PHYSICS

Paper 0625/12
Multiple Choice (Core)

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

Key messages

Candidates should be reminded to read the questions carefully to ensure they understand what is being asked.

General comments

Candidates found **Questions 2**, **9**, **11**, **13**, **25**, **26**, **30**, **36** and **37** accessible. However, **Questions 3**, **6**, **12**, **20**, **22**, **32**, **35** and **39** proved very challenging for many candidates.

Comments on specific questions

Question 1
Some candidates did not read this question carefully enough. The question required candidates to identify the instruments necessary to measure the volume of an irregularly shaped rock – it did not require the mass of the rock as well.

Question 3

This question proved challenging for many candidates. Stronger candidates realised that they needed to find the total time taken (100 s up the hill plus 50 s down) and divide this into the total distance travelled (600 m).

Question 5

Although the question was answered reasonably well, there were a significant number of candidates who thought that there must be a resultant force in the direction of the velocity in order to keep an object moving at constant speed in that direction.

Question 6

Only stronger candidates answered this question correctly. Many candidates thought that response **A** was correct as they applied the formula for density without thinking the problem through.

Question 8

Although many candidates were able to solve this problem, a large minority gave **C** as their answer, suggesting that they had difficulty with the manipulation of equations.

Question 10

Although most candidates showed a good grasp of energy transfers, some candidates thought that the ball started with kinetic energy and this was transferred to gravitational potential energy.

Question 12

This question proved challenging for many candidates. Although most candidates ruled out option **A,** (chemical change) all other options were selected by equal numbers of candidates.

Question 13

Almost all candidates recognised that the lower points are at higher pressures than the upper points. However a number of candidates thought that the less dense liquid would produce a greater pressure than the more dense liquid.

Question 14

Stronger candidates showed an understanding of the theory of the use of a manometer, and also the ability to think through a problem in a logical fashion.

Question 16

This question proved challenging for most candidates. The simple concept of mass was not well understood.

Question 18

Many candidates did not link the period of time that the temperature is constant, in a cooling experiment, with the solidification of the liquid. Either that or they failed to understand that a liquid melts at the same temperature that it solidifies.

Question 19

The question was answered well by candidates who had experience of doing the experiment but it was more challenging for candidates has only seen it described in a book.

Question 20

Only stronger candidates were able to answer this question correctly. The logic is that the rise in temperature of the cooler plate will be slowest when there is least energy emitted from the hotter plate (shiny white) and when it absorbs the smallest proportion of that energy (once more, the shiny white plate).

Question 28

The vast majority of candidates recognised that the charge carriers in a metal are free electrons but there was some confusion as to their direction of flow.

Question 31

Some candidates incorrectly believed that the current in a circuit increases when the resistance of a variable resistance is increased.

Question 32

Understanding that a parallel circuit has less resistance than a series circuit (and therefore more current) was not well understood. Candidates chose each of the four options in almost equal numbers.

Question 33

A number of candidates showed a lack of understanding of parallel circuits but stronger candidates were about to answer correctly.

Question 38

Only stronger candidates recognised the correct diagram with many thinking that the superscript referred to the number of neutrons in the nucleus rather than the number of nucleons.

Question 39

Many candidates lacked an understanding of background radiation and some thought it was due to the rock itself while other candidates thought that it is infra-red radiation from the Sun.

Question 40

This question proved challenging to many candidates. The most common error was to simply find the half-life of the isotope and not to go on to use that to find the remaining mass of the isotope.

PHYSICS

Paper 0625/22
Multiple Choice (Extended)

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

Key messages

Candidates should be reminded to read the questions carefully to ensure they understand what is being asked.

General comments

The general standard was very high with most candidates answering **Questions 1**, **2**, **4**, **5**, **7**, **9**, **11**, **13**, **17**, **19**, **22**, **25**, **27**, **29**, **31** and **37** really well. **Questions 8**, **14**, **23**, **29** and **40** proved more challenging for some candidates.

Comments on specific questions

Question 1

This question was answered well by almost all candidates.

Question 3

Although most candidates were able to answer this question correctly, there was a sizeable minority who divided the change in speed by the total time elapsed (4.0 s).

Question 6

Although this was answered quite well, there were a number of candidates who divided by the total volume of liquid, rather than the extra added liquid.

Question 8

This question caused some difficulties with many candidates failing to consider the weight of the ruler.

Question 10

This question proved challenging and many candidates thought that the incoming ball stopped after the collision. Even more candidates appeared to equate the momentum of the second ball and the momentum of the first ball.

