PHYSICS

Paper 0625/12
Multiple Choice (Core)

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

Key messages

Candidates should be reminded to read the questions carefully and, in particular, to pay strict attention to any units used.

General comments

Candidates answered **Questions 6**, **20**, **23**, **29** and **36** well. Many found **Questions 1**, **9**, **12**, **15**, **19**, **26**, **27** and **28** more challenging.

Comments on specific questions

Question 1

The majority of candidates did not recognise that the figures given were in centimetres and that the correct answer was in millimetres.

Question 2

Only better performing candidates understood that in the absence of air resistance, objects fall with a constant acceleration.

Question 3

The question was answered quite well; a significant number of candidates divided rather than multiplied the speed of the train by the time it took to pass.

Question 4

Candidates answered this well.

Question 5

This was often answered well; there was a tendency for candidates to think, when finding the weight of an object from its mass and vice versa, that they must multiply the two together. Where candidates had written out the formula, this was less common.

Question 6

Candidates answered this well.

Question 7

The question was answered well; there were some candidates who added the two forces together, not realising that when the forces are in opposite directions they will then subtract.

Question 8

A minority of candidates gave the correct response, possibly indicating that it is an experiment that they had not carried out themselves.

Question 9

Candidates needed to recognise that the work done against gravity is dependent on the vertical height that the object is moved not the total distance.

Question 10

There was a misconception among many candidates that the faster an object travels, the greater power it has. Candidates needed to distinguish between the general use of terms like power, in everyday language, and the precise meaning as used in science.

Question 11

Many candidates thought that the atmosphere only supports a shorter column of mercury when the barometer tube is wider.

Question 12

Many candidates found this question challenging. All the objects have the same mass but candidates did not realise that the maximum pressure will be exerted by the object with the smallest contact area with the surface.

Question 13

Better performing candidates recognised that it is the striking of the molecules against the tyre wall that exerts the pressure.

Question 14

Candidates answered this well.

Question 15

Many candidates did not understand the term *fixed points*.

Question 16

Better performing candidates answered correctly and showed their understanding of the term in the question.

Question 17

This question was answered well with candidates showing their understanding of the solidification and condensation in microscopic terms.

Question 18

A considerable number of candidates incorrectly believed that convection currents occur in a vacuum.

Question 19

It was clear that many candidates, even if they had seen this simple experiment, did not understand the reason why the ice does not melt, even when the water at the top of the test-tube is boiling.

Question 20

This was answered well by most candidates.

Question 21

Many candidates knew that light slows down on moving from air to glass; fewer realised that the refracted ray moves towards the normal.

Question 22

Candidates answered this well.

Question 23

Candidates showed a good understanding of the meaning of the principal focus of a lens and answered this well.

Question 24

A number of candidates thought that a campfire emits microwaves.

Question 25

The question was not answered particularly well, with candidates clearly not understanding that sound waves are longitudinal.

Question 26

Candidates found this question challenging as they did not recognise the idea that sound is produced by vibrating sources and that ultrasound is very high frequency (greater than 20 kHz).

Question 27

Candidates found this challenging.

Question 28

Many candidates recognised that a steel bar can be magnetised by connecting it to a d.c. power supply inserting; very few realised that hammering a steel bar when it is lying in the direction of a magnetic field will also cause it to become magnetised, even fairly weakly.

Question 29

This was answered correctly by almost all candidates.

Question 30

There were some good responses to this question; many candidates thought that increasing the diameter of the conductor increased its resistance.

Question 31

Relatively few candidates knew that in any device the energy eventually becomes low grade internal energy in the surroundings.

Question 32

Only the strongest candidates answered this correctly.

Question 33

Candidates found this question challenging.

Question 34

This question was answered well by better performing candidates.

Question 35

Candidates answered this well.

Question 36

This question was answered well.

Question 37

Candidates answered this well.

Question 38

It was evident that many candidates did not read the question carefully enough and tried to find the number of neutrons in the nuclide rather than the number of nucleons.

Question 39

Candidates found the concept of half-life difficult and this was shown with many thinking that the half-life of the isotope was two hours.

Question 40

This was generally answered well, showing an understanding of the penetration of the different types of radiation.

PHYSICS

Paper 0625/22
Multiple Choice (Extended)

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

General comments

Candidates answered **Questions 3**, **11**, **20**, **21**, **22**, **27**, **35** and **39** well. They found **Questions 8**, **12**, **15**, **24** and **25** more challenging.

