PHYSICS

Paper 5054/01
Multiple Choice

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

General Comments

The number of candidates sitting the examination in November 2009 was 9793. The mean score was 21.3 out of 40 (53%) and the standard deviation was 18%.

In general, the results show that the candidates were well prepared over the whole syllabus, but that they may be less familiar with diverging lenses than with converging ones.

The candidates found **Question 15** easy but had difficulty with **Questions 9** and **22**.

Comments on Individual Questions

Question 6

Many candidates chose **D**, which would have been true had the coin been travelling in a straight line and not in a circle.

Question 8

Most candidates incorrectly chose **B**. The 'pivot point' is the bus wheel, not the corner of the ramp.

Question 9

Candidates found this to be a difficult question. Many forgot that the load is 'shared' in the original case, and so chose **C**.

Question 11

Many of the weaker candidates ignored the atmospheric pressure.

Question 22

The majority chose **C**, which would be correct for a converging lens.

Question 34

Option **A** was popular, with the correct frequency but wrong amplitude.

Question 37

The most popular option was **D**. This corresponds to 1000 Ω, i.e. one third of 3000 Ω instead of one third of the total resistance.

PHYSICS

Paper 5054/02
Theory

General comments

The marks obtained on this component ranged across the entire spectrum of possible scores. A few very able candidates obtained very high marks (greater than 70/75) only losing a small number of marks in a variety of questions. A rather smaller number of candidates scored very few marks (less than 10/75), although the majority of these tended to leave significant sections of the paper blank. There did not seem to be a language problem in many of these cases and, as with the overwhelming majority of the candidates, the answers that were given by the weaker candidates were almost always fluent, well expressed and intelligible, even if the answer itself was inaccurate or insufficient. The answers given by weaker candidates did include errors, omissions and misunderstandings of the physics being tested, but it was clear that the vast majority of candidates understood the questions and had attempted to answer them. Most candidates scored a mark somewhere between these two extremes, which reflected the full extent of the understanding of the subject.

It is clear that candidates are getting better at adopting the practices suggested in previous examination reports. In particular, candidates tend to quote formulae and show the working out which frequently results in at least some of the marks allocated to a particular part of a question being awarded, even when the final answer is wrong. An unsupported wrong answer will invariably lose all the marks. Likewise, when answers are rounded to an appropriate number of significant figures, most candidates round correctly and it is pleasing that very few candidates are giving answers as fractions. The inclusion of the correct unit as an integral component of a final numerical answer, however, is still a problem for some candidates, and this can result in a reduction in the total mark obtained on the whole paper where unit errors are repeated many times throughout.

Candidates should be encouraged to follow the instructions on the paper and to write their answers in the spaces provided. In future papers, all questions will have an allocated answer space which should make the handing in and sorting out of question papers at the Centres simpler and candidates will be less likely to omit sections of the questions without realising it.

In ***Section B*** where a choice of questions is offered, **Question 11** proved very much less popular than the other two questions, and those candidates who chose it tended to score less highly on it. This can be partially explained by the fact that weaker candidates were more likely to choose this question and some of the weakest candidates might well have been equally unfamiliar with the subject material being tested in each of the three optional questions. Only a small fraction of those candidates who chose **Question 11**, however, went on to tackle the **OR** section where the understanding of the operation of logic gates was being examined. This section could have been the source of many comparatively straightforward marks but it is clear that very few candidates have the confidence or understanding to tackle questions on this optional section of the syllabus.

Comments on specific questions

Section A

Question 1

(a) (i) The answers to this part were quite disappointing and even good candidates failed to state that the increased pressure at the given depth is caused by the *weight* of the water above it.

(ii) Here many candidates did refer to the "density of the liquid" but very few mentioned the alternative answer "the gravitational field strength". The bare answer "gravity" was not considered sufficiently precise by the Examiners.

(b) (i) Although most candidates obtained the correct answer, some attempted to add together the two pressures but did not obtain this value.

