PHYSICS

Paper 0625/12
Multiple Choice (Core)

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

General comments

Candidates answered **Questions 1**, **2**, **5**, **8**, **15**, **27**, **30**, **35** and **38** very well. **Questions 3**, **7**, **12**, **17**, **18**, **25** and **37** were more challenging for many candidates.

Comments on specific questions

Question 3

Many candidates did not realise that the acceleration of free fall is constant if friction can be ignored. Many candidates thought that the acceleration would increase.

Question 7

Many candidates showed little understanding of the concept of the principle of equilibrium. They did not understand that if an object is moving in the straight line at constant speed the resultant force on the object is zero. Most candidates thought that there must be a force in the direction of the movement.

Question 10

Although many candidates were able to identify the advantages and disadvantages of using wind turbines to generate electricity, a significant number incorrectly thought that they produced a constant output irrespective of weather conditions.

Question 12

Only stronger candidates showed an understanding of the operation of a simple barometer. Most thought that the height of the mercury column would halve if the diameter of the tube was doubled.

Question 13

Although many candidates were able to apply the formula $P = \frac{F}{A}$, a significant number multiplied the force by the area.

Question 17

Only stronger candidates showed an understanding of thermal capacity. Most thought that the larger the temperature rise, the greater the heat capacity.

Question 18

Only the strongest candidates answered this question correctly and showed an understanding of the graph.

Question 22

Although most candidates chose the correct answer, many thought option **D** was the correct response. This showed a failure to fully understand that the direction of travel of the wave is perpendicular to the wavefronts.

Question 25

Only stronger candidates recognised that the sound travelled to the cliff, and then reflected from the cliff and travelled back to the ship. Thus, the distance from the ship to the cliff is half the total distance travelled by the sound and is equal to the speed of the sound multiplied by half the time taken, not the total time.

Question 32

Many candidates confused the circuit with a parallel circuit. Only stronger candidates recognised that in this series circuit, the current is the same all the way round the circuit.

Question 37

Only the strongest candidates answered this question correctly and the most common response was **D** (circuit R only). Many candidates did not read the question with sufficient care and thought it was asking for the circuits which produced a force on the wire in the same direction as in the original example, not the opposite direction.

PHYSICS

Paper 0625/22
Multiple Choice (Extended)

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

General comments

There were some very strong performances, showing that many candidates had a good knowledge and a real depth of understanding of the work.

Questions 1, **5**, **6**, **22**, **32**, **36 39** and **40** were answered very well. Many candidates found **Questions 3**, **9**, **12**, **17**, **19**, **21**, **28**, and **37** more challenging

Comments on specific questions

Question 3

This question required candidates to consider a novel situation. Most candidates were able to rule out option **A**, but candidates chose the remaining options in almost equal numbers, indicating possible guessing.

Question 7

Almost all candidates were able to calculate the magnitude of the third horizontal force on the car (the rolling frictional force). However, many candidates were under the misapprehension that the force was in the forward direction, failing to understand that the resultant force on an object moving in a straight line at constant speed is zero.

Question 9

The most common error in answering this question was to incorrectly think that the total weight of the athlete and his pack was placed on his arms, whereas his feet carried some of the weight.

Question 19

Only the strongest candidates answered this question correctly. The logic is that the larger the specific heat capacity of the hotter material (the metals), the greater the temperature rise of the cooler material (the liquid). Also, the lower the specific heat capacity of the cooler material (the liquids), the more its temperature will rise.

Question 21

Only the strongest candidates answered this question correctly. All three observations were correct, but many candidates thought that the reduction in energy loss by convection, due to the small size of the air bubbles, was incorrect.

Question 28

Most candidates thought that the number of molecules in both the compressions and in the rarefactions would decrease when a quieter sound is played.

Question 34

This question proved challenging for some candidates. Many candidates thought that the total current in the cell was double the current in the lower arm of the parallel section even though the resistances in the two arms were different. This showed a failure to really understand parallel circuits.

Question 37

Most candidates recognised that the particle must travel in a direction perpendicular to the magnetic field for there to be a force on it. However, not all candidates were able to correctly apply the left-hand rule to give the specific direction of the force.

