O-LEVEL PHYSICS

Paper 5054/01
Multiple Choice

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

General Comments

The mean score for this paper was 28.3 out of 40 (71%) and the standard deviation was 20%.

The uniformly good responses to all the questions showed that the candidates had a good understanding of all parts of the syllabus.

Questions 6, **7**, **8**, **11** and **15** were found to be relatively easy.

Individual Comment

Question 1

Almost half of the candidates, including many of the high-scoring ones, chose option **B**.

PHYSICS

Paper 5054/02

Paper 2 Theory

General comments

The overall impression of the examiners was that candidates were generally well prepared for the examination. Good candidates were readily able to score high marks and even weak candidates were able to show some understanding of the syllabus in every question. It is pleasing that the majority of the candidates produced clear and legible answers. The detail provided by candidates in answers to ***Section B*** was usually very good and it was encouraging to find that the majority of candidates started a calculation by writing down the equation that was relevant. Candidates should be encouraged not to start their answer by repeating the question.

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

There was no evidence of candidates having too much or too little time. There were only occasional instances of misinterpretation of the instructions on the question paper, when some candidates answered all three of the ***Section B*** questions.

Comments on specific questions

Section A

Question 1

(a) Although most candidates realised that a force and a distance must be known to calculate power, few answers specified that the distance was the height of the stairs and that the force was the weight of the candidate. Most candidates correctly suggested that the time should be measured.

(b) There were many possible precautions, for example ensuring that the time is measured by several people and averaged, that the height is measured vertically or that the balance being used to measure mass has no zero error. Most answers were vague and merely suggested that the experiment should be "repeated" or "done accurately".

(c) The formulae for power and work were well known and both marks were often scored. However a fairly common error was the suggestion that force is calculated by measuring the acceleration of the candidate as he runs up the stairs and the formula F=ma then used. There was no penalty if extra kinetic energy was included as the candidate accelerates up the stairs, as long as the major increase in potential energy had been included in the calculation.

Question 2

(a) The front wheel of the cyclist should be marked anywhere between 36 m and 50 m, but not at either of these positions. Many candidates had not realised that the cyclist is slowing down at 12 s and thus could not have travelled 50 m. Such candidates failed to earn one mark in **(a)** but could earn all the other marks in the question, even if their line in **(b)** did not show any deceleration at the end of the graph.

(b) Points were generally plotted well on the graph axes at 4, 8 and 12 s. However many candidates merely joined the origin to the first point using a straight line. The question states that the cyclist accelerates from rest and so the initial line should be curved. After 12 s the gradient of the line should decrease to show that the cyclist slows down. A correctly shaped curve from 12 to 16 s was drawn by the best candidates but was not required for full marks.

(c) The question required candidates to find an average speed and this is most simply calculated with the standard formula for speed using the distance travelled by the cyclist at 12 s. Some candidates measured the slope of the graph, found several speeds in an attempt to find an average or used 16 s instead of 12 s. They were able to earn one mark if their calculation showed clear evidence of the formula being used for speed.

Answer: **(c)** 3.0 m/s

Question 3

(a) Most candidates realised that as the coil turns the sides cut the lines of magnetic flux. A number of candidates confused the generator with a motor and described how current caused the coil to turn.

(b) The purpose of the slip rings is to allow the induced current to be connected to the load without the wires becoming tangled. Many candidates merely stated that the split rings cause the current to change direction every half turn or were used to support the coil.

(c) The majority of candidates did not produce an adequate definition of Lenz's law as applied to the direction of the induced current. A common error was to state the right hand rule for finding the direction of the induced current. This was not accepted as Lenz's law.

(d) Increasing the number of turns in the coil, increasing the strength of the magnet or using a larger coil are all methods of increasing the induced e.m.f.. However some candidates incorrectly suggested that increasing the current applied would increase the induced e.m.f.

Question 4

(a) It was pleasing to find many answers that correctly defined the critical angle as the angle of incidence in the denser or slower medium when the angle of refraction is 90°. Other definitions were possible and accepted in terms of, for example, the smallest angle of incidence for which the ray emerges from the denser medium. A few candidates described total internal reflection rather than the critical angle.

