PHYSICS

Paper 0625/11
Multiple Choice Core

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

General comments

There was a wide range of scores on the paper, with some candidates showing a good understanding of the syllabus content. **Questions 1**, **13**, **16**, **29**, **31** and **38** were answered well by the vast majority of candidates. Candidates found **Questions 15**, **21**, **28**, **32**, **33**, **37**, **39** and **40** more challenging.

Comments on specific questions

Question 13

Although most candidates correctly identified the movement of molecules in liquids and solids, there were a few who thought that there was no movement of the molecules in a solid.

Question 15

Most candidates understood that liquid Y, with the larger expansivity, expands more than liquid X, which has the smaller expansivity. However, some candidates did not realise that liquid Y contracts more than liquid X when it is cooled.

Question 16

Only stronger candidates were able to identify the materials from which the pan was made and showed good practical understanding of conduction.

Question 21

Only stronger candidates showed an understanding of total internal refraction. The question clearly stated that the angle of incidence is greater than the critical angle and therefore, all the light is reflected back into the glass.

Question 28

This question proved challenging for many candidates. The circuit is a form of potentiometer, the current is the same in both resistors and therefore (using $V = IR$) the potential difference across the $2.0\,\Omega$ is twice that across the $1.0\,\Omega$ resistor. The total potential difference across the two resistors is the sum of the potential differences across the two resistors which is 18 V.

Question 29

Most candidates recognised that the energy lost is in the form of low-grade thermal energy.

Question 31

The majority of candidates correctly identified the components in the circuit. Those who got it wrong, almost always confused cells with batteries.

Question 32

Many candidates thought that the total resistance of two resistors in parallel is equal to the average of the two resistances rather than it being smaller than either resistor. The logic is that the charge carriers now have a choice of paths to take, meaning that more charge carriers can pass per unit time.

Question 33

Only stronger candidates showed full understanding of the role of the earth wire in a domestic electricity supply.

Question 37

Only stronger candidates demonstrated their understanding of the α-scattering experiment. To show full understanding of the experiment, candidates needed to know that a small proportion of the α-particles are repelled by the nucleus and that the electric charge on the nucleus is produced by the protons in the nucleus.

Question 39

Candidates were expected to be able to identify the types of radiation in an absorption experiment from the results of the experiment. To do this, they needed to show knowledge of penetration of the different types of radiation through different materials. Only stronger candidates showed this basic knowledge.

Question 40

Only stronger candidates answered this correctly. Candidates needed to be familiar with, and to fully understand the meaning of half-life in order to answer this type of question.

PHYSICS

Paper 0625/12
Multiple Choice Core

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

General comments

There was a wide range of scores on the paper, with some candidates showing a good understanding of the syllabus content. **Questions 1**, **4**, **6**, **10**, **16**, **18**, **21** and **25** were answered well by the vast majority of candidates. Candidates found **Questions 2**,**15**, **20**, **22**, **32**, **37** and **39** more challenging.

Comments on specific questions

Question 4

Only a few candidates had problems with this question. The most common error was to choose the response in which the mass was smallest without considering the effect of volume.

Question 6

Most candidates understood that an object is in equilibrium if both the resultant force acting on it and the resultant moment on it are zero.

Question 10

Most candidates showed a good understanding of the work done when different loads are move through different distances.

Question 15
Only stronger candidates appeared to recognise the term ‘heat capacity’. Candidates should be encouraged to familiarise themselves with basic terminology.

Question 16

Most candidates were able to identify the materials from which the pan was made, showing that there was a good practical understanding of conduction.

Question 18

Some candidates did not read the question carefully enough. The question asked which row in the table did **not** show a correct unit for the quantity in the left-hand column. The symbol λ does not represent a unit, it is merely used to label an unknown wavelength.

Question 20

Many candidates recognised that total internal reflection did not occur in the example, but others were unable to identify the angle of incidence of a light ray striking the surface of a glass block.

Question 21

Most candidates were able to recognise the reversed image that is seen in a plane mirror.

Question 22

Candidates needed to read this question carefully. The basic physics that was needed to answer the question successfully was that all electromagnetic waves travel at the same speed in a vacuum and a knowledge of the wavelengths of different types of electromagnetic wave.