PHYSICS

Paper 0625/32
Core Theory

Key messages

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

General comments

Many candidates were well prepared for this paper. Equations were generally well known by stronger candidates, but a significant number of other candidates were unable to recall standard equations.

Often candidates knew how to apply their knowledge and understanding to fairly standard situations. Weaker candidates had difficulty in applying their knowledge to new situations, did not show the stages in their working and did not think through their answers before writing.

Often candidates set out their calculations well but some candidates would have benefitted from more clarity in this area. A few candidates found transposing equations challenging. They regularly started with a correct formula but could not always translate this into correct use of the data in the question.

The questions on levers, energy transformations in an electric circuit, frequency and wavelength of a wave, drawing ray diagrams, advantages and disadvantages of using wind turbines as an energy source, explaining the action of a variable resistor in a circuit and half-life calculation were more challenging for many candidates. Some candidates either did not read the questions carefully or gave answers that were related to the topic being tested, but did not answer the question in enough detail to receive credit.

Most candidates indicated by their knowledge and skills that they were correctly entered for this Core Theory paper. A few candidates found the subject matter and level of some questions very straightforward and would have been better entered for the Extended paper.

Comments on specific questions

Question 1

(a) Most candidates gave a correct answer of 0.3 cm.

(b) Most candidates were well prepared for questions involving the displacement method of determining volume and gave clear concise descriptions.

Question 2

(a) Many candidates correctly calculated the moment of the 8.0 N force, but very few gave the correct unit. Common errors were to use a distance of 10 cm instead of 15 cm for the distance from the line of action of the force to the pivot, or to try to balance the 8.0 N force with a force on the other side of the pivot.

(b) Many candidates found this question challenging and drew the force 10 cm from the end of the rule rather than 10 cm from the pivot. Other candidates failed to draw an arrow giving a clockwise moment.

Question 3

(a) Most candidates correctly calculated the weight of the ball. Weaker candidates transformed the mass in kilograms to a mass in grams. Another common error was to divide by 10 instead of multiplying.

(b) Only stronger candidates recognised **T – U** as decreasing acceleration. The most common error was to link to slowing down. Most candidates recognised **U – V** as moving with constant speed, but many linked **U – V** to at rest.

(c) The majority of candidates correctly calculated the distance fallen by the ball as 40 m. A common error was using $\text{distance} = \frac{\text{speed}}{\text{time}}$.

(d) Almost all candidates answered this correctly.

Question 4

(a) Many candidates gained full credit, but a number found this question challenging. A common error was to state that electrical energy was emitted by the filament lamp.

(b) The majority of candidates thought that electrical energy rather than chemical energy was decreasing in the battery.

(c) Most candidates were able to link the principle of conservation of energy to the circuit.

Question 5

(a) Only the strongest candidates answered this question fully correctly. A number of candidates thought it sufficient to state that the wind turned the turbine blades and this then produced electrical energy.

(b) (i) Most candidates identified a disadvantage of using wind turbines compared to coal fired power stations.

(ii) Many candidates gave vague or insufficient responses, such as “it is more eco-friendly” or “it has less pollution”.

Question 6

(a) Candidates were well prepared for this item, with the vast majority gaining full credit.

(b) (i) The majority of candidates recognised Brownian or random motion of the smoke particle.

(ii) The majority of candidates struggled with this question, with many repeating the answer to **(i)**.

Question 7

(a) Many candidates incorrectly thought that the volume of steel would have the greatest increase in volume.

(b) (i) Most candidates answered this question correctly.

(ii) The majority of candidates identified the correct temperature range of the thermometer.

(iii) Fewer candidates were able to identify the fixed points of the Celsius scale. Common errors were to repeat the range of the thermometer or to write down all the numbers on the thermometer.

(c) There were many correct applications or consequences of thermal expansion, but the explanations often lacked detail. Weaker candidates often struggled with this item and simply tried to explain the expansion of mercury in a liquid-in-glass thermometer.