Question 12

Only the strongest candidates were able to answer this question correctly. The simplest way of solving this problem is to equate the initial kinetic energy with the work done by the brakes against friction. Many candidates gave option **B** suggesting that they either simply multiplied the mass of boy and bicycle by the speed or attempted to use the kinetic energy but forgot to include the factor of ½ in the kinetic energy formula.

Question 14

The question asked candidates to solve a problem, by proportion, but with two variables. Many candidates found this very challenging, with options **A**, **B** and **C** being chosen in almost equal number suggesting many candidates guessed.

Question 15

Although most candidates were able to solve this problem, many candidates thought that the initial pressure was less than atmospheric pressure.

Question 18

Although this was reasonably well answered, a significant number of candidates incorrectly thought that a thermocouple is always more sensitive than a liquid-in-glass thermometer.

Question 21

Most candidates answered this question well but there were quite a lot of candidates who thought that no energy was transferred between molecules in a plastic.

Question 23

Waves will not propagate through gaps which are significantly narrower than the wavelength of the wave itself. Very few candidates understood this.

Question 24

A significant number of candidates thought that the image in the plane mirror was formed at point **A**.

Question 32

Although the question was answered correctly by many candidates, a significant minority failed to convert the 1.0 minutes into seconds.

Question 35

Only stronger candidates were able to answer this question correctly. The way forward here was to recognise that when the two inputs to a NAND-gate are joined, then it acts as a NOT-gate. The logic then becomes much more accessible.

Question 36

Although the majority got the correct answer, a significant number of candidates did not understand that the increase in the field strength caused by increasing the current would increase the density of the field lines.

Question 39

A significant number of candidates showed little understanding of the concept of background radiation.

Question 40

Only the strongest candidates recognised that the change in mass owing to the loss of beta-particles would be negligible and thus the overall mass of the block (now containing both caesium and barium isotopes) would remain virtually the same.

PHYSICS

Paper 0625/32
Core Theory

Key messages

- Candidates should be given opportunities to practice applying their knowledge to new situations by attempting questions in support materials or exam papers from previous sessions.
- In calculations, candidates must show clear working to support their answers. When a candidate makes an error that leads to an incorrect numerical answer and no working is shown, credit for any correct methods used cannot be given.
- Candidates should be reminded to use the number of marks given at the end of a question as a guide to the form and content of their answer.

General comments

A high proportion of candidates were well prepared for this paper. Equations were generally well known by most candidates.

The questions on the hydroelectric power station, transfer of thermal energy, electromagnetic induction and radioactivity topics were generally only answered well by the stronger candidates. There was a significant number of candidates who either did not read the questions carefully enough, or gave answers that were related to the topic being tested, but did not answer the question as it had been set.

Many candidates knew how to apply their knowledge to a new situation but others become confused and displayed a lack of breadth of understanding. More successful candidates were able to think through the possibilities and apply their knowledge when the question asked for suggestions to explain new situations.

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

Comments on specific questions

Question 1

(a) The majority of candidates correctly calculated the thickness of one sheet of paper. Weaker candidates divided one of the dimensions of the pile paper by another dimension.

(b) Most candidates correctly used length × breadth × height to show that the volume of the pile of paper was 3000 cm^3.

(c) Most candidates gave a suitable device for measuring mass. Weaker candidates gave answers such as vernier callipers.

(d) Most candidates correctly calculated the density as 0.8 g/cm^3. Weaker candidates used an inverted form of the equation for density.

Question 2

(a) (i) The vast majority of candidates identified section **B** as representing the cyclist travelling at constant speed.

(ii) Many candidates gained full credit by calculating the area under the speed-time graph. However, some candidates found this question challenging and a common mistake was to simply multiply the speed by a time of 5 seconds.

(b) (i) Many candidates answered this correctly. However, a common error was to forget that the cyclist had travelled four times around the track.

(ii) The majority of candidates correctly subtracted the time on the first stopwatch from that on the second stopwatch. A common error was to omit the decimal fractions and give an answer of 23 seconds. This may have been due to incorrect rounding and candidates should be aware that readings from stopwatches should be stated to the number of decimal places indicated on the device.

Question 3

(a) Most candidates gave a correct extension. However, some candidates failed to use a straight edge to accurately determine the extension from the graph which meant that no credit could be awarded.

