PHYSICS

Paper 0972/21
Multiple Choice Extended

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

Key messages

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

General comments

Candidates answered **Questions 5**, **7**, **9**, **11**, **14**, **16**, **22**, **29** and **39** well but found **Questions 8**, **12**, **13**, **21**, **31**, **33**, **34**, more challenging.

Comments on specific questions

Question 7

Candidates showed a good understanding of the difference between vectors and scalars.

Question 8

Only the strongest candidates answered this question correctly. The most common error was to fail to recognise that the change in momentum was 50 kg m s^{-1} (25 – (–25)). In addition, a lot of candidates did not notice that the time was given in milliseconds.

Question 12

The majority of candidates incorrectly thought that the width of the tube would alter the height of the liquid column and showed little understanding of this method of measuring pressure.

Question 13

Many candidates did not take sufficient care when considering consistency of units. Only a relatively small percentage recognised that the area of the plug was in cm^2.

Question 14

Candidates showed a good understanding of Brownian Motion.

Question 21

Stronger candidates answered correctly. However, many candidates correctly identified the change of direction of propagation of the waves, but incorrectly thought that the wavelength (and hence the speed) of the waves would decrease on entering the deep water.

Question 22

Most candidates were aware that the image in a plane mirror is virtual.

Question 23

Only the strongest candidates answered this question correctly. Candidates needed to identify the principal focus, then trace the two rays from the lens to the screen in order to determine the size of the image.

Question 24

Candidates showed a good knowledge of the regions of the electromagnetic spectrum that are used for specific jobs.

Question 31

This question proved challenging for many candidates. Candidates needed to recognise that the thermistor's resistance increases as the temperature decreases, thus the current in the circuit decreases, the p.d. across the resistor decreases and therefore the p.d. across the thermistor increases.

Question 33

Stronger candidates answered this question correctly. Weaker candidates did not recognise the logic gates that were being used and failed to work their way through the truth table.

Question 34

Many candidates did not recognise that the role of either a circuit-breaker or a fuse is to disconnect the live wire from the appliance and so did not select the correct answer.

PHYSICS

Paper 0972/41
Extended Theory

Key messages

In numerical questions involving the use of a formula, candidates are strongly advised to begin their answer by writing down the formula that they have learnt, e.g. F = ma, I = V / R, and not a transposed version. In many cases, answers started with a wrongly transposed version of a formula or with numbers substituted in the wrong version.

Also in numerical questions, candidates should check that they give answers with the correct unit.

General comments

Many candidates performed well on this paper. They often demonstrated a thorough understanding and recall of a large proportion of what they had been taught, read the questions with great care, and carefully planned their approach before beginning to write. In other cases, candidates did not read the questions carefully enough or in questions requiring explanations and descriptions, the required points were not given in a logical order. Candidates should avoid explaining the same point in different ways to ensure they do not contradict themselves.

For many candidates two topics in particular proved challenging. In **Question 1**, few candidates correctly interpreted the distance-time graph. In **Question 2**, understanding of the concept of moments was weak. Candidates seemed unfamiliar with the idea of the suspension of a plank from two ropes rather than it being balanced at a single fulcrum.

Comments on specific questions

Question 1

(a) (i)1 Most candidates used the correct approach and calculated the average speed correctly.

(i)2 Few candidates calculated the correct speed. Almost all candidates used the coordinates of the graph at time 100 s and gave the answer as 36 m / s, not realising, or forgetting, that this approach would only have been valid if the graph had been a straight line passing through the origin.

(ii) Most candidates incorrectly assumed that the gradient of the graph at 20 s and at 100 s determined the acceleration at these times and answered accordingly.

(b) (i) Many candidates used $F = ma$ and calculated the resultant force correctly. Most stated the formula and gave the unit.

(ii) A number of different meanings of deceleration were acceptable. However, there were some examples of a correct meaning being stated along with an incorrect one such as “decreasing acceleration”, or “rate of acceleration decreases”. Such answers contradicted themselves.

Question 2

(a) Only the strongest candidates answered this question correctly and stated the moment of P about B as $P \cdot 1.5$ or $1.5P$.

(b) (i) Some candidates stated the moment of W about B as 210 Nm but some answers did not included the unit.

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

(iii) Two approaches were possible and the easier one required the idea that total upward force = total downward force. The other method, using moments, was less successful.

Question 3

(a) Most candidates answered this well.