Question 8

(a) (i) Most candidates answered this question correctly.

(ii) Only the strongest candidates gained full credit for a correct determination of the wavelength of the wave. The most common error was to give 112 cm as the wavelength.

(iii) Only stronger candidates gained full credit by using the definition of frequency and counting the number of waves emitted in two seconds on **Fig. 8.1**. Many weaker candidates invented their own equations such as frequency = wavelength × amplitude.

(b) (i) Many candidates gained full credit and a significant number gained partial credit as they had the labels interchanged. A common error was to label the boxes “alpha rays” and “beta rays”.

(ii) Most candidates gave a correct use of gamma rays, but weaker candidates failed to gain credit as they gave vague or insufficient answers, such as “used for treatment in hospitals”.

Question 9

(a) (i) Most candidates correctly drew a normal to the mirror. Candidates should ensure that they use a ruler for drawing straight lines.

(ii) The majority of candidates gained credit here, but many gave careless measurements or estimations of the angle of reflection.

(b) The most common errors in answering this question were failing to draw the line through the principle focus, or failing to draw an arrow downwards from the axis to the point of intersection of the rays.

Question 10

(a) (i) The majority of candidates answered this question correctly. The most common error was to give copper instead of iron, or to add steel to a correct answer of iron.

(ii) Most candidates identified the variable resistor.

(iii) Many candidates found this question challenging, with only stronger candidates able to explain that by varying the resistance, the current in the coil and therefore the strength of the electromagnet was varied.

(b) Many candidates answered this well. The most common error was to recall an incorrect arrangement of V = IR.

Question 11

(a) (i) Some candidates answered this question well but the vast majority thought that the reading in A_2 was smaller than the reading on the other two ammeters.

(ii) Many candidates answered correctly but others thought that the reading would be the same on all three ammeters.

(iii) Many candidates gave vague statements such as “the lamps will have the same brightness” or “the lamps will have the same voltage”.

(b) (i) Only the strongest candidates answered this question correctly. The most common error was to give an answer for three lamps connected in series.

(ii) Many candidates answered this question correctly. The most common error was to answer a different question by comparing the resistance of two lamps in parallel to two lamps in series.

Question 12

(a) (i) The vast majority of candidates identified the number of neutrons as 146. The most common errors were to give the nucleon number or the proton number.

(ii) Very few candidates gained full credit. Candidates failed to realise that the charge on a nucleus is simply the number of protons in the nucleus. The most common error was to state that the nucleus had a neutral charge.

(b) The majority of candidates gained full credit here. The most common error was to state that alpha particles are electromagnetic waves.

(c) Only the strongest candidates answered this question correctly. The most common error was to calculate the time for three half-lives instead of two half-lives.

PHYSICS

Paper 0625/42
Extended Theory

Key messages

It is essential that candidates show their working and write down the equations.

Candidates should be reminded that Q is not the correct symbol for thermal energy. The only symbol for energy is E.

All but the very strongest candidates would benefit from more practice in applying their knowledge in unfamiliar situations. This would deepen candidates' understanding and improve their performance in the examination.

General comments

Many candidates were well prepared for this paper. Equations were generally well known but the use of equations and the quantities represented were not always understood. There were frequent examples where candidates substituted numbers from the question in the wrong place in equations.

Unless otherwise stated, it is expected that candidates should round their final answer to 2 significant figures. However, intermediate values should not be rounded or truncated as this frequently leads to an inaccurate final answer. A noticeable number of candidates did make significant figure errors, either incorrectly rounding or rounded to 1 significant figure.

Generally, candidates followed the instructions in the questions. However, sometimes candidates did not read the questions carefully enough and wrote known standard facts when the question required the application of these facts.

The use of units by most candidates was generally good.

Comments on specific questions

Question 1

(a) This was correctly answered by nearly all candidates. A few candidates made an error in the unit in their answer.

(b) (i) Mistakes in drawing a straight line to the correct point were rare. A few candidates did not interpret the scale correctly and plotted (9, 120) or (8, 110) or were completely wrong.

