PHYSICS

Paper 5054/11
Multiple Choice

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

General comments

A few candidates scored marks that were very high and a somewhat larger number produced answers that suggested that guessing had been a significant factor in choosing many of the answers. The questions which were answered correctly by the largest proportion of candidates, tended to be those which examined the knowledge of a straightforward fact that is likely to be found in a textbook. A few, fairly direct, calculations were also well answered. **Questions 11**, **12**, **14**, **17** and **38** fitted into these categories. Questions where the application of a principle or of knowledge in an unusual setting were, by and large, less well answered although the candidates who performed well on the whole paper also tended to give correct answers for these questions.

Comments on specific questions

The correct answer to **Question 1** was the most commonly chosen but the other options also attracted a significant number of candidates. These pieces of factual recall were widely but not universally well-known.

In **Question 4** only a small minority of candidates chose the correct option. More candidates chose the incorrect options **B** and **D** than the correct answer **C**.

Newton's third law of motion is very commonly misunderstood by candidates who often try to apply it to any situation where there are two forces acting in opposite directions. That option **C**, the correct answer to **Question 6**, was the least frequently chosen is a clear illustration of the confusion that this law causes. It is only in option **C** that the two forces considered act on different objects and so, for this reason, this is the only possible correct answer.

Question 8 is a relatively straightforward question and the expression *against gravity*, reveals which of the given lengths is the one that is to be used in the calculation. Even so, option **D** was supplied by just as many candidates as the correct option **B**. Only a very small number of candidates chose either of the other options.

In **Question 23**, the option **B** was chosen only slightly less frequently than the correct answer **C**. As the mirror rotates, so does the normal at the point of incidence. This is why the angle of incidence increases. It is probable that many of the candidates who chose option **B** did not consider the movement of the normal.

Although the correct answer was the most commonly chosen in **Question 27**, more than half of the candidates supplied answer **B** or **C**. This illustrates the erroneous belief amongst some candidates that when a question is asking for two facts and the answers are set out in a table such as this, the correct answer to both parts cannot be the same and hence only **C** and **D** can be correct. This question shows that this belief is not valid.

In **Question 33**, the length of coil Q is greater than that of P and as a result, it has a greater resistance and it contains more turns. This is a second example of the correct answer being the line in the table where the two entries are identical.

Many candidates struggled with **Question 34** and only a very few candidates supplied the correct answer. The e.m.f. induced in the coil depends on the rate of cutting of magnetic flux and this is zero when the magnet is stationary. This occurs at the two extreme positions where the velocity of the coil changes from a negative value to a positive value and vice versa. As it does so, there is a time when its velocity is zero.

PHYSICS

Paper 5054/12
Multiple Choice

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

General comments

The marks scored on the paper ranged from full marks for the very best candidates to very much lower scores for some of the other candidates. Similarly, the candidates found some of the questions very accessible with a very large number of candidates supplying the correct answer whilst other question proved much more challenging with only the candidates who achieved the highest marks elsewhere on the paper supplying the correct answer. The questions that are found to be the most straightforward, tend to require knowledge of the sort of facts that are commonly given in textbooks or the application of fundamental principles or formulas in relatively standard ways in familiar situations. Some very direct calculations are also found to be quite well answered. Questions which were well-answered and which belong in these categories include **Questions 11**, **12**, **15**, **19**, **24 and 26**.

Comments on specific questions

It is option **C** that is the correct choice for **Question 3**. The gravitational force on object Q is double that on p and because the mass of Q is double that of P, the acceleration produced is the same. Although **B** proved to be a more popular choice than the correct answer, the statement in **B** is not in fact correct and so cannot be the correct explanation. Although statement **A** is, in itself, correct, it does not explain why the two accelerations are equal.

Although the calculations in **Question 5** are fairly straightforward, there is more than one stage to the arithmetic and so this question was not especially well answered.

The correct answer to **Question 10** is the force that balances the resultant of forces X and Y and not the resultant itself. The most commonly selected option was option **A** which corresponds to the resultant force. This is a question that needed to be read carefully.

Question 14, is a relatively straightforward question and the expression *against gravity*, reveals which of the given lengths is the one that is to be used in the calculation. Even so, option **D** was supplied by rather more candidates than the correct option **B**. Only a very small number of candidates chose either of the other options.

Question 20 was a fairly direct test of what happens when a substance cools. The substance is already a liquid and so the first time that the temperature remains constant occurs as the liquid is solidifying. It follows that the end of the solidification process takes place at point **C**. This, therefore, is the correct answer. The second occasion at which the temperature of the substance remains constant occurs when the solid has reached room temperature. This is time **D**.

Many candidates struggled with **Question 37** and only a very few candidates supplied the correct answer and the correct answer proved to be the least popular choice. The e.m.f. induced in the coil depends on the rate of cutting of magnetic flux and this is zero when the magnet is stationary. This occurs at the two extreme positions where the velocity of the coil changes from a negative value to a positive value and vice versa. As it does so, there is a time when its velocity is zero.

In Question 30, the delay between the two echoes is due to the extra 300 m that the sound that sets off to the right has to travel before it returns as an echo to the man with the gun. This difference in distance enables the speed of sound to be calculated. The answers that were based on adding the distances in some way were therefore incorrect.

The correct answer to **Question 38** was also the most commonly supplied by candidates. There were, however, many candidates who were unaware of the effect of the temperature decrease on the thermistor and since, in addition, the principle of the potential divider is often found to be quite challenging, the significant number of candidates who chose one of the other answers can be understood.

PHYSICS

Paper 5054/21
Theory

Key messages

- A small number of candidates write some answers in pencil before writing over the answer in ink. This often leads to the answer being less legible and, when combined with crossings out and uncertain expression, the answer can be extremely difficult to interpret.
- To gain full credit, candidates should always give units when giving the final answer to numerical questions. They should also be encouraged to give answers to an appropriate number of significant figures (usually at least two), and for this reason, fractions are not accepted.
- A carefully drawn diagram can often show what the candidate intends to convey much more accurately than just words. Whenever a diagram is asked for or suggested, it is usually worth drawing it carefully and neatly and then labelling it, so that its intention is clear.
- The number of marks shown and the amount of space provided give a guide to the length of the answer required, and candidates who exceed the space provided may be wasting time giving unnecessary or irrelevant detail. It is helpful if candidates confine their answers to the space provided. Sometimes, the need arises to cross out an answer to part of a question and replace it with a new answer elsewhere. If this is done, candidates should make a simple reference to the location of the new answer. Candidates must not, however, write answers on the front of the cover sheet.

