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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**.

UNIVERSITY *of* CAMBRIDGE
International Examinations

PHYSICS

GCE Ordinary Level

Paper 5054/01
Multiple Choice

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

General comments

The mean score was 23.3 out of 40 (58%), with a standard deviation of 19%.

The responses showed that all parts of the syllabus had been well covered, although electrical safety questions still cause some problems. Candidates found **Question 7** very easy but had difficulties with **Questions 9**, **17**, **20**, **31** and **36**.

Comments on specific questions

Question 9

Many candidates used the direct distance PC instead of the perpendicular distance QC.

Question 17

Over 40% chose option **A**, suggesting that they did not carefully read the stem which referred to a cooling liquid.

Question 20

The statistics suggest that most candidates guessed the answer. Visualising the wave movement seems to be difficult.

Question 21

Most of the weaker candidates just divided 20 cm by 4 Hz.

Question 27

Many candidates do not seem to realise the significance of the term potential *difference.*

Question 31

The most popular choice was option **B**, which is a dangerous situation but would not affect the fuse.

Question 36

The stronger candidates chose correctly, but the largest number chose option **B**.

Paper 5054/02
Structured and Free Response

General comments

The impression gained by the Examiners was that there were more strong entries and that there were fewer weaker candidates who found real difficulty in understanding the paper this year.

The majority of the entry coped well with the understanding and writing of English. Numerical values are usually given in each question to two significant figures and it is expected that candidates will give their answers to two or three significant figures. More answers this year were given to only one significant figure, which was not acceptable. Candidates should actually calculate the numerical answer and merely giving one significant figure or leaving the answer as a fraction may lose credit. However, where one significant figure is sensible (e.g. in **Question 1)** or where the question asks for a fraction (e.g. in **Question 10**) there was no penalty.

Question 11 proved slightly less popular than the other two questions in ***Section B***. However, those candidates who answered **Question 11** were often rewarded with very high marks for their knowledge of d.c. electricity.

There was little, if any, indication that candidates were limited by time in answering the paper.

Comments on specific questions

Section A

Question 1

(a) A good understanding was shown that mass is the amount of matter in a body, although other definitions and ideas are possible and were given.

(b) The names given to the two forces were most usually tension and weight. It was expected that the two forces should be drawn along the central line of the diagram. Some leeway was allowed, but a number of candidates drew the forces alongside the diagram and did not show the forces apparently acting on any point of the mass. Calculations were usually correct, with some candidates not realising that the upwards force must be equal to the downwards force.

(c) Comparatively few candidates made sensible comments about the upward force. Full marks were obtained simply for stating that the force increases because the spring is stretched. Many candidates suggested that the force increases because of Newton's third law, as a consequence of the increased downward force that pulled the mass downwards.

Answer: **(b)** 4.0N, 4.0N.

Question 2

(a) Explanations of the basic cause of pressure, the impact of molecules on the walls of the container, were good. One mark was reserved for a sensible explanation of how the molecules can cause the same pressure on two surfaces of different cross-sectional area. Many answers correctly suggested that there were more impacts on the larger area, but that the number of impacts per unit area was the same. However, a significant numbers of answers stated that the frequency of collision on the two surfaces was equal or that the frequency of collision increased as the area decreased.

(b) The formula for work and its unit were well known. However, a significant number of candidates failed to write down the formulae is this section. In **(ii)**, candidates who initially gave the formula for Boyle's law, or suggested that pressure is inversely proportional to volume, generally achieved success. A significant minority of candidates merely tried to increase the pressure by 20% and achieved the answer 120 000Pa.

Answers: **(b)(i)** 2.3J, **(ii)** 1.25 $\times 10^5$Pa.

Question 3

(a) The definition of wavefront was known by many candidates. It is best expressed as the line joining points having the same phase on the wave, e.g. the line joining crests along a wave.

(b) Although most candidates recognised that the wavelength decreases in the diagram, they did not realise that the frequency is constant and thus the speed of the wave decreases.

Answer. **(a)(i)** 19.8°.

Question 4

(a) A good proportion of answers gave the correct order of the electromagnetic spectrum. Those candidates who gave the reverse order were still able to score one mark.

(b) The uses of ultra-violet radiation were well known, with the production of a suntan, sterilization, vitamin D, and the testing of banknotes being the most popular. Common errors were that ultra-violet radiation can cure cancer (which is not a use), or is used to scan inside the womb.