(b) The refractive index may be found from the critical angle or by using 63° as the angle of incidence and 40° as the angle of refraction. Errors were caused when candidates used the wrong angles entirely or if 40° was used as the angle of incidence. In either case candidates were required to state the formula that they used in the calculation and the correct formula, even with the wrong values, earned credit. The inverse of the accepted answer earned two of the three marks available.

(c) The vast majority of the candidates drew a correctly reflected ray.

Answers: **(a)** 46° **(c)** 1.39

Question 5

(a) The question implied that the two spheres are rubbed separately to obtain positive and negative charges on each. Many candidates suggested the two spheres are rubbed together and this was accepted as long as the positive sphere clearly lost electrons and the negative sphere gained electrons. A common error was to confuse the simple situation with charging by induction. Many candidates incorrectly suggested that positive electrons were involved.

(b) The general quality of the field patterns drawn was encouraging, with, in general, lines drawn from the positive to the negative charges. Some candidates drew all field lines as straight even through there should be some curvature of the lines at the top and bottom of the diagram.

(c) The formula relating charge, current and time was well known. However many candidates made arithmetical errors in the calculation involving negative powers of ten.

Answer: **(c)** 9.0×10^{-11}A

Question 6

(a) As many candidates found this section difficult, the meaning of live was allowed as the wire of high voltage, where energy or voltage arrived at the circuit or the dangerous wire. The neutral wire was zero or low voltage or the wire connected to earth at the generator or the wire that completes the circuit with the live wire to provide passage of current. Many candidates failed to distinguish between current and voltage, e.g. it was common to find answers such as "there is no current in the neutral wire or voltage flows in at the live wire". The meaning of earth was usually known, with many clear statements that the earth wire was connected to ground or the wire that allowed fault currents to pass safely to earth.

(b) (i) The answer to this section simply required candidates to realise that, as each of the lamps are switched on one by one, the current increases, the wire becomes hotter or electrons move faster. Many candidates did not explain what happened clearly enough or stated that the fuse would blow or the circuit melt, ignoring the simpler changes that would happen initially.

(ii) If a fuse of too high a rating is used in a plug the dangerous situation occurs when the current becomes too large and the fuse does not blow, enabling the cable to overheat, causing a fire or damaging an appliance connected to the cable. Many candidates merely suggested that the fuse would blow, stating that a melting fuse could cause a fire.

(c) The majority of candidates gave a good answer to this simple question in terms of either the conduction of current by water or by the electrocution that may be caused if hands are wet when handling an electrical plug.

Question 7

(a) There was a lack of familiarity with the use of the cathode-ray oscilloscope and there were fewer candidates than expected who showed two correct connections between the resistor and the Y input of the CRO. A common mistake was to connect the battery across the Y-input or to show connections to the Y-gain control. However some candidates showed great familiarity with the CRO and even ensured that the negative of the cell in their diagram was connected to earth, a point that was not required by the mark scheme.

(b) Many candidates were able to calculate the p.d. in **(b)(i)**, but then sometimes did not draw a line in **b(ii)** 1.5 squares above or below the original trace.

Answers: **(b)(i)** 6.0V

Question 8

(a) The question asked candidates to explain the meaning of radioactive decay and the answer required mention of the spontaneous or random decay of a nucleus or the emission of alpha, beta or gamma particles from the nucleus. There was often confusion between decay and fission and some candidates gave a definition of half life. Once the nucleus, rather than an atom, had been established as the basis of radioactivity then marks were scored but scoring two marks for this section was surprisingly rare.

(b) Many candidates correctly identified the background radiation as being responsible for the count rate before treatment. There were also those who suggested that the food itself contained radioactive material – which was accepted, as was the idea that the count before treatment is needed as a control to determine whether there has been any increase in the count caused by the treatment. In **(ii)** many candidates made the correct deduction that the food has not become radioactive because the average count is the same or that the difference in count is very small, caused by random fluctuations. A few candidates came to the correct conclusion without actually considering the data. For example, "The food does not become radioactive because gamma-rays are very penetrating and pass straight through the food" was a typical approach of such answers.

