PHYSICS

Paper 5054/01

Multiple Choice

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

General comments

The mean score on this paper was 23.0 out of 40 (57.5%) and the standard deviation was 17%.

The results showed that all sections of the syllabus had been covered well. **Questions 7** and **21** were found to be the easiest.

Comments on Individual Questions

Question 9

A large number of candidates chose B, forgetting that the increase in load is shared between two springs.

Question 10

The lower-scoring candidates chose the energy conversion during each rise after bouncing instead of the energy 'loss' during each bounce.

Question 14

Many candidates chose C. This is a general problem arising from the fact that gas pressures are often quoted as if 'absolute' rather than 'in excess of atmospheric pressure' e.g. tyre pressures.

Question 23

More candidates opted for each of A and B than for the key, C.

Question 34

The statistics suggest some guessing between A, B and C.

Question 40

Almost half of the candidates forgot that most of the alpha-particles pass straight through the foil.

PHYSICS

Paper 5054/02

Structured and Free Response

General comments

The paper appeared to differentiate well between candidates of differing ability. There were a good number of able candidates able to score highly, but there were also a number of candidates unable to handle even some of the simple ideas in the paper. The general standard of English in the answers was acceptable although a minority of candidates appeared not to understand the meaning of some parts of the questions.

Calculations were generally performed well, with the majority of candidates able to give the correct formulae, either in words or, more usually, using the correct symbols. There were still, as in previous years, some candidates who consistently failed to give a unit for their final numerical answer and lost a mark as a consequence. Rounding errors in the numerical answers to calculations were common; for example in **Question 9(a)(ii)** the answer to 4 significant figures is 0.001727 but many candidates merely wrote down 0.00172, dropping the last figure rather than rounding correctly to 3 significant figures. Where candidates showed their working, credit was given; however when working was not shown and the answer was wrong, as in this case 0.00172 was wrong, then marks were lost. Candidates should be advised to write their answer out with more significant figures than necessary and then at the final stage to round their answer to 2 or 3 significant figures, if appropriate.

In ***Section B***, **Questions 9** and **10** were far more popular than **Question 11**. It appeared that candidates from some Centres answered **Question 11** with only a little knowledge of the basic ideas of thermionic emission and the cathode-ray oscilloscope.

There are still many Centres where answer booklets were attached to every script but where only a few of these booklets were actually used. Lined pages are provided at the end of the question paper for ***Section B***. Only when these lined pages are filled should extra paper or an answer booklet be used for the answers to this section.

Comments on specific questions

Section A

Question 1

(a) The question asks for a vector diagram to be drawn to find the resultant of two forces. Many candidates found this question difficult, partly because of the complex nature of the diagram. One major error was to draw a vector diagram with a force in the direction of the wire X. Many weaker candidates omitted arrows on lines which may have been meant to be part of a vector diagram. Those candidates who started by drawing a horizontal and a vertical force were usually successful, although sometimes the resultant was drawn in the wrong direction. The question asks for the direction of the resultant and this was often omitted in the answer but was accepted relative to either the horizontal or vertical. It was helpful when candidates drew an angle on their vector diagram to define the angle given as their answer. Candidates were often successful in calculating the magnitude of the resultant force using Pythagoras' equation and this was accepted.

(b) The force in the wire X is equal to the resultant found in **(a)**, in order that the microphone is at rest.

Question 2

(a) The answers to this section were generally correct.

(b) Some candidates had difficulty in expressing their answers. Many candidates realised that the rod did not balance but only the best candidates explained unambiguously what happened. Answers such as "it falls off at the metal head" or "it tilts at the metal head" were not complete. Only better candidates were able to explain the motion in terms of the moment, such as "the anticlockwise moment is larger than the clockwise moment"; poorer answers suggested that "the force on the left is larger than the force on the right". Some candidates misunderstood the question and suggested that the pencil rolls underneath to move the rod along.