(c) Most candidates achieved both marks in this section, choosing two common properties of all electromagnetic radiations. Properties such as being transverse waves, being able to reflect or carry energy, having the same speed or being able to travel in a vacuum were well known. Vague statements, such as 'they have a wavelength' or 'they obey $v=f\lambda$' were not accepted.

Question 5

(a) The diagram showing increased loudness and pitch was well drawn, but candidates did not always score full marks in **(ii)** because they failed to link loudness clearly with amplitude and pitch clearly with frequency or wavelength. Some candidates even suggested that a louder sound produced waves with a larger frequency.

(b) In comparison to **(a)** this section was poorly answered. Candidates were expected to state that electrical energy changes into chemical energy when a battery is charged. Often candidates stated that chemical energy changes to electrical energy. Candidates were not penalised for adding to the changes and involving heat and even light, although wrong sequences were penalised, e.g. electrical energy to chemical energy to heat energy.

Question 6

(a) The position of **X**, the point where most positive charge is situated on the ball, was correctly marked by the majority of candidates. In **(i)**, most candidates were able to explain the repulsion of like charges but then did not explain their answer in terms of the movement of electrons, which is what the question demands. Positive charge was often stated to move to the left of the ball, whereas it is the negative electrons that move to the right. The majority of answers stated that negative charge moves down the rod but it was not clear that electrons were moving in this direction, particularly as some candidates stated that negative ions move down the rod or positive electrons move up the rod.

(b) The formula Q = It was known and used correctly by a good proportion of the candidates.

Answer: **(b)** 0.0133A.

Question 7

(a) The standard mistake in this question was to confuse magnetic and electrostatic repulsion. A sizeable minority of those candidates who realised that the iron rods are magnetised or have poles, stated that like charges on the rods repel. The best candidates made clear that the ends of each rod next to each other have the same magnetic pole. Weaker candidates suggested that one whole iron rod had one polarity and the other rod had a similar polarity and thus repelled.

(b) There should be no movement when one of the iron rods is replaced with a copper rod. Many candidates correctly recognised that copper was non-magnetic but then incorrectly suggested that the rods would attract each other.

Question 8

(a) Full marks were only obtained in this question if the answer stated that alpha and beta particles are stopped by the lead or inner container and that some of the gamma rays can escape from the box. Many candidates suggested that all of the gamma rays can pass through only a centimetre of lead. Weaker candidates merely suggested that alpha particles are stopped by paper and beta particles by a few millimetres of aluminium.

(b) Few candidates explained that using tongs or tweezers allows many of the particles emitted by the source to miss the teacher. However, full marks were usually obtained with a statement of two different methods of protection. Although lead gloves and suits are not used with radioactive sources available to teachers, or even at all, these answers were accepted as a method of protection. Many candidates described unrealistic situations such as lead-lined rooms and suits of two centimetre thickness lead.

(c) The Geiger-Muller tube was the most common detector named in **(i)**. Candidates who used a cloud chamber found more difficulty in **(ii)** in explaining how this detector shows random emission but some were successful. Good candidates merely explained that the number of counts in any time period, or the reading of a ratemeter, varies at different times. Candidates often tried to explain how to distinguish between the three different types of radiation, and the method described using their detector did not explain randomness in any sense.

Section B

Question 9

(a) There were some good answers explaining the use of a fuse and the need to connect the metal casing to the earth wire in a mains circuit. It was very unusual for any candidate to earn poor marks in this section. However, there was some confusion between the two situations with some candidates wrongly suggesting that the earth wire protects the appliance, ensuring that the fuse does not melt and that the fuse is primarily there to prevent electrocution, rather than to protect the circuit.

(b) Candidates frequently coped well with the calculations, although errors with powers of ten and the failure to convert minutes into seconds were common. In **(ii)**, a sizeable proportion of the answers showed no real understanding of how to calculate the number of kWh supplied but wrong answers in **(ii)** were still able to score full marks in **(iii)** even though the cost of using the kettle would have been very high indeed.

(c) Most candidates scored one mark for recognising that the more energetic molecules escape, but there were very few references to the remaining molecules having less kinetic energy, or that latent heat or energy is required to break the bonds between the molecules. Some answers were excellent, although there were many poorly worded accounts and some confusion with convection currents.

Answers: **(b)(i)** 720 000J, **(ii)** 0.2kWh, **(iii)** 1.6c.