General comments

The questions were accessible to all candidates and there was no section of any of the questions where a correct response was not seen.

The standard of written English was high and there was no evidence of a language problem, even for the weaker candidates. The quality of expression, even among the weaker candidates was good, even if the underlying physics was sometimes inaccurate.

Where a question calls for extended prose, candidates should take time to plan their answer, and not list everything that they know about a topic. For example in **Question 9(a)(i),** answers lacked structure and the explanation of the operation of a transformer was often lost amongst random irrelevant facts about transformers in general. The more able candidates expressed themselves eloquently and succinctly, confining their answers to the question asked, and were awarded full credit.

Calculations were generally performed well. Most candidates were able to quote a relevant formula, either in words or symbols and substitute correctly into it. Occasionally candidates who had performed a correct calculation lost a mark by either omitting to give a unit or by giving an incorrect unit.

A minority of candidates ignored the rubric for **Section B** and answered all three questions.

Comments on specific questions

Section A

Question 1

(a) The majority of candidates were able to differentiate between the terms *velocity* and *speed*.

(b) (i) The calculation of the resultant force on the car presented little problem to the majority of candidates. Marks were occasionally lost by the omission of the unit for force.

(ii) This more demanding part caused candidates problems because they found difficulty expressing the fact that because there was a resultant forward force on the car, the actual forward force on the car needed to be greater than the resultant force. Mention of air resistance and/or friction gained partial credit here.

(iii) Most candidates were able to calculate the increase in speed over the first 4.0 s of the motion and were content to state that this was the final speed of the car. Far fewer candidates added the increase in speed to the initial speed of the car to determine the actual final speed.

Question 2

(a) The weight of the bed was almost always calculated correctly.

(b) (i) Most candidates were able to partially state the principle of moments by stating that the clockwise moment was equal to the anticlockwise moment. Far fewer candidates went on to state that this was for a body in equilibrium.

(ii) The principle of moments was nearly always used by candidates in an attempt to find the size of the total upward force exerted on the bed. Many candidates did not understand the given diagram and used incorrect values for the distances of the respective forces to the hinge.

Question 3

(a) Chemical energy was almost always correctly given as the form of energy stored in the oil.

(b) (i) Most candidates knew that oil is a non-renewable energy source, but many struggled to explain what this meant.

(ii) Nearly all candidates were able to name one relevant environmental issue associated with the burning of oil in electrical power generation.

(c) The majority of candidates did not know the definition for efficiency. Answers were often very general with no mention of energy, work or power. The term <u>useful</u> energy output was hardly ever seen. A very common incorrect answer was the efficiency was equal to output divided by input.

Question 4

(a) Many candidates scored one of the available two marks by stating that the critical angle was the smallest angle for total internal reflection or the angle of incidence for refraction along the surface. Far fewer candidates went on to qualify this statement by saying that it only occurred when light travelled from a more dense to a less dense medium.

(b) In this standard bookwork question, candidates were required to complete the paths of three rays passing from water into air. Completely correct answers were rare, and many of the ray directions drawn were obviously guesses. Candidates who had correctly explained what the term *critical angle* meant, contradicted their written answers when they drew the paths of the three rays after they had struck the water surface.

Question 5

(a) The term *frequency* was well understood by candidates.

(b) (i) Most candidates selected a correct form of the wave equation and calculated the wavelength of the sound wave correctly.

(ii) Correct answers to this part were rare. Candidates who realised that the frequency of the sound would not change when the sound passed from air to glass, almost always followed this by the incorrect statement that the speed of sound would therefore decrease on entering the glass.

(c) (i) Few candidates stated that the sound was produced by the loudspeaker because the (cone of the) loudspeaker vibrates. Many more candidates were able to go on to describe how this sound travelled through the air.

(ii) Candidates found difficulty expressing their ideas here, but the better candidates realised that the sound heard would decrease because there were fewer particles present to transmit the sound.

Question 6

(a) (i) Most candidates correctly identified the type of magnetic pole produced at X, Y and Z.

(ii) Only a handful of candidates gave a correct response to this question. Most candidates correctly stated that X and Y would attract, but went no further than this. The question asked candidates to state what happens to X and Y and only a very small minority stated that a consequence of the attraction is that the flexible strips would therefore move towards each other.

(b) Again, only a small minority of candidates could give an example of the use of a relay. Even fewer of those who were able to give a correct use were able to explain why a relay was used in the stated use.

Question 7

(a) (i) Most candidates knew that the purpose of the live wire in the mains electricity supply in the home is to supply the e.m.f. or voltage.

(ii) Fewer candidates realised that a neutral wire is needed to complete the circuit.

(b) (i) The action of a fuse in a circuit was well known. Most candidates stated that the fuse would blow/melt when the current exceeds the rated value. Many of these candidates did not then go on to state that the circuit would then be broken or the current would stop flowing.

(ii) The majority of candidates knew that the fuse is located in the live wire, but far fewer gave good explanations for the reason for placing the fuse here.

Section B

Question 8

(a) (i) The descriptions of the composition and structure of a neutral atom of sodium-24 were very good. Most candidates organised their answers and produced coherent descriptions. A mark was occasionally lost because candidates did not make it clear that the electrons were in orbit outside the nucleus and the protons and neutrons were inside the nucleus.

(ii) The majority of candidates correctly stated that sodium-24 had one more neutron than sodium-23.

(b) (i) The fact that a beta-particle is an electron was well known.

(ii) Those candidates who knew the charge and mass number for a beta-particle usually completed the nuclide equation correctly.

(c) Most candidates knew that gamma rays were electromagnetic radiation and gained the first of the two marks for this question. The second mark proved to be somewhat more elusive because candidates tended to offer no more details. To gain the second mark, candidates need to say that the electromagnetic waves had very high frequency or very short wavelength.

(d) (i) Although most candidates had the correct direction of deflection for the beam of beta-particles, many candidates did not realise that the deflection starts immediately the beam enters the electric field. It was not uncommon to see diagrams where the beam of beta-particles continued in a straight line in the electric field and suddenly deflected when half way through the plates. Many candidates did not realise that the path taken by the beta-particles in the field would be curved and not straight.