(b) The majority of candidates identified **B** as the easier spring to stretch, but only more able candidates gave an adequate reason. Weaker candidates repeated the stem of the question by stating that spring **B** was easier to stretch and this could not be credited.

(c) (i) The majority of candidates correctly calculated the extension of the spring for a load of 6.0 N. Only weaker candidates gave the reading of 43.9 cm as their answer.

(ii) Only a few candidates gained full credit for this question. The majority of candidates failed to recognise the need to repeat each reading and to calculate the average extension for each load.

Question 4

(a) Candidates found the description of using a hydroelectric power station to generate electricity challenging. The most common error was to state the turbine generated electricity.

(b) Only the strongest candidates were able to give three advantages of generating electrical energy using a hydroelectric system compared with a coal-fired power station. The most common error was lack of detail. Candidates should be aware that “less pollution” was an insufficient response. In a comparison with a coal-fired power station, an answer such as “less atmospheric pollution” would have been sufficient for credit.

(c) (i) The majority of candidates correctly identified kinetic energy as the useful energy transformation.

(ii) The majority of candidates recognised that the second drill was less efficient than the first drill. A common error was to state it was less reliable.

Question 5

(a) (i) Almost all candidates recognised that the pressure of air in the bottle would increase.

(ii) Many candidates gained partial credit but only the strongest gained full credit.

(b) The majority of candidates were able to recall and use the equation for pressure. Unfortunately, a significant number of candidates rounded their answers incorrectly.

(c) (i) The majority of candidates correctly calculated the area of the circle.

(ii) The majority of candidates correctly explained that the area in **Fig. 5.3** was smaller than that in **Fig. 5.2.**

Question 6

(a) Very few candidates were able to state a physical property that varies with temperature.

(b) (i) The majority of candidates identified 8.30 p.m. as the time at which the heater was switched off.

(ii) The majority of candidates identified 9.00 p.m. as the time at which the curtains were closed, and gave a suitable explanation. Weaker candidates failed to gain full credit due to incorrect explanations, such as "after 9.00 p.m. the temperature decreased".

(c) Only the strongest candidates answered this question correctly.

Question 7

(a) (i) Many candidates correctly identified angle **Z** as the angle of refraction. The most common error was to give angle **Y** as the angle of refraction.

(ii) The majority of candidates were able to give a suitable example of a transverse wave. Weaker candidates incorrectly gave "sound wave" as an example of a transverse wave.

(b) Almost all candidates correctly drew wavefronts showing diffraction after passing through the gap and identified the name of the effect as diffraction.

Question 8

(a) Many candidates gained full credit for this question. The most common errors were incorrect placement of the voltmeter, or not identifying a variable resistor as a device for varying the current in lamp **B**.

(b) The majority of candidates gained full credit for this calculation. Weaker candidates used an inverted form of the equation for resistance.

Question 9

(a) (i) Most candidates identified the missing region as X-rays.

(ii) Most candidates identified radio waves as the region with waves of the longest wavelength. However, almost every region was given in answers with the most common error being gamma rays.

(b) The majority of candidates correctly identified ultrasound as the wave with the lowest speed in air.

(c) Although this question was answered well by stronger candidates, weaker candidates often lacked detail and consequently described methods that would not work. Candidates should be aware that a stopwatch is started when a source is seen to make a sound, and stopped when the sound is heard. Candidates should also be aware that a distance of 20 metres between the source and the timer is insufficient for accurately starting and stopping a stopwatch.

Question 10

(a) Very few candidates gained full credit for this question. The majority of candidates failed to link the relative movement of the magnet and coil to the cutting of magnetic field lines, and hence the direction of the e.m.f.

(b) Many candidates answered this question well. A common error was to fail to identify **X** as a step-up transformer and **Y** as a step-down transformer.

Question 11

(a) Many candidates gained partial credit, with only the strongest gaining full credit. A common error was omitting that friction caused electrons to transfer.

(b) The majority of candidates recognised that the rods would move apart because they both had the same type of electric charge.

Question 12

Only the most able candidates answered fully correctly. Many candidates gave good descriptions of using different absorbers between the source and the detector, but a lack of detail or accuracy often resulted in only partial credit being awarded.

PHYSICS

Paper 0625/42
Extended

Key messages

- Numerical questions usually require the use of a formula. Candidates are advised to begin their answer by writing down the formula without rearrangement. This avoids the possibility of an error in the rearrangement of the formula or the use of wrong numbers.
- If candidates are required to define a quantity, e.g. acceleration, candidates should ensure they give a precise statement in words or a formula with its symbols explained as required.