Question 10

(a) Rarely was a candidate confused by the data and fully correct answers were common in this section. Some candidates in **(iii)** changed the mass of water from 50 g into 0.050 kg to use in the equation involving specific heat capacity unfortunately but did not then make the corresponding change to the value of the specific heat capacity.

(b) The definition of power as energy change or work done per unit time was correctly quoted by most candidates in some form. The answer to **(ii)** was accepted in any form, as a number, fraction or percentage. A significant number of candidates gave the fraction as 72/9.3 rather than as 9.3/72, but it was encouraging that most candidates could use the formula for power, energy and time in an unfamiliar situation.

(c) Most candidates scored at least one mark in **(i)**, but full marks were only earned for answers that involved melting ice and boiling water. A number of candidates merely suggested that the thermometer should be placed in ice to check the 0ºC marking. It was not necessary to mention that the water should be pure or that the pressure should be standard atmospheric pressure, although some very good candidates did make these comments. In **(ii)** and **(iii)** many candidates were confused between sensitivity and speed of response. Good answers in **(ii)** suggested that the change in temperature was too small to record on a thermometer where the smallest division was 1ºC and then in **(iii)** suggested that the bore of the thermometer should be thinner or the bulb should contain more mercury. Many candidates, however, suggested that the bulb should be made of thinner glass which increases the speed of response and not the sensitivity or the size of the response.

Answers: **(a)(i)** 77 800, **(ii)** 9.33J, **(iii)** 0.044ºC; **(c)(ii)** 0.13.

Question 11

(a) The basic circuit diagram to measure resistance was usually produced, with weaker candidates drawing a voltmeter in series rather then in parallel with the lamp. Many candidates failed to include any method of altering the current in the circuit that they drew. A simple variable resistor or a variable voltage power supply would have sufficed. Many candidates were able to suggest a suitable range, from 0 to a value between 12 and 20V. Weaker candidates merely suggested an upper value or did not refer to the range of the voltmeter to be used. In **(ii)** a surprisingly large number of candidates incorrectly stated that the resistance decreases as the p.d. increases.

(b) Those candidates in **(b)(i)** who simply read values of the p.d. from the graph were generally successful, although others who performed calculations at the start of this section often lost their way. Some candidates misread the scales of the graph, but this only led to a loss of one mark in **(b)(i)** and one mark in **(b)(ii)**. The formula for the calculation of resistance was well known. In the last section of **(b)(ii)**, the combined resistance of the lamp and wire in parallel can be calculated from the p.d. across and the total current into the combination. Some candidates used the parallel resistor formula, which is also acceptable, but were often unsuccessful, either because of the extra arithmetic involved or because they used, in their calculation, the resistance of the lamp obtained in **(b)(i)**, where the p.d. across the lamp is not 12V.

Answers: **(b)(i)** 3.0V 12V 15V 3.75Ω, **(ii)** 0.8A 2.0A 2.8A 15Ω.

Paper 5054/03

Physics Practical

General comments

Section A of the paper was, generally speaking, of a comparable standard to that set in November 2004. In **Question 2**, Supervisors had reported that some candidates may not have understood the word extension. In view of this candidates were allowed to give either the total length of the spring or its extension. However, in order to determine the extension or length it was expected that two scale readings would be taken on the metre rule and that these would be subtracted to determine the extension or the length. If this was not done a total two marks would have been lost. It was also expected that if candidates had carried out the experimental work carefully, then they would have obtained an answer in the region of 7.0 g/cm^3 to 10.0 g/cm^3. An answer in this range was only obtained by the best candidates. In this section of work candidates also had to draw a diagram showing the correct use of a set square against the vertical metre rule in order to take the reading. Only the best candidates scored this diagram mark.

In **Question 4** of November 2004, it was rare to see a mark of less than 10 out of 15. The marks in this question this year were generally lower and more widely spread. Good candidates produced excellent graph work and often scored 14 or 15 out of 15 marks. Weaker candidates only recorded temperature readings every minute, recorded temperatures to the nearest degree, drew a poor tangent and used a small triangle to determine the gradient of the graph. Such errors probably lead to a mark in the region of 8 out of 15.

Comments on specific questions

Section A

Question 1

(a) The properties of the springs used around the world were variable. Whilst the normal ranges were quoted in the mark scheme, Examiners often allowed credit for values outside these ranges where there was evidence that the springs used at a particular Centre were different to those expected or where candidates had clearly obtained a value for the density in the expected range from values that were outside the expected ranges. Despite these problems the majority of candidates obtained an acceptable value for the length of the spring that was in the required range, was measured to the nearest mm or better and had a correct unit.