(b) (i) Partial credit was awarded for giving the change of chemical energy to kinetic energy (in the initial throw). However, some candidates referred to potential energy rather than chemical energy.

(ii)1 The formula *mv* for momentum was well known and most candidates gained credit for this or for $4.0 \cdot 12$. The unit was more often stated as kg m / s than as Ns. However, some candidates omitted a unit or wrote kg / m / s.

(i)2 Many successful calculations of the average resultant force were seen.

Question 4

(a) Many candidates gained credit for this question. However, some candidates used the wrong formula for the volume of a cylinder or stated a wrong unit for the density they had found.

(b) (i) Few candidates were able to name the device. The most common incorrect answer was barometer.

(ii) The correct formula was usually written down and used. Some candidates failed to convert the 2.0 cm level difference to 0.02 m. Others made their final step the subtraction of their answer from the atmospheric pressure.

(iii) This question proved challenging for many candidates. Having used the correct formula in **(ii)**, candidates needed only to state that the area of cross-section of the tube had no bearing on the value of *h*, or that the pressure of a liquid column depends only on the values of the quantities in the formula.

Question 5

(a) Some candidates seemed to have no knowledge of a thermocouple and attempted to draw another kind of thermometer.

(ii) Candidates gave a range of answers and full credit was frequently awarded.

(b) The sensitivity of a thermometer was not a well-known concept for many candidates. In **(i)**, most candidates could suggest higher sensitivity for partial credit but few could make a statement equivalent to “the mercury thread moves further for a given temperature change”. Similarly in **(ii)**, again greater sensitivity was suggested for partial credit, but a minority of candidates correctly suggested greater expansion or more liquid expanding.

Question 6

(a) Most candidates gave at least two factors that determine the rate of evaporate.

(b) The most common approach required the ideas of higher energy or faster molecules evaporating, leaving behind the lower energy or slower molecules. References to hotter or colder molecules were not acceptable. There was sometimes confusion in answers, with sweating mentioned or with convection being involved.

Question 7

(a) Most candidates mentioned a single or one colour, frequency or wavelength and gained credit.

(b) Many candidates answered this question well. The most accurate drawings were seen on scripts where the reflected and refracted rays had been drawn first. A few candidates drew the reflected and refracted wavefronts in the glass, making drawings less clear.

(c) Many candidates gained full credit for this question. Where candidates gained only partial credit, this was usually for errors in the drawing or labelling of the amplitude.

Question 8

(a) Many candidates stated that vibration takes place in the direction of travel of the wave. However, very few made the required point that it is particles that vibrate. Credit was also awarded to many candidates for stating that the wave consists of compressions and rarefactions.

(b) (i) Most candidates gave a value for the speed in the range 900 to 2000 m / s.

(ii) Many candidates gained full credit for this question. However, some candidates omitted the unit or transposed the formula wrongly.

Question 9

(a) Many candidates answered correctly but a few drew a circuit with the lamps in series.

(b) Most candidates gained for credit for both parts of this question.

(c) Most candidates gained credit for writing down E = IVt or E = Pt. Subsequent credit depended on correct substitutions and correct arithmetic. Many candidates made errors in one or other of these.

Question 10

(a) Most candidates correctly suggested iron or soft iron for the material of the core.

(b) (i) The magnetic field set up by the primary coil was sometimes not described as alternating or changing. Few candidates stated that this field was cut by or linked with the secondary coil. Candidates also needed to state that a voltage was induced in the secondary coil. The required word “induced” was sometimes absent.

(ii) Most candidates calculated the generator voltage correctly. However, some candidates failed to state a formula and so used the numbers incorrectly.

(c) Candidates who suggested that current would be lower gained partial credit. Following this, many went on to the conclusion that this leads to less heat production. Those who suggested changes in resistance were unsuccessful.

Question 11

(a) Many totally correct nuclide equations were given. However, in some cases candidates wrote “C” rather than “N” as the symbol for the product nucleus.

(b) Only the strongest candidates gained full credit for this question. For each type of radiation, many candidates failed to state clearly whether or not the emission takes place. Even if a correct statement was offered, explanations were often incorrect.

PHYSICS

Paper 0972/61
Alternative to Practical

Key messages

- Candidates need a thorough grounding in practical work during the course, including reflection and discussion on the precautions taken to improve reliability and control of variables.
- Candidates should be aware that as this paper tests an understanding of experimental work, explanations will need to be based on data from the question and practical rather than theoretical considerations.
- Candidates should be ready to apply their practical knowledge to unusual situations.
- Questions should be read carefully to ensure that they are answered appropriately.