(ii) It was encouraging that many candidates scored both marks here, in a calculation that involved numbers which are not especially easy to manipulate. Some candidates, however, did not realise that this was a *Boyle's Law* question and produced an answer using ratios:

$$\text{e.g. } 2.55 \times 10^5 : 6000 = 3.60 \times 10^5 : V$$

Question 2

(a) This part was usually well answered with many candidates quoting the correct formula, substituting in the correct values and then obtaining the correct numerical answer with unit. There were a few candidates, however, who divided the force by the distance, and even some candidates who obtained the correct numerical answer but then gave N/m as the unit. Other incorrect units given included *W* and *Pa*.

(b) Candidates needed to be quite specific about the nature of the opposing force acting on the boat. "Air resistance" or "resistance due to the water" or "friction due to the water" were acceptable but "resistance" or "friction" on its own was not considered good enough. The effect of friction between the men's feet and the roof of the tunnel was not an acceptable answer because of the wording of the question. An explanation of how the friction or resistance ensured that some work done on the boat by the men did not end up as kinetic energy was credited. This question was answered well by some candidates and poorly by others and this helped to differentiate the candidates by ability.

Question 3

(a) (i) The majority of the candidates understood what was required here and obtained full marks. Some candidates simply referred to the hockey player losing negative charge without stating that these lost negative charges are electrons. Although correct up to a point, these candidates were not fully credited. Candidates who referred to the movement of positive electrons scored nothing, as did those who explained the whole process in terms of the movement of positive charges.

(ii) Here again most candidates produced the correct answer, but some missed the point and referred to the *attraction* between the player and the surface.

(b) (i) There was a wide variety of answers offered here, although many candidates were able to describe the discharging of the player in one way or another, and so were credited. Again there was some misunderstanding of what was being asked, and some rather irrelevant points were made by some candidates.

(ii) It was satisfying that many candidates scored at least two marks here in a calculation that involved the division of quantities given in submultiples of the SI base unit. However, only a small number of candidates went on to obtain the correct answer with the correct unit – $2.4 \times 10^{-7}\,C$. In particular, the unit of charge, *the coulomb*, was very commonly omitted or substituted in otherwise correct answers.

Question 4

(a) (i) It was surprising how many candidates were unable to obtain full marks on this standard image construction. Errors included rays which did not obey the *Laws of Reflection* and rays that did not start at M. The range of locations for I was wide, with many candidates placing it to the right of the coin.

(ii) Most candidates labelled the image, but not always at the intersection of the construction lines.

(b) A common answer here was 0.17 m, even from some candidates who drew the correct diagram in part **(a)**, but equally some candidates who drew the wrong diagram were still able to quote a correct value here.

Question 5

(a) (i) Most candidates positioned the labels C and R correctly and scored full marks. However, some of the candidates who drew a line or a bracket to indicate the rarefaction, (or less commonly the compression), drew a bracket that was far too large, e.g. 4 or 5 cm, or asymmetrically positioned about the centre of the rarefaction (or compression).

(ii) It was disappointing that some candidates who were attempting to measure the correct distance obtained answers that differed significantly from the correct answer. A common error was to state the length of the diagram given, ~14.8 cm, rather than the wavelength.

(iii) The majority of candidates attempted to use the correct formula $v = f\lambda$, and it was encouraging that a high proportion of the candidates were able to obtain the correct answer, even though the frequency was not quoted in its base unit. Many of those who did not consider the factor of 1000 (from 5.1 kHz) or the factor of 100 resulting from measuring the wavelength in cm, which most candidates did, were still able to obtain some credit.

(b) Many candidates knew exactly what was required here and were able to describe how a longitudinal wave differs from a transverse wave. It is unfortunate that some candidates, who probably had some idea of what was expected, expressed their answers in vague, meaningless or contradictory terms. A particularly obvious confusion was evident when some candidates stated that "transverse waves travel in a direction perpendicular to their direction of motion". It is clear that this means something quite different from what the candidate probably intended.