Question 25

Most candidates were aware that iron is the only magnetic material in the given list

Question 28

Only stronger candidates answered this well. The circuit is a form of potentiometer, the current is the same in both resistors and therefore (using $V = IR$) the potential difference across the $2.0\,\Omega$ is twice that across the $1.0\,\Omega$ resistor. The total potential difference across the two resistors is the sum of the potential differences across the two resistors which is 18 V.

Question 32

Most candidates thought that the total resistance of two resistors in parallel is equal to the average of the two resistances rather than it being smaller than either resistor. The logic is that the charge carriers now have a choice of paths to take, meaning that more charge carriers can pass per unit time.

Question 37

Only stronger candidates showed understanding of the α-scattering experiment. Candidates needed to know that a small proportion of the α-particles are repelled by the nucleus and that the electric charge in the nucleus is produced by the protons in the nucleus.

Question 39

Only stronger candidates used the information about the half-life of the isotope that was given. If the term half-life was understood, then candidates knew that the count rate would have fallen to half the initial rate after six hours and that after another six hours it would have fallen to half again, i.e., a quarter of the initial count. Graph **C** should have been identifiable as the only possible graph.

PHYSICS

Paper 0625/13
Multiple Choice Core

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

General comments

There was a wide range of scores on the paper, with some candidates showing a fairly good understanding of the syllabus content. **Questions 6**, **7**, **13**, **16**, and **31** were answered well by most candidates. Candidates found **Questions 2**, **20**, **20**, **22**, **32**, **37** and **39** more challenging.

Comments on specific questions

Question 2

This was a challenging question, but most candidates understood that the distance travelled in equal time intervals increased as the time increased, as shown by graphs **A** and **C**. To find the actual distance travelled the area under the original speed-time graph needed to then be calculated.

Question 4

This was usually answered correctly but the most common error was to choose the response in which the mass was smallest without considering the effect of volume.

Question 6

Most candidates understood that an object is in equilibrium if both the resultant force acting on it and the resultant moment on it are zero.

Question 7

Most candidates showed a good understanding of the work done when different loads are moved through different distances.

Question 13

Most candidates showed a good understanding of the effects of compressing a gas.

Question 16

Most candidates were able to identify the materials from which the pan was made, showing that there was a good practical understanding of conduction.

Question 20

A large majority of candidates were able to identify the angle of incidence of a light ray striking the surface of a glass block. However, few of those correctly stated that total internal reflection did not occur.

Question 21

Most candidates were able to recognise the reversed image that is seen in a plane mirror.

Question 22

Candidates needed to read this question carefully. The two pieces of basic physics that were needed to answer the question successfully were that all electromagnetic waves travel at the same speed in a vacuum and a knowledge of the wavelengths of different types of electromagnetic wave.

Question 28

Only stronger candidates answered this well. The circuit is a form of potentiometer, the current is the same in both resistors and therefore (using $V = IR$) the potential difference across the 2.0 Ω is twice that across the 1.0 Ω resistor. The total potential difference across the two resistors is the sum of the potential differences across the two resistors which is 18 V.

Question 31

The majority of candidates showed a knowledge of circuit diagram symbols and the component needed to vary the current in a circuit.

Question 32

Most candidates thought that the total resistance of two resistors in parallel is equal to the average of the two resistances rather than it being smaller than either resistor. The logic is that the charge carriers now have a choice of paths to take, meaning that more charge carriers can pass per unit time.

Question 35

A significant number of candidates recognised the correct shape of the magnetic field of a current in a straight conductor but did not know the field direction.

Question 39

Many candidates found using the half-life quantitatively challenging.

Question 40

Only stronger candidates answered this question correctly. Other candidates incorrectly thought that γ-rays are not very penetrating.

PHYSICS

Paper 0625/21
Multiple Choice Extended

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

General comments

There was a wide range of marks scored with some outstanding papers. **Questions 1**, **4**, **11**, **12**, **16**, and **39** were answered well by most candidates. Candidates found **Questions 5**, **13**, **22, 31**, **36**, **37**, **38** and **40** more challenging.

Comments on specific questions

Question 4

This question was answered well, showing a good understanding of density.

Question 5

This was a more challenging question, with a calculation that many seemed to be unfamiliar with. Candidates needed to understand that the resultant vertical force on the bridge is equal to the total downward force, and then to take moments about one of the pillars. This gave a pair of simultaneous equations which could be used to find the values of T_1 and T_2.