(ii) The majority of candidates knew that gamma-rays would not be deflected as they passed between the charged plates.

(iii) Most candidates could explain the difference in the two paths they had drawn and knew that beta particles were charged, whereas gamma-rays are uncharged.

(e) Candidates found difficulty in explaining why the 15 hour half-life of sodium-24 makes it a suitable isotope for use in diagnosing medical conditions. Only the more able candidates realised that the half-life time allowed enough time to take measurements but was short enough so that the body is not irradiated for too long.

Question 9

(a) (i) This straightforward question was very poorly done. Complete descriptions of how a transformer operates were rarely given and full marks for this question were rarely awarded. Candidates did not organise their answers and wrote at length, often giving random, irrelevant facts about transformers and hardly ever mentioning the magnetic fields involved and the production of an induced e.m.f.

(ii) Although many candidates could identify a diode as a circuit component that allows current to pass in one direction only, far fewer were able to draw its circuit symbol. Many candidates missed out the vertical line at the tip of the triangle symbol, and others got the symbol confused with that of a NOT gate.

(b) (i) A satisfactory explanation of what is meant by e.m.f. was beyond the scope of all but the most able candidates. Very few candidates related e.m.f. to the energy transferred per unit charge, and even fewer related this to the complete circuit.

(ii) Only the better candidates realised that the resultant e.m.f. in the circuit was the difference between the two given voltages. Most candidates added the voltages even though they were in opposition.

Candidates fared better with the calculation of the current in the circuit and the quantity of charge passing through the resistor in 1.5 hours. A common failure in the charge calculation was the failure to convert the given time to seconds.

(c) A majority of candidates were unable to explain why it was not necessary to earth the battery charger.

Question 10

(a) (i) Candidates coped well with explaining the difference in the densities of oil and a gas using molecular ideas.

(ii) This was the poorest answered question on the paper. Only a handful of candidates were able to explain the incompressibility of oil. There was hardly ever a mention of large (repulsive) forces between the molecules preventing such a compression.

(b) (i) The calculation of the volume of oil in the pan was done well by the majority of candidates.

(ii) 1. Candidates who organised their explanations generally were able to score two of the three marks available. Candidates had the choice of explaining thermal conduction through the base of the saucepan either in terms of molecules **or** free electrons. Inevitably many answers were a confused muddle and a mixture of both methods and candidates were penalised for this.

2. This part was much better answered and most candidates identified convection as the mechanism by which the thermal energy spreads through the oil in the pan. Molecular descriptions of the mechanism of convection were good.

3. Candidates were asked to suggest a suitable material for the handle of the pan and to explain their choice. Most candidates named a suitable insulator, but a large number did not state in their answer that this was the reason for their choice.

(c) (i) The meaning of the term *boiling point* was well known. Candidates were required to state that it was a <u>temperature</u>. Vague answers stating that it is the <u>point</u> where a liquid becomes a gas were not awarded credit.

(ii) The calculation to find the thermal energy needed to heat the oil to its boiling point was well done by the majority of candidates.

(iii) Few candidates could account for the fact that the actual thermal energy output from the hotplate in raising the oil to its boiling point would be greater than the value calculated in **(ii)**. Of those candidates who realised that this was due to heat losses, few stated that heat would be lost to the air/surroundings or had been used to heat the pan itself.

PHYSICS

Paper 5054/22
Theory

Key messages

This paper tests the candidates' ability to reveal an understanding of the subject in many different ways. Some credit is awarded for the recall of factual knowledge that is essential to an understanding of the subject at this stage. Credit is also awarded for applying that knowledge in both familiar and unfamiliar situations in a manner that shows that the basic principles of the subject are properly comprehended. Hence, the candidates who gain the most credit are those who have learnt the facts and see how they are related to the ways in which the concepts and ideas are derived and who can apply them in the way asked for in particular questions. There are no short cuts and, in a paper, such as this one, where a wide range of different topics are tested, the candidates who have a thorough familiarity with the subject as set out in the syllabus are those who are the most successful.

Within the published syllabus, there can be found an extensive list of the most frequently used command words which let the candidate know the sort of answer that is expected. The candidate is also able to deduce, from the mark allocation, what sort of answer is required if full credit is to be gained. Candidates should be reminded that a lengthy and detailed answer to a question where the credit available is small cannot make up for an excessively brief and superficial answer to a question where substantially more credit can be obtained. Candidates should not, however, place too much significance on the amount of answer space that has been supplied. Where a single answer line or a small blank space is given on the paper, it can safely be assumed that a protracted explanation or a complicated calculation is not expected. Where rather more answer space is available, candidates should not be under the impression that they are expected to write until there is no space left. It is known that candidates have handwriting of differing sizes and that some crossing out is needed; in many cases, there will be unused answer space remaining after a complete and correct answer has been given. It is possible that full credit is awarded for the final answer even though the candidate has not shown the working out. This is not always the case, however, and it is appropriate to advise candidates to show the working. It is tempting, when using a calculator to determine a numerical answer not to show the working. If this is done and the answer proves to be incorrect, then all the credit is forfeited. Nearly all numerical answers require a unit and the overwhelming majority of candidates are very diligent in supplying a unit. There remain a small number of candidates who do not do this and who, as a result, lose credit. Often, candidates who have been completely rigorous in supplying units elsewhere in the paper, omit the unit of angle, the degree (°) where it is required just as much. This happened on this paper, from time to time, in the answers supplied to **Questions 8(b)(ii)** and **8(b)(iii)**.

General comments

It is inevitable, that some candidates indicate a clear and detailed knowledge of the subject whilst others struggle more noticeably to supply answers that match the expectations of the examiners. On rare occasions, the choice of an inappropriate word or the use of an unusual word order leads to ambiguity or uncertainty in what is intended; the fundamental principle is that candidates should supply simple and direct answers that address the exact point that the question is assessing.

It is helpful if candidates confine their answers to the space provided. Sometimes, the need arises to cross out an answer to part of a question and replace it with a new answer elsewhere. If this is done, candidates should make a simple reference to the location of the new answer. Candidates must not, however, write answers on the front of the cover sheet.