(ii) Most candidates calculated the correct height having recognised the need to use the area under the graph. Others incorrectly used distance = speed x time or Pythagoras theorem to calculate the length of the line.

(iii) A number of candidates incorrectly assumed that a straight line with a positive gradient was required. However, in most cases these candidates gained some credit for the correct constant speed completion of the graph. A small number of candidates drew the horizontal section at 200 m/s instead of below 200 m/s.

Question 2

(a) This question was generally well answered.

(b) (i) This was answered well by many candidates who used the idea of the product of force and time. However, there were also a significant number of candidates who wrote confused or vague answers talking about the 'rate of force', 'the force over a time' or the 'total force in a certain time'.

(ii) Some candidates failed to recognise the link between **(i)** and **(ii)** and instead used an alternative method using F = ma. However, some of these candidates stopped after calculating the acceleration or thought that the acceleration was the force.

(c) This question was generally well answered.

Question 3

(a) (i) Many candidates calculated the correct value for the speed of the air. There were some arithmetic errors and some candidates were unable to rearrange the equation correctly or substituted wrong numerical values. Most gained some credit for the correct equation.

(ii) This question was well answered except by weaker candidates who often thought they needed to do a calculation and hence divided by a number other than 1. There were a significant number of unit errors, normally stating J instead of W.

(b) (i) Most calculations of the output power were successful. Unsuccessful attempts were usually due to the equation P = VI not being known.

(ii) The equation for efficiency was generally well known and there were many successful calculations of the value. However, many candidates incorrectly inverted the equation. Others, who had a wrong value for input power, realised that they would get an answer greater than 100 per cent and wrote down input power/output power. Credit was not awarded for a vague output/input without reference to power.

(c) Very few incorrect values of the volume were seen. Some candidates had the equation for density inverted or rearranged incorrectly and there were some significant figure errors and occasionally an omitted unit or a unit of m^2.

Question 4

(a) Major sources of error were failure to quote per kg or per unit mass in the definition of specific latent heat of fusion or adding 'per °C'. Other candidates confused the definitions of specific heat capacity and specific latent heat. Some omitted to use energy and some confused melting with vaporisation or simply did not know what fusion meant.

(b) (i) Some candidates used an incorrect transposition of the equation $E = mc\Delta T$, or an incorrect unit was quoted for the value in the final answer. Some candidates just multiplied the values for l, m and ΔT. The question deliberately did not specify any type of water. Some candidates seemed to know the specific heat capacity of water and gave 4 200 as their answer without calculation. A few did not accept their own calculated answer as it was not 4 200 so crossed out their calculation and gave 4 200 on the answer line. A minority of candidates gave an incorrect unit.

(ii) Most candidates quoted the correct equation and gave a correct answer. A common incorrect answer was 0.12 kg. These candidates were unable to round 0.106 kg to 2 sf correctly.

Question 5

(a) It was quite common for candidates to incorrectly quote convection as one of the processes of thermal energy transfer.

(b) Most answers referred to vibration of particles and overlooked the fact that the question was about thermal energy transfer in a metal. Very few candidates gave complete answers mentioning the movement of delocalised electrons.

(c) Most candidates correctly selected 'shiny white' and gave an acceptable explanation. Some explanations were too vague, e.g. 'shiny white reflects heat'. A valid comparison needed to be made for full credit to be awarded.

Question 6

(a) (i) Most candidates had a correct general idea that a diffraction pattern should be drawn. However, there was frequently insufficient knowledge of physics or insufficiently careful drawing for credit to be awarded. Only the very strongest candidates gained full credit.

Those candidates who correctly drew vertical straight lines as crests in the upper section of the figure sometimes incorrectly spaced the lines. In the lower section, the lines drawn were often straight or had straight sections. Some candidates drew continuous curves or straight lines with curved ends, i.e. confusing diffraction round a corner with diffraction through a gap.

(ii) This question was usually answered well.

(b) (i) Although stronger candidates answered this well, many candidates had little idea of the direction of movement of the waves. Some candidates drew the direction as heading back towards the barrier or along the wave crests.

(ii) This question was usually answered well.