Question 6

(a) (i) Many candidates calculated the correct current value but then incorrectly rounded the value obtained to 2.82 A. Some candidates obtained the correct answer from substituting in some way into a rearranged $V = IR$. This was not credited.

(ii) A significant minority of candidates gave answers smaller than the answer obtained in **(a)(i)** and some did not realise that fuses of this size are generally only available with whole number ratings. Some weaker candidates just gave 230 V or 650 W here.

(b) (i) Most candidates realised that an electric shock or even electrocution was a possible consequence of the live wire touching the casing, but few stated explicitly that this was because the casing was itself now live. Many candidates wrongly use the word *electrocution* to mean the same as *electric shock*. Some candidates believed that the fault suggested here would inevitably result in the microwave oven catching fire or exploding.

(ii) The operation of the earth wire and a fuse of a suitable rating was rarely explained thoroughly, but an encouraging number of candidates were able to explain what was happening with sufficient clarity, and consequently obtained full marks here. Some candidates felt that if the fuse rating was large enough the fuse would not blow and so all would be well.

Question 7

(a) Only a few candidates were able to state that the centre of mass of the concrete slab was located 1.0 m from the wall.

(b) (i) A very large number of candidates were able to state *the principle of moments* correctly but those who lost a mark usually omitted any reference to the system being at equilibrium. Some candidates, however, simply defined what is meant by *the moment of a force*.

(ii) This calculation was very poorly performed, with only a very few candidates using the answer obtained in **(a)**.

Question 8

(a) Most candidates knew what the terms in the question meant and calculated the correct numerical values. Only **(ii)** produced a significant number of incorrect answers. Candidates often gave the neutron number instead of the nucleon number.

(b) There were again a large number of correct answers here which made **Question 8** a very high-scoring question, even for the weakest candidates. There were some wrong answers, however, and it was not always clear where these answers came from. The most common pair of wrong answers, however, was 19 and 18.

Section B

Question 9

(a) (i) Many candidates answered this part accurately and obtained full marks. The most common causes of lost marks included the use of 22 °C as the temperature rises, the confusion of the specific heat capacity with the thermal energy (heat) required and using the unit J / (kg °C) with the final answer.

(ii) This part was also answered correctly by many candidates. Some candidates used the incorrect formula P = Et or substituted the P value for E and vice versa into the correct formula. There were also candidates who obtained the correct numerical answer but who then used the unit *minutes.* Some even divided this answer by 60 but still used *seconds* as the final unit.

(iii) Many candidates obtained the correct answer here and the errors that did appear were largely improbable guesses, e.g. "the power of the heater is less than 2600 W", "there is more than 35 kg of water in the boiler".

(b) (i) Few candidates referred to *the expansion* of the water as it is heated, although many more did realise that its density decreased. Likewise, very few candidates explained why a convection current ensures the transfer of thermal energy (heat) throughout the water. The simple statement "the convection current mixes up the water" would have sufficed here. Some otherwise good answers were spoiled by the suggestion that the water molecules expand or that the density of the molecules decreases. A few candidates referred to convection currents in the air rather than in the water.

(ii) It was encouraging that many candidates realised that steel is a better thermal conductor than plastic, but only a minority of such candidates actually answered the question fully by further stating "more heat is transferred through the steel" or "heat is transferred through the steel faster".

(c) Most candidates scored well here. The process was almost universally identified as *evaporation* and many candidates were able to supply two acceptable differences between evaporation and boiling. Some candidates gave "specific latent heat of vaporisation" as the answer to **(i)** and some suggested in **(ii)** that evaporation did not require any energy input or that evaporation is a slower process. Neither of these two points was credited.

Question 10

(a) (i) This calculation was often correct although the answer 1.87 N was a surprisingly common error. W = m/g was the formula used by some candidates.