Question 3

(a) This was, in essence, a simple calculation of a potential energy change. However many candidates did not use a mass of 1 kg in the equation but tried to use temperature, or introduced *ºC* as a unit in the final answer. Candidates who quoted the formula P.E. = mgh were awarded at least one mark.

(b) The formula for energy transfer was well known. However, using the equation correctly proved to be more difficult. In particular, many candidates confused energy with temperature change. In stating the final unit the degree sign alone is not sufficient; ºC was required.

Question 4

(a) This section of the question was answered well and a good understanding was shown of the equation for acceleration. There were a number of candidates who gave an incorrect unit, m/s rather than m/s^2.

(b) (i) Although most candidates drew two horizontal arrows, they often failed to show the relative lengths of the arrows in the forward and in the backward direction. The question states that there are two horizontal forces acting on the aeroplane as it accelerates. These forces were meant to be a thrust from the engines and a resistive force, either friction between the wheels and the ground or air resistance. As the aeroplane is accelerating the forward force should have been larger than the backwards force. A number of candidates drew forward forces on each engine as well as friction and air resistance at a number of places either on or near the aeroplane. This was acceptable as long as the total forward force was larger than the total resistive force.

(ii) It was intended that candidates would be comparing a forward force with a backwards force and stating the name of the backwards force, as either air resistance or friction. A significant number of candidates, although not scoring the mark for showing the relative sizes of the arrows, were able to state that either air resistance or friction was the smaller force. A number of the more able candidates also described or explained how this force was formed. This was acceptable, although sometimes the force was not clearly named.

Question 5

(a) The question asks for a statement of two differences in the properties of liquids and gases and an explanation of these differences in molecular terms. Many candidates failed to identify any property of the liquid or gas; such candidates usually only wrote about the differences between the arrangement of, or the forces between, molecules in liquids and gases and did not give the properties of liquids and gases. Common acceptable choices of property were the difference in density, compressibility and conduction of heat but other properties including expansion on heating, diffusion, viscosity and the speed of sound were acceptable. Many good candidates failed to score full marks because they stated the same difference twice in slightly different forms; for example stating as their first difference that gases are compressible and as their second difference that gases do not have a fixed volume or that liquids are incompressible. A number of candidates suggested that liquids have a fixed shape whereas gases do not; this was not acceptable.

(b) There were few fully correct answers to this section which asks for an explanation of the cooling effect of evaporation. The better answers suggested immediately that faster molecules escape leaving behind the slower molecules. Weaker candidates often failed to mention molecules at all or did not include any ideas about evaporation in their answer.

Question 6

(a) The vast majority of candidate knew that the red end of the spectrum was refracted least by the glass prism and arrives at P.

(b) The speed of light of both red and blue light is equal in a vacuum but many candidates incorrectly suggested that there was a difference in these speeds.

(c) The majority of candidates were able to draw the correct refraction at the two faces of the prism. Weaker candidates failed to earn full marks by drawing two rays produced as the red ray is refracted and thus incorrectly suggested that dispersion occurs.

Question 7

(a) The vast majority of candidates gave the correct value of the total e.m.f. but a few candidates failed to give the unit.

(b) The values of current in the first row were almost always correctly stated. However, the most common response for the second row was 4.6, 2.3 and 2.3 which earned some credit by showing that candidates understood that the current in two parts of a parallel circuit combines at the intersection. It was disappointing that only a very few candidates understood that each lamp, when connected in parallel, would have a current of 4.6 A.

(c) It is possible to obtain the answer directly with the formula energy = QV. Many candidates did obtain the correct answer by a more complicated route, first finding the time using the equation Q=It; this was acceptable and any slight rounding errors involved in the series of calculations was ignored.

Question 8

(a) More than half of the answers gave the correct answer as fusion. A common spelling error was to give the answer as fussion which was accepted, but not answers such as fission, radioactive decay or exothermic.

(b) (i) Few candidates gave a convincing explanation that the decrease in mass results in a conversion of the lost mass into energy. Candidates often added nothing to the wording of the question.