(b) Equally a correct value for *N* was obtained by the majority of candidates.

(c) Generally candidates obtained a correct value for *D*, quoted the answer to the nearest mm or better and gave an appropriate unit. Despite the variation in the length and the mass of springs, the majority of springs had the same diameter.

(d) Most candidates obtained a correct value for the mass *M* of the spring and carried out a correct calculation of the density of the material of the spring. A value in the correct range was only obtained by those candidates who had taken correct measurements in the earlier part of the question. Weaker candidates often used an inappropriate number of significant figures or either omitted or quoted an incorrect unit for the density e.g. g/cm.

Question 2

(a) In order to determine the extension of the spring, Examiners expected candidates to take a scale reading at the bottom of the unloaded spring and then a scale reading at the bottom of the loaded spring, the extension could then be determined by subtracting the two scale readings. This technique was used by a relatively small number of candidates. A number of candidates determined the total length of the spring by taking scale readings at the top and bottom of the loaded spring; this was allowed as described above. Few candidates showed the correct use of the set square up against the vertical rule in order to ensure that the reading was at the same horizontal height as the end of the spring. The alternative mark of showing the eye level with this reading was also rarely scored. Since the idea of extension was rarely shown, a second alternative mark of showing the correct extension of the spring was awarded to some candidates.

The third mark in this section was for the correct use of a set square at the base of the rule to check that the rule was vertical. This mark was scored by the better candidates.

(b) The same comments apply to **(b)** as apply to the measurement mark in **(a)**.

(c) Candidates who correctly understood extension and who correctly fully immersed the masses in water in **(b)** obtained a value for the density which lay in the correct range, although this was quite a rare occurrence. As well as obtaining values outside the range, candidates also quoted an inappropriate number of significant figures for the density or omitted units from the final answer.

Question 3

(a)(b) (d)(i) These three sections were effectively marked together so that if an error was made in one section that error could be carried forward to the next. Missing units from a given quantity were only penalised on one occasion. Good candidates obtained a correct current value of 0.12 A in part **(a)**. Quite a number of candidates obtained values that were a factor of 10 different from this correct value e.g. 0.012 A or 1.2 A. However even with these incorrect values, the correct trend of increasing current was observed in parts **(b)** and **(d)(i)**. The popular mistake in the readings of potential difference was the use of incorrect precision, e.g. readings were quoted as 6 V rather than 6.0 V. If this was repeated throughout the three sections then the candidate would not have obtained the correct trend of a fall in the values of the voltage.

(c) Examiners were expecting candidates to deduce information about the resistors from the observations of current, e.g. *X* has a higher resistance because it allows less current to pass through it. In fact most candidates calculated the values of *X* and *Y* and were credited with the mark.

(d)(ii) Not all candidates obtained the correct current in **(d)(i)**, presumably because a correct parallel connection had not been made. Such candidates would find it difficult to score the mark here. Examiners were expecting candidates to comment on the currents and to relate the resistance change to the currents. Successful candidates:

- Stated that the current in **(d)(i)** was either the sum of the currents from parts **(a)** and **(b)** or was greater than the currents in parts **(a)** and **(b)**, indicating that the parallel combination had least resistance.
- Calculated the resistance of the parallel combination from the current and voltage readings in part **(d)(i)**. No credit was given to those candidates who calculated the resistance of the parallel combination by using the parallel resistors formula since this did not use the experimental results of **(d)(i)**.

Section B

Question 4

(a)(b) These first two sections proved to be quite a good discriminator between candidates. The best candidates:

- Gave appropriate table headings with units.
- Recorded temperatures at half minute intervals or less.
- Recorded some temperatures to better than the nearest degree as they interpolated between the divisions of the thermometer.
- Obtained a correct shaped smooth curve.

Popular mistakes amongst the weaker candidates included:

- Only recording temperatures at 1.0 minute intervals.
- Not recording any temperatures to better than the nearest degree.
- Recording times in an inconsistent way, e.g. 1.00 minutes, 1.30 minutes, 2.00 minutes, 2.30 minutes, etc. It was clear that 1.30 minutes actually meant 1 minute 30 seconds or 1.50 minutes.
- Not recording the initial temperature when the stopwatch was started.
- Not recording the temperature for the full 5 minutes of the experiment.