General comments

The strongest candidates showed great consistency over most aspects of the paper. A large proportion of other candidates showed strength in some questions on the paper but showed a lack of consistency. A small proportion of candidates were weak in all questions on the paper.

Comments on specific questions

Question 1

(a) Vague answers such as "acceleration is increase in velocity (or speed)" were seen in a number of answers.

(b) (i) Very few candidates failed to draw the first two sections of the graph correctly. Drawing the final section depended on the correct use of the formula $a = \frac{(v - u)}{t}$ and credit was available for writing this down. Some candidates subsequently failed to rearrange this formula correctly or substituted the wrong numbers. Nevertheless, many candidates were successful in using the formula and drew the final section of the graph correctly.

(ii) Most candidates could state that the direction of the resultant force on the car was towards the centre of the circle. However far fewer candidates could state that the velocity changes its direction as they failed to take into account the fact that velocity is a vector quantity.

Question 2

(a) A number of candidates repeated the question in their answers. A small minority of candidates grasped the idea that the potential energy of the object increases because work is done by the force used to raise it. Alternatively, some candidates gained credit by referring to mgh and the increase in the value of h.

(b) The increase in g.p.e. was usually calculated correctly. However a small minority of candidates failed to calculate the total mass of all the passengers.

(c) The efficiency could be calculated using either work or power, but some candidates confused the two. Others wrote down a formula for efficiency with input and output interchanged from their correct positions. Some candidates had the correct working but gave the final fraction or percentage with one significant figure only and so could not be awarded credit.

Question 3

(a) This was only answered well by the strongest candidates. The answer "force multiplied by distance" was a common answer. Others candidates gave "perpendicular distance" but failed to add '"from a point" or "from a pivot".

(b) (i) A significant number of candidates wrote down "pivot" rather than centre of mass. Centre of gravity, though not the normal term, was also accepted.

(ii) Most candidates successfully worked out the correct answer of 16 kg. Some gave the answer as 16 g however.

(iii) Some candidates wrote only about the equilibrium of the forces. A smaller number of candidates only considered the equilibrium of the moments of the forces. However, many candidates covered both aspects. More candidates were successful in using the data from the figure about the forces correctly rather than about the moments.

Question 4

(a) Most candidates gained only partial credit. This was often because they made insufficient reference to molecules. Only the stronger candidates stated that the liquid molecules collide with the spoon. Many answers began with a statement that energy or heat was transferred from the liquid to the spoon which gained credit. Many answers then referred to the molecules of the spoon beginning to vibrate, rather than having faster or increased vibration.

(b) This question proved challenging for many candidates. Answers needed to mention the transfer of energy to free electrons in the spoon but this was only given by stronger candidates. More answers referred to the movement of electrons through the spoon.

(c) Most answers dealt successfully with the calculation of the loss of thermal energy from the liquid.

Question 5

(a) (i) Answers showing only changes of direction at the surrounding circle or curved paths between changes of direction instead of straight paths could not be credited.

(ii) The sudden changes of direction of the smoke particles had to be attributed to the smoke particles being hit by randomly moving air molecules, thus causing the smoke particles to undergo their sudden changes of direction or Brownian motion. Most candidates gained at least partial credit for this.

(b) Success in this calculation depended on the use of $F = \frac{(mv - mu)}{t}$ or impulse = mv – mu followed by correct substitutions in the formula stated. Having quoted the formula correctly, some candidates failed to make the correct substitutions. Many candidates, however, arrived at the correct force.

Question 6

(a) A majority of candidates could identify the four required radiations.

(b) (i) Weaker candidates were able to write down $n = \frac{\sin i}{\sin r}$, but had difficulty with the calculation.

(ii) Most candidates could correctly draw the path of the red ray in the prism. There was less certainty, in particular from weaker candidates, about its path on leaving the prism, with some candidates showing no change of direction.

(iii) Correct responses required knowledge of the correct order of the colours of light in the visible spectrum along with the detail of the refraction of a blue ray compared with the red ray. This proved challenging for many candidates.

Question 7

(a) Many weaker candidates had difficulty in manipulating the formula or the data and calculated a speed for the light in water that was greater than that in air.

(b) (i) Most candidates succeeded in showing that the wavefronts in the plastic met the incident wavefronts at the boundary and were parallel with each other. Only stronger candidates showed these wavefronts making a smaller angle with the boundary than the incident ones.