(ii) The correct equation $E=mc^2$ was usually given, but substitution into the equation was often poor, with the speed of light being used without squaring or with mistakes made with the power of ten.

Section B

Question 9

(a) (i) This section requires an explanation of how sound travels through air. A full answer requires the explanation that air molecules vibrate and that such vibration is caused either by the vibrating loudspeaker or by collision with other air molecules. Weaker candidates stated that “sound is caused by vibrations” but it was not clear what was actually vibrating. The longitudinal nature of the oscillation earned credit if full marks had not been awarded.

(ii) Most candidates were able to compare pitch and frequency correctly, but many candidates confused loudness and pitch, stating that a loud sound had “high amplitude and high frequency” or even tried to explain what is meant by “loud-pitched”.

(iii) The formula for speed in terms of distance and time was well known but common errors were to use the formula 2d/t for the speed, even though no reflection was involved, or to use the wrong speed of sound, usually 300 m/s rather than 330 m/s given in the question.

(iv) It was intended that candidates should recognise that, because sound travels faster in water than in air, less time is taken by sound through the water. A significant number of candidates incorrectly suggested that, as water is denser than air, the sound is slower in water. Merely suggesting that as the speeds are different then the times are different was not sufficient.

(b) (i) The formula for speed in terms of frequency and wavelength was well known but many candidates failed to convert the frequency from 0.20 kHz into 200 Hz when using the equation.

(ii) A surprising number of candidates drew a transverse rather than a longitudinal wave. The general standard of the longitudinal waves drawn was good, with compressions and rarefactions clearly evident. The indication of one wavelength was, however, poorly shown and the wavelength shown was often not the correct repeat distance for the longitudinal wave drawn.

Question 10

(a) (i) Most candidates drew reasonable circles around the wire in an anticlockwise direction but full marks were only obtained with diagrams showing circles that were progressively further apart, showing that the field decreases away from the wire.

(ii) Simple statements that the field increases or that the lines are closer were accepted.

(b) (i) The equation for resistance was usually but not always correct. Candidates should be encouraged to complete the calculation and give 0.75 ohm, and not leave their answer as 6/8 or even ¾ ohm.

(ii) The equation Q=It was well known, although many candidates failed to convert the time of 2.0 minutes into 120 s for use in the formula.

(c) (i) The correct answer, from N to S, was commonly given although some candidates described the field due to the wire as well as the field due to the magnetic poles.

(ii) Many candidates did not realise that the wire will move because it carries a current in a magnetic field. Such candidates described what happens to the magnetic field and not what happens to the wire. Good answers made clear that the force was into the page or drew sketch diagrams making the direction clear. Candidates should be encouraged to give diagrams where they find difficulty in their explanations.

(iv) Many candidates produced a good description of how a motor works and earned considerable credit. Full marks were earned by explanations that applied knowledge of the motor to the question, with a clear description or diagram showing that there were opposite forces on each side of the coil because the current was in the opposite direction and that the commutator reverses the current at a particular position as the coil rotates. A common mistake was to give a description of an a.c. generator.

Question 11

(a) Although this question was rarely attempted this section often gained full marks, showing a good knowledge of the equation for power.

(b) (i) To obtain full marks it was necessary to describe thermionic emission or the release of electrons from J and their subsequent attraction by K and their movement in the apparatus. Many candidates did not appear to link this question with any knowledge or appreciation of thermionic emission.

(ii) Where it was recognised that electrons were moving between the two electrodes in the glass vessel, the mark was usually awarded for a statement that the electrons collide with air particles or are otherwise deflected.

(iii) Most candidates incorrectly suggested that the electrons or charges were attracted or repelled by the magnet, whereas the electrons are deflected sideways.

(iv) A statement was required that the current becomes zero and an explanation that electrons were repelled by the positive terminal K. Few candidates who attempted this question were able to obtain full marks.

