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FOREWORD

This booklet contains reports written by Examiners on the work of candidates in certain papers. **Its contents are primarily for the information of the subject teachers concerned**.

PHYSICS

GCE Ordinary Level

Paper 5054/01
Multiple Choice

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

General comments

The number of candidates sitting the examination in June 2005 was 8028. The mean score for this paper was 28.5 out of 40 (71%) and the standard deviation was 19%.

The responses were good throughout the paper, showing that all the candidates were well prepared over the whole syllabus.

Questions 7, **14**, **26** and **29** were found to be very easy.

Comments on specific questions

Question 6

Answers **B** and **C** proved popular with a number of candidates. Perhaps it was not realised that it was the two 0.75 m lengths which had to be added.

Question 11

Many candidates were not able to suggest how to obtain the energy equivalent of 2 kg of matter. Responses **A**, **B** and **C** all had their supporters.

Question 22

B, **C** and the correct answer **D** were all popular choices. It is possible that “guessing” at the overall picture was more popular than considering refraction at each surface in turn.

Question 25

Almost as many candidates chose option **B** as chose the correct option, **C**.

Question 28

Only **C** was rarely selected suggesting that candidates were only familiar with the symbol for a lamp.

Question 32

Most candidates chose **A** or **C** in equal numbers. The weaker candidates chose **C**, assuming that the currents were in opposite directions because the compasses pointed in opposite directions.

Question 37

The largest number of candidates opted for **D**, taking one third of the fixed resistor value instead of the total resistance value. The higher-scoring candidates chose correctly.

Question 38

Almost all the candidates eliminated **A**, realising that gamma radiation was present. The other three options attracted similar numbers of candidates.

Paper 5054/02

Structured and Free Response

General comments

The overall impression of the Examiners was that candidates had shown a better standard of explanation in their answers this year and that it was thus easier to award marks for their knowledge of Physics. The standard of grammatical English was generally high and was commented on favourably by many of the Examiners. The detail provided by candidates in answers to ***Section B*** was usually more than adequate and it was encouraging to find that the majority of candidates were able to quote formulae when answering numerical questions. Candidates should be encouraged to write an equation down directly in the form that had been learnt rather than writing down an algebraic transformation of the equation which may be wrong. A sizeable proportion of candidates were let down by an inability to manipulate equations to give the correct answer.

There were no major variations in performance between questions, although, as always, individual parts of some questions caused more difficulties than others. In particular the single mark in **Question 2 (b)** was often not awarded. Candidates were able to choose two questions from three in ***Section B***. The difference in performance between the questions in this section was not major. There was a range of difficulty within most questions which allowed the weaker candidates to display some knowledge but was a challenge to the most able.

There were no lined pages on the question paper this year as the questions filled the question booklet.

The time available for the examination appeared to be more than adequate. The vast majority of candidates attempted only two questions from ***Section B*** and made full attempts at all the questions in ***Section A***.

Comments on specific questions

Section A

Question 1

(a) A significant number of candidates drew an arrow from the Sun to the Earth, rather than the other way round.

(b) Most answers displayed an understanding that speed is distance divided by time, with the best candidates actually calculating the speed of both planets. The units quoted were usually millions of km/years but any conversion to other units was acceptable. Weaker answers compared the size of circumferences and time of orbits without any clear reference to speed. In **(ii)** many candidates found the closest, rather than the largest distance of approach. Only about half the candidates realised that the two radii have to be added to find the largest distance between the two planets in their circular motion round the Sun.

Answers: **(b)(ii)** 258 million km.

Question 2

(a) This was a disappointing question because many candidates failed to either draw a ray th optical centre of the lens or to draw two rays from the top of the object that met at the sam on the image. However, candidates who had learnt the correct technique for drawing ray diag through lenses were able to demonstrate their technique.

(b) As the object approaches the lens, the lens should move closer to the object, or away from the film. The majority of candidates were completely unclear about which direction the lens should be moved. Suggesting that the lens moves forwards, for example, was often spoilt when a candidate made clear that this was the same direction that the object was moving. Candidates should be unambiguous about any direction that they quote by, for example, stating "to the right", which will be interpreted from the diagram.

(c) Some excellent diagrams were produced and it was unusual for a candidate to score very badly in this question. A few candidates did not realise that dispersion occurs at the first face or that the final spectrum is diverging and not a parallel set of rays.

Question 3

(a) As is often the case, some candidates found difficulty in describing the role of molecules in forming a pressure. Molecules should strike the walls of the container, and, to form a large pressure, they must strike often or with a great frequency or speed. In **(ii)** most candidates earned the mark by realising that there will be fewer molecules inside the cylinder.