Comments on specific questions

Question 1

(a) This was quite commonly well answered and the majority of candidates were awarded full credit. There were some candidates, however, who divided the acceleration by the time taken rather than multiplying them and a smaller number stuck with the unit in the question and gave m/s^2 as the unit of speed.

(b)(i) Many candidates gave the correct answer but some attempted a calculation using the numbers from the question and obtained a non-zero answer.

(ii) This was well answered with a significant number of candidates being awarded full credit. Some candidates did not draw the line with sufficient care and errors were made in drawing the horizontal part of the graph. It was sometimes drawn at 16 m/s and sometimes close to a value of 1.7 m/s.

(iii) Most candidates gave the correct answer but answers that relied on determining the gradient of the line were given by a minority of candidates.

Question 2

(a)(i) This was correctly answered by most candidates with only a small number using the weight instead of the mass in the formula *mgh*.

(ii) Many candidates supplied two relevant forms of energy although gravitational potential energy was a common inappropriate choice.

(b)(i) This was rarely correct and the answers 'forwards' or even 'downwards' were given very commonly.

(ii) Even the candidates who obtained full credit in many other parts of the paper were tempted to give the erroneous answer 'They are equal' here. Only a small minority realised that the question related to the centripetal acceleration of the skateboarder.

Question 3

(a)(i) This was very frequently correct with a few candidates predicting what lay ahead and calculating a moment rather than the weight.

(ii) **1.** Many candidates understood how to obtain a moment but the perpendicular distance was taken as 0.70 m much more often than the correct 0.35 m.

2. Few candidates realised what was expected and many gave answers that related to the calculation of the moment.

(b) Very few candidates realised that a change in the direction of the force would reduce the magnitude of the perpendicular distance.

Question 4

(a) Only a minority of answers included the word 'temperature'. The answer 'the point at which a liquid turns to a gas' was not awarded any credit.

(b)(i) This was commonly awarded full credit. The most frequent reason for the forfeiting of credit was the substitution of 250 (°C) as the temperature change. The temperature change must be obtained from the graph in Fig. 4.2 and *t* (which is given as 250 s) was defined as the time and not as temperature or temperature change.

(ii) Few answers referred to the loss of thermal energy at all and many answers stated that the change in the rate of temperature increase was due to convection in the water.

(c)(i) A majority of candidates, but by no means all candidates, were awarded full credit for stating, in some way, that the temperature of the water remained constant at this point.

(ii) Few answers were given in terms of the molecules and some that were merely introduced them as a description of the boiling water.

Question 5

(a) There were some very good answers to this part with a common cause of lost credit being the omission of any reference to the molecules exerting a force on the inner walls.

(b) This part was well answered by many candidates and especially well answered by those candidates who performed well elsewhere on the paper. Some candidates assumed a direct proportionality between the pressure and the volume and oddly a few others obtained the correct answer by the application of the formula $m = rV$. Perhaps the Greek r was confused with a p.

Question 6

(a) There were many good answers given on this part of the paper and full credit was awarded quite commonly. A common reason for the forfeiting of credit was the omission of any description of how the electrons were accelerated.

(b) The answer 'so that electrons reach the screen' was quite commonly given but it is not in itself the full explanation that was required.

(c) This was poorly answered and very few candidates related the movement of charged particles to an electric current. Many answers suggested incorrectly that an electric charge and a magnetic pole were in some sense equivalent terms and that either a repulsion or an attraction was one consequence of this.

Question 7

(a) Full credit was awarded to only a minority of the candidates. Inaccurate subtraction or the absence of any description of the structure of the neutral atom were frequent reasons for full credit not being awarded.

(b)(i) In both parts, the answer supplied was often correct but some answers only refer to properties other than the ionising effect.

(ii) Although many candidates gave two correct precautions, others only gave one. Answers that refer only to protective clothing or containers are not considered sufficiently detailed; it must be clear that the protection is due to the presence of lead.

Question 8

(a)(i) This was commonly correct but not invariably so. Some candidates attempted to read the graph backwards.

(ii) This was well answered with only some candidates curving the line downwards or continuing with a horizontal line.

(b)(i) This part was generally well answered although there were candidates who used 3.5 (cm) in the calculation rather than 0.035 (m).

(ii) Many candidates quoted or attempted to use the equation: $p = F/A$. The two most significant sources of lost credit were an incorrect rearrangement of the equation and an inaccurate value for the base area of the block. The length of 3.5 cm was often used when calculating its area.

(iii) This was very poorly answered with the overwhelming majority of candidates attempting a subtraction rather than an addition. The tension in the spring and the force on the base due to the pressure in the water act in the same direction.

(c)(i) This was poorly answered. Very few candidates realised that the atmospheric pressure acts on the upper surface of the block directly and acts on the lower surface of the block because it is transmitted through the water.

(ii) This was very well answered with the overwhelming majority of candidates being awarded full credit.

(d) There were few completely correct answers here but many candidates made relevant points. Most commonly, these included some reference to the pressure at the lower surface of the block increasing and to the upper force increasing as a consequence.

Question 9

(a) Many candidates knew what a current is but many did not refer to the *rate* of flow of electric charge.

(b)(i) Although this was often correct, the answer 1.5 V was also quite frequently given. Perhaps the terms cell and battery are commonly confused.

(ii) This was frequently calculated correctly.

(iii) This was also well answered, although some candidates divided the voltmeter reading by the current or used the electromotive force (e.m.f.) of the cell in the multiplication rather than the voltmeter reading.

(iv) Although the effect of the temperature increase was commonly stated correctly, many candidates omitted to give an explanation.

(c)(i) Most field patterns were of the correct basic shape although some were drawn with crossing and irregularly shaped field lines.

(ii) **1.** Only a few answers were sufficiently detailed. In particular, the fact that an S-pole is induced on the upper surface of the cylinder and the fact that opposite poles attract were not mentioned very frequently.

2. This was well answered by many candidates.

Question 10

(a)(i) Although the correct value was supplied by most candidates, there were many variations that were not correct.

(ii) The appropriate equation was well known and many candidates obtained full credit.

(b)(i) The correct answer was commonly supplied even by candidates who performed less well elsewhere on the paper.

(ii) This was very commonly completely correct. A few candidates, who wrote the correct equation in terms of the sine functions, simply substituted the value of the angles rather than their sines and obtained an inaccurate value for the angle.