Section B

Question 9

(a) Full marks were rarely awarded for this section, although all candidates obtained some marks for the common sense approach that suggests evaporation increases with an increase in temperature or when a fan blows across the surface, whereas it decreases if a sheet of plastic covers some of the surface or if the tank is painted white. The explanation of these effects caused some problem. Some candidates took the plastic cover as covering the tank rather than the surface of the water but still obtained the explanation mark for suggesting that the evaporated water might condense and fall back into the tank. Poorer answers suggested that the plastic over keeps the water hotter or cooler. The most effective answer explaining the effect of the fan was to suggest that the humidity of the air above the water decreases allowing more molecules to escape or that the fan blows away some of the lower energy molecules that would return without the effect of a wind. Although most candidates recognised that the tank would receive less energy when painted white it was rare to find a candidate who suggested that heat radiation, light or infra red would be reflected. More usually candidates made vague suggestions that "heat" was not absorbed by the white surface. Candidates should be encouraged to distinguish clearly between conduction, convection and radiation where thermal energy is transmitted.

(b) The calculations in this section were generally done well and the formulae for density, specific heat capacity and power were well known. The weakest section tended to be **(i)** where candidates had to multiply the area of the tank by the decrease in height of the water. Many candidates incorrectly attempted to use the density of water at this stage. If a candidate used a wrong value obtained in **(i)** for subsequent calculations in the rest of this section full marks could be obtained in these later sections if there were no more errors.

Answers: **(b)(i)** 0.015 m^3 **(ii)** 15 kg **(iii)** 3.3×10^7 J **(iv)** 825 W

Question 10

(a) In **(i)** most candidates realised that pressure = force/area but did not define 1 Pa as the pressure exerted when a force of 1 N acts on an area of 1 m^2. The calculation in **(ii)** was well answered with most candidates using the correct weight of 600 N. The answer to **(iii)** was very simple but some candidates became confused and suggested that the pressure decreases.

(b) (i) Many candidates incorrectly assumed direct proportion between volume and pressure. Those who correctly stated the Boyle's law formula were generally successful but many candidates failed to give any assumption that they made in their calculation, e.g. that the temperature is constant or that no gas escapes from the tyre.

(ii) The kinetic theory explanation of pressure and its increase with temperature was well known. Some candidates failed to explain that pressure is caused by the impact of molecules on the sides of the container, in this case the tyre. Full answers mentioned not only the increase in speed or kinetic energy of the molecules but also that the molecules hit the walls more frequently or harder. Weaker answers merely suggested that the molecules hit more as the temperature is raised.

Answers: **(a)(ii)** 2.5×10^5 Pa **(b)(i)** 0.014 m^3

Question 11

(a) A sizeable minority of candidates incorrectly stated that the component C was a resistor, or even a capacitor rather than a fuse. Stating that the fuse controls the current (rather than limits it) was insufficient to gain full credit for the purpose of a fuse. Most candidates correctly identified component D as a switch, and gave a good description of the purpose, referring to switching the current or circuit on and off.

(b) The calculations in this section were well done by almost all candidates, although a common mistake was to merely divide the 0.42 A into two and state that this was the current in both lamps, suggesting that resistors in parallel have the same current. This is only true if the lamps are identical and the question clearly states that the lamps are different.

(c) (i) Almost all candidates drew the circuit diagram correctly, but in **(ii)** most candidates incorrectly suggested that the current in the series circuit is larger. It was not appreciated that the total resistance when two resistors are connected in series is greater than when they are connected in parallel.

(d) Many candidates knew that resistance is inversely proportional to area and deduced the doubling of resistance, but some obtained the correct result following unnecessary lengthy calculation. The concept of resisitivity is not included in the syllabus.

Answers: **(b)(i)** 0.25 A **(ii)** 0.17 A **(iii)** 960 Ω **(d)** 1920 Ω

PHYSICS

Paper 5054/03

Practical Test

General comments

Both the standard of the candidates and the paper were very similar to June 2005. The mark scheme for the long thermal physics question in June 2006 was eased to allow candidates to score some marks for determining the rate of change of temperature and the power of the candle flame. The electrical question this year was straightforward in that it only required candidates to measure current values. The deduction of the resistance value was found to be more straightforward than had been anticipated by the Examiners. All other questions were comparable to those of June 2005.

Comments on specific questions

Section A

Question 1

(a) Most candidates obtained a sensible value for the length of the 20 marbles in the channel, however not all candidates quoted the value to the nearest mm.