(b) The correct answer should be 0.398 m^3, since the volume of the cylinder should be subtracted from 0.4 m^3. However, since the data in the question was only given to 2 significant figures the answer 0.4 m^3 was accepted for full marks. The question asked for a statement of the equation used in the calculation and so full marks were not earned unless some form of Boyle's law was quoted.

Answer: **(b)** 0.398 m^3 (0.40 m^3 to 2 significant figures).

Question 4

(a) The majority of candidates stated that the water has least P.E. somewhere along the lowest pipe, and if they found difficulty in expressing this marked an x on the diagram to make it clear.

(b) The formula for efficiency was well known. The question states that "the water loses 5.0×10^9 J of energy". Many good candidates took this to mean that the total input energy was 9.5×10^9 J, rather than 5.0×10^9 J. Since this was a reasonable interpretation of the question, 47% was also accepted as an answer. In **(ii)** errors were often arithmetical or the conversion from 30 minutes to seconds was ignored or calculated wrongly.

(c) There were a large number of sensible advantages suggested. The most common was a lack of pollution, since no harmful gases are emitted. The low cost of the fuel involved was also mentioned, as was higher efficiency, the rapid response of a hydroelectric power station and the renewable nature of the energy supply. Candidates should not, however, state that a renewable energy source can be used again.

(d) Many candidates having stated in **(c)** that hydroelectric power stations produce no pollution stated in this question that they did produce pollution! There were many possibilities for a correct answer, such as flooding of the area to form a lake (or down river if the dam should fail), destruction of forests, scenery or habitats, and silting of the lake. Many candidates suggested that fish would be affected but this was not accepted without some indication of where or how they would be harmed as, with a dam, there is likely to be more water available for fish.

Answers: **(b)(i)** 0.9 or 90% or 0.47 or 47%, **(ii)** 2.5×10^6 W.

Question 5

(a) The arrows in compasses A and C should point to the right and in B to the left. Many candidates tried to draw a magnetic field loop around the coil which then meant that A and C were not horizontal.

(b) Most candidates realised that the poles in the soft iron pieces were in the order SNSN (starting from the left) or NSNS, and thus unlike poles faced each other. The pole pieces move together and this was well stated, but sometimes there was little or no explanation of the reason.

(c) The majority of candidates realised that the field reverses in **(i)** and is weaker in **(ii)**. Weaker candidates failed to make their answers clear by stating, for example that the field "changes".

Question 6

(a) Only a few candidates failed to earn the marks in this section, particularly as they could fo calculations provided for the television.

(b) More power is used by the water heater since its resistance is lower. However, other corre statements were also accepted, in particular a correct comparison of the currents. Answers in terms of the high specific heat capacity of water were often not clear enough.

(c) The majority of candidates showed that they understood the purpose of the fuse, by indicating that the current in the water heater is greater than 3A and thus the fuse will melt. Some candidates failed to score because they merely stated that a 13A fuse was needed, or that the fuse would stop the appliance being damaged, and some incorrectly stated that a blown fuse creates a short-circuit.

Answer: **(a)** 3024, 3.024, 1.512.

Question 7

(a) Electrons flow in the opposite direction to the conventional current. Many candidates seemed unaware of this.

(b)(c) The light dependent resistor (LDR) was well known and the effect of light on the circuit was well understood. A few candidates brought increased current into their argument, which then caused difficulty in explaining that the p.d. across the LDR decreases.

Question 8

(a) The majority of candidates gave the correct answer, with an occasional failure to give the correct or any unit.

(b) The formula for calculating current was widely known, although a few candidates used 1.5V rather than 3.0V in their calculation.

(c) There were many acceptable advantages of connecting cells in parallel. The most common was that if one of cell fails to function then the circuit would continue to operate. There was the occasional difficulty in making this point clear. Other acceptable answers were a smaller resistance, longer operating time or less loss of energy. When compared to cells in series, cells in parallel produce less current when connected to a resistor larger than the internal resistance of one of the cells and more current when connected to a smaller resistance. Thus merely suggesting that a higher current can be produced was not sufficient.

Answers: **(a)** 4.5V; **(b)** 0.30A.

Section B

Question 9

Most candidates coped well with **(a)** but the marks awarded for **(b)** were much lower.