(iii) This was often but not always correct; the value 45° was often given.

(c)(i) The rays drawn were quite commonly correct although common problems stemmed from incorrect refraction at the second surface or the emergent rays being parallel.

(ii) Most candidates had some idea of what was seen but rather fewer candidates gave a sufficiently detailed description.

(iii) **1.** Some candidates did not place the X on the screen and of those that did, many were found in the middle of the visible light spectrum.

2. This tended to be well answered but the imprecise answer 'Black surfaces are good emitters and good absorbers of infra-red radiation' was too general; the emission property of the blackened bulb does not explain why the thermometer is a good detector.

(d) Many answers were too general and only restated what was already given in the question. Whilst a detailed understanding of the operation of an intruder alarm was not required, the way in which infra-red radiation enabled such an alarm to operate was expected.

PHYSICS

Paper 5054/31
Practical Test

Key messages

Good answers require good practical skills, particularly in following instructions, making observations, taking measurements (with repeats and averages where appropriate) and recording and processing results according to the instructions given. Weaker responses often recited parts of theories or quoted work the candidates had revised and this was not often an appropriate answer. Good answers show all repeated measurements (even in the unlikely case that they are the same), all working for calculations, state units for quantities and give answers correctly rounded to an appropriate precision. Measurements taken from an instrument (e.g. ammeter or voltmeter) should be recorded to the precision of the instrument. In questions where a unit is specified it should be ensured that quantities are converted so that the final answer is given in the required unit.

General Comments

Good answers demonstrated that candidates were able to read the question and perform the tasks as requested, take measurements to an appropriate precision, with repeats and averages, process those results, present results in a table, perform calculations using given formulae and/or plot line graphs, and with guidance from the instructions in each part of the question paper draw conclusions or make comments based on those results. Good responses gave answers with correct units and to appropriate precision, usually two or three s.f.

It is in the interests of the candidates that supervisors provide a complete set of results for each set of apparatus used by candidates, especially when electrical circuits or optics equipment are used.

Comments on specific questions

Question 1

There were some good answers. Some centres reported that the clay had a tendency to drop off the spring, but most sets of results indicated little problem.

(a) Candidates were asked to measure the coiled part of the length of a vertical spring, attach a weight (modelling clay) and then measure the new length. The better responses gave for each part at least two repeat measurements of all lengths, with answers within range and to the nearest millimetre, averaged and with unit (mm or cm, but m would also be accepted). The extension, *e*, of the spring was calculated and good responses gave *e* to the nearest mm with the unit stated.

(b) (i) The same measurements were taken while the clay was immersed in water. In the better responses repeat measurements were written down with correct average and units.

(ii) The extension was calculated and good answers gave a value for *e* smaller than their first value, with units and to the nearest mm.

(c) Better responses calculated the density using the two values of *e* substituted into the given equation and answers were within range and given to two/three s.f. with the correct unit. A significant number of responses were out of range.

Question 2

(a) Candidates were provided with a pendulum made from a ruler suspended by two threads and asked to position the threads correctly, set it oscillating and then time the oscillations.

(i) Candidates were asked how they checked the rule was vertical. Good answers gave a concise description of the method with the measurements required and how those measurements indicated the rule was vertical (threads were parallel/had the same separation all along their length, or they were aligned with a distant known vertical reference line).

(ii) Candidates were asked how they checked the rule was horizontal. The better responses again gave a concise method, some with measurements to back up the description and explained how this showed the rule to be horizontal (same height above the bench all along the length of the rule or using a known reference line). Many weaker responses omitted to state how their method showed the rule was horizontal. Some responses referred to the use of a spirit level, but this piece of equipment was not provided. The method using set squares was unreliable as it was likely to disturb the rule.

(b) Ten oscillations were counted and to obtain accurate values repeat timings should be taken. The better responses wrote down several repeated timings to three s.f. which were then averaged to give their value for *t* with units. Times should be written with correct notation, e.g. 7.23 s (correct) and neither 7:23 s (incorrect) or simply copying the stopwatch display with superscripts. The time for one oscillation was then calculated (dividing *t* by 10) and the better answers were given to two/three s.f. with the correct unit and within range.

Question 3

(a) Measurement of potential difference in Volts and current in Amps both to 2 d.p. were required.

(b) The formula given in the question was used to calculate the resistance of the diode. The better answers were within the range of 1.0 to 3.0 Ohms and given to 3 s.f. with the correct unit.

(c) A resistor was placed in series with the diode and another set of voltmeter and ammeter readings recorded. The readings obtained should have been smaller than the first and within range, to 3 s.f. and with units.

(d) The formula given in the question was used to calculate the resistance of the diode. The better answers calculated the resistance to be larger, also given to 3 s.f. with the correct unit.

(e) This mark depended on the quality of the results: a correct set of results demonstrated that as the current decreased, the potential difference across the diode decreased (by a small amount) and the resistance of the diode increased (or *vice versa*). Better responses referred to the changes in current, potential difference and resistance. There were few good responses.

Question 4

(a) Candidates were asked to set up an object lens and screen according to a given diagram and for part **(a)** find the lens position where a smaller focussed image is formed and to measure the distance between the lens and object, u_S.

(b) (i) The same set up was used but this time the larger focussed image position was to be found, u_L.

(ii) The candidates values were then used to calculate *d* (the difference between u_S and u_L) and then *y* ($D^2 - d^2$).
Good responses showed the average of repeated measurements (if time allowed) given to the nearest mm with units and within range.

(c) The better answers showed at least 5 sets of results written in a table with headings and units and including the results from **(b)** obtained by repeating the procedure using a wide range of separations of object and screen. Good sets of results showed that as *D* increased the value of *y* increased. Weaker responses often omitted the results from **(b)**.

(d) The values of *y* and *D* were then plotted on a graph with *y* on the *y*-axis and *D* on the *x*-axis and the straight line of best fit drawn. Graph plotting has improved but there are still some responses showing poor choices of scale (a good scale is based on e.g. 2, 5 or 10 per cm and bad scales on 3, 7, etc.). Better graphs had axes both labelled with the quantity and unit, a good choice of scale with neat, accurately plotted points extending over at least half the grid and good placement of a fine straight line of best fit.