Question 11

This was answered well with almost all candidates recognising that the pressure on the base of the flasks due to a liquid depends only on the depth of the liquid.

Question 12

This was a well answered question and candidates showed a good understanding of the process of evaporation.

Question 13

Many candidates were under the misapprehension that all the gas was pushed into the 20 cm^3 cylinder, rather than the gas now being contained in both cylinders giving an increased volume of 100 cm^3.

Question 22

Only stronger candidates answered this question correctly with other candidates not recognising that it takes about 8 minutes for the light from the Sun to reach us on the Earth.

Question 31

Candidates needed to trace the current direction through each diode to ensure that the current was not in the opposite direction to the arrow on the symbol.

Question 36

Only stronger candidates answered this correctly. The most common response was option **B**, no change. In practice the interaction between the field from the magnetic poles and the current cause an upward force on the wire and a downward force on the magnetic poles themselves. This downward force pushes the top pan balance downwards, leading to an increased reading.

Question 37

Many candidates thought that the neutron number fell by 4. This may have been because candidates did not read the question carefully enough and were confused between neutron number and nucleon number.

Question 38

Many candidates were unclear how to use the information about the background count. The most common mistake was to correctly subtract the background count (30) from the initial count (530 – 30 = 500), halve what remains (500 / 2 = 250) but then not to add the background count to this before reading the half-life from the graph. Other candidates totally ignored the background count and simply halved the initial count.

Question 39

Most candidates answered this well, with only a few thinking that the 340 counts were all from the source.

Question 40

Candidates should be aware of the uses of different types of ionising radiation. Even without this specific knowledge, they should be able to deduce which statement is incorrect from the known properties of the different radiations.

PHYSICS

Paper 0625/22
Multiple Choice Extended

Question Number	Key
1	C
2	D
3	B
4	C
5	A
6	B
7	C
8	D
9	A
10	A

Question Number	Key
11	C
12	C
13	D
14	C
15	D
16	B
17	C
18	C
19	B
20	C

Question Number	Key
21	B
22	A
23	C
24	B
25	A
26	A
27	B
28	D
29	D
30	D

Question Number	Key
31	D
32	A
33	B
34	D
35	B
36	C
37	C
38	B
39	A
40	B

General comments

There were some excellent responses showing a genuine understanding of the whole syllabus. **Questions 1**, **11**, **13**, **16**, **21**, **26**, **31**, and **33** were answered well by most candidates. Candidates found **Questions 7**, **18**, **19**, **22**, and **37** more challenging.

Comments on specific questions

Question 7

In this question, option **C** was incorrect (and therefore the key) because the momentum of the hot gas and the momentum of the rocket are in different directions. Momentum is a vector quantity and so, although the magnitudes of the two are equal, one is considered to be positive and the other negative.

Question 10

Most candidates showed a good understanding of the work done when different loads are move through different distances.

Question 11

Candidates showed a good understanding of evaporation, and this question was usually answered correctly.

Question 18

Candidates needed to read the question carefully. The question asked which row in the table does **not** show a correct unit for the quantity in the left-hand column. The symbol λ does not represent a unit and is merely used to label an unknown wavelength.

Question 19

Only stronger candidates answered this correctly. Candidates needed to link the two formulae $n = 1 / \sin c$ and $n = \sin i / \sin r$. Although many candidates clearly attempted to do this, many forgot the inversion in the latter formula.

Question 21

A large majority of candidates were able to recognise the reversed image that is seen in a plane mirror.

Question 22

Although many candidates got this correct, there was a significant minority who did not recognise that it takes light from the Sun approximately 8 minutes to reach the Earth.

Question 26

The circuit symbol for the ammeter was correctly identified by most candidate.

Question 28

Only stronger candidates answered this correctly. The circuit is a form of potentiometer, the current is the same in both resistors and therefore (using $V = IR$) the potential difference across the $2.0\,\Omega$ is twice that across the $1.0\,\Omega$ resistor. The total potential difference across the two resistors is the sum of the potential differences across the two resistors which is 18 V.

Question 31

A large majority of candidates recognised that the e.m.f. of the battery was the sum of the e.mf.s of the individual cells in series.