(a) The graphs drawn usually scored full marks, although axes were not always labelled and there were some problems in representing a uniform deceleration at the end of the journey. Similarly, most candidates gave an adequate definition of acceleration in words. Equations were sometimes given and these were accepted as long as the terms involved in the definition were explained. Explanations in **(iii)** were varied and often displayed a candidate's inability to express the idea correctly. For example "constant acceleration" was often expressed as "acceleration at constant speed" or "a uniform velocity change" with no explanation given of the word uniform. The unit quoted in **(iv)** was often wrongly quoted as m/s.

(b) Candidates were asked to name the horizontal and vertical forces. Any four from we... force, air resistance, friction and the driving force from the engine were accepted. ... names for these forces were accepted as long as their function was clear, and a diag... candidates was often helpful in awarding marks. Many candidates only gave one horizonta... vertical force and some did not give the direction of the forces. Answers to **(ii)** were often v... weak, with either just the statement that the forces were balanced/unbalanced or with a... explanation that was confused. Candidates were expected to mention that the forwards force was larger, the same as, or less than the backwards force. Many answers were well expressed, particularly when mention was made of the resultant force or when simple diagrams were drawn showing one force being larger than another. Any sketch graph with axes labelled and with a non-straight line was accepted in **(c)** and most candidates scored this mark.

Answer: **(a)(iv)** 2.5 m/s^2.

Question 10

(a) Almost all candidates scored the mark in **(i)**. Candidates generally displayed knowledge of the three forms of heat transfer in **(ii)** but did not relate their answers to the actual situation given in the question. However, when mention was made of vibration of the molecules and then transfer of energy from molecule by conduction, the marks were awarded. Most candidates understood the phenomenon of convection but did not always explain that the hot air expands and becomes less dense. It was less common to find reasonable accounts of radiation, where, for example, radiation was mentioned as being electromagnetic or infra-red. Some candidates were unable to write enough detail in their answer to **(ii)**. In **(iii)** many candidates incorrectly stated that the carpet absorbs heat and thus feels warm. Full answers required the idea that the carpet or the trapped air inside was a bad conductor or reduced convection.

(b) Answers to this section produced higher marks than **(a)**. The simple calculations were very frequently correct. Insulating the roof was frequently chosen as the best option for the house owner. A comparison of installation costs, or savings was not always given as an explanation for the choice of option, rather, a reference to the 25% of heat lost through the roof was sometimes the only explanation given. Answers to **(iii)** were usually sensible and well expressed. A large number of options were available, such as painting walls white, using curtains, preventing drafts, insulating the walls, reducing the temperature in the house etc. Some candidates, however, suggested painting the walls black or gave methods that had already been given in the question.

Answers: **(a)(i)** 25%; **(b)(i)** X=$800, Y=$100.

Question 11

(a) Most candidates appreciated the nuclear structure of the atom and an accompanying diagram made their understanding clear. In **(ii)** candidates needed to mention that radioactive decay involves the nucleus and this was sometimes not clear, although usually some marks were awarded for the emission of an alpha, beta or gamma particle, or for some mention of instability or randomness. In **(iii)** the question asks not for the causes of background radiation but an explanation of the meaning of background radiation. A reference to a specific cause, such as cosmic rays, was insufficient but many candidates were successful when they explained that it was naturally occurring, from the surroundings or present without a source. In **(iv)** the majority of candidates appreciated the halving procedure that occurs in a half life. However, subtraction of 18 counts/minute was necessary before the halving process, and there was no need to add on the 18 at the end as the question asks for “the count rate due to the sample of atoms alone”.

(b) The better candidates found this section straightforward and scored full marks. Annotated equations for alpha and beta decay were helpful although in **(ii)** the question asks for a description of the change that occurs in the atom.

Answers: **(a)(iv)** 205; **(b)(i)** 84.

Paper 5054/03

Practical Test

General comments

Both the standard of the candidates and the paper were very similar to June 2004.

Comments on specific questions

Section A

Question 1

(a) Most candidates obtained a sensible value for the length of the string of between about 80 cm and 90 cm. Because of the difficulties marking the string and then measuring the length, candidates were allowed to measure the length to the nearest cm, although good practice would be to attempt to measure such lengths to the nearest mm. Rather than measuring 4 circumferences as a single length, a number of candidates measured 4 single circumferences. This was not an acceptable technique, because the percentage error in each of these measurements would be greater than the percentage error of measuring the total length of string corresponding to four circumferences.

(b) D was calculated correctly and in most cases a sensible value was obtained. Those candidates losing this mark often did so because of the use of an inappropriate number of significant figures. Since l had been measured to 2/3 significant figures the value of D should have been quoted to the same precision.