(e) A gradient triangle should have been drawn (or at least correctly indicated with some appropriate marks) and the same triangle used. Good responses had a large triangle, correctly placed and the same triangle used to calculate the gradient (increase in *y*/increase in *D*) of the best straight line. The gradient was then used to calculate the focal length of the lens. The better answers were in the range 13 cm to 17 cm. A number of candidates drew a triangle but used numbers corresponding to a different triangle.

PHYSICS

Paper 5054/32
Practical Test

Key messages

Good answers require good practical skills, particularly in following instructions, making and recording observations, taking measurements (with repeats and averages where appropriate) and recording and processing results according to instructions given. Good responses show all repeated measurements (even in the unlikely case that they are all the same), all working for calculations, state units for quantities and give answers correctly rounded to appropriate precision. Measurements taken from an instrument should be recorded to the precision of the instrument. In questions where a unit is specified it should be ensured that quantities are converted so that the final answer is given in the correct unit.

General comments

The standard of responses was generally very good and of a similar standard to previous years. Graph plotting continues to improve. Good answers demonstrated that candidates were able to: read the question and perform the tasks as requested, take measurements to an appropriate precision, with repeats and averages, process those results, present results in a table, perform calculations using given formulae and/or plot good line graphs, and with guidance from the instructions in each part of the question paper, draw conclusions or make comments based on those results. Good responses gave answers with correct units and to appropriate precision (usually two or three s.f.).

It is in the interests of the candidates that supervisors provide a complete set of results for each set of apparatus used by the candidates, especially when electrical circuits or optics equipment are used.

Comments on specific questions

Question 1

Candidates were required to measure the dimensions of a convex lens and use a formula to calculate its focal length.

(a) Candidates measured the edge thickness of the lens and as this was small (<4 mm) answers to the nearest 0.5 mm were expected. Better responses gave repeated and averaged values for *t*.

(b)(i) Better responses (rarely seen) had repeated and averaged values written down for the diameter of the lens and a suitable diagram in **(b)(ii)**. Measurements to the nearest mm were required.

(ii) There were three options for a diagram: perpendicular viewing of the scale reading at the lens edges, using two set squares placed like a pair of Vernier calliper jaws against the lens edge and at right angles to the edge of the rule, or drawing diameters indicating measurements taken at several different orientations of the lens.

(c) Better responses annotated the diagram in Fig 1.3 to show two set squares placed like a pair of Vernier Calliper jaws touching the thickest part of the lens at its centre and with one flat side of the triangle along the edge of the ruler. Values for the centre thickness of the lens should have been in the range of *t* and 10 cm.

(d) The accepted range for the focal length was 7.5 to 30 cm. Weaker responses often used quantities with different units in the formula thus getting an incorrect answer, whilst better responses showed measurements converted into consistent units and gave their final answer with units and two or three s.f.

Question 2

Candidates were required to rotate a ruler attached to a spring and time its oscillations.

(a) Better responses described the amplitude gradually decreasing. Weaker responses either described the apparent speed of the motion decreasing or gave incorrect amplitude changes.

(b) (i) Better responses listed repeated and averaged times for 10 oscillations, counted correctly. Better answers showed several repeated times to three s.f. which were then averaged to give *t* with units of seconds(s). Some responses, particularly the weaker ones, wrote down incorrect notation for the times. For example 7.23 s is correct and 7:23 s incorrect. Weaker responses sometimes just wrote down times incorrectly by giving the appearance of the digital stopwatch display with superscripts as well as ':' replacing '.' and this should not be done.

(ii) The time for one complete oscillation was calculated (*t*/10) and in the better responses final answers were given to two/three s.f. with correct units(s) and within range. Some weaker responses calculated the inverse of the correct answer.

(c) A piece of Blu-Tack was attached to the ruler and candidates timed oscillations again. Better responses showed repeated and averaged times with units and two/three s.f. and the times were larger than in **(b)**.

(d) The better answers showed the ratio calculated and rounded correctly and in the range 1.0 to 1.2 with no units.

Question 3

Candidates were asked to connect one resistor at a time into a circuit, measure the potential difference across it and the current flowing through the circuit. Some centres reported difficulty in obtaining the resistors requested but the ones used for this examination were generally found to be acceptable.

(a) Using the 10 Ω resistor, better responses showed that the resistor had been connected correctly and recorded voltages to 0.1 V and current to 0.01 A or better, with units and in the required ranges. Answers that were out of range could only be considered if the supervisors provided full sets of measurements for each set of equipment used.

(b) Using the 22 Ω resistor, better responses showed that the resistor had been connected correctly and recorded voltages to 0.1 V and current to 0.01 A or better, with units and in the required ranges.

(c) Better responses described how their results showed that as the resistance increased the current reduced and the potential difference (reading on the voltmeter, or voltage) increased. Weaker responses omitted quantities or gave the wrong changes. The quotation of Ohm's Law was not required.

(d) The resistance of X was calculated by substituting candidates' values into the given formula. Better answers were calculated correctly with a positive value, in the range 6.0 Ω to 20.0 Ω and given to two or three s.f. and with the unit.

Question 4

(a) Candidate's were required to measure the coiled part of a spring. Most answers were within the accepted range, to the nearest mm and with unit. There were few responses showing repeated measurements. Weaker responses often gave values out of range, perhaps as they included the loops at the ends of the spring.

(b) Candidates were asked to set up the apparatus and measure two lengths

(i) There were many answers for which no mark was awarded because length, *x*, was only recorded to the nearest cm or no unit was given.

(ii) There were many good responses giving *L* and *e* to the nearest mm and quoting the correct unit.

(iii) Candidates were asked how they checked the rule was horizontal. Good responses explained briefly the method and the measurements required and how those measurements indicated the rule was horizontal (same height above the bench all along the length of the rule or use of a horizontal reference line). The better responses also provided measurements to back up their descriptions. Some responses omitted to state how their measurements proved the rule was horizontal. Some responses referred to the use of a spirit level even though this piece of equipment was not provided. Some responses described less reliable methods which were likely to disturb the apparatus, e.g. using set squares and some referred to the clamp/retort stands being vertical (this cannot be assumed).