(iii) Most candidates were able to gain some credit, with many gaining full credit. Some candidates confused increase with decrease.

Question 7

(a) (i) Most candidates answered this question correctly.

(ii) This was generally well answered but some candidates selected three answers. This indicated a contradiction and could not gain full credit.

(b) Generally all parts of this question were well answered except by weaker candidates.

In **(i)** and **(ii)** many candidates drew the red ray refracted down more than the green. Some redrew a new incident ray and then a red ray parallel to the green. Neither of those responses gained credit.

In **(iii)**, some candidates were not careful in drawing the red ray leaving the glass block. Candidates needed to have indicated that the rays were parallel.

Question 8

(a) This question was generally answered well.

(b) Many stronger candidates calculated the resistance of the wire XQ correctly, demonstrating through their working that they understood that R is proportional to l. If candidates substitute values into equations which are incorrect, they need to understand that they may not gain full credit for their working out if they have not written out the equation first. Ambiguities in the values they substitute can make it unclear whether they were using the correct equation. For partial credit for partially correct answers, detail and clarity are very important.

Question 9

(a) and (b) These questions were usually well answered.

(c) This was generally answered well. However, two common errors were not reading from the question that all possible combinations of input were required and that the 2nd and 3rd rows were both written as 01 or both written as 10. Many weaker candidates wrote column E having the opposite state to the correct state.

Question 10

(a) Many candidates gained full credit but some candidates merely restated what was in the question.

(b) There was a wide variety of answers but most stronger candidates gained full credit. Stating that the magnetic field varied was too vague and only gained partial credit.

(c) Only the very strongest candidates gained full credit. Very few identified that it was a current in the base of the pan that was responsible for the heating effect. Most candidates correctly stated that thermal energy was produced which caused a temperature rise. Even though the question referred back to **(b)** and the quantity induced in the base of the pan, a number of candidates referred to thermal energy produced in the coil.

Question 11

(a) This was well answered by most candidates but weaker candidates made a variety of errors especially with the mass.

(b) The question required candidates to apply the different penetrating powers to the specifics of this application. Most stated that beta would pass through the foil but many explanations were insufficient with only the strongest candidates explaining how it must be beta and that it could not be alpha or gamma. Some candidates focused on relative ionising strengths without applying it to this situation.

PHYSICS

Paper 0625/52
Practical

Key messages

- Candidates need to have a thorough grounding in practical work during the course, including the reflection on and the discussion of the precautions taken to improve reliability.
- Numerical answers should be expressed clearly, rounded to the appropriate number of significant figures and with a correct unit where applicable. These aspects will be tested at some point in the paper.
- **Candidates should be ready to apply their practical knowledge to designing an investigation or suggesting how experiments could be improved or** how **more accurate results** could be **obtained.**

General comments

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

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

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

Questions on experimental techniques were answered much more effectively by candidates who showed evidence of having had regular experience of practical work. This was seen in the good practical details given by some candidates in **Question 1(a)**.

It is important that numerical answers should be correctly rounded to a number of significant figures which is appropriate to the data given in the question or a measurement carried out by the candidate. Use of a recurring symbol does not indicate the intended number of significant figures. A set of similar quantities should be expressed to a consistent number of significant figures.

Comments on specific questions

Question 1

(a) Most candidates obtained credit for measurements in an appropriate range but relatively few gained credit for both readings expressed to 1 or 2 decimal places.

Some sensible methods for measuring the diameter more accurately were suggested, most often by measuring the gap between two blocks. However, very few candidates suggested measuring the diameter in more than one place around the circumference or along the length of the rod to allow for variations.

Answers involving Vernier callipers were generally not precise enough to be credited.

(b) Most candidates answered this correctly and gave an appropriate magnitude of mass.

(c) Many candidates gained full credit here, but units were sometimes later contradicted in **(e)**.

(d) This was generally answered well, with sensible values given and the correct line of sight shown. Candidates should ensure that drawing is done carefully, in this case with a ruler, when a precise indication is required.

(e) Many correct calculations were given but relatively few candidates obtained credit for both values of ρ being within 10% of each other. Each method needed to be carried out carefully to obtain this result.