(c) Some candidates did not achieve the mark for the measurement of the internal diameter and the height because readings were quoted to the nearest cm. Also large values were often obtained for the internal diameter possibly because the diameter was measured in the region of the rim rather than the body of the beaker. These large internal diameters were given credit at this point but they often led to a negative value for the density which was penalised in part **(d)**.

(d) Most candidates measured a correct value for the mass of the beaker and calculated the density correctly. The major problem in this part was negative densities which were obtained because the internal diameter was greater than the external diameter. Candidates who had obtained such values should have re-checked their measurements to see where the mistake had been made. It was clear that a number of candidates had done this. Because of the complexity of the formula, significant figure errors were ignored in this question.

Question 2

(a)(b) Most candidates obtained good values for the time for the water to cool from 80ºC to 75ºC in both of the beakers. In the majority of cases the time taken for the water in the 250 cm^3 beaker to cool was less than that for the water in the 100 cm^3 beaker to cool. Most candidates recorded times to the nearest second or better and Examiners allowed answers such as 1 minute 25 seconds. The only problem arose when candidates gave answers such as 1.25 minutes. It was unclear whether this meant 1 minute 25 seconds or 1 minute 15 seconds and Examiners generally penalised such methods of recording the time.

(c) Despite the fact that stirring the water is a common precaution to take in a heat experiment, few candidates actually stated this precaution. The most common precaution was reading the scale of the thermometer with the eye on the same horizontal level as the meniscus, although some candidates did, incorrectly, refer to looking vertically at the thermometer. The other often stated precaution was ensuring the bulb of the thermometer did not touch the side or base of the beaker.

(d) Candidates could only gain the final mark if the results indicated that the 250 cm^3 beaker cooled at a faster rate. Most gained this mark and correctly stated that the beaker had a larger surface area of water that was open to the air.

Question 3

(a)(b)(c) The first 4 marks of this question were all based on the table of results. A number of ca omitted one or more units in the table and therefore lost the unit mark. There were other where the current measured by the candidate had been misread e.g. the Supervisor suggested t the maximum value of the current was likely to be of the order of 0.3 A and yet the candidate was quoting values of 3.0 A. Generally measurements of potential differences were correct but some candidates used an extremely narrow range e.g. 1.0 V to 2.0 V. In most cases the resistance values were calculated correctly and gave the correct trend of an increase in resistance as the potential difference across the lamp increased.

(d) The comment mark could only be scored if the results the candidate had obtained showed the correct trend in resistance values. A number of candidates had the correct results showing that the resistance increased as the potential difference increased but went on to incorrectly state that the lamp obeyed Ohm's law. Since the temperature of the lamp is increasing and the resistance is increasing, it does not obey Ohm's law.

Section B

Question 4

(a) The expected value for the height of the ball above the bench was about 5.0 cm. A number of candidates did not quote this value to the nearest mm, or confused the height of the ball above the bench with the length of the pendulum and quoted values in the region of 60.0 cm. To ensure that the height was vertical, candidates should have used the right angle of a set square between the bench and the vertical rule. This should have been shown on a diagram showing, the bench, the rule and the set square.

(b) The idea of part **(b)** was to get candidates used to timing 10 oscillations and repeating their measurements in order to obtain an average value for 10 T and then T. Only the best candidates achieved the 2 marks in this question. Very few candidates showed the time for 10 oscillations and even fewer repeated the time for 10 oscillations. There were also quite a large number of candidates who quoted the time for 10 oscillations to the nearest second despite the fact that a stopwatch had been specified in the question.

(c)(d) Good candidates obtained all 4 marks for the table of results. Errors made by candidates included the following:

- units omitted from the headings of the table
- only a very small range of h values were used by some candidates e.g. 5, 6, 7, 8, 9 and 10 cm
- values showed the wrong trend, i.e. as h increased T should have decreased, but a number of candidates found that T increased as h increased.

Most candidates obtained correct values for T^2 but these were sometimes quoted to 2 or less significant figures, this was insufficient precision considering the range of T values that was used by most candidates.

(e) It was pleasing to see that the majority of candidates correctly labelled and put units on the axes of their graph. However, it was disappointing to find that the scale chosen for the graph often meant that the plotted data occupied less than half the grid in either direction. Data points were plotted correctly and the line drawn was often the best fit.

(f) When determining the gradient of the graph, many candidates are now using a large triangle. Candidates should also use points that are on the line. A number of candidates use data points that are not on the best fit line to determine the gradient and this leads to the loss of marks. The final mark which was for accurate results was obtained by the most able candidates.