(c) (i) Little detail was required with, for example, just a statement that the trace is a horizontal line because the timebase pulls the electrons horizontally. A very few candidates appeared to have some practical knowledge of the cathode-ray oscilloscope and were able to state that since the applied voltage is zero a horizontal line must be produced.

(ii) The trace in this section stays as a horizontal line and moves slowly up (or down) the screen, being finally deflected by 3 divisions. Good candidates recognised that there would be a deflection of 3 divisions but the majority of candidates suggested that a wave would be produced and even incorrectly drew a sinusoidal trace.

(iii) A brief statement that the trace moves beyond the edge of the screen was required. Those candidates who appeared to have a practical understanding of the oscilloscope were able to use their practical knowledge and achieve a successful explanation.

PHYSICS

Paper 5054/03
Practical Test

General comments

Generally speaking, candidates found this paper more straightforward than that set in November 2007. **Question 1**, which was about a beaker of water being used as a cylindrical lens, was more straightforward than the refraction through a glass block experiment set in 2007. The cylindrical lens question used a light source rather than the locating pins that were used in the refraction question. Examiners used a wide range of acceptable values for the focal length of the lens, which meant that most candidates achieved the range mark. **Question 2** involved the acceleration of connected masses, and was generally better answered than the floating block experiment set in November 2007. Taking repeat readings when an experiment involves timing seems more natural to candidates than taking repeat readings when taking measurements on a wooden block. In **Question 3**, candidates were unsure of the circuit symbol for the LDR, quoted current in amps rather than milliamps, did not quote readings to sufficient precision and did not realise that a decrease in current must have been caused by an increase in resistance. **Question 4** involved the equilibrium of a rule, held in position by a stretched spring. Generally candidates found this easier than the electrical question of November 2007. In particular, the final three marks on the mark scheme in November 2007 were rarely scored. By contrast in November 2008, the final two marks simply involved the calculation of the gradient of the graph.

Comments on specific questions

Section A

Question 1

(a) (ii) The majority of candidates obtained a correct answer of between 10.0 cm and 14.0 cm. There were very few answers outside this range; the only mistakes that lead to the loss of the mark were either the omission of units or quoting the value to the nearest cm.

(iii) Most candidates who obtained this precaution mark did a good diagram either showing the use of a set square to show the object or screen perpendicular to the rule, or showing the eye vertically above the reading being taken on the rule. Note the eye needed to be vertically above the reading being taken, not vertically above the rule.

(b) The calculation of the focal length was generally done correctly. The candidates who lost the mark did so because of the omission of units. A number of candidates seemed to have reasoned that the quantity should not have units. However these candidates should note that the unit of $u\ v$ is cm^2 and not cm.

(c) In the majority of cases the change in u and v was appropriate and candidates obtained two values of f that were within the required range. In a small number of cases an increase in u produced an increase in v and this can only be because the candidate did not produce a sharply focused image of the slit.

Question 2

(a) The majority of candidates obtained two marks for the timing of the fall of the heavier mass. The points which lead to the loss of marks were as follows:

- Some candidates quoted times to the nearest second, e.g. 2 s, 3 s, etc.
- Some candidates had misread the digital stopwatch and quoted times such as 0.02 s, 0.03 s, etc.
- Some candidates were confused between minutes and seconds so assumed that 2.23 seconds was actually 2 minutes and 23 seconds or 143 seconds.
- A single correct measurement of time was sometimes quoted; this gained 1 mark but did not gain the mark for repeat timing.
- Units were sometimes omitted from the readings of time.

(b) Error carried forward from the incorrect times was allowed so most candidates obtained the mark for the practical acceleration even though in some cases the values were far in excess of the acceleration due to gravity. There were two main reasons for the loss of the mark:

- The omission of, or the wrong unit for, the acceleration. Typically a unit of m/s was used.
- The value of *t* in the expression for the acceleration was not squared.