Comments on specific questions

Question 1

The majority of candidates had little difficulty with this question. Some candidates did not pay enough attention to units.

Question 2

This was problematic for some candidates with the most common error being to think that the heavier the ball, the faster it would fall.

Question 3

The vast majority of candidates answered this question correctly.

Question 4

Candidates answered this well.

Question 5

Candidates answered this well.

Question 6

There were some candidates who thought that the air resistance is zero when a skydiver is travelling at constant speed. They confused this with zero resultant force.

Question 7

There was some confusion here with candidates not showing an understanding that when an object moves in a circle at constant speed there is a resultant force towards the centre of the circle.

Question 8

Only the better performing candidates answered this correctly and recognised that force = rate of change of momentum.

Question 9

Candidates needed to recognise that the work done against gravity is dependent on the vertical height that the object is moved, not the total distance.

Question 10

The most common error was to use the energy going to heat up the room, rather than the energy used to light the room.

Question 11

This was answered correctly by almost all candidates.

Question 12

Many candidates thought that the atmosphere only supports a shorter column of mercury when the barometer tube is wider.

Question 13

Candidates answered this well.

Question 14

A significant number of candidates thought that energy is absorbed when the mercury solidifies.

Question 15

The majority of candidates thought that neither change would increase the sensitivity of the thermometer. This could be because they did not understand the term 'sensitivity' or because they did not appreciate the physics of the situation.

Question 16

The question demonstrated the need for candidates to recognise the correct units. Thermal capacity is defined as the energy needed to cause unit rise the temperature of a body, hence the unit must be J / °C.

Question 17

The question was answered well; a number of candidates thought that electrons carried the current in all liquids.

Question 18

A number of candidates thought that a shiny surface emitted radiation at a greater rate than a dull surface.

Question 19

Candidates found this calculation challenging.

Question 20

The vast majority of candidates answered this correctly.

Question 21

This was answered correctly by most candidates.

Question 22

This was a well answered question, with candidates showing a good understanding of the meaning of the principal focus of a lens.

Question 23

The question was often answered correctly; a significant minority of candidates thought that sound travels by longitudinal waves.

Question 24

Candidates found this question challenging as they did not recognise the idea that sound is produced by vibrating sources and that ultrasound is very high frequency (greater than 20 kHz).

Question 25

Candidates found this challenging.

Question 26

A large number of candidates thought that the magnet should be pointing north-south to demagnetise the bar magnet. This would tend to align the domains in the north-south direction, whereas if placed in an east-west direction the domains are not aligned in this way.

Question 27

This was answered well by almost all candidates.

Question 28

Candidates answered this well.

Question 29

Candidates answered this well.

Question 30

A number of candidates did not know the direction of the current in a diode from the circuit diagram symbol.

Question 31

Candidates needed to work through the effects of increasing the brightness of light falling on a LDR and then the effect of this on the reading on the voltmeter across another resistor. Some candidates found this challenging but was answered well by a considerable number of candidates.

Question 32

Candidates found this a challenging question.

Question 33

Most candidates recognised the gate as being a NOR-gate.

Question 34

Candidates answered this well.

Question 35

Candidates answered this well.

Question 36

A number of candidates thought that the force would be either into or out of the page.

Question 37

This was answered well by the vast majority of candidates. Of those who did not answer correctly, the most common error was to give the half-life of the isotope as two hours.

Question 38

Although the majority had little difficulty with this question, it was evident that some candidates did not read the question carefully enough and tried to find the number of neutrons in the nuclide rather than the number of nucleons.

Question 39

This was answered correctly by almost all candidates.

Question 40

Candidates found this question challenging, with only better performing candidates able to deal with taking more than one decay.

PHYSICS

Paper 0625/32
Core Theory

Key messages

- Candidates should be reminded to read questions carefully noting the question requirements, the marks allocated and the space available for responses. In a significant number of cases, candidates did not answer the question asked. In some of these cases, the response indicated knowledge and understanding of physics but credit could not be given as the response did not address the question as it had been asked.

- Candidates should also be advised that long and detailed responses to short response questions often do not gain full credit as candidates include information that is incorrect or a response that contradicts itself. For questions that have one line and one mark allocated, a concise response, that may only be one key word, is acceptable.

- When completing questions requiring calculations, candidates should routinely set out and explain the stages in their working clearly. Partial credit may be available for clear working even if the final answer is incorrect.