(ii) Many candidates did not indicate the arrow showing the direction of travel of the refracted wave with sufficient accuracy.

(iii) This question proved challenging for most candidates.

Question 8

(a) A majority of candidates wrote down P = IV and used it successively to calculate the current.

(b) (i) A large number of candidates used the result of the calculation in **(a)**, using Q = It and E = VIt in their calculations. This approach was regarded as invalid for the electrical energy used by the car as a whole. Apart from these candidates, those who used E = QV were usually successful.

(ii) Many candidates carried out the required division of 3.2×10^6 by 3.6×10^4 successfully. A small number of candidates inverted the data for the division or multiplied them.

Question 9

(a) Most candidates had difficulty in **(i)** and **(ii)** in interpreting the shapes of the graphs to determine the effect on the resistances of the resistor and the lamp.

(b) Partial credit for stating the formula could usually be awarded. A fairly common mistake was to read the current in the resistor rather than the current in the lamp.

(c) Most candidates attempted to calculate the combined resistance of the two components when connected to a 6.0 V supply. Some candidates succeeded but very few could manage this calculation and failed to gain credit. The simpler approach of adding the two currents at a p.d. of 6.0 V was not seen very often but was usually successful.

(d) More candidates were successful in this question. Again the simpler and more successful approach of adding the two p.d.s at a current of 4.0 A was not often seen.

Question 10

(a) The most common correct factor chosen was the strength of the magnetic field. Few candidates included the speed of the wire AB and even fewer, the length of AB.

(b) (i) The formula required was well known and many successful calculations of the number of turns in the secondary coil were seen.

(ii) Very few candidates drew a circuit with both a diode and a resistor. If they did, the symbol for the diode was sometimes wrong.

Question 11

(a) (i) A large majority of candidates satisfactorily conveyed the idea of storage in a box with lead walls.

(ii) Responses such as "using tongs" or "wearing lead gloves or lead suits" were credited. Candidates who simply stated "wearing gloves or protective clothing", or who gave simple answers such as "with care" could not be credited however.

(b) Only the strongest candidates gained full credit for this question.

Most candidates successfully identified the types of emission in the first column. In the second column, there was less success in writing down a few centimetres or up to 10 cm for α-particles and a few metres or up to 10 m for β-particles.

In the right-hand column, most candidates identified lead for γ-rays and aluminium for β-particles, but many failed to include an acceptable thickness for one or both of these absorbers.

(c) Most candidates correctly wrote down alpha in **(i)** and beta in **(ii)** and gained full credit.

PHYSICS

Paper 0625/52
Practical

Key messages

- Candidates need to have a thorough grounding in practical work during the course, including reflection and discussion on the precautions taken to improve reliability and control of variables.
- Candidates should read questions carefully to ensure that answers relate to what is being asked.
- Numerical answers should be expressed clearly, to the appropriate number of significant figures and with a correct unit, where applicable.
- Candidates should be ready to apply their practical knowledge to unfamiliar situations.

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.

Candidates who had regular experience of practical work were well prepared to answer questions on experimental techniques. This was seen in the clear practical details given by some candidates in **Question 1(d)**.

There were questions where candidates needed to devise approaches to investigations which may or may not be familiar to them. Stronger answers were produced by candidates who read the question carefully and who showed logical application of good experimental practice. A number of candidates showed sound practical knowledge when answering **Question 3(f)** and **Question 4**.

Comments on specific questions

Question 1

The practical and graphical aspects of this question were well done by quite a number of candidates. However, the additional questions proved difficult for many.

(a) Most candidates carried out the practical satisfactorily and obtained answers of the expected order, calculating the *b* values correctly.

(b) There were many well-drawn, accurate graphs with clearly labelled axes.

Plotting was mostly correct. Many candidates indicated the plots with fine crosses as advised in previous reports to Centres. Small dots were acceptable but were often obscured when the line was drawn through them, making it difficult to distinguish correctly plotted values. 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.

Some candidates plotted points on the grid lines when they should have been between them. Where these were within half a square of the correct value, they were given credit.

Scales were usually sensible, especially if candidates took the advice in the question not to start the axes at the origin. Only a few candidates used impractical scales which often meant that full credit could not be awarded when determining more difficult positions for plotted points.

Many candidates produced a fine, straight, well-judged line of best fit and only a very few joined points together.

A very small number of candidates incorrectly equally spaced the given *b* values on the horizontal axis, producing an inconsistent scale.