(ii) Many candidates were able to state the correct answer here although some gave 10 m/s^2 and others used an incorrect unit for acceleration.

(iii) Many candidates performed this calculation with ease, but a small number simply did not know the formula for kinetic energy and failed to gain any credit. There were some candidates who quoted the formula $\frac{1}{2}mv^2$ but then substituted 3.2 rather than 3.2^2 and obtained the wrong numerical value as the final answer.

(b) (i) This was a poorly answered part of the question and few candidates scored well here. The fact that **device A** compares masses whilst **device B** measures weights, was rarely properly described. The effect of the decreased weight on Mars was also rarely dealt with in sufficient detail.

(ii) It was surprising that so few candidates knew the correct answer here and the answer "device B" was only slightly less common than the correct answer.

(c) Most candidates scored full marks here. The fact that it was the volume that was required was well known and almost all candidates were able to describe in detail a procedure for finding it. Even candidates who suggested the use of a beaker, rather than a measuring cylinder, were often able to score full marks by making some other point in their descriptions.

Question 11

This question was rarely attempted by the most able candidates and very few scored high marks.

(a) (i) Many candidates scored the formula mark for $V = IR$. A much smaller number, however, went on to obtain 0.45 A. Both 0.5625 A (9/16) and 2.25 A (9/4) were fairly common.

(ii) Many candidates correctly used the value obtained in **(i)** and were able to score credit here.

(b) (i) This was a poorly answered part of the question and few candidates scored well. Few candidates drew straight line graphs of positive slope and a significant minority indicated that the resistance of a metal conductor decreases as the temperature rises.

(ii) It was surprising that the majority of candidates stated that the voltmeter reading rises as the temperature rises. This included most of the candidates whose graph in **(b)(i)** indicated in some way that the resistance of a metal conductor increases with temperature. It is clear that the operation of a potential divider is very poorly understood by a very high proportion of the candidates.

(iii) Some candidates used voltmeters that began at a value other than 0 and others suggested a range whose maximum value was less than that obtained in **(a)(ii)**.

EITHER

(c) (i) This part was poorly answered with some candidates describing an experiment in which the small metal conductor X is used with a liquid in glass thermometer.

(ii) Many candidates stated one advantage of using the circuit in Fig. 11.1 as a thermometer and some went on to state a second acceptable advantage. Some candidates referred mysteriously to the "meniscus" of the circuit or to "the bulb of mercury". Answers that suggested that the thermometer based on Fig. 11.1 was more accurate or precise were not accepted.

(iii) Some candidates explained clearly and precisely what the expression *non-linear* meant but others were too specific and consequently inaccurate. Many suggested that *non-linear* meant "inversely proportional" or that the voltmeter reading was "totally random".

OR

Only a small proportion of those candidates who attempted **Question 11** chose to answer this part. It is clear that many candidates do not understand the operation of logic gates and frequent reference was made to "the current at A".

(c) (i) The truth table for a NAND gate was known by most of the candidates who attempted this part but some gave the truth table for an AND gate or an OR gate.

(ii) Most candidates stated that one of the inputs had the logical value 0 but many did not then refer to the second input or make it clear that its logical value, given that the other input has a logical value of 0, does not affect the final output. Many candidates were not sufficiently specific here. A reference to the logical value of the output was expected.

(iii) This part was very poorly answered. Very few candidates made any reference to the new logical values of the input or to the new logical value of the output. Attempts to explain the LED switching off in terms of the change in the resistance of X were usually confused and inaccurate.

PHYSICS

Paper 5054/03
Practical Test

General comments

The standard of questions was very similar to that of November 2008.

At some Centres the standard of practical work was excellent with many candidates at such Centres obtaining very high marks. There were very few Centres where candidates obtained less than 10 marks.