Question 37

This question was challenging for some candidates. They thought that the neutron number fell by 4. This may have been because candidates did not read the question carefully enough and were confused between neutron number and nucleon number.

Question 39

Only stronger candidates used the information about the half-life of the isotope that was given. If the term half-life was understood then candidates would have known that the count rate would have fallen to half the initial rate after six hours; after another six hours it would have fallen to half again, i.e., a quarter of the initial count. Graph **C** should have been identifiable as the only possible graph.

PHYSICS

Paper 0625/23
Multiple Choice Extended

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

General comments

There were some very good scripts, and many candidates showed an understanding across a good proportion of the syllabus. **Questions 1**, **3**, **12**, **14**, **16**, **21**, **23**, **24**, **26** and **33** were answered well by most candidates. Candidates found **Questions 9**, **11**, **19**, **25**, **29**, **37** and **39** more challenging.

Comments on specific questions

Question 9

There was a wide spread of responses to this question. Many candidates chose option **A** (geothermal energy) but the centre of the Earth is hot due to the residual energy during the formation of the planet and also radioactive decay of heavy elements also contributes.

Question 11

This question was challenging for some candidates as they thought that the pressure at the bottom of R was greater than the pressure at the bottom of cylinder P. The important point is that the pressure on the base is determined by the vertical depth of the liquid above the base.

Question 12

Candidates showed a good understanding of the process evaporation.

Question 14

This was a well answered question with relatively few candidates failing to notice that the mass was given in grams whereas the specific heat capacity was given in J / kg°C.

Question 16

Most candidates were able to identify the materials from which the pan was made, showing that there was a good practical understanding of conduction.

Question 19

A relatively large number of candidates were under the misapprehension that there is a change in frequency when a light travels from one medium to another. It is the wavelength that changes and this produces a change in speed.

Question 21

Most candidates were able to identify the object between the photographer and the image as a mirror.

Question 21

Most candidates were able to recognise the reversed image that is seen in a plane mirror.

Question 25

Only stronger candidates answered this correctly and recognised that the only field which produces a force on a stationary charge is an electric field. Other candidates incorrectly thought that a stationary charged object in a magnetic field experienced a charge.

Question 29

Many candidates were not familiar with the current-voltage characteristic graph for a filament lamp. The important point is that the resistance increases as the temperature increases, and therefore the current increases at a slower rate.

Question 32

Many candidates thought that the total resistance of two resistors in parallel is equal to the average of the two resistances rather than it being smaller than either resistor. The logic is that the charge carriers now have a choice of paths to take, meaning that more charge carriers can pass per unit time.

Question 37

Many candidates thought that the neutron number fell by 4. This may have been because candidates did not read the question carefully enough and were confused between neutron number and nucleon number.

Question 39

The previous question required a half-life calculation which was successfully completed by most candidates. This question was also a calculation involving half-life, but it differed as it also involves allowing for the effect of background count and only stronger candidates recognised this. Other candidates were unclear how to use the information about the background count. The most common mistake was to correctly subtract the background count (20) from the initial count (180 – 20 = 160), halve what remains (160 / 2 = 80) but not to add the background count to this before reading the half-life from the graph. Some other candidates totally ignore the background count and simply halve the initial count.

PHYSICS

Paper 0625/31
Core Theory

Key messages

- Candidates should ensure they are clear about what a significant figure is. Centres should encourage candidates not to round to 1 significant figure and should set practice exercises on this topic.
- Centres should encourage candidates to ensure that working and answers to numerical questions are as clear as possible and that all handwriting is legible.

General comments

Most candidates were well prepared for this exam and were able to apply their knowledge and physics understanding to the questions set to produce correct responses.

Candidates should ensure their use of language is precise, particularly when using the pronouns "it' or "they" to ensure their answers are clear. Similarly, candidates frequently stated a property had changed but failed to state how it had changed i.e., increased/decreased.

Almost all candidates attempted all the items and there was no evidence of candidates having insufficient time to complete the paper.

Comments on specific questions

Question 1

(a) The majority of candidates gained full credit but errors in using the millimetre scale on the ruler were common. A small number of candidates used their own rulers rather than the ruler in the figure.

(b) (i) The vast majority of candidates correctly identified some form of balance as a suitable device for measuring mass.