Question 2

(a) Most answers showed sensible room temperatures and most candidates obtained a clear, continuous fall in temperature. Only a few candidates recorded room temperature as the value of θ when $t = 0$ or did not wait for the temperature to reach a maximum value before starting the timing. This was reflected later in the calculation of the initial cooling rate.

(b) This was usually answered well with only a few candidates omitting units or not recording temperature as °C. It is not good practice to record units against each value in the column and this sometimes led to contradiction with those in the headings. It should be noted that 'sec' or 'secs' are not accepted as abbreviated units for seconds.

(c) Most candidates calculated correctly but there were some rounding errors. A suitable, consistent unit for cooling rate was often given.

(d) Many candidates obtained cooling rates which did not follow the expected decreasing trend. Suitable values in support of a pattern over the full 270 seconds of the experiment were seen in many cases.

The room temperature measured in **(a)** was often suggested as the probable final temperature after cooling for many hours, with values such as 0 °C only rarely given.

(e) Some stronger candidates answered this question well, referring to the individual rates calculated in **(c)** rather than the overall cooling rate, and relating the comparison to the pattern of cooling obtained in the experiment. It was expected that the cooling rate values should be matched to the initial temperature of each 90 second period to justify the suggestion given.

Suitable control variables were given by many candidates, generally relating to the volume of water used or the room temperature.

Question 3

(a) Most candidates gave valid measurements and a suitable value for R_0. Although there were variations within centres, any sensible values expressed to more than 1 significant figure were accepted.

(b) Good sets of values were generally recorded but some current readings were inconsistent and lacked a second decimal place. Calculations of $1/I$ were often correct, but there were rounding errors in a number of answers. The quality of practical work behind many responses showed in the pattern of increasing current.

(c) There were many well-drawn, accurate graphs with clearly labelled axes. There was sometime a poor choice of scale but only a few candidates used impractical scales which led to problems with determining more difficult positions for plotted points.

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

Many candidates produced a well-judged straight line as intended and as indicated by their accurate plots. However, some joined points together or forced the line through the origin when the plots did not justify this. The pattern of plots should indicate the trend of the line, whether straight, as expected, or a simple curve.

A very small number of candidates equally spaced the $1/I$ values from the table on the horizontal axis. They produced an inconsistent scale and could not be awarded credit for the scale or for the plots, as their positions could not be determined correctly.

Some candidates failed to follow instructions carefully and plotted I instead of l, or instead of $1/I$.

(d) Most candidates showed a clear, large triangle drawn on the graph line and the values of *E* were often in range. However, a small number of candidates drew triangles to plotted points which were not on the best fit line.

(e) Many candidates gained partial credit by stating that the 30.0 cm length would be most affected by the ammeter resistance. However, only a minority went on to explain that the extra fixed resistance of the ammeter would become a greater proportion of the total as the resistance of the wire became smaller with decreasing length.

Question 4

There were many clear, straightforward answers which gained full credit and most candidates gained at least partial credit. The strongest responses showed a logical approach, structured as suggested by the bullet points in the question, with concise sentences which communicated ideas well. Candidates can often miss straightforward points if planning is not approached in a sequential way. The quality of response varied greatly, and candidates should be made more aware that a practical solution is required in this type of question rather than any theoretical explanation of, for example, the energy changes involved.

Many candidates showed a circuit with a series ammeter, but this was sometimes negated by a line through the symbol or the inclusion of an unnecessary power supply. A circuit involving a parallel voltmeter was accepted.

Most candidates were able to identify the need for an ammeter. As an alternative, a voltmeter was also accepted provided that the method mentioned that current would need to be calculated from the voltmeter reading. A metre rule was sometimes included and was required if the independent variable was to be the distance between the fan and the turbine. A device for measuring air speed was given in the equipment list and did not need to be stated as additional apparatus.

Many candidates specified a constant distance between the fan and turbine or a fixed fan speed as a variable to control, depending on the suggested method. Factors such as the resistance or dimensions of the turbine blades were ignored here as these were given apparatus. However, mention of a constant angle of air flow gained credit.