General comments

Many candidates had been prepared well for the examination. Many of the better performing candidates demonstrated that they were able to apply their knowledge and understanding of physics to a variety of contexts. Teachers should seek to provide further opportunities for candidates of all abilities to apply what has been learnt in a range of situations so as to promote confidence and develop better understanding of the applications of physics. Candidates also need to have covered all sections of the Core syllabus and be encouraged to attempt all questions.

There were a significant number of higher scoring candidates who may have benefitted from being prepared and entered for the Extended Theory paper. Candidates were, in many cases, able to demonstrate their knowledge and understanding of key concepts. Some areas of the syllabus topics were better understood than others; density and pressure calculations were very well answered as were questions on changes of state, sound and waves. Sections of the syllabus that were less well known included questions on expansion, moments and factors affecting the size of the e.m.f. across a conductor.

In many cases candidates used and applied standard equations correctly and a majority of candidates were also able to rearrange equations to calculate an unknown quantity, for example, time in **Question 8(b)(ii)**.

There was very little evidence of candidates being unable to access questions as a result of poor language skills and the vast majority of candidates were able to express their ideas appropriately. There was no indication of candidates having insufficient time to complete the examination paper. In a small number of cases candidates left parts of a question unanswered suggesting that candidates' knowledge and understanding was less than secure, for example, **Questions 11(b)(ii)** and **11(c)** on induced e.m.f.

Comments on specific questions

Question 1

(a) (i) There were many correct responses. **C** was the most common incorrect response.

(ii) Many candidates answered this correctly with **B** being the most common incorrect response.

(iii) There were many partially correct responses of 128 m. Candidates often forgot to halve the area under the graph.

(b) This question was usually answered correctly.

(c) Many candidates gave answers in terms of calculations or vague responses in terms of the slope of the line, which could not be credited.

Question 2

(a) This was answered well by the better prepared candidates.

(b) A high proportion of candidates gained full credit for this question. Where errors were made, this was usually in giving an incorrect unit.

Question 3

(a) The most common response was to repeat the stem of the question, stating that this is the point of balance or equilibrium. There were also other vague responses in terms of the mass being concentrated at this point.

(b) (i) This question was answered well by only the better prepared candidates. Very few candidates gained partial credit as responses were often just a value with no indication of the physics used to obtain the answer.

(ii) There were many candidates who did not gain credit for this question. The expression $F = m \times g$ was often stated but an incorrect answer of 250 N was given.

Question 4

(a) Better performing candidates gave the correct response for this question. Many incorrect responses gave terms associated with thermal energy.

(b) There were many correct responses; copper, iron and graphite were common incorrect responses.

(c) Many candidates gained at least partial credit for their responses to this question.

(d) Many candidates recognised that the contents were dangerous or the need to prevent leaks. Very few candidates gained full credit. A common misconception was that the concrete prevented loss of heat.

(e) There were a number of vague responses in terms of harmful or pollution.

(f) There were many correct responses; vague responses such as ‘light’ or ‘water’ did not gain credit.

Question 5

(a) Most candidates answered this very well.

(b) There were many correct responses from better prepared candidates.

Question 6

(a) Most candidates answered this correctly.

(b) Many candidates gave vague responses about collisions and vibrating atoms that could not be credited. A common error was answers referring to increasing pressure, despite the question stating constant pressure.

(c) Very few candidates correctly ticked all three boxes.

(d) This question was not answered well. Very few candidates showed an understanding of the uses and disadvantages of expansion. A common misconception was that materials that expand do not return to their original size or shape.

Question 7

(a) There were many correct responses for this question.

(b) This question was not answered well by most candidates and many candidates did not answer the question as it had been asked. There were a high number of responses in terms of longitudinal – sound and transverse – light. Common errors included answers in terms of different amplitude, frequency and speed.

Question 8

(a) This was well answered by almost all candidates.

(b) (i) A high proportion of candidates gained at least partial credit for their response to this question.

(ii) A common error was forgetting to convert kilometres to metres.

Question 9

This question was generally not answered well and there were very few candidates who gained full credit. Common errors included responses in terms of the heater expanding, causing atoms to expand and then water evaporating resulting in water of a lower density.

Question 10

(a) Candidates found this question challenging. A very common incorrect response was 20°.

(b) Better performing candidates were able to gain credit for both parts of this question.

(c) The majority of candidates gave a correct response.

Question 11

(a) This question was usually answered correctly.

(b) (i) This was only answered correctly by the very strongest candidates. A variety of units was seen including N, J and Amps.

(ii) Candidates found this question challenging.