(c) (i) Many candidates drew a clear, good sized triangle to determine the gradient from but some omitted to indicate their method on the graph.

(ii) The M_R value was often within the expected range and many candidates included a unit of g and gave their answer to two or three significant figures.

(d) Many candidates answered the question on the accurate premise that the correct mark on the rule would not be visible. However, having stated that the centre line of the block should be marked, most did not suggest marking the side of the rule appropriately. The best answers referred to measuring the width of the block and placing its edge at half this distance from the correct mark.

Some candidates also explained how the mark on the rule could be seen through the gap in a slotted mass.

It is possible that many candidates had not placed the block accurately but merely estimated the correct position.

(e) Very few candidates were able to relate the larger values to the smaller effect of uncertainties in the readings. Credit was given to answers demonstrating an understanding of the concept of percentage uncertainty and how this might influence the accuracy of a result.

Question 2

Many candidates were able to answer this question well but the practical aspects proved difficult for a few.

(a) (i)-(ii) Most candidates obtained a suitable value for the current and gave the correct unit. Many candidates measured the potential differences correctly and recorded them with appropriate units. However, some clearly reversed the readings for the lamps, incorrectly recording the larger potential difference for lamp **X**.

(iii) As expected, the potential difference across the two lamps in series was often close to the sum of the individual values and, for many candidates, they were identical.

(iv) A large number of candidates correctly agreed with the statement but some lost credit with vague answers such as "they partly agree". The justification was not so well answered, with some candidates simply stating that the values were within experimental accuracy, but with no values quoted. Weaker answers stated that the two values were not equal, so therefore the statement was incorrect.

(b) The vast majority of candidates calculated the resistance value correctly and gave the correct unit. Fewer expressed the answer to the expected two or three significant figures and this was particularly the case when the result of the calculation was a single figure value.

(c) Most candidates drew two components recognisable as lamps in parallel and gained credit for this. Many went on to show a correct circuit but an equal number of candidates gave incorrect symbols or connections. A common error was to show the lamps as two circles with an X in one and a Y in the other.

(d) (i)- (ii) Most candidates recorded values from the rearranged circuit and calculated the new resistance of the lamp. Many obtained a value for R_2 which was, as expected, higher than R_1.

Some candidates, who had drawn incorrect circuits in **(c)**, were still able to obtain valid results here, presumably by altering their circuits while reconnecting.

Question 3

This was a question that many candidates were able to answer successfully in part. The majority of candidates read and followed the instructions carefully.

(a) The vast majority of candidates were able to record decreasing temperature values

(b) (i) Most candidates obtained values which were decreasing more quickly than for the larger volume of water. Where this was not the case, it was often because the starting temperature was significantly lower than for the previous set of readings, causing a lower rate of cooling. Candidates should be able to use water from sources of similar temperature throughout the practical examination.

(ii) The time column was almost always correct and the units were often appropriate for the headings. However some candidates omitted the units.

(c) Most candidates gained credit for recognising that a larger volume of water had a lower rate of cooling. Some expressed this in terms of heat or temperature rather than cooling rate and needed to realise that using the terminology from the question would have made answers clearer.

Where a lower cooling rate for the smaller volume of water had been incorrectly obtained, credit was given for this interpretation of the readings.

Fewer candidates gained full credit for a justification using their recorded data. The most straightforward explanations compared the temperature changes for the two beakers over the whole time interval of 180 s. Answers relating to a smaller section of the table were generally not rigorous enough.

(d) Many candidates were able to derive the appropriate unit of °C / s and carry out the calculations correctly. The unit was sometimes omitted or the values incorrectly rounded.

(e) Few candidates recognised that the values for cooling rate calculated in **(d)** gave a clue as to why starting temperatures should be equal. However, some realised that x_2 had a lower value than x_1 and was calculated from a lower starting temperature.

Some candidates obtained identical values for the cooling rates and gained credit for explaining how these results did not support the statement.

(f) The most straightforward answers to this question described cooling experiments with two beakers, one with insulation and no lid and the other with a lid and no insulation. A simple diagram was sufficient to gain credit. Where an experiment involving a beaker with insulation or lid and a plain beaker was suggested, there was generally no explanation of how loss of thermal energy from the sides and top could be compared.

Question 4

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 missed straightforward points as their planning was not approached in a sequential way.