Paper 5054/04

Alternative to Practical

General comments

The range of marks achieved by the candidates was from 30 to 0, with the majority scoring between 15 and 25. In general the candidates were well prepared and showed an understanding of practical skills in answering the questions. Most of the scripts were well presented but some candidates make it difficult for the marker by not writing clearly and legibly, particularly when writing numbers. There were some candidates using pen for the graph work and drawing diagrams. They should be reminded to use a sharp pencil.

As has been said before, the best possible preparation for candidates for this paper is familiarity with handling equipment and use of a wide variety of apparatus.

Comments on specific questions

Question 1

This question was longer than those seen in previous papers. It enabled the candidate to develop a topic and to be questioned on different aspects of the same practical situation. Many candidates scored full marks on this question although some did not appreciate that the question continued over the page and answered parts **(e)** and **(f)** as if they were a new question.

(a) Most of the candidates were able to calculate the mass and volume of the marbles accurately from the data given in the table, although some made the question too difficult and performed complex calculations. A common error was to include units with each calculated value which were not needed as they were given in the headings

(b) The graph was generally very well completed with only a small number of candidates making basic errors such as:

- axes wrong way round
- axes not labelled with quantity and unit
- scales able to be doubled.

The required graph was a best fit straight line through the origin (which should have been shown on the scales). The best fit line should have points equally distributed above and below the line, not joining the last point to the origin.

(c) The expected answer here was to find the gradient of the best fit line, using at least half the line drawn, and give a final answer with the correct unit. Some credit was given however for answers which involved averaging individual results or use of single values from the table.

(d) Candidates had no problems identifying the type of glass with a density near to their answer.

(e)(i) Many excellent answers were seen here with candidates appreciating the practical problems of water on the marbles after the volume is measured.

(ii) Fewer candidates were able to identify the reasons for choice of measuring cylinder size, with many quoting just ‘more accurate’. Choice of equipment from a range available is a skill most would be able to do when performing a practical, but explaining the choice takes careful use of language. Clear answers were seen such as ‘the measuring cylinder must be large enough to fit all the marbles in’ and answers quoting the volume to be measured were credited.

(f)(i) Excellent answers stating a vernier calliper or micrometer were given. Credit was given to answers using a ruler only if several marbles and end block were also used.

(ii) The required answer here was ‘diameter’ of the marble. Credit was given if this was clearly stated in **(iii)**.

(iii) Candidates who had answered **(i)** and **(ii)** correctly were able to complete the question.

Question 2

This question was well answered by most candidates.

(a) The candidates were asked to re-draw the circuit. Only a few altered the existing circuit.

Common errors were to swap the meters, place the voltmeter across the variable resistor rather than the bulb, or to draw lines for the connecting wires then draw the meters over the top.

(b) Although most of the candidates could identify the three correct column headings, many missed the unit mark by omitting the unit for resistance. The use of the first column for 'reading or observation number' left candidates with insufficient columns for the three quantities required.

(c) Candidates often tried to use an equation (V = IxR) here, resulting erroneously in inverse proportion between I and R or simply stated direct proportion instead of considering the properties of the filament of a light bulb as a wire with resistance even when I = 0.

Question 3

This question was well answered by most candidates who showed an understanding of the practical details.

(a) The candidate was required to make the link between the number of inversions and the temperature rise of the lead. The data shows a small temperature rise for 100 inversions of the tube.

(b) An appreciation of the care needed when using liquid-in-glass thermometers was shown here as almost all the candidates identified the reason for removing the thermometer during the experiment.

(c) There were many excellent responses here with candidates identifying good advantages and disadvantages of a longer tube. The commonest answers were greater gain in gravitational potential/kinetic/thermal energy and the practical difficulties in handling a longer tube. These ideas were generally well explained.

(d)(i) A surprising number of candidates found the substitution of the values given in the stem of the question into the given relationship difficult. Common mistakes included ignoring the length, l, on the top line or trying to convert units when this was not required.

(ii) Many answers were too vague here such as 'errors in readings'. A specific difficulty with a named measurement was required for the mark to be awarded.

Question 4

This question involves an investigation and an appreciation of variables in this context. Although some candidates were unsure about how to answer a question of this type, there were many excellent responses showing a good understanding of investigations.

(a) The candidate was required to identify two alternative variables for this experiment. Several repeated the variable already identified in the question, and others gave factors that could not be controlled, such as gravitational field strength.

(b) In this question many candidates gave far too much detail, explaining why they thought the time to fall would vary, whilst others gave answers relating to the speed of fall rather than the time taken. It is important to remind candidates to answer the question asked clearly and concisely.

A comparison was required in the answer.

(c) There were a large number of excellent answers to this question, with a variety of suggestions. The most common answer was to repeat readings and find the average.