(c) Graph plotting was excellent. Most candidates realised that it was not necessary to start the scale at the origin and as a result used a scale which spread out their data over an acceptable area of the page. Axes were labelled and appropriate units were included, points were plotted correctly and a smooth fine curve was drawn with a pencil.

(d) The best candidates:

- Drew a tangent to the curve at 150 s.
- Used a large triangle to determine the gradient of this tangent. Since some candidates did have a vertical scale for their graph which started at the origin, the large triangle was judged in the horizontal direction only. Examiners expected candidates to have a base for their triangle which was greater than 8.0 cm long.
- Correctly read the sides of the triangle to determine the gradient.
- Gave the answer to 2 or 3 significant figures with a negative sign.

These good candidates obtained the maximum 4 marks in this section.

Weaker candidates:

- Drew tangents in the wrong places. 1.5 minutes was a popular alternative, this was obviously a confusion between 150 s (2.5 minutes) and 1.5 minutes.
- Used small triangles to determine the gradient of the tangent.
- Omitted the negative sign or used an inappropriate number of significant figures. Answers were often quoted to 1 significant figure as candidates confused significant figures and decimal places e.g. –0.06ºC/s.

The weakest candidates often did not draw a tangent. Such candidates used two points on the curve to find the gradient. This was not an acceptable procedure and they could only score the final mark.

(e) In the original mark scheme a mark was to be given here for the use of a small volume so that a reasonably large drop in temperature would be observed. This assumed that candidates had left the apparatus as set up by the Supervisor and had poured water into the beaker in order to just cover the bulb of the thermometer. Supervisors reported that candidates had had to dismantle apparatus and carry the beaker across the laboratory in order to fill the beaker with hot water. This meant that there was far more water in the beaker than originally anticipated. In the final mark scheme the mark was given for any sensible volume of water with an appropriate unit. Virtually all candidates scored the mark.

(f) Precautions such as not allowing the bulb of the thermometer to touch the side or base of the beaker were not allowed since the apparatus had been set up by the Supervisor. Thus stirring and the avoidance of parallax error were the only precautions that were allowed. However, to score the avoidance of parallax error mark clear details of how the parallax error was to be avoided had to be given.

Paper 5054/04

Alternative to Practical

General comments

A wide range of marks was achieved by candidates. The candidates generally showed that they had a good understanding of practical skills and used these in answering the questions. The number of scripts with poor presentation was smaller than in previous sessions. It is pleasing that the majority of the candidates produced clear legible answers and used a sharp pencil for graph work and drawings.

Perhaps it should be repeated that the best possible preparation of candidates for this paper is regular practical work in lessons and experience of a wide variety of apparatus.

Comments on specific questions

Question 1

This short first question introduced candidates to the action of an LDR and its use in a light meter.

(a) Most candidates were able to score two marks here for using the information in the stem of the question to explain that since the resistance in the circuit (or of the LDR) decreases, the current will increase. Alternatively, the second mark could be scored by describing the movement of the needle on the meter correctly.

(b) Many candidates had difficulty explaining the meaning of calibration and merely restated the stem of the question which was not creditworthy. The response required some indication of the addition of numbers, graduations or values on the scale. A few excellent responses were seen where the candidates described the need for two fixed points to be marked using known values. A common poor response was that the ammeter was 'adjusted to read in units of light intensity'.

Question 2

The majority of candidates scored half marks or more on this longer question.

This question tested the candidates' ability to produce a clear table of results with both quantity and unit in the headings and to plot a graph of those results. It also required candidates to look carefully at the diagram and give answers showing an appreciation of the practical nature of problems when handling equipment.

(a)(i) The required answer here was that this enables large and small values (for current, distance or light intensity) to be measured. Responses were often too vague or again simply repeated the stem of the question. Again the need for an explanation caused difficulties for the weaker candidates. Many candidates gave answers describing the need to take several readings and obtain an average.

(ii) A large number of different answers were given here. Common incorrect answers given by candidates were; numerical answers with no units; distances (in cm); current in A or just the largest current reading i.e. 3.77 mA. A surprisingly common error here was to give a pair of values for both distance and current. Although the expected answer would show a range as in 0 to 5 mA, a single value of 4, 5 or 10 mA was allowed.

(b) Most candidates were able to score at least two of the three marks here. Common mistakes were to give ammeter reading rather than current (or I) in the heading or omit the unit for one of the quantities. A surprising number of candidates omitted to include the values in the table. These should be in ascending or descending order, but credit was given if the pairs of readings were correct in any order. A few candidates thought that a derived value (often resistance) was needed and attempted to manipulate the data given.