It was important to describe the steps of the experiment and many good responses were seen. The detail most often omitted was the measurement of the air speed. Fan speed, which is rarely a continuous variable, was frequently quoted instead. Many candidates recognised the need to repeat the measurement of current with a different independent variable.

A comment on the analysis of results was expected. The most straightforward responses suggested that, if a change in the independent variable produced a change in the measured dependent variable, this showed that air speed affected the current generated by the turbine. Many candidates incorrectly made a prediction of the relationship or gave a conclusion instead, but this was ignored if correct analysis had been suggested in addition.

Mention of a graph with suitable axes clearly stated was sufficient to gain credit for analysis. The use of a bar chart was not appropriate for a continuous variable such as speed of air flow.

Credit for additional detail was not often awarded but the measurement of at least 5 sets of data in order to plot a graph was the most frequently seen detail where it was awarded.

PHYSICS

Paper 0625/62
Alternative to Practical

Key messages

- Candidates need to have a thorough grounding in practical work during the course, including the reflection on and the discussion of the precautions taken to improve reliability.
- Candidates should read questions carefully so that answers are informed by results and practical considerations rather than from theoretical considerations.
- Numerical answers should be expressed clearly, rounded to the appropriate number of significant figures and with a correct unit where applicable. These aspects will be tested at some point in the paper.
- Candidates should be ready to apply their practical knowledge to designing an investigation or suggesting how experiments could be improved or how more accurate results could be obtained.

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

Questions on experimental techniques were answered much more effectively by candidates who showed evidence of having had regular experience of practical work. This was seen in the good practical details given by some candidates in **Question 1(a)** and **Question 2(b)**.

It is important that numerical answers should be correctly rounded to a number of significant figures which is appropriate to the data given in the question or a measurement carried out by the candidate. Use of a recurring symbol does not indicate the intended number of significant figures. A set of similar quantities should be expressed to a consistent number of significant figures.

A number of candidates showed good practical knowledge when answering **Question 4**.

Comments on specific questions

Question 1

(a) Most candidates obtained credit for measurements in an appropriate range but relatively few gained credit for both readings expressed to 1 decimal place.

Some sensible methods for measuring the diameter more accurately were suggested, most often by measuring the gap between two blocks. However, very few candidates suggested measuring the diameter in more than one place around the circumference or along the length of the rod to allow for variations.

Answers involving Vernier callipers were generally not precise enough to be credited.

(b) Many candidates gained full credit but units were sometimes later contradicted in **(d)**.

(c) Most candidates read the water levels correctly with only a few recording the upper values of the meniscus.

(d) The calculation was usually well done but there were sometimes inconsistencies in the number of significant figures between the two density values.

(e) The correct line of sight was generally shown. Candidates should ensure that drawing is done carefully, in this case with a ruler, when a precise indication is required. The perpendicular nature of the line of sight was the important aspect here.

(f) Very few candidates answered this correctly. Many had not read the method in sufficient detail and referred to the rod not being fully submerged. Some candidates referred to poor experimental practice such as not accounting for parallax in readings, when the question stated clearly that the method was carried out carefully.

The expected responses were to outline possible sources of inaccuracy which were inherent in the method. These included the relative lack of precision in measuring cylinder scales or the possible absorption of water by the wooden rod. Many candidates negated otherwise correct answers by adding additional, unacceptable responses.

Question 2

(a) Most candidates recorded the room temperature correctly.

(b) This was usually answered well with only a few candidates omitting units or not recording temperature as °C. It should be noted that ‘sec’ or ‘secs’ are not accepted as abbreviated units for seconds.

Many candidates had clearly experienced practical work of this type and described techniques for obtaining accurate temperature readings. Others missed the point and interpreted the question as asking for control variables.

(c) Most candidates calculated correctly but there were often rounding errors.

A suitable, consistent unit for cooling rate was often given.

(d) Many candidates obtained credit for the first part of this question. There were suitable values in support of the description of the pattern over the full 270 seconds of the experiment in many cases but some candidates did not include these.