(b) Ideally the set squares should have been used like the jaws of vernier callipers in order to take scale readings at each end of the line of marbles. Very few candidates adopted this technique. However other techniques were given credit, such as pushing the spheres together from each end so that there were no spaces between the spheres or quoting the scale readings which lead to the value of *L.* No credit was given to candidates who simply said that there were no spaces between the spheres, the technique used to ensure this had to be stated.

(c) Most candidates measured correctly the volume of water that just covered the spheres.

(d) The calculation of the volume of the spheres proved difficult for a number of candidates. The most popular mistake was that the value of *D* was squared rather than cubed. Also a number of candidates converted *D* to metres in order to calculate a volume in m^3. This lead to difficulties in the next part of the question where volumes in cm^3 and m^3 were combined. Generally in the practical paper it is not necessary to convert to metres and kilograms when dealing with lengths, masses, volumes, density, etc.

(e) It was expected that candidates would evaluate the ratio rather than leave it as a fraction so that an answer to an appropriate number of significant figures could be quoted. Quite a number of candidates left the answer as a ratio. Also candidates quoted units with the ratio which was not correct.

Question 2

(a) In order to determine the extension of the spring, scale readings need to be taken at the base of the unloaded and loaded spring. These should then be subtracted to obtain the extension. Only the better candidates adopted this technique. The extension should also be quoted to the nearest mm with an appropriate unit.

(b) The use of the set square against the horizontal bench in order to check that the metre rule was vertical was rarely seen. However a number of candidates checked that the rule was vertical by lining it up with the vertical stand and this was accepted.

(c) It was disappointing to see large numbers of candidates quoting the time for 20 oscillations to the nearest second. Candidates should have been provided with a stopwatch reading to 0.1 seconds or better or should have used their own watch provided it could read to the same precision. Good candidates obtained a correct value for the period but popular mistakes included, using 20T instead of T or working out the frequency rather than the period.

(d) If the experiment had been carried out correctly the ratio T^2/x should have been equal to 4.02 s^2/m or 0.0402 s^2/cm. Good candidates obtained a value within acceptable ranges of these values, those who obtained values outside the ranges had often measured the extension incorrectly, possibly using the total length of the spring rather than the extension.

Question 3

(a) Most candidates drew a correct circuit diagram. The candidates who did not obtain this mark either drew a diagram of the circuit without using correct circuit symbols or placed the resistors in series rather than in parallel.

(b), (c) Good candidates obtained correct values for the three currents and were awarded the three marks.

and (d) If the first current was not correct, marks were often obtained for the other two values on an error carried forward basis because the candidates' results showed the correct trend in the values obtained. Omission of units was only penalised once as was the use of incorrect precision when the currents were measured.

(e) Originally the final mark was to be awarded for the realisation that since the second current was approximately half the first current, then the resistance must have been doubled because the power supply voltage was approximately the same. A large number of good candidates calculated the supply voltage by using the first current and resistance and then calculated the second resistance. This was an impressive piece of physics for candidates at this level. Weaker candidates incorrectly thought that the resistance had been halved because the current had been halved.

Section B

Question 4

(a) Quite a number of candidates only measured two masses, the mass of the empty beaker and the mass of the beaker together with the water. No subtraction was done in order to calculate the mass of water. The subsequent high value for the mass of water leads to a high value for the power of the candle at the end of the question. Examiners had hoped candidates would interpolate between the divisions of the thermometer when room temperature was measured but only the best candidates adopted this technique.

(b) 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.
- Temperature values only being recorded at 1 minute intervals. In such an experiment it is best to record temperatures at, at least, half minute intervals.
- Temperatures not recorded to better than 1ºC.

(c) It was pleasing to see that the majority of candidates correctly labelled and put units on the axes of their graph. A larger proportion of candidates chose an acceptable scale for their graph compared to June 2005.

(d) As the question did not ask candidates to determine the gradient of the graph in order to find the rate of rise of temperature, it was decided to mark this section of the paper relatively leniently. A large number of candidates simply recorded the temperature at 150 s and gained no marks. One mark was given to candidates who found an appropriate temperature difference either by using two points on their curve or on a tangent. A second mark was then awarded for dividing this temperature difference by an appropriate time. Only the best candidates scored both marks.