General comments

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

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

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

Questions on experimental techniques were answered much more effectively by candidates who clearly had experience of similar practical work and much less successfully by those who apparently had not. Some candidates appeared to have learned sections from the mark schemes of past papers and wrote responses that were not appropriate to the questions set on this question paper.

It is expected that numerical answers will be expressed to a number of significant figures which is appropriate to the data given in the question or a measurement carried out by the candidate.

Comments on specific questions

Question 1

(a) The majority of candidates successfully recorded the length of the spring but a few gave an answer in cm instead of mm.

(b) Most candidates successfully calculated *e* and obtained a correct value for the spring constant.

(c) Many candidates recorded *t* suitably although some of those incorrectly calculated the period *T*. Relatively few candidates realised that the unit of T^2 is s^2. Most were able to calculate the second value for the spring constant.

(d) In this question, candidates were required to make a judgement based on their own values for *k*. The statement needed to be clear, saying that either the results support the assertion that the two values for *k* are the same within the limits of experimental accuracy or that they are not. The justification then needed to match the statement with wording that gave a clear explanation of why the results were judged to be within, or beyond, the limits of experimental accuracy.

(e) Partial credit was awarded to candidates who suggested at least three additional values of mass. Further credit was awarded for using a range of masses that is realistic for this experiment in a school laboratory setting (between 50 g and 600 g).

Question 2

(a) Most candidates recorded the current correctly.

(b) Most candidates recorded the correct potential difference in the table.

(c) A significant number of candidates did not complete the table headings.

(d) Most candidates labelled the graph axes correctly and drew them the right way round, choosing a suitable scale. Plotting was generally accurate. Candidates should use neat crosses for the plots, or neatly circled dots so that the accuracy of the plotting is clear. Many candidates drew a well-judged straight line although some drew a 'dot-to-dot' line whilst others drew a straight line that did not match the plots.

(e) In this question candidates needed to clearly show the triangle method on the graph, with a large triangle using at least half the distance between the extreme plots. Many candidates achieved this. The value of *R* was expected to be correctly calculated, within the acceptable range and with the unit Ω.

Question 3

(a) Most candidates drew the normal and incident ray correctly. Candidates were expected to know that greater accuracy is achieved in this experiment when the pin separation is large. Candidates were given credit here for using a pin separation of at least 5.0 cm. Some candidates sensibly used a pin separation well in excess of 5.0 cm.

(b) Many candidates drew the line joining P3 and P4 with care and extended it to the normal. They went on to measure *a* and *b* accurately and therefore obtained a value of refractive index within the tolerance allowed. Candidates were expected to realise that an answer to two or three significant figures was required here.

(c) Many candidates calculated *n* correctly. They were also expected to work out that *n* has no unit.

(d) Successful candidates made relevant suggestions from their experience. Some candidates appeared to be relying on answers they had learned from past papers that were not appropriate for this question. This usually resulted in candidates suggesting precautions rather than identifying difficulties.

(e) The correct response, "View base of pins" was chosen by many candidates but all responses were chosen by some candidates. Candidates should be aware that viewing the bases of the pins is a very useful precaution in this type of experiment as it overcomes the problem of ensuring that all four of the pins are vertical.

Question 4

Many candidates coped well with this planning question. Those who followed the guidance in the question were able to write concisely and addressed all the necessary points. Most candidates explained a relevant experiment, although some described an investigation that appeared to be based on a question from a

recent past paper. A significant number of candidates drew a circuit diagram in which the voltmeter was in series with other components. It is important that candidates state clearly the readings that must be taken. In this investigation, many candidates did not specify measurement of current and potential difference. Candidates needed to explain that the time taken for a specific temperature rise must be measured. Many missed this point and wrote about measuring the temperature every 30 s. Construction of a table of readings helped some candidates to organise their thoughts and to write clearly about how to carry out the investigation. The table needed to include columns relevant to the description. Typically there were columns for time, potential difference, current and power, with appropriate units.

Credit was awarded for sensible suggestions of possible variables that should be kept constant. For example, the starting temperature of the water, volume of water used and same finishing temperature.

Candidates were expected to explain how to reach a conclusion from their readings. Candidates should be aware that this is not the equivalent to making a prediction about the expected results.