Most candidates were able to identify a factor to investigate and a variable to control. Although most candidates recognised the latter as a variable to keep constant, others gave a range of variables to control, some of which would actually change. Size of ball was often chosen as a factor to investigate and was accepted. However, a more specific definition of “size”, such as diameter or mass was needed for further credit.

A metre rule was generally listed as a piece of additional apparatus and many candidates suggested that Vernier callipers should be used to measure the diameter of the ball or the diameter of the crater. A balance was often omitted when mass was the factor under investigation.

Credit for the actual method required three aspects to be mentioned – measurement of the factor, dropping and removal of the ball and measurement of a named aspect of the crater, such as diameter or depth. Many candidates neglected to mention measurement of the factor or simply referring to “size” of the crater or ball.

Many candidates suggested repeating their experiment with other values of the factor.

A number of candidates gave an additional point, suggesting a means of ensuring a reliable experiment or a suitable range of values to be used.

Some of the most common responses were “repeat the experiment and average”, “remove the ball carefully” and “level the sand each time”. Some candidates suggested taking five sets of data, or measuring the diameter of the ball or crater in several places and taking the mean.

Only a very few candidates described a way to measure the depth of the crater accurately.

Some of the ranges of values given were impractical, such as the use of masses of 50 kg or drop heights of 10 m.

Many candidates suggested the use of a line graph although some did not specify axes. Others did not gain credit as they used the word “size” instead of diameter or depth. Some weaker candidates used a bar chart which was not appropriate for a continuous variable such as diameter or mass.

PHYSICS

Paper 0625/62
Alternative to Practical

Key messages

- Candidates need to have a thorough grounding in practical work during the course, including reflection and discussion on the precautions taken to improve reliability and control of variables.
- Candidates should read questions carefully to ensure that answers relate to what is being asked.
- Numerical answers should be expressed clearly, to the appropriate number of significant figures and with a correct unit, where applicable.
- Candidates should be able to apply their practical knowledge to unfamiliar situations.

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
- 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.

Candidates who had regular experience of practical work were well prepared to answer questions on experimental techniques. This was seen in the clear practical details given by some candidates in **Questions 1(a)** and **(b)** and **Question 2(b)**.

There were questions where candidates needed to devise approaches to investigations which may or may not be familiar to them. Stronger answers were produced by candidates who read the question carefully and who showed logical application of good experimental practice. A number of candidates showed sound practical knowledge when answering **Question 2(f)** and **Question 4**.

Comments on specific questions

Question 1

Parts of this question were well done by quite a number of candidates. However, comments on practical details and analysis of results proved difficult for many.

(a) Many candidates answered the question on the correct premise that the 95 cm mark on the rule would not be visible. However, having described that the centre line of the block should be marked, most did not suggest marking the side of the rule appropriately. The strongest answers referred to measuring the width of the block and placing its edge at half this distance from the 95 cm mark.

(b) This question required candidates to recognise that achieving balance is difficult in the practical situation. Good answers referred to moving the rule slowly backwards and forwards on the pivot and finding the point between just tipping one way and then the other. Theoretical answers regarding calculation of moments did not gain credit.

(c) (i) There were many well-drawn, accurate graphs with clearly labelled axes. Plotting was mostly correct. Many candidates indicated the plots with fine crosses as advised in previous reports to Centres. Small dots were acceptable but were often obscured when the line was drawn through them, making it difficult to distinguish correctly plotted values. 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.

Some candidates plotted points on the grid lines when they should have been between them. Where these were within half a square of the correct value, they were given credit.

Scales were usually sensible, especially if candidates took the advice in the question not to start the axes at the origin. Only a few candidates used impractical scales which often meant that full credit could not be awarded when determining more difficult positions for plotted points.

Many candidates produced a fine, straight, well-judged line of best fit and only a very few joined points together. There was a tendency by some candidates to join the first and last points with a straight line, wrongly ignoring the other points which lay only to one side of the line.

A very small number of candidates incorrectly equally spaced the given *b* values on the horizontal axis, producing an inconsistent scale.

(ii) Many candidates drew a clear, good sized triangle with which to determine the gradient but some omitted to indicate their method on the graph.

(iii) The M_R value was often within the expected range and many included a unit of g and gave their answer to two or three significant figures.

(d) Very few candidates were able to relate the larger values to the smaller effect of uncertainties in the readings. Credit was given to answers demonstrating an understanding of the concept of per cent uncertainty and how this might influence the accuracy of a result.

Question 2

Most candidates gained at least partial credit for this question but quite a number found the analysis challenging.