Comments on specific questions

Section A

Question 1

(b) The majority of candidates recorded a correct time for the temperature to fall from 60 °C to 50 °C. Occasionally the unit was omitted or there was a systematic error in the timing, e.g. 0.12 seconds, and so no credit could be given.

(d) The majority of candidates answered this correctly. Marks were lost for the same reasons as in **(b)**.

(e) The most frequent error in part **(e)(i)** was the omission of units for the rate of fall of temperature. Occasionally candidates worked out the time taken for the temperature to fall by 1 °C, i.e. they worked out the inverse of the ratio given on the question paper. In **(e)(ii)** there was much discussion of the insulating properties of tissue and of the fact that tissues reduced heat loss, but not all candidates stated that the rate of fall of temperature was reduced.

(f) Only the best candidates gained credit. The idea was that all other conditions had to remain the same so that the experiment was a fair test.

Question 2

This was the most discriminating of all the questions on the paper.

(c) Despite the fact that the question asked candidates to show the two readings that were used to obtain the vertical displacement of the rule, at least 50% of candidates did not do so. There were a few cases where x_1 was given to the nearest cm, or where the unit was omitted from the value. Good candidates found a value to the nearest mm, quoted a unit with the value and obtained a value for the ratio of x/M that lay within 10% of the second value of the ratio.

(d) There was no requirement for scale readings here, but the answer had to be to the nearest mm with unit and within 20% of the previous ratio. Good candidates were able to do this.

(e) In **(i)** the main error was the omission of units from the value of the ratios. In **(ii)** only the best candidates realised that the ratios should have the same value if the vertical displacement of the rule was directly proportional to the mass suspended from the rule. To obtain the mark in **(ii)**, candidates had to discuss the values of the ratios from **(i)**. Some said that direct proportion was produced if the displacement increased as the mass increased. This was insufficient to score, as candidates had to refer to the ratios. A number incorrectly said that the ratios should increase with the mass if direct proportion were produced. In other cases the ratios differed by more than 50%, but candidates still said that the results indicated direct proportion, which was obviously not the case.

Question 3

This was probably the least discriminating of all the questions on the paper. The majority of candidates took at least 3 readings, obtained a correct average, obtained an answer in the range 1.5 to 2.5 seconds and thus gained the marks for **(a)**. Candidates did not answer **(b)** correctly. As the front of the ball would hit the paper towels at the end of the runway, then the front of the ball needed to be released from the 0.800 m mark on the rule. A small number of candidates used a small rule or set square across the tracks at 0.800 m and removed the obstacle to release the ball. These candidates gained credit in **(b)**. Generally the calculation of acceleration was correct. Thus most candidates obtained most of the marks for this question. Errors that lead to the loss of marks in the various sections are listed below:

- omission of units for the time in **(a)**
- a systematic error in the time in **(a)**, e.g. 0.020 seconds rather than 2.0 s
- a single, or only 2 measurements of time in **(a)**
- failing to square *t* in the expression for the acceleration in **(c)**
- using m/s for the units of acceleration in **(c)**

Section B

Question 4

(a) Candidates were instructed to label points A and B on the circuit, but some did not do so. If these points were not labelled, then it often appeared that the voltmeter was in series with the remainder of the components in the circuit and thus no marks were gained for the circuit diagram. Most candidates gained credit for the correct position of the voltmeter, although a small number of candidates connected an ammeter between points A and B rather than a voltmeter. The mark for the arrangement of the components in the circuit was lost for the following reasons:

- the use of an a.c. power supply rather than a d.c. power supply
- the circuit symbol for a cell resembling that of a capacitor
- the omission of the resistor X or the switch

(b) In the majority of cases a correct voltmeter reading was obtained and the power was calculated correctly. Marks were lost for the following reasons:

- the unit was omitted from the value of the voltage
- the voltage was not quoted to the nearest 0.1 V, e.g. 1 V
- the power was not calculated correctly, in particular, there was a power of 10 error, e.g. 0.1 W rather than 0.01 W