(c) Better responses wrote a table within the grid labelled Fig. 4.4 with correct headings (*x*, *L*, *e* with units). And included the results from part **(b)** and a further five sets of results each obtained for different values of *x* over a range of at least 50 cm. Better responses showed the correct trend of *x* increasing as *x* increased. Weaker responses often omitted units, and/or omitted the results from **(b)** or gave fewer sets of results. Some of the weaker responses showed *e* decreasing as *x* increased, indicating incorrect measurements or incorrect processing of results.

(d) Most responses were good, the graphs had axes labelled with the quantity and unit, a good scale choice, accurately, neatly plotted points extending over at least half of the grid and good choice of best fit straight line. Weaker responses showed inappropriate scale choice, poor plotting of points and either bad line judgement or 'dot-to-dot' lines.

(e) Candidates were asked to find the gradient of the graph.

Good responses drew a large gradient triangle using their line of best fit. The triangle should have utilised at least half of the best fit line and the same triangle should have been used to obtain values for the increase in the *y* direction (increase in *e*) and the *x* direction (corresponding increase in *x*) and to calculate the gradient. Better responses obtained values in the range 0.2 to 0.3 and no unit. Some candidates drew a large triangle but used numbers corresponding to a different triangle.

PHYSICS

Paper 5054/41
Alternative to Practical

General comments

The aim of the examination is to enable candidates to display their knowledge and understanding of practical physics techniques. These include:

- graph plotting
- tabulation of readings
- manipulation of data to obtain results
- drawing conclusions
- dealing with possible sources of error
- control of variables.

The level of competence shown by the candidates was sound, although, as in previous years, some candidates continue to approach this paper, as they would a theory paper, and not from a practical perspective. Only a very small number of candidates failed to attempt all sections of each of the questions and there was no evidence of candidates suffering from lack of time. Many candidates dealt well with most of the practical skills required but some had difficulty in suggesting suitable practical techniques and apparatus. The better candidates were able to follow instructions, record observations clearly and perform calculations accurately and correctly although very few were able to give an answer to the correct number of significant figures. Units were generally well known and usually included where needed, writing was legible and ideas were expressed logically. Candidates did less well in graph plotting.

Comments on specific questions

Question 1

(a) This was intended to be an easy start to the paper and most candidates gained both marks. A small number of candidates forgot to divide by 14 and gained one mark only. A very small minority added the two numbers together and divided by two and consequently scored nothing.

(b) The idea of carrying out a fair experiment in order to be confident of a conclusion is extremely important in practical science. Most candidates scored at least one mark here.

(c) Candidates were expected to suggest a piece of apparatus which would speed up the evaporation of the water. The most suitable would have been a fan but we also accepted any form of heater in the room unless it was directly heating the water.

Question 2

(a) This was poorly answered and yet the candidates only had to follow the instructions given. The ability to draw a straight line with arrows to indicate a length is a skill that candidates need to improve upon. The distance moved by the car should have been from the same point on one car to the exact same point on the next car but many drew a line from the front of one car to the back of another.

(b) The candidates were asked how the height could be measured accurately and one mark was given for suggesting the apparatus required i.e. a metre rule or a tape measure. The second mark was for accuracy, e.g. using a set square to ensure the metre rule was vertical to the bench or a correct explanation of how parallax error is avoided.

(c) (i) This was challenging and only a handful of candidates realised that the variation of data for this experiment was so large that giving a final answer to any accuracy higher than one centimetre would be incorrect.

(ii) This simply required averaging the lengths given and most, but not all, scored both marks.

(iii) The standard of graph plotting was disappointing this time. Most candidates had correct, labelled axes, and had used sensible scales which maximised the use of the given grid. Points were generally accurately plotted but some lost this mark for the lack of clarity in the placing of their points or by using an oversized dot or 'blob'. The trend of the points was clearly a curve but the majority of candidates drew a straight line through the points. Those who did draw a curve forced their line through every point (sometimes with straight lines from point to point) and this lost the mark. Marks lost could often be avoided if candidates were to use a sharp pencil to plot their points and draw the line. There was less evidence this year of scales on the axes which were multiples of 3, 7, etc. The use of such scales makes it difficult for the candidates to plot their points accurately, and difficult for the examiner to check the accuracy of these plots so marks are lost.

(iv) The majority of candidates answered this well and gained the mark when referring to their drawn graph.

(d) This was well answered and the majority of candidates scored the mark.

Question 3

(a) Candidates were expected to connect the leads from the heater in the diagram to the terminals of the power supply and also correctly place an ammeter and voltmeter in the circuit. Generally, this was poorly answered. Many candidates ignored the heater leads completely or short circuited the heater and so scored no marks. Most candidates did realise that the ammeter should be placed in series but many also put the voltmeter in series as well.

(b) (i) The candidates were required to read the meters in the diagrams and the majority did this correctly.

(ii) Candidates were expected to use the equation and values given to calculate the specific heat capacity of the aluminium. Many candidates fell at the first hurdle and could not correctly do the calculation and so did not score either mark. Those who did this calculation correctly found it challenging to give their answer to two significant figures and lost the second mark. Only a minority scored both marks.

(c) Candidates were expected to give practical reasons why the calculated value might be different. Most suggested incorrect readings and this did not score the mark. Candidates did not seem to realise that heat would be lost to the surroundings and that lagging could prevent this. There were other possible answers but marks were rarely awarded.

Question 4

(a) Candidates have been asked similar questions on previous papers and so this should have been a familiar idea. The performance of candidates was much better than in previous years and there were some excellent responses. However, many candidates still measured the diameter of one straw rather than lining up ten straws and measuring across all ten before dividing by ten to find the diameter of one straw. Some confused radius and diameter. Others wrapped string around the straw to find a circumference and then gave this measurement as the diameter. A few were confused by the mention of a box of straws and thought the box had to be included in some way.

(b) This was intended to be challenging and only the more able gained the marks. Some realised that the straws needed to be filled with water and the volume of water should then be measured using a measuring cylinder. To gain the second mark, some idea of increasing the accuracy was required and this mark was rarely awarded.