(ii) The majority of candidates correctly determined the volume as 4 cm^3 using the scale on the measuring cylinders. A common error was to simply state the volume with the wire submerged, i.e., 22 cm^3.

(c) Most candidates correctly evaluated the density as being 7.8 g/cm^3. The most common error was to use an incorrect arrangement of the equation density = mass/volume.

Question 2

(a) (i) Almost all candidates correctly stated the times indicated on the stopwatches. A common error was to simply write down the numbers shown on the stopwatches, e.g., 0614, instead of placing a decimal point after the 6 to read 6.14 s.

(ii) The majority of candidates correctly determined the average of the two readings. A common error was to subtract the two readings instead of adding them before dividing by two.

(iii) Most candidates correctly stated that decreasing the angle of the slope would decrease the speed of the trolley. The most common error was to make statements that were too vague, e.g., “move the block backwards”.

(b) Almost all candidates correctly determined the average speed as 0.15 m/s. The most common errors were using an incorrect arrangement of the equation, or rounding their answer to one significant figure, i.e., 0.2 m/s.

(c) The majority of candidates correctly determined the distance travelled by evaluating the area under the graph as 3.2 m. The most common error was to state distance = speed x time, and to evaluate 1.6 × 4.0. Weaker candidates divided the time by the speed.

Question 3

(a) Only the strongest candidates gained full credit here. The majority of candidates gave vague descriptions which indicated that they had never seen or attempted a similar experiment. Centres should encourage candidates to carry out the experiments listed in the specification.

(b) The vast majority of candidates correctly calculated the moment of the weight as 28 Ncm. Weaker candidates divided the distance by the weight.

Question 4

(a) Most candidates drew acceptable graphs to show the cooling and freezing of the substance. The most common error was the omission of a horizontal section at 20°C to indicate the freezing of the substance.

(b) Almost all candidates gained credit for this question, indicating that the kinetic molecular model of matter was well understood for solids.

Question 5

(a) Most candidates correctly calculated the pressure of the bottle on the bench as 0.48 N/cm^2. Weaker candidates used an incorrect arrangement of the equation, often multiplying 25 and 12.

(b) Only stronger candidates answered this correctly. Weaker candidates did not link the collisions of high-speed molecules on the walls of the bottle with the internal pressure of the bottle. Very few compared the internal gas pressure and the external atmospheric pressure.

Question 6

(a) (i) (ii) The majority of candidates gained at least partial credit. A common error was to state that Q was the amplitude of the wave, and that T was the wavelength of the wave.

(iii) Many candidates gave correct statements for the frequency of a wave. The most common error was to give a vague reference to time, rather than stating the number of waves sent out in one second.

(b) Most candidates gained at least partial credit for this question and were able to describe an experiment to determine the speed of sound in air.

Question 7

(a) Many candidates found this item challenging, with many drawing a reflected rather than a refracted ray. Only stronger candidates correctly identified the angle of incidence and the angle of refraction.

(b) Only stronger candidates were able to link the angle of incidence being greater than the critical angle causing the ray to have total internal reflection.

(c) (i) Only stronger candidates stated that the speed of light was the same as the speed of the X-rays. Candidates seemed evenly split on whether the frequency of visible light was lower or higher than the frequency of X-rays.

(ii) The vast majority of candidates were able to give a suitable use of X-rays.

Question 8

(a) (i) The vast majority of candidates answered this correctly.

(ii) Stronger candidates gained full credit for this question. Very few candidates linked the induced magnetism in the iron bar to two opposite poles being next to each other and therefore attracting.

(b) (i) The majority of candidates gave good descriptions of the movement of electrons. Weaker candidates did not identify the direction in which the electrons moved, or stated that positive charges were moving.

(ii) The majority of candidates answered this correctly. A common error was to state two insulators.

Question 9

(a) (i) The vast majority of candidates correctly identified a voltmeter. The most common error was to state ammeter.

(ii) The majority of candidates answered this correctly. A common error was to state voltage rather than volt.

(b) (i) The majority of candidates correctly evaluated the resistance as 32 ohms. The most common error was to use an incorrect arrangement of the equation $V = IR$.

(ii) Only stronger candidates were able to link increased length and smaller diameter to an increase in resistance.

Question 10

(a) (i) Stronger candidates were able to describe the need to both connect the wire to the galvanometer and then to move the wire near the magnet.