(e) Error carried forward was allowed for the first mark of the power calculation. Thus those candidates who had an incorrect value for the rate of rise of temperature or an incorrect value for the mass of water could gain the first mark. This often lead to powers of the order of kilowatts which were not sensible for a candle. Thus the second mark could only be scored by those candidates who had followed all procedures correctly and had obtained a value for the power in the correct range.

PHYSICS

Paper 5054/04

Alternative to Practical

General comments

The range of marks achieved by candidates was from 30 (full marks) to zero.

The majority of centres had prepared the candidates well and it was pleasing to see so many scripts where candidates had used sharp pencils and rulers for graphical work and when annotating diagrams.

It is important that candidates have experienced a wide range of practical situations in preparation for this paper and that they give practical detail in answering the questions. This was particularly important in question three where the candidates were given limited apparatus and then asked to describe what they would observe.

In numerical answers it was disappointing to see so many candidates losing marks for either too many or too few significant figures.

Some candidates are still writing far too much. They should be encouraged to read the question carefully and only answer the question as given.

On the other hand, some candidates are giving insufficient detail to questions relating to a given practical situation. For example, the answers ‘to avoid error’ or ‘to make the experiment more accurate’ should be avoided and specific detail of that practical given.

Comments on specific questions

Question 1

This question carried 14 marks and included drawing a graph, showing an understanding of straight line graphs and of the term *extension*.
Many candidates scored full marks for this question.

(a) The responses to part **(a)** needed to be marked on the diagram. No credit was given here for written comments in the body of the question.

(i) The majority of candidates were able to mark clearly and to label a vertical line showing the length of the spring.

(ii) To score this mark, candidates needed to demonstrate their practical skills by drawing a vertical ruler or labelled line with close proximity to the spring. This is a practical detail to reduce the possibility of parallax error. Many candidates drew the ruler either in front of or behind the spring which was acceptable.

(iii) Candidates were able to draw an acceptable eye or labelled point to show a suitable position for taking the reading. It is possible that some candidates did not read the question carefully enough as the eye drawn was not level with their lower end of the marked length of the spring. A few candidates attempted to draw a three-dimensional view which was not clear enough.

(b) The question required candidates to suggest a way of improving the table, not the readings taken. Comments on repeat readings, the number of significant figures used or the order of the columns were ignored. The required answer concerned the order in which the results were recorded, which stimulated the candidates to explain by a large number of acceptable ways.

(c) Many candidates drew excellent graphs using a sharp pencil and a ruler for the line. A few however are still using pen or large crosses and thick or freehand lines. It is important that the ruler used is long enough to draw the line in one go, as those with two lines of slightly different gradients will not score the fourth point.
Errors seen in scripts included:
– omission of quantity or unit or both,
– axes the wrong way round,
– scales unsuitable i.e. going up in x3 or x7,
– scale(s) too small i.e. could be doubled,
– points plotted incorrectly or rounding values of length *l* to the nearest cm.

(d) (i) The majority of candidates were able to link the question to the practical situation and explain that the spring has an initial length when there is no load. Comments that only used the graph, such as ‘the graph does not go through the origin’ were not creditworthy here.

(ii) There is still considerable confusion among many candidates with ‘direct proportion’ and a ‘linear relationship’. Many candidates appear to believe erroneously that any straight line graph means that the two quantities are directly proportional. **Question d (i)** gave the candidates a clue by pointing out that the graph did not go through the origin. To score the mark, the response needed to include a clear statement that they are NOT directly proportional, followed by a correct explanation.
Examples of correct explanations given by candidates are:
– since the graph does not go through the origin,
– since *F*/*l* (or *l*/*F*) is not constant (this was often well supported by evidence from the graph),
– since equal increases in *l* do not give equal increases in *F*,
– since doubling F does not double *l*.
An example of an incorrect explanation given by candidates is:
– since the graph is a straight line.

(e) (i) It was pleasing to see many clear statements that extension is the increase in length of the spring. Some candidates however lost the mark by stating erroneously that this was from the previous length. Some weaker candidates thought that this was related to the elastic limit of the spring or to the force needed to produce the change in length.