(c) Many candidates gained partial credit for a response in terms of the strength of the magnet. Relative speed of movement was rarely seen.

Question 12

(a) There were many correct responses to this question. A common error was to answer in terms of radioactive emissions, for example, alpha, beta and gamma.

(b) There were many partially correct responses; very few candidates included the term ‘nucleus’ in their answer.

PHYSICS

Paper 0625/42
Extended Theory

Key messages

- Candidates should be reminded to read the introduction to questions with great care. There were several instances in this paper where more careful reading of the question could have had a significant influence on the answer that was subsequently written.
- In calculations that depend on the use of a formula, it is always advisable to begin by stating the correct formula in any form, e.g. $I = V/R$ or $V = IR$ or $R = V/I$. This allows partial credit to be awarded, even if the stated formula is then wrongly transposed or the wrong numbers are substituted.

General comments

Over the whole range of ability, with the exception of the question involving moments of forces, considerable success was achieved with numerical work. Candidates who could recall the correct formulae were in general able to gain credit in this type of question. Wrong or missing units from numerical answers were fairly rare.

Generally better performing candidates were able to write acceptable answers in appropriate scientific language. Candidates who performed less well tended to write lengthy answers, sometimes missing the required point or contradicting a correct point already made.

A very large majority of candidates were able to complete the paper in the time allowed.

Comments on specific questions

Question 1

(a) Most candidates drew graph A correctly. Graph B was frequently drawn as a straight line of steeper gradient than graph A, rather than the required curve. Some of the curves that were drawn became horizontal at higher time values and credit could not be awarded.

(b) Many candidates were familiar with the concept of speed-time graphs and frequently graphs S and T were both drawn correctly.

(c) For most candidates this calculation involved two distinct stages. The first was to determine the acceleration using $F = ma$ and then the final speed using $a = (v - u) / t$ or $v = at$. Candidates were more successful with the first stage than the second.

Question 2

(a) Most candidates could state that momentum has direction. Answers which stated that momentum = mass × velocity and velocity has direction or is a vector were also acceptable.

(b) (i) The correct numerical value of the change of momentum was calculated by a majority of candidates. There were occasional errors in the unit, sometimes shown as Nm, suggesting confusion between momentum and moment of a force.

(ii) Many candidates stated force = change of momentum / time or $m(v - u) / t$ and worked out the average force correctly.

(c) (i) Success in this 'show that' question depended on equating the given absorbed energy to ½mv^2. A large proportion of candidates answered this well.

(ii) Correct answers gave the suggestion that the car, not the wall, would be damaged.

Question 3

(a) Very few candidates could recall the condition, which must be true if an object does not accelerate or rotate. This comes from Section 1.5.3 of the Core syllabus concerned with the conditions for the equilibrium of a system.

(b) (i) Candidates were reasonably successful in calculating the moment of the weight of the boat about point P.

(ii) The correct use of the moment calculated in **(i)** gained credit. Only a small number of candidates were able to equate this moment to the moment of T_1 about point P.

(iii) The straightforward approach required application of the idea that total upward force = total downward force. Only a small number equated moments successfully.

Question 4

(a) Many candidates correctly explained that bulb A sinks because it is more dense than the water. Some of these did not explain why the other bulbs are floating. Answers suggesting that bulb A sinks because it is more dense than the other bulbs were not credited.

(b) (i) The delay in the rise in temperature of the water could have been explained in terms of the low thermal conductivity of glass or the high specific heat capacity of water. Correct responses were rare. Answers such as 'it takes time for heat to be conducted through the glass', or similar, were not accepted.

(ii) The fact that the function of the thermometer depends on the change in density of water with temperature was not understood by many candidates. Instead, they assumed that it depended on a change in density of the bulbs, in spite of the fact that the question stated that the bulbs do not expand.

(c) Only better performing candidates could identify the range of temperature as 24°C to 26°C.

Question 5

(a) Most candidates could state in **(i)**, two ways in which evaporation differs from boiling. In **(ii)** the majority gave an acceptable example of a change of state.

(b) (i) Many candidates could state the change of state taking place at point B. The cooling of liquid at A and the cooling of solid at C were much less frequently identified.

(ii) If the correct formula could be recalled, the energy removed was usually calculated correctly. There was a considerable proportion of candidates who did not answer this question.

Question 6

(a) Better performing candidates stated visible light and infra-red (not simply heat) as the types of radiation emitted.