(ii) The majority of candidates were able to give two ways of increasing the e.m.f. The most common errors were to state “increase the current” or “use a bigger magnet”.

(b) (i) Many candidates found this item challenging, with very few drawing an arrow from the north pole to the south pole of the magnet.

(ii) The majority of candidates gave two ways of increasing the speed of rotation of the coil.

(iii) The majority of candidates were able to describe a method for reversing the direction of rotation of the coil.

Question 11

(a) The majority of candidates gained at least partial credit. A common error was to indicate that gamma radiation was the most ionising.

(b) The majority of candidates calculated that three half-lives had passed in 45 hours, but only the strongest could then go on to determine that 10 mg would remain after 45 hours.

PHYSICS

Paper 0625/32
Core Theory

Key messages

- Candidates should note the number of marks available, and the space allocated for responses, as these provide a clear indication of the type of answer expected. For example, for a two-mark question, two distinct points should be given.
- In calculations, candidates should set out and explain their working clearly. Credit may be given for correct working even if the final answer is incorrect.
- Before starting their response, candidates are advised to read the question carefully, paying attention to the command words to ensure they focus their answers as required.

General comments

Some areas of the syllabus were better known than others. In particular, interpreting motion graphs, centre of mass, the convection section of thermal processes, geothermal resources, the action of a variable potential divider and radioactivity were not well understood.

Equations were generally well known by all but the weakest candidates. Many candidates understood how to apply equations to fairly standard situations well. For many candidates, the non-numerical questions posed more of a challenge than the numerical questions

Comments on specific questions

Question 1

(a) This was answered very well, with most candidates gaining full credit. There was some confusion between a speed–time graph and a distance–time graph. This confusion resulted in several candidates determining the area under the graph to find the distance travelled.

(b) A large number of candidates gave the correct answer. However, some candidates had difficulty in interpreting motion graphs. Consequently, “constant speed” was a common answer. In addition, many answers were too vague to credit, e.g. “constant motion”.

(c) Most candidates realised that the cyclist was travelling fastest in section CD and gave a valid reason. Others just calculated the speed for the reason. This was insufficient unless compared to the speeds in the other sections.

(d) Many candidates answered this question well and showed full working with the correct unit. These candidates successfully applied the equation speed = total distance/total time. Other candidates attempted to find the average speed of each section and usually only gained credit for recalling the equation and unit. Common incorrect units were m and m/s^2.

Question 2

(a) The recall of how to obtain an average value for a small length by measuring multiples was varied. Many candidates gave a fully correct answer, often with a clear labelled diagram to support the written answer. Others merely measured the thickness of one coin using the ruler and some repeated the measurement several times and found the average value.

(b) (i) Most candidates answered this question well, writing the equation and showing full working. The question asked candidates to show that the density was about 10 g/cm^3. Therefore, the final value of 9.7(2) needed to be seen to gain full credit.

(ii) The vast majority of candidates gave a correct explanation but a number of candidates did not state if the coin would float or not.

Question 3

(a) Most candidates gave the correct answer.

(b) Many correct answers were seen. However, other answers were too vague or focused on wind or air pressure.

Question 4

(a) (i)(ii) The vast majority of candidates gave the correct answers.

(b) Many candidates gave the correct answer, writing the equation and showing full working. For full credit, an understanding that the mass of 5 000 g needed to be converted to kg before being substituted into W = mg was required. However, some candidates performed an incorrect conversion. A common error was to divide the mass by 100. Weaker candidates often used an incorrect equation i.e. W = m/g.

(c) (i) Many correct answers were seen and a significant number of candidates calculated the volume.

(ii) The vast majority of candidates gave the correct answer, writing the equation and showing full working. There were several incorrect answers based on the incorrect equation pressure = force/volume.

Question 5

(a) Only stronger candidates answered this question well and many others did not give an answer at all. Candidates familiar with the experiment gave fully correct answers, usually with a clear labelled diagram supporting the written answer. Other incorrect answers focused on swinging the wood on the nail or merely paraphrased the question.

(b) The majority of answers were correct, but some candidates drew the X too high on the line of symmetry.

(c) Most candidates gave the correct answer. Many other explanations were either too vague or concentrated on a difference in surface area.

Question 6

(a