of similar values should be expressed to a consistent number of significant figures. This was demonstrated in many good responses to **Question 3(c)**.

There will be questions in which candidates will be asked to devise approaches to investigations which may or may not be familiar to them. Candidates are able to answer these by carefully reading the brief and with logical application of good experimental practice. A number of candidates showed good practical knowledge when answering **Questions 2(d)**, **3(f)** and **4**.

Comments on specific questions

Question 1

Most candidates were able to complete the ray-trace and graph successfully.

(a) The majority of candidates measured the angle θ accurately and were able to draw a good normal line.

(b) Many candidates recognised that **P** was not at a suitable distance for ray-tracing, giving the appropriate reason that it was too close to **N**. Many gave the acceptable minimum distance of 5 cm but it should be noted that **P** should be as far from **N** as possible for the accurate ray-tracing.

(c) Many candidates showed good skills in completing the diagram and recorded an accurate value for *a*. Use of thick pencil lines or lack of precision had a significant detrimental effect on the value obtained.

(d) There were many well-drawn, accurate graphs with clearly labelled axes. Scales were usually chosen sensibly. Only a few candidates used impractical scales which almost always meant they had difficulty in plotting some points.

Plotting was mostly careful and many candidates indicated the plots with fine crosses. Small dots were acceptable but were often obscured when the line was drawn through them. The large dots used by some candidates were not acceptable as the intended value could not be determined clearly. A sharp pencil should be used for the plots and for the line so that accurate drawing may be achieved and errors easily corrected.

Many candidates produced a well-judged curve as indicated by their accurate plots. However, some candidates joined points together or tried to fit a straight line to them.

A very small number of candidates equally spaced the *a* values from the table on the vertical axis, producing an inconsistent scale and made errors in the scale and also in the plots as their positions could not be determined correctly.

(e) Many candidates answered well and discussed the difficulty of achieving precision with a ray of finite, possibly increasing width or the large effect on the value of *a* by small variations in angle θ. The difficulty in placing the mirror's reflecting surface on line **EF** was also mentioned. However, some candidates incorrectly quoted examples of poor practical procedure, despite the reference in the question to the experiment having been carried out carefully.

(f) This question was about the reliability of data and the most common correct answers referred to repeating readings and calculating average values or taking further values of θ.

Question 2

Many candidates were able to deal well with questions on the basic practical and only the supplementary questions proved difficult for some candidates.

(a) The room temperature was usually read correctly.

(b) Most candidates completed the time column correctly. Units were generally correct but in some cases units were omitted.

(c) Many candidates produced good conclusions based on the readings in the table. Justifications correctly based on the difference in temperature change over the full 180 s of the experiment were frequently seen.

(d) Many candidates realised that an additional experiment without insulation or lid, or with both, could be used as a comparison with the results from beaker **A** or beaker **B** in order to show the effect of each of these factors individually.

(e) Most candidates calculated the average cooling rate correctly, expressing it to the expected 2 significant figures, and many gave the correct unit of °C / s.

Many candidates recognised the importance of keeping the initial temperature the same but fewer were able to relate that to the lower cooling rate produced by a lower starting temperature or the converse for a higher starting temperature. Only a few candidates gave good responses regarding the use of cooling rates at different temperatures from beaker **A** readings.

Question 3

Many candidates produced strong responses to this question.

(a) Many candidates drew the correct voltmeter symbol connected across terminals **P** and **Q.** Only a few showed it connected in series or in parallel to the resistance wire itself. Most candidates read the values of V and I correctly.

(b) Most candidates completed the column headings correctly. Some omitted the units with only a very small number giving incorrect units.

(c) Accurate calculation was generally seen with good attention paid to correct rounding. Most sets of R values were expressed to a consistent number of significant figures. Most candidates also correctly produced values of resistance per unit length.

(d) The most usual method of calculating R_{25} was to multiply an R / l value by 25 cm. Other candidates used proportion from an R value. Each of these methods was credited.

(e) Few candidates recognised the difficulty of achieving a precise contact with a crocodile clip or measuring an accurate length in these circumstances. Many talked of the heating effect of current but this would be the same for all students carrying out the experiment and did not explain differences.

The difficulty of interpolating meter readings between marked values was rarely mentioned.

(f) The most straightforward answers to this question involved reproducing **Fig. 3.1** with a variable resistor connected in series above terminals **P** or **Q**.

Many candidates were able to draw an accurate symbol for a variable resistor. Some, however, showed it connected in such a way that the voltmeter would measure the potential difference across the variable resistor as well as the resistance wire. Other candidates omitted the voltmeter or the variable connection of the crocodile clip.

Question 4

Stronger candidates answered this question well. The question required the design to be developed from a standard experiment rather than being a practical that was likely to have been experienced in this form. However, it was possible to obtain credit for aspects of good practice and planning.

The strongest responses showed a logical approach, structured as suggested by the bullet points in the question, with concise sentences which communicated ideas well. Weaker candidates sometimes missed straightforward points as planning was not approached in a sequential way.

Most candidates were able to identify the need for a stopwatch or metre rule to measure the dependent variable such as time for a number of oscillations or amplitude at a particular point in the process.

It was expected that the apparatus would be modified by fixing the card to the rod to provide air resistance as the pendulum moved. Few candidates suggested this and instead most talked about waving the card to create an air stream. This gained credit only if it was described as being done as the pendulum swung towards the card. When swinging away from the card, the action would assist the pendulum rather than resist its motion.

A number of candidates ignored the use of the card and gained credit by suggesting variations to the shape of the bob to provide different amounts of air resistance. However, it was difficult to suggest an independent variable in this case.

It was important that candidates described the steps of the experiment rather than just implying the release of the pendulum and measurement of the dependent variable. It was also necessary to state that it should be repeated with a different value of independent variable such as the area of the card.

The length of the pendulum or mass of the bob were generally identified as control variables. Constant angle of release was common and was accepted, even if too large.

Many well thought-out tables were seen, containing clear columns for readings of independent and dependent variables, with appropriate units. Some omitted units or gave units to variables which had not been measured as part of the described method (e.g. N for air resistance).

A comment on the analysis of results was expected. The most straightforward responses suggested that if a change in the independent variable produced a change in the measured dependent variable, this showed that air resistance affected the swing of the pendulum. Many incorrectly predicted a conclusion instead, often quoting theory to support this.

Mention of a graph, with suitable axes clearly stated was sufficient to gain credit for analysis. Candidates needed to recognise that the use of a bar chart was not appropriate for a continuous variable such as area of card or period of oscillation.

Many candidates gained credit for an additional point, suggesting a means of ensuring a reliable experiment.

Some of the most common responses stipulated the timing of a number of oscillations before calculating a mean for each value or taking at least five sets of data. Other candidates mentioned further examples of good practice such as releasing the bob from a small angle or the use of a fiducial mark to aid counting of oscillations.