(b) Most candidates correctly stated that the liquid level in the left-hand tube falls and the level in the right-hand tube rises, with better performing candidates able to go on to give an explanation.

Most candidates described the better absorbing property of the matt black bulb compared with the shiny bulb. Better performing candidates explained that the temperature of the air in the left-hand tube rises more than the temperature of the air in the left-hand tube and that the pressure of the air in the left-hand tube rises more than the pressure of the air in the left-hand tube.

Question 7

(a) The correct boxes describing the image were ticked by a large majority of candidates.

(b) Most candidates drew the correct ray to locate a principal focus; some did not label the principal focus as F, or located it at the centre of the lens.

(c) The focal length was measured with acceptable accuracy by most candidates.

(d) Many candidates did not recognise that a converging lens has two principal foci. This resulted in them incorrectly drawing another ray through the principal focus on the opposite side of the lens to the one they had marked. Only a small minority of candidates drew an acceptable ray.

Question 8

(a) In **(i)**, the correct material and the reason for using it were usually identified. In **(ii)**, most candidates correctly wrote down iron, or soft iron; many were unclear as to the reason for its use, often suggesting that it is magnetic, rather than that it is easily magnetised and demagnetised or can act as a temporary magnet.

(b) (i) The difference between transformers X and Y was known by a large majority of candidates.

(ii) Many candidates were unclear as to why a very high voltage is used, with some suggesting that it reduces resistance. A significant proportion could suggest that a lower current in the cables results in a smaller loss of energy or power in the form of heat. Better performing candidates were also able to state how the lower current allowed thinner cables to be used.

(iii) Better performing candidates stated that using 240 V is a safety issue, i.e. is safer for consumers to use rather than a much higher voltage.

Question 9

(a) Many candidates, in deciding what happens to the resistances, clearly looked at the shape of the graph rather than considering the values of p.d. / current. Common answers for **(i)** were increases rather than constant and for **(ii)**, decreases rather than increases.

(b) Using correct formulae and correct data from the graph allowed many candidates to be awarded full credit in both **(i)** and **(ii)**. Mistakes were usually in reading data from the graph.

(c) (i) The idea that in a parallel circuit, the e.m.f. of a supply is the same as the p.d. across each parallel circuit component, was not well known. Wrong answers of 40 V were often seen.

(ii) The idea that the current from the supply in a parallel circuit is the sum of the currents in each parallel component was more firmly understood. Correct answers of 3.6 A were common.

Question 10

(a) Most candidates are aware that electrons are the relevant particles and know that they flow from the negative terminal to the positive one.

(b) (i) This was almost always answered correctly.

(ii) There was some difficulty for a minority of candidates in recalling the formula $E = IVt$. Few correct answers were seen.

(iii) With the help of the figure and/or their observance of thunderstorms, many candidates were able to identify light energy and sound energy as being produced in the air above the ground.

Question 11

(a) A majority of candidates successfully conveyed the idea that alpha and beta particles were present, with most offering satisfactory evidence. There was less success for candidates in dealing with gamma rays, for which the significance of the background radiation was frequently not recognised.

(b) Full credit was frequently awarded for, in order, 90, 40 and 0 count/s.

PHYSICS

Paper 0625/52
Practical Test

Key messages

- Candidates need to have a thorough grounding in practical work during the course, including reflection on the significance of precautions taken to improve reliability and control of variables.

- Candidates should be aware that as this paper tests an understanding of practical work, explanations and justifications need to be based on data from the question or the implications of observations rather than theoretical considerations.

- The questions should be read carefully so that answers address those specific points referred to in the question rather than more general aspects of the same topic.

- 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 in planning and designing an experiment to investigate a given brief. It is important for candidates to have wide experience of practical work.

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 and justifying conclusions
- dealing with possible sources of error
- controlling variables
- making accurate measurements and observations.

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 clearly had a background of similar practical work. The quality of the results obtained was also a reflection on the candidates' experience of experimental work.

The practical nature of the examination should be borne in mind when explanations or justifications are asked for. This was seen in some of the excellent, straightforward responses to **Question 1(d)** and **Question 2(c)(ii)**, which required a reference to results rather than theory and in the clear practical details given by some candidates in **Questions 1(c)** and **(e)**, **Questions 2(a)(ii)** and **(d)** and **Question 3(f)**. Less strong responses sometimes indicated that candidates had not read the specific requirements of the questions carefully.