PHYSICS

Paper 5054/42
Alternative to Practical

Key messages

Candidates should be reminded to include units when quoting the values of physical quantities. They should be encouraged to check that the unit they have provided is appropriate for the calculated or measured quantity.
Candidates should be made aware that it is important to record measurements to the correct precision. In particular, measurements made with a rule should be given to the nearest millimetre. If a measured length is, say, exactly 5 cm, the value should be quoted as 5.0 cm.
Candidates often lose credit for lack of care and attention to detail when drawing or annotating diagrams. The accuracy of straight lines on diagrams could be greatly improved by using a sharp pencil and a ruler.
Candidates should be advised to avoid using rote phrases, such as, ‘to make it more accurate’ or ‘to avoid parallax error’. These comments need to be linked to the practical situation being considered, and candidates should state why the accuracy has improved or how parallax error was avoided.
Candidates should be reminded that, when plotting a graph using data obtained from practical work, there will almost always be some scatter about the line of best fit. Forcing the line through all points will often produce a curve that is not smooth, and candidates should be discouraged from doing this.

General comments

The level of competence shown by the candidates was sound, although, as in previous years, some candidates continue to approach this paper, as they would a theory paper, and not from a practical perspective. Only a very small number of candidates failed to attempt all sections of each of the questions and there was no evidence of candidates suffering from lack of time. Many candidates dealt well with the range of practical skills being tested. The stronger candidates were able to follow instructions, record observations clearly and perform calculations accurately and correctly. Units were well known and usually included where needed, writing was legible and ideas were expressed logically. The standard of graph plotting continues to improve.

The questions were accessible to all candidates and there was no section of any of the questions where a correct response was not seen, although **Questions 2(a)(ii)**, **3(c)** and **4(b)(ii)** produced only small numbers of correct responses.

Comments on specific questions

Question 1

(a) (i) The volume of the liquid in the measuring cylinder was read correctly by almost all candidates. Where mistakes were made, the most common incorrect volumes recorded were 60.4 cm^3 and 76 cm^3.

(ii) Most candidates knew the correct way to read the volume of liquid in a measuring cylinder, and the need to take the reading at the bottom of the liquid meniscus. Many went further, and stated that the reading should be taken when viewing perpendicularly to the scale. Merely mentioning the need to avoid parallax error did not gain credit – candidates were expected to say how this would be achieved.

(b) (i) Almost all candidates knew that a balance of some kind would also be needed to determine the density of the liquid.

(ii) The explanations given by candidates on how they would use the chosen apparatus to determine the density of the liquid were usually concise and clear. Confusion sometimes occurred when candidates attempted to explain how they would determine the mass of the liquid by subtracting the two measurements made. It was not uncommon for candidates to state that the mass of the measuring cylinder and the water should be subtracted from the mass of the empty cylinder in order to determine the mass of the water. Almost all candidates knew that the density of the liquid could then be determined by the ratio of mass to volume.

(c) This more difficult part proved to be more troublesome, with many answers appearing to be guesses. The more able candidates used the density formula to deduce that an overestimate of the volume of the liquid would result in a calculated value for the density of the liquid that was too small.

Question 2

(a) (i) Large numbers of candidates were unable to suggest how the connecting wires could be connected to the pencil lead. Candidates should have practical experience of connecting components together in electric circuits.

(ii) Again, it became obvious from reading candidates' responses to this question, that many candidates had not seen a micrometer or had not used one to determine the diameter of a wire. Of those candidates who were able to describe how to use a micrometer correctly, only a very small number explained the need to repeat the measurement at different points along the length of the pencil lead.

(iii) The calculation was usually performed correctly, but marks were lost due to incorrect rounding of the answer. The requirement that the answer be quoted to two significant figures was also often ignored, and credit lost as a result of this omission.

(b) (i) The graph question was done well, with most candidates scoring three or four marks. The axes were usually labelled and sensible scales were chosen. There was less evidence this year of scales on the axes that were multiples of 3, 7, etc. The use of such scales, makes it difficult for the candidates to plot their points accurately, and difficult for the examiner to check the accuracy of these plots. Most candidates plotted the points accurately and drew a best-fit straight line, as requested. Candidates should be reminded that they need to plot to the nearest half square, so plotting all the points on grid intersections will sometimes mean an error in the plot.

(ii) When determining the gradient of a straight-line graph, candidates are expected to draw a large gradient triangle, which covers more than half the plotted line. Despite the instruction in the question for candidates to show clearly on the graph how they determined the gradient, in many cases there was no evidence given, and consequently credit was lost.

(iii) Most candidates gained one of the available two marks by substituting the value for the gradient of their graph into the given equation to calculate the value of d. The second mark proved to be somewhat more elusive as candidates were instructed to give their answer in standard form – this instruction was either ignored or done incorrectly.

Question 3

(a) Candidates met with more success with this question on resistor colour coding than has happened in previous years. The colours of the first two bands presented little problem, but the third band was most often stated to be black instead of brown.

(b) Completely correct circuit diagrams were rare. Most candidates had an idea of what was required but their circuits were spoiled by careless drawing and by unfamiliarity with the correct symbols for standard circuit components. Candidates should be encouraged to use a ruler to draw a circuit diagram and not to draw lines through the circuit components. The correct symbol for a diode was not well known. Many diode symbols were confused with those of NOT gates. The vertical line at the tip of the triangle symbol for a diode was frequently missing. Most candidates included an ammeter connected in series to measure the current through the diode, but the voltmeter needed to record the potential difference across the diode often also appeared connected in series instead of in parallel with the diode.

(c) Very few candidates could describe how readings for different values of the potential difference V across the diode could be taken. The expected answers, namely, to use a variable power supply/add extra cells/add a variable resistor to the circuit were rarely seen.

(d) Candidates met with more success here, and most were able to explain how they could modify the circuit to show that a diode conducts in one direction only. A very common incorrect answer was to replace the d.c. supply with an a.c. supply.

Question 4

(a) Most candidates measured the dimensions of the cube correctly and were able to determine its volume.

(b) (i) Candidates were required to use the given cross section to count the number of 2 mm · 2 mm squares occupied by it. Most candidates obtained values for the number of squares being between 100 and 140, for which they scored one mark. Candidates who were able to estimate the number as being between 110 and 130 scored two marks. The range of estimated values for the number of squares varied from 20 to 500.

(ii) This part was very poorly answered. Only the more able candidates were able to use their answer from the previous part to estimate the cross sectional area of the cylinder. The most common misconception was that the number of squares counted be multiplied by 2 mm to determine the area, instead of by 2 mm · 2 mm.

Many candidates who did correctly determine the numerical value of the area, spoiled their answer by either omitting the units or by giving incorrect units.