(a) (i) Most candidates gained credit for the temperature readings with only a small number of incorrect answers, such as 80.7 rather than 87°C. A few candidates left the answer blank.

(ii) The time column was almost always correct and the units were often appropriate for the headings. Where credit was not gained, it was generally for omitting the answers.

(b) Many candidates were able to give a practical precaution. The most common responses given were reading the scale perpendicularly or waiting for the indicated temperature to finish rising at the start. There were, however, a large number of precautions which did not refer to temperature readings but to other aspects of the experiment, implying that the question had not been read carefully.

(c) Most candidates gained credit for recognising that a larger volume of water had a lower rate of cooling. Some expressed this in terms of heat or temperature rather than cooling rate and needed to realise that using the terminology from the question would have made answers clearer.

Fewer candidates gained full credit for a justification using the data from the table. The most straightforward explanations compared the temperature changes for the two beakers over the whole time interval of 180 s. Answers relating to a smaller section of the table were generally not rigorous enough.

(d) (i)-(ii) Many candidates were able to derive the appropriate unit of °C / s and carry out the calculations correctly. The unit was sometimes omitted or the value for x_2 rounded incorrectly to 0.066.

(e) Few candidates recognised that the values for cooling rate calculated in **(d)** gave a clue as to why starting temperatures should be equal. However, some realised that x_2 had a lower value than x_1 and was calculated from a lower starting temperature.

(f) The most straightforward answers to this question described cooling experiments with two beakers, one with insulation and no lid and the other with a lid and no insulation. A simple diagram was sufficient to gain credit. Where an experiment involving a beaker with insulation or lid and a plain beaker was suggested, there was generally no explanation of how loss of thermal energy from the sides and top could be compared.

Question 3

Many candidates were able to answer this question successfully.

(a) Most candidates drew the correct voltmeter symbol in parallel with lamp **X**. A few candidates incorrectly drew a line through the voltmeter or showed it connected in series.

(b) This was generally answered well. Only a small number of candidates gave 0.32 or 3.4.

(c) (i)(ii) The readings were usually accurate and very few candidates omitted or gave incorrect units.

(iii) Many candidates correctly agreed with the statement but some lost credit with vague answers such as "they partly agree". The justification was not so well answered, with a number of candidates simply stating that the values were within experimental accuracy, but with no values quoted.

Weaker answers stated that 3.0 and 3.1 were not equal, so therefore the statement was incorrect.

(d) The vast majority of candidates calculated the resistance value correctly.

(e) (i) Most candidates drew two components recognisable as lamps in parallel and gained credit for this. Many went on to show a correct circuit but an equal number of candidates gave incorrect symbols or connections. A common error was to show the lamps as two circles with an X in one and a Y in the other.

(ii) Many candidates recognised that an increase in temperature would increase the resistance of the lamp but fewer were able to give the evidence of a brighter bulb having a greater temperature to gain full credit.

Question 4

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 missed straightforward points as their planning was not approached in a sequential way.

Most candidates were able to identify a factor to investigate and a variable to control. Although most candidates recognised the latter as a variable to keep constant, others gave a range of variables to control, some of which would actually change. Size of ball was often chosen as a factor to investigate and this was accepted. However, a more specific definition of "size", such as diameter or mass was needed for further credit.

A metre rule was generally listed as a piece of additional apparatus and many candidates suggested that Vernier callipers should be used to measure the diameter of the ball or the diameter of the crater. A balance was often omitted when mass was the factor under investigation.

Credit for the actual method required three aspects to be mentioned – measurement of the factor, dropping and removal of the ball and measurement of a named aspect of the crater, such as diameter or depth. Many candidates neglected to mention measurement of the factor or simply referring to "size" of the crater or ball.

Many candidates suggested repeating their experiment with other values of the factor.

A number of candidates gave an additional point, suggesting a means of ensuring a reliable experiment or a suitable range of values to be used.

Some of the most common responses were “repeat the experiment and average”, “remove the ball carefully” and “level the sand each time”. Some candidates suggested taking five sets of data, or measuring the diameter of the ball or crater in several places and taking the mean.

Only a very few candidates described a way to measure the depth of the crater accurately.

Some of the ranges of values given were impractical, such as the use of masses of 50 kg or drop heights of 10 m.

Many candidates suggested the use of a line graph although some did not specify axes. Others did not gain credit as they used the word “size” instead of diameter or depth. Some weaker candidates used a bar chart which was not appropriate for a continuous variable such as diameter or mass.