It is expected that numerical answers will include a relevant unit and will be expressed to a number of significant figures that is appropriate to the data given in the question. These points were demonstrated in many of the responses to **Questions 2(b)** and **(c)(i)**. Candidates should be reminded that use of a recurring symbol does not indicate the intended number of significant figures.

In questions in which candidates are asked to outline a plan for an investigation, they should be reminded of the need for careful reading of the brief and the logical application of good experimental practice. A number of candidates showed good practical knowledge when answering **Question 4** but it was clear that may candidates had not been prepared for this or had limited experience of basic experiments.

Comments on specific questions

Question 1

This was answered well by many candidates; providing explanations sometimes proved challenging.

(a) (i) A sensible value for the temperature of the cold water was seen in almost all answers.

(ii) Decreasing temperatures were generally given; a small number of candidates recorded the cold water temperature at 0 s and so could not be credited as the temperature showed an increase in the following 30 s.

(b) (i) There was usually a clear differential between the warm water and cold water temperatures and a set of boiling tube temperatures decreasing less rapidly than in the beaker with cold water.

(ii) Responses were generally good; many candidates omitted the time unit. A small number of candidates attached a unit to all temperatures in the column and this should be avoided. There is significant risk of contradiction and a number of candidates incorrectly gave °C in the heading and ° in the column. The majority completed the time column correctly.

(c) Some good answers were seen here, often referring to perpendicular viewing of the reading or stirring the water before taking the temperature. A number of candidates misread the question and gave answers which referred to conditions of the experiment rather than reading the thermometer.

(d) Many answers correctly concluded that a higher surrounding temperature reduced the cooling rate of the water in the boiling tube, citing a greater temperature change over 180 s of the tube in the beaker with cold water as evidence. A number of candidates gave temperature changes over a shorter period of time or outlined theoretical reasons rather than using results to support their conclusion. If, through errors in the practical process, the water in the boiling tube in warm water cooled more rapidly, it was expected that this should be the conclusion. Results obtained in the experiment needed to be used for statements of conclusion. A few candidates in this situation adapted their statement to match what they expected through theoretical considerations and these answers could not be credited.

(e) Candidates found this the most challenging part of the question. Various improvements were seen, including ensuring that the initial temperatures or the volumes of water in the boiling tubes were the same. Some candidates explained that either of these factors affected the cooling rate of the water; many were unsure of the reason for controlling these variables. Insulation of the beaker to keep the temperature of the surrounding water more constant was seen from the better performing candidates. A common error was to suggest the provision of insulation or a lid for the boiling tube, removing the ability for the water to cool.

Question 2

Good responses to this question were seen from many candidates; some sections proved challenging for a significant number.

(a) (i) Most candidates had measured the length of the wires correctly; many recorded the values in centimetres rather than the required metres as indicated by the column heading. Potential differences recorded to at least one decimal place and currents recorded to at least two decimal places as expected were often seen.

(ii) Despite the word 'precisely' being highlighted in the question, few candidates were sufficiently careful here. The length to be measured was between the inside edges of the crocodile clips where they met the wire. Very few candidates took the simpler ways of indicating this by drawing arrows on the wire or employing vertical construction lines. The use of arrows some way from the wire led to inaccuracy for many candidates.

(b) Many candidates produced correct calculations; a significant number showed faulty rounding. A lot of candidates were either not consistent or expressed answers to four or more significant numbers.

(c) (i) There were many correct calculations; there were fewer with the three values within 10% of each other.

(ii) The statement was often correct, with a matching explanation of the results being within the limits of experimental accuracy. Where the values for resistance per unit length were not within 10% of each other, an opposite conclusion was expected with a justification that they were outside the limits of experimental accuracy. The reasons given were sometimes theoretical, assuming that the resistance wires were of the same type (although they had not been described as such) and therefore would have the same value of resistance per unit length. Explanations which did not refer to results gained no credit. A significant number of candidates stated that, as results were not exactly equal, the suggestion was not supported.

(d) A number of candidates responded correctly, often suggesting that the current should be reduced or giving ways in which this could be achieved, for example using longer or thinner resistance wires. The provision of a series variable resistor was seen in a few responses. Candidates should be encouraged to give a single answer when a single precaution is asked for, rather than risk contradiction by giving additional answers. In this question, the contradictory answers of 'reduce the current' and 'increase the voltage' were often seen together.

Question 3

This question was answered well by many candidates with some candidates able to demonstrate strong graph work.

(a) Most candidates recorded values for the height of the object that were reasonable.

(b) Most responses showed a range of decreasing values for the height of the image.