(c) (i) The calculation of the theoretical acceleration was also a test of significant figures so only answers of 0.89 or 0.892 ms^{-2} were accepted. The three main reasons for the loss of marks were:

- Using an inappropriate number of significant figures, e.g. 0.8918 ms^{-2}.
- Incorrect rounding in the calculation e.g. answer given as 0.891 ms^{-2}.
- Incorrect calculation.

(ii) The comment about friction had to be related to the results to gain the mark in this section. Some candidates had a practical acceleration that was greater than the theoretical acceleration and still said that friction affected the results; such a comment did not gain the mark.

Question 3

(a) Most candidates did not obtain the mark for the circuit diagram. The main mistakes were as follows:

- The circuit symbol for the light dependent resistor was often not known.
- Many candidates used the symbol for an a.c. power supply rather than a d.c. power supply.
- Examiners did not expect the voltmeter to be shown in the circuit diagram. Some candidates showed the voltmeter in the correct position, which was fine, but in other cases the voltmeter was shown in series with the other components in the circuit and this did not gain the mark.

(b) The majority of candidates were not awarded this mark because the unit of current was given as amps rather than milliamps i.e. the current was quoted as 2.3 A rather than 2.3 mA. The only other errors were either the complete omission of units or inappropriate precision, e.g. 2 mA rather than 2.0 mA.

(c) Most candidates obtained the mark for the potential difference reading. The mark was allowed even if the Examiners suspected that the potential difference was measured across the resistor rather than across the LDR. Those candidates who measured the potential difference across the resistor were penalised in **(d)** because the potential difference decreased rather than increased when the LDR was covered with the disc. Some candidates measured the terminal potential difference of the power supply, but this generally did not get the mark because it was in excess of 3.0 V.

(d) Those candidates who had placed the voltmeter correctly in **(c)** generally scored the first mark in this section. Only the most able candidates realised that the decrease in current and increase in potential difference were due to the increase in the resistance of the LDR when it was covered by the disc.

Section B.

Question 4

(a) The length l of the spring was generally recorded correctly. Occasionally a candidate quoted the value to the nearest cm, e.g. 2 cm and lost the mark

(b) The value of *d* should have been in the region of 45.0 cm because the mass was suspended close to the 60.0 cm mark and the pivot was at the 15.0 cm mark. The range given in the mark scheme allowed the candidates to adjust the position of the mass as instructed in the question paper. A number of candidates obtained a *d* value in the region of 60.0 cm, indicating they had not subtracted the distance of the pivot from the end of the rule from the reading of the position of the mass on the rule. When the value of *y* was determined, candidates should have taken scale readings from the metre rule at the top and bottom of the coiled part of the spring and then subtracted the two scale readings. This technique was rarely seen.

(c) The second value of *d* should have been in the region of 40.0 cm because candidates were instructed to reduce the distance by 5.0 cm. In some cases candidates reduced the distance **to** 5.0 cm.

(d) The main reasons for the loss of marks in **(d)** were as follows;

- Candidates did not include the results from **(b)** and **(c)** in the table. This could also lead to the loss of marks on the graph, because the data associated with these sections was not plotted.
- Units were omitted from the table.
- The range of *d* values used in the table was small.

(e) Graph plotting was generally good. Most candidates labelled the axes and chose a suitable scale. Those candidates who started the graph at the origin generally gained the scale mark. However some candidates tried to spread the data over more of the page by not starting the graph at the origin. In some cases this lead to the loss of the scale mark because the data occupied less than 8 cm horizontally or less than 12 cm vertically.

(f) The main reasons for the loss of marks in the gradient determination were:

- The use of a small triangle. Candidates should aim to use as much of the grid as possible when determining the gradient of the graph.
- Some candidates used two points on a curve when determining the gradient. This was not allowed. If the graph was drawn as a curve, then a tangent to the curve should have been drawn.
- The gradient of the graph was not quoted to an appropriate number of significant figures, e.g. 0.2 was a popular wrong answer because the value was only quoted to 1 significant figure.
- A small number of candidates used cm as the unit of the gradient, but the gradient did not have units.