(c) Good candidates obtained full marks for the results. Marks were lost for the following reasons:

- Units were omitted from the table headings.
- Generally the voltage should have increased as the resistance increased, but the results of some candidates did not always follow this trend. The most likely reason for this was incorrect connection of the resistors, e.g. a candidate thinks that they have connected two 100 Ω resistors in series but they have actually connected them in parallel.
- In some cases powers were calculated correctly but then rounded to 1 significant figure to make the graph easy to plot. This was penalised in the table, but error carried forward was allowed for the plotting of the points on the graph.
- Five of the values of power may have been correct but a sixth value was wrong because of a power of 10 error.

(d) The majority of graphs plotted had the correct orientation and the axes were labelled with the correct unit. Suitable scales caused a major problem for some of the weaker candidates. This was particularly the case where there were one or two points above 0.01 W. In such cases candidates often used a scale of 2 cm equivalent to 0.001 W below 0.01 W, and 2 cm equivalent to 0.01 W above 0.01 W. The resistance scale was even more confused. Candidates distributed the resistance values that they had used evenly along the resistance axis so that the scale varied as follows:

0 to 50 Ω equivalent to 2 cm
50 to 100 Ω equivalent to 2 cm
100 to 200 Ω equivalent to 2 cm
200 to 500 Ω equivalent to 2 cm
500 to 1000 Ω equivalent to 2 cm
1000 to 2000 Ω equivalent to 2 cm

In previous papers, candidates have used a range of resistance values successfully and Examiners had never seen this type of mistake before. Analysis of data that leads to a maximum point has been set in previous papers and at least 50% of candidates drew a smooth curve through their plotted points. However, a large number of candidates connected the points “dot to dot” or drew a straight line to represent the rising curve and a straight line to represent the falling curve. The intersection of the two lines was then used to determine the maximum resistance. This technique, which lost credit, seemed to be more common than in previous years

(e) Only very good candidates obtained the marks for obtaining a correct value for the resistance that gives maximum power, because of the requirement to have a good, smooth curve.

PHYSICS

Paper 5054/04
Alternative to Practical

General comments

Candidates entering this paper scored the full range of marks. Overall the candidates seemed well prepared, and although there was still evidence of candidates approaching the paper in the same way as a theory paper, more were attempting the questions from a practical perspective. This was apparent in **Question 1(a)** and **Question 3(a)**.

The graph work was well completed and there were fewer instances of the use of unsuitable scales. The drawing of a smooth curve was well attempted.

Many candidates still have difficulty with calculations involving square roots. There was some evidence of candidates not having the use of a calculator, but this was less noticeable than in the past. However, the ability to quote an answer to a given number of significant figures still causes difficulty for many candidates.

Most candidates were able to give the correct units in **Question 4(c)** when reading the meters, but many had difficulty with the conversion of mA to A for the following calculation.

Comments on specific questions

Question 1

This question required the candidates to appreciate the practical difficulties in balancing a metre rule on a knife-edge and to realise that the distances are measured from the centre of the rule. Graph plotting and taking a reading from a graph were also tested.

(a) Many candidates answered this as a theory question. Very few gave practical answers such as 'holes may have been drilled in one end of the rule' or 'one end of the rule may have been worn away'. Credit was awarded for comments that the centre of gravity of the rule was not in the centre, but many candidates who simply stated that the rule was not balanced in the centre did not gain credit. Practical detail was required, such as an end error (dead space) or that the mass of the two halves of the rule were not equal.

(b) (i) Although the majority of candidates gave the correct answer here, a surprising number did not read the question correctly and gave the diameter of the mass, or read the scale incorrectly giving answers such as 85.7. The unit was not required here as the question asked for the position to the nearest 0.1 cm.

(ii) The many and varied responses here was surprising as many candidates did not realise that they had to subtract 50 from their answer to **(b)(i)**. It is possible that some of the unexplained answers resulted from candidates using a reading from the graph in their answer to **(c)(ii)**. However, able candidates did give correct responses to both parts. The unit was required in this part of the question.