(c) The graph work was generally good and neat accurate graphs were seen from a large proportion of the candidates. Points were plotted accurately and good curves of best fit were drawn. Some, however, still do not label the axes with both quantity and unit. Only very few candidates drew the axes the wrong way round or chose scales which were not sensible.

(d) The response required here was to explain somehow that the graph shows an inverse relationship, such as increasing the distance decreases the current. Credit was given for inversely proportional. Weaker candidates gave the relationship as directly proportional or simply stated that the LDR was (inversely) proportional to the distance.

(e) Candidates needed to relate their answer to the apparatus as shown in the diagram rather than just state parallax error here. Answers were many and varied and any description of a practical problem was given credit here.

(f) The fact that the lamp was unstable was noticed and well explained by many able candidates. Weaker candidates often gave answers that would have scored a mark if given in **(e)**.

Question 3

This question was very poorly answered by all but a very few candidates.

(a) Many candidates did not understand what was required here and attempted to redraw most of the apparatus in Fig. 3.2 with the Sun instead of a lamp. About half the candidates did attempt to draw a simple diagram. Credit could be gained either from a correct ray diagram or by drawing the apparatus showing how it is used. A surprising error made by a fair proportion of candidates was to mark the focal length from the Sun to the lens rather than from the lens to the screen. Omission of the Sun or parallel rays was also seen in good diagrams that were otherwise correct. Very few candidates used a ruler here and produced freehand sketches. Although this was not penalised if the intention was clear, the use of rulers in ray diagrams should be encouraged.

(ii) The use of the windows results in a slight increase in the object distance. This mark was gained by abler candidates.

(b)(i) Very few answers showed an understanding of the apparatus drawn. These, however, described the process of reflection of the rays by the mirror well.

(ii) Very few correct responses were seen to this part of the question. It was disappointing that so few were able to consider the effect on the rays of light by the changes in the apparatus given.

Question 4

The majority of candidates were able to score marks on this question. Some had obviously used this standard equipment and were able to explain the practical details considered when the experiment was performed.

(a) The ideal answer here links the volume and length to the cross-sectional area of the tube which remains constant. This was seen in a few excellent responses. Credit was given for answers explaining that increasing the volume causes the length to increase. A common mistake here was made by candidates who did not read the question carefully enough and compared the pressure of the gas with its volume.

(b) Again, high level answers here explained the need to allow time for the temperature of the gas to return to room temperature after the change in volume and several able candidates explained this well. Credit was also given for responses explaining that time was needed for the gas column to stabilise.

(c) Many excellent responses were given here with candidates showing that doubling the pressure results in halving the length of the gas column. Alternatively, full credit was given for showing that P x V gave the same value each time. A common mistake here was to say that increasing the pressure by 100 kPa decreased the length by 17.9 cm. A simple table of the results on its own or a statement that increasing one decreased the other did not score the mark as an explanation of how they showed inverse proportionality was required. Candidates should be encouraged to use any data given in the question in their answers.

(d) This mark was gained by the majority of candidates. The mark was given for the simple statement that it reduced error. The reduction of parallax error was seen in many good scripts and candidates should be encouraged to give this sort of detail in their answers.

Question 5

Many candidates scored well on this question although weaker candidates did not give sufficient detail; relating to the practical situation given.

(a) A large variety of responses were credited here. The response seen most frequently was that brass/metals are good conductors. This unqualified response was credited, although good conductors of heat is a better answer. Good conductor of electricity was not credited. Other good responses commented on the high melting point or low heat capacity. Expansion of the cube was also seen in many responses. This was ignored as irrelevant.

(b) Most candidates scored one out of the two marks here for stating that the temperature of the water must be measured. For two marks, they needed to measure the initial and final temperatures of the water or the temperature change of the water. Many lost the second mark by including the initial temperature or the temperature change of the brass.

(c) A large range of possible answers were allowed here. Weaker candidates did not gain credit for simple statements of errors such as parallax error without giving detail such as in reading the thermometer. Repeating the experiment is not an acceptable response here. Many well considered responses were seen describing heat loss by the cube during the transfer. Heat loss or gain from the beaker needed to be explained as both may occur at different times during the experiment.

(d) Candidates found it difficult to separate the cause of the error in **(c)** and the practical detail on how to reduce it in **(d)**. These two parts were marked together to enable good responses to be credited.