(c) Calculations were generally well done, with only a very few candidates reversing the equation and calculating $1/M$.

(d) Some good graphical skills were shown in many answers. Most candidates chose a suitable scale and labelled the axes correctly, showing *M* without a unit. Plotting was generally good. Where unusual scales had been suggested, plotting was often more awkward and mistakes occurred. Many candidates indicated the plots with fine crosses as advised in previous reports to Centres. Small dots are acceptable but are often obscured when the line is drawn through them, making it more difficult for these to be identified. A sharp pencil should be used for the plots and for the line so that accurate drawing may be achieved and errors easily corrected. The common response was an attempt at the smooth curve, which was most often indicated by the plots. A few candidates wrongly chose to fit a straight line to the plots; only a small minority joined points together.

(e) Many answers lay within the expected range, with clear construction lines shown on the graph.

(f) A number of candidates suggested that the hand or rule would block the image, making it difficult to measure. Fewer gave the matching improvement of fixing a grid to the screen or using a translucent screen so the image could be measured behind it. A common incorrect answer was the use of a transparent ruler, which would distort the image. Other responses were vague, sometimes gaining partial credit for the difficulty, but not often for the solution.

Question 4

A number of candidates answered well here. For the better performing candidates, it was often the question which was answered most accurately; others found it challenging.

There were some very clear answers with a significant amount of good detail. Most of these followed the structure suggested by the question and it was clear from some responses that the bullet points had been used by candidates as a checklist of what was to be included.

Candidates needed to read the brief carefully. Many long answers contained little that could be credited while more concise responses addressed the required investigation closely and gained full credit.

Many answers included diagrams to help explain the plan which supported the answer given. Candidates may find it easier to draw a table or graph rather than describe it in the text and good examples of this were seen.

A good number of candidates realised that the wooden rod could be used to produce a series of springs with a regular diameter; a significant number used the rod merely as a means of suspending the spring. It was common to ignore the need to describe how the spring could be made.

Many candidates described the experiments for measuring spring extension well; some had missed the requirement to compare materials and hence the need to control factors such as length and thickness of the wire making up the spring. A small number described the extension of a wire rather than a spring. Repeating the experiment for different materials of spring was sometimes omitted altogether.

Stronger answers were clear about the need to record the extension for each material with either a fixed value of load or a range of loads. In addition, a bar chart was often suggested for the former and, for the latter, a graph of extension versus load for each material, often drawn on the same axes. It is good practice to include units along with quantities on table headings or graph axes and some clear examples of this were seen.

When giving possible difficulties which might be encountered or additional points relating to practical techniques it was clear to see which candidates were used to carrying out a range of experiments and those who were not. Good examples of this were the need to apply loads slowly and the recognition that the ends of the spring should be bent into a loop or hook so that the spring could be suspended from a support and loads could be hung on the spring.

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 on the significance of precautions taken to improve reliability and control of variables.

- Candidates should be aware that as this paper tests an understanding of practical work, explanations and justifications need to be based on data from the question or the implications of observations rather than theoretical considerations.

- The questions should be read carefully so that answers address those specific points referred to in the question rather than more general aspects of the same topic.

- 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 in planning and designing an experiment to investigate a given brief. It is important for candidates to have wide experience of practical work.

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 and justifying conclusions
- dealing with possible sources of error
- controlling variables
- making accurate measurements and observations.

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 clearly had a background of similar practical work. The quality of the results obtained was also a reflection on the candidates' experience of experimental work. This was seen in the clear practical details given by some candidates in **Questions 1(c)**, **(e)** and **(f)**, **Questions 2(e)** and **(f)** and **Questions 3(e)** and **(f)**.

It is expected that numerical answers will include a relevant unit and will be expressed to a number of significant figures that is appropriate to the data given in the question. These points were demonstrated in many of the responses to **Questions 2(c)** and **(d)(i)**.

Where explanations or justifications are required, candidates should base them on practical considerations, using data from the question. Theoretical responses are not usually adequate, particularly when reference to the results is asked for. Good detail was seen in many of the answers to **Question 1(d)** and **Question 2(d)(ii)**.

In questions in which candidates are asked to outline a plan for an investigation, they should be reminded of the need for careful reading of the brief and the logical application of good experimental practice. A number of candidates showed good practical knowledge when answering **Question 4** but it was clear that many candidates had not been prepared for this or had limited experience of basic experiments.

Comments on specific questions

Question 1

This was answered well by better performing candidates; others found it challenging.