(c) (ii) The graph was well executed. The quality of the curved line was considerably improved from previous years. Many candidates gained full marks here. The most common error was to misplot the point at 75 g.

(d) (i) It was pleasing to see many candidates appreciate the need to fill in the large gap between the 200 and 400 g points on the graph. However, a significant number of candidates reverted to a stock answer, and thought this was a repeat reading and gave the response 'to get an average'. The response 'to make it more accurate' was not acceptable, but many good responses referring to a more accurate curve or graph were accepted.

(ii) A surprising number of good candidates lost credit here by either not showing marks on the graph or by omitting the unit.

(e) This part of the question required the candidates to give a practical reason, and the common response 'the rule will not balance' was insufficient. Some candidates thought that the mass would need to be placed too close to the centre. Able candidates were able to explain clearly that the distance required was greater than the length of the ruler.

Question 2

Although the majority of candidates had some experience of this experiment, a few confused it with measuring the speed of sound by using an echo from a building or wall. The explanations caused some difficulty, with candidates not expressing their ideas clearly enough. A number of candidates did not appreciate that a starting pistol does not fire bullets and commented on safety issues.

(a) Measuring tape was by far the most popular correct answer. Few candidates mentioned a trundle wheel. A single metre rule was not acceptable, but the use of two or more was allowed. The use of string was not allowed unless an explanation of how it was made 100 m long was included.

Several candidates used the time and the speed of sound to calculate the distance.

(b) The majority of candidates were able to correctly answer this part of the question, although they found it difficult to express themselves clearly in English. Some candidates thought the students would hear the bang before seeing the smoke.

(c) Most candidates correctly linked this to the avoidance of echoes. Incorrect responses included the safety aspect of using a gun, the need to produce echoes and the problems of noise from the buildings interfering with the experiment.

(d) 1 and 2 Given the large choice of acceptable responses here most candidates gained some credit. Many, however, lost credit by effectively giving the same response twice using a different form of words.

(e) Most candidates correctly stated that the speed of sound would be faster. Marks were not given for answers referring to the time taken being shorter or faster.

Question 3

Questions on optics seem to cause difficulties for candidates. This question was not well answered.

(a) Although this practical has been tested in the past, very few candidates showed any understanding of the question. A few candidates gave perfect answers, but the majority drew a ray diagram for a near object. Many left the answer blank.

The few candidates who used a distant object often gave a text book diagram of a lens with parallel light and no practical detail of how the focal length was measured.

(b) Most candidates scored some credit here for stating that f decreases as the number of lenses increases. Credit was given for inversely proportional. A few excellent responses showed the relationship mathematically by proving that $f \times N$ (number of lenses) was a constant.

Question 4

This question tested standard circuitry for measuring resistance, reading from a scale and a calculation involving the taking of a square root. A surprising number of candidates found all these tasks difficult. Many candidates thought the resistor was a variable resistor.

(a) Although most candidates were able to put the ammeter in series in the circuit, the voltmeter was found everywhere possible. Many put it also in series. Those who put the voltmeter in parallel usually put it across the resistor or cell rather than the wire.

(b) Many correct answers were given here, but a significant number thought it was used to vary the current.

(c) (i) Most candidates read the scale correctly, but some lost credit for omitting the unit.

(ii) This scale proved to be more difficult to read, with the most common incorrect response being 69. Those who gave a unit were as likely to give A as mA.

(d) Many candidates lost some credit for using their mA answer from **(c)(ii)** as A or not converting their answer to A correctly. However, they still gained credit for giving their answer to 2 significant figures. There were, however, many well laid out correct answers from able candidates.

(e) The majority of candidates gained credit here for a micrometer. A small minority who had correctly calculated the diameter suggested a ruler/metre rule/measuring tape to check its value.