The room temperature measured in **(a)** was generally suggested as the probable final temperature after cooling for many hours. However, other values including 0 °C were often given, suggesting that some candidates had not recognised the gradual decrease in cooling rate which was clear from their calculations.

(e) Some stronger candidates answered this question well, referring to the individual rates calculated in **2(c)** rather than the overall cooling rate, and relating the comparison to the pattern of cooling obtained in the experiment. It was expected that the cooling rate values should be matched to the initial temperature of each 90 second period to justify the suggestion given.

Suitable control variables were given by many candidates, generally relating to the volume of water used or the room temperature.

Question 3

(a) Most candidates gave correct measurements and a suitable value for R_0, but the current was read incorrectly as 0.23 A in a few cases.

(b) This was usually calculated correctly but with the value often rounded wrongly to 2.85.

(c) There were many well-drawn, accurate graphs with clearly labelled axes. There was sometime a poor choice of scale but only a few candidates used impractical scales which led to problems with determining more difficult positions for plotted points.

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

Many candidates produced a well-judged straight line as intended and as indicated by their accurate plots. However, some joined points together or forced the line through the origin when the plots did not justify this. The pattern of plots should indicate the trend of the line, whether straight, as expected, or a simple curve.

A very small number of candidates equally spaced the $1/I$ values from the table on the horizontal axis. They produced an inconsistent scale and could not be awarded credit for the scale or for the plots, as their positions could not be determined correctly.

Some candidates failed to follow instructions carefully and plotted I instead of l, or instead of $1/I$.

(d) Most candidates showed a clear, large triangle drawn on the graph line and the values of E were often in the expected range. However, a small number of candidates drew triangles to plotted points which were not on the best fit line or omitted a triangle altogether.

(e) Many candidates gained partial credit by stating that the 30.0 cm length would be most affected by the ammeter resistance. However, only a minority went on to explain that the extra fixed resistance of the ammeter would become a greater proportion of the total as the resistance of the wire became smaller with decreasing length.

Question 4

There were many clear, straightforward answers which gained full credit and most candidates gained at least partial credit. The strongest responses showed a logical approach, structured as suggested by the bullet points in the question, with concise sentences which communicated ideas well. Candidates can often miss straightforward points if planning is not approached in a sequential way. The quality of response varied greatly, and candidates should be made more aware that a practical solution is required in this type of question rather than any theoretical explanation of, for example, the energy changes involved.

Many candidates showed a circuit with a series ammeter, but this was sometimes negated by a line through the symbol or the inclusion of an unnecessary power supply. A circuit involving a parallel voltmeter was accepted.

Most candidates were able to identify the need for an ammeter. As an alternative, a voltmeter was also accepted provided that the method mentioned that current would need to be calculated from the voltmeter reading. A metre rule was sometimes included and was required if the independent variable was to be the distance between the fan and the turbine. A device for measuring air speed was given in the equipment list and did not need to be stated as additional apparatus.

Many candidates specified a constant distance between the fan and turbine or a fixed fan speed as a variable to control, depending on the suggested method. Factors such as the resistance or dimensions of the turbine blades were ignored here as these were given apparatus. However, mention of a constant angle of air flow gained credit.

It was important to describe the steps of the experiment and many good responses were seen. The detail most often omitted was the measurement of the air speed. Fan speed, which is rarely a continuous variable, was frequently quoted instead. Many candidates recognised the need to repeat the measurement of current with a different independent variable.

A comment on the analysis of results was expected. The most straightforward responses suggested that, if a change in the independent variable produced a change in the measured dependent variable, this showed that air speed affected the current generated by the turbine. Many candidates incorrectly made a prediction of the relationship or gave a conclusion instead, but this was ignored if correct analysis had been suggested in addition.

Mention of a graph, with suitable axes clearly stated was sufficient to gain credit for analysis. The use of a bar chart was not appropriate for a continuous variable such as speed of air flow.

Credit for additional detail was not often awarded but the measurement of at least 5 sets of data in order to plot a graph was the most frequently seen detail where it was awarded.