(a) Most candidates answered correctly but 10.8 and 30.7 were seen on a few occasions.

(b) Responses were generally good; many candidates omitted the time unit. This was the most common error, rather than showing the units wrongly. The majority completed the time column correctly.

(c) Some good answers were seen here, often referring to perpendicular viewing of the reading or stirring the water before taking the temperature. A number of candidates seemed to misread the question and gave answers that referred to conditions of the experiment rather than reading the thermometer.

(d) Many candidates concluded correctly that a higher surrounding temperature reduced the cooling rate of the water in the test-tube, citing the greater temperature change over 180 s of the tube in beaker **A** as evidence. A number of candidates gave temperature changes over a shorter period of time or outlined theoretical reasons rather than using results to support their conclusion and did not gain full credit.

(e) Candidates found this the most challenging part of the question. Various improvements were given, including ensuring that the initial temperatures or the volumes of water in the test-tubes were the same. Some candidates explained that either of these factors affected the cooling rate of the water; many were unsure of the reason for controlling these variables. Insulation of the beaker to keep the temperature of the surrounding water more constant was suggested by some candidates. A common error was to suggest the provision of insulation or a lid for the test-tube, removing the ability for the water in it to cool.

(f) The question was well answered by many, often using a clear diagram.

Question 2

Candidates found this question challenging.

(a) Many good answers were seen with a correct voltmeter symbol on the main part of the circuit, in parallel with the resistance wire. A lot of candidates, even those with strong answers to other questions, gave incorrect answers, frequently showing the voltmeter in series or connected across a small section of the resistance wire.

(b) The majority of candidates answered correctly with the most common error being to record the current as 0.44 A rather than 0.48 A.

(c) Many candidates produced correct calculations; a significant number showed faulty rounding, particularly to 2.58 rather than 2.59. Many candidates did not give the required number of significant figures, expressing answers to four or more, or were inconsistent.

(d) (i) There were many correct calculations; fewer responses included the appropriate unit of Ω/m.

(ii) The statement was often correct, with a matching explanation of the results being within the limits of experimental accuracy. The reasons given were sometimes theoretical, assuming that the resistance wires were of the same type (although they had not been described as such) and therefore would have the same value of resistance per unit length. Explanations which did not refer to results gained no credit. A significant number of candidates stated that, as results were not exactly equal, the suggestion was not supported.

(e) Despite the word 'precisely' being highlighted in the question, few candidates were sufficiently careful here. The length to be measured was between the inside edges of the crocodile clips where they met the wire. Very few candidates took the simpler ways of indicating this by drawing arrows on the wire or employing vertical construction lines. The use of arrows some way from the wire led to inaccuracy for many candidates.

(f) A number of candidates responded correctly, often suggesting that the current should be reduced or giving ways in which this could be achieved, for example using longer or thinner resistance wires. The provision of a series variable resistor was seen, but only in a few responses. Candidates should be encouraged to give a single answer when a single precaution is asked for, rather than risk contradiction by giving additional answers. In this question, the contradictory answers of 'reduce the current' and 'increase the voltage' were often seen together.

Question 3

This was the question most well answered by candidates across the ability range.

(a) Responses to this question were mostly correct.

(b) Calculations were generally done well, with only a very few candidates reversing the equation and calculating $1 / M$.

(c) Some good graphical skills were apparent in many answers. Most chose a suitable scale and labelled the axes correctly, showing M without a unit. Plotting was generally good. The points at 35.0, 0.73 and 55.0, 0.37 proved to be the most significant sources of plotting error. Many candidates indicated the plots with fine crosses as advised in previous reports to Centres. Small dots are acceptable but are often obscured when the line is drawn through them, making it more difficult for these to be identified. A sharp pencil should be used for the plots and for the line so that accurate drawing may be achieved and errors easily corrected. The most common response was an attempt at the smooth curve, which was clearly indicated by the plots. Only a few candidates wrongly chose to fit a straight line to the plots or joined points together.

(d) Most answers lay within the expected range, with clear construction lines shown on the graph.

(e) Many candidates suggested that the hand or rule would block the image, making it difficult to measure. Fewer gave the matching improvement of fixing a grid to the screen or using a translucent screen so the image could be measured behind it. A common incorrect answer was the use of a transparent ruler, which of course would distort the image. Other responses were vague, sometimes gaining partial credit for the difficulty, but not often for the solution.

(f) Better performing candidates recognised that a focused image would be achieved only if the object, lens and screen were perpendicular.

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