PHYSICS

Paper 5054/04

Alternative to Practical

General comments

The full range of marks was available in this paper and candidates marks ranged from 29 to zero.

There were no questions which caused specific difficulties to candidates. The candidates showed a good awareness of the practical situations used and were able to apply their practical skills in answering the questions.

Many candidates however were unable to read the micrometer accurately in **Question 3** and some struggled to explain the experimental procedure required to answer **Question 4(b)**.

The graph work was good and the candidates scored well here, but many lost the last mark for not being able to draw a straight line of best fit accurately. It must have points both above and below the line. A line with four points on it and the other two above was not a line of best fit.

Candidates should be encouraged to use a 30 cm ruler in the examination. Some candidates drew graph lines that were clearly in two sections and not one straight line. It also caused loss of accuracy in **Question 2** when producing the rays back behind the mirror and resulted in answers outside the acceptable range.

All candidates appeared to have sufficient time to complete the paper.

Comments on specific questions

Question 1

The question was generally well answered with many candidates scoring well. It involved a practical investigation into the variation of pressure with depth of water and used a manometer to measure the pressure. The question tested an understanding of parallax error and how to reduce it, graph plotting skills and an understanding of the relationship between the plotted values.

(a) This was well answered with many candidates correctly quoting 21. The most common incorrect response was to simply read the right hand water level which gave 36 cm. Some candidates gave 15 cm for their answer and others added the values or even averaged them.

(b) Candidates are becoming more familiar with the requirement for the description of parallax error, and the correct statement ‘line of sight is perpendicular to the ruler’ was often seen. Very few used the simple response of drawing the eye position on the diagram to illustrate their answer. Incorrect responses seen included ‘sight parallel to reading’, ‘view perpendicular to meniscus’ and ‘repeat reading and find average’.

(c) The graph was generally well drawn, with candidates clearly labelling both axes and using sensible scales. Some candidates managed to plot the points using the wrong axes as the values were similar. Some candidates lost the plotting mark for drawing dots that were too large (maximum size allowed 1 mm or ½ small square in diameter) but it was drawing the line of best fit that caused most difficulty here. Some candidates drew the line through the origin even though **(d)** asks them to explain why it does not go through the origin. Some skewed the graph, but the most common error was to draw the line through four points leaving two above the line.

(d) This part of the question was least well answered. The candidates were asked to suggest why the graph does not go through the origin. Many simply stated 'because they are not directly proportional'. This does not answer the question. Some good responses were seen, with candidates noting that there was an initial pressure in the thistle funnel before immersing in the water.

(e) Many candidates were able to identify that increasing *d* increases *p*. However many went on to incorrectly state that they were therefore directly proportional and lost the mark. Good candidates stated that the graph is linear.

(f) The majority of candidates were able to read the value correctly from their graph within the range 18.5—19.5. It was good to see so many using clear guide lines drawn to both axes on the graph.

Question 2

Many candidates have obviously used pins in ray tracing and were able to complete the ray diagram accurately.

(a) Almost all candidates scored at least two marks here for simply following the instructions. The rays were generally drawn with a soft pencil and accurately went through the points. Some candidates did not continue the rays in a straight line and joined P_2 and P_3, thus losing the third mark. A few candidates failed to join the ray to O and lost the first mark here.

(b) Candidates who had completed **(a)** accurately were able to repeat the exercise for Q.

(c) The majority of candidates who had completed **(a)** and **(b)** were able to draw the mirror line in the correct position. A few candidates managed to incorrectly draw a horizontal line for the mirror, presumably because this was the mirror orientation when they had performed the experiment.

(d) Producing the two reflected rays back to locate the position of the image was correctly done by about half the candidates. Some incorrectly labelled the image on the mirror, and others along the extended incident rays.