(ii) A surprising number of candidates were unable to calculate the extension of the spring even though they had correctly explained extension in **(e) (i)**. The first mark was awarded for correctly reading the length of the spring (24.5 cm) from the graph at 5.5 N. Most candidates scored this mark.
e = 20.5 cm

(iii) Most candidates scored this mark. The mark was awarded for a straight line from the origin and subsequent deviation from a straight line was ignored as this detail was not required by the question.

Question 2

This question carried 3 marks and required an understanding of a fair test in a practical investigation. Few candidates scored full marks for this question, most scoring two of the three marks.

(a) The vast majority of candidates correctly gave iron or soft iron as their answer.
A few gave vague answers such as ‘a metal’. Incorrect metals seen were copper and aluminium.
A few candidates are tempted to give more than one answer. This is to be discouraged as any incorrect answer will lose the mark.

(b) Most candidates were able to describe counting the number of paper clips attracted to the electromagnet. Candidates were not asked to describe the whole experiment, but many did in great detail. These usually included the required point.

(c) Most candidates did not appreciate that this question was about a fair test. The length of the wire used in the experiment was a variable that needed to be controlled. Some able candidates produced excellent answers explaining that changing the length of the wire would change the current or the resistance of the circuit.

Weaker candidates thought that candidate B was going to join short pieces of the wire and there was some confusion between resistance and resistivity.

Question 3

This question carried 7 marks. It required candidates to describe observations of a circuit, i.e. the brightness of the light bulb with the different components given. Many candidates used additional apparatus not supplied. Inclusion of an ammeter and/or voltmeter were not penalised if used correctly.

Few candidates scored full marks for this question and it discriminated well.

(a) The circuit diagrams were often poor. Candidates seemed unclear how to draw the puzzle box in the circuit. Any attempt was accepted where the intentions were clear.
Common errors were:
– to include in the circuit all the components possibly in the puzzle box,
– to put the lamp in parallel with the puzzle box,
– to draw a complete circuit with no puzzle box.

(b) For the first mark the candidates were required to indicate that they would observe the brightness of the bulb.
The second mark was awarded for a clear description of the need to reverse the connections to the battery or puzzle box. This was credited if described anywhere in **(b)** or **(c)**.

(c) For each possible component, the candidate was required to describe the brightness of the bulb if it was in the puzzle box. Some excellent answers were seen.

Question 4

This question carried 6 marks. This question required measurement from diagrams on the paper and a calculation to the correct number of significant figures. An appreciation of the practical difficulties involved in taking the readings with real apparatus was required.

Few candidates scored full marks for this question although some excellent answers were seen.

(a) (i) Although most candidates were able to measure the thickness correctly to the nearest mm (0.8 cm) most candidates then quoted the diameter as simply 5 cm rather than 50 mm or 5.0 cm.
A surprisingly common error was to use the ruler from the 1.0 cm mark rather than zero (explained in part **(ii)** due to wear or inaccuracy of the ruler at 0), then forgetting to subtract 1.0 cm from the answer, so giving t = 1.8 cm. Candidates should be advised to check their work carefully for obvious mistakes.
t = 8 mm, d = 50 mm

(ii) There were many and varied acceptable explanations here, most of which described the use of check readings. Credit was given for annotations on the diagram showing the use of tangents, the side view or for geometrically constructing accurate diameters.

(b) A disappointing number of candidates were unable to perform the calculation accurately. Those who did often lost the mark for too many significant figures (maximum of three allowed) or for incorrect or missing units.
V = 7.86 cm^3

(c) This presented the candidates with a practical problem which some found difficult to explain in words. There were many good answers explaining that the thickest part of the lens was in the centre so there would be parallax error in taking a reading. Some candidates explained that the lens was slippery or difficult to hold.
Answers simply stating the use of a micrometer were not accepted.
Some candidates thought the real lens would be smaller even though the diagram is described as full size.

(d) (i) Most candidates appreciated the need for a displacement method. For only one mark, a detailed account was not needed. Those who described the experiment needed to use a graduated vessel of some form, not just a beaker.

A surprising number of candidates thought that the lens was hollow and that they were finding the volume of air inside the lens.
Answers describing the use of different measuring instrument or density of glass were not credited.

(ii) A few excellent candidates showed a appreciation of the problems of having a lens of small volume but of relatively large diameter which meant the scale would probably be only to the nearest cm^3 and therefore less accurate.