(e) The measurement of the distance between the image and the object was required to the nearest mm. It was disappointing to see candidates who had done everything else correctly lose the mark by stating 13 cm rather than 13.0 cm or by failing to give the unit. The value was expected to be in the range 12.5 cm to 14.0 cm.

(f) The response 'to make the experiment more accurate' was acceptable here, as was the idea that the pins may not be vertical. Many candidates did not gain the mark by simply stating 'to avoid parallax error' which was insufficient. Some good candidates explained that the ray was drawn on the paper, so the pins needed to be viewed where they entered the paper.

Question 3

The question required candidates to be familiar with and be able to read a micrometer screw gauge.

(a) An understanding of zero error with specific reference to a micrometer screw gauge was required. Many candidates did not score the mark, as the failed to state that the reading was not zero when no object was being measured or when the micrometer was closed. Just stating that the zeros on the main scale and the rotating scale did not line up was insufficient.

A few candidates described a zero error in a different measuring instrument such as a metre rule.

(b) The correct answer here (0.16 mm) was seen in scripts from able candidates. However, the majority of candidates were unable to take the correct reading (1.28 mm) from the diagram. Most did gain one mark by reading the value 28 from the rotating scale. Many then added this to 1.5 rather than 1 mm. A large number of candidates ignored the fact that the paper was folded three times. Those who used this information often divided their reading by 3 or by 6 rather than by 8.

(c) Advantages:

The commonest correct response here was that it is easier to read the thickness. Other responses allowed included ‘quicker to use’ and ‘more precise reading’. Many candidates confused precision with accuracy. The fact that it has more significant figures does not make the micrometer more accurate.

A common incorrect response was that there is no parallax error. This is true of digital scales, but here there is no parallax error in the non-digital micrometer as the scales are touching, so this was not accepted.

Disadvantages:

The commonest correct response seen involved the use of a cell or battery in the digital micrometer. The simple statement ‘easily damaged’ was not acceptable as it is as robust as the non-digital micrometer. Some reference to the circuitry or digital scale was required.

Question 4

This question was testing practical circuitry with lamps. An understanding that the voltage marking on a lamp determines its brightness when different voltages are applied was required. The requirement to design a simple experiment with basic electrical apparatus to perform a specific task was poorly attempted with many candidates resorting to describing experiments they had previously performed or observed rather than answering the question.

(a) (i) The candidates needed to respond that the lamp was either dim or not lit. Weak responses such as ‘the lamp does not work’ were not accepted.

Most candidates were able to state that the lamp now glows. The lamp will be at ‘normal brightness’ so just bright was acceptable, but very bright was not.

It was disappointing that many candidates confused the terms ‘glow’ and ‘blow’ in **(a)(i)** and **(ii)**. Credit was given if the candidate had given sufficient additional detail to show that this was a language problem rather than incorrect physics.

(ii) Good candidates answered the question and explained what was observed, i.e. that the bulb glows brightly then goes out. Descriptions of what happens to the filament were allowed, e.g. ‘the filament melts’.

Many candidates had difficulty explaining their answers and used terms such as ‘the lamp fused’ or ‘the bulb burns’. Credit was given for a range of explanations.

The second mark was dependent on the first being scored. That this was due to the high voltage or high current was given by most candidates.

Some candidates did not understand the simple circuit. Some thought that the circuit was broken in diagrams showing a battery of cells with a dotted line between the cells. Others thought that as the voltage increased the current would decrease thus the lamp would appear less bright.

(b) This part of the question was poorly answered. Some able candidates gave perfect descriptions of an experiment with clear diagrams and explanations. However, others tried to adapt experiments they had seen.

Few candidates included a variable resistor or variable power supply in the circuit, and those who did were often unable to draw the correct circuit symbol.

Many used ammeters and voltmeters as well as a resistor and calculated the voltage.

The voltmeter was often drawn in series in the circuit rather than in parallel with the lamp.

Few candidates were able to describe how the circuit was adjusted to increase the voltage across the lamp until it blows.

A surprising number of candidates thought that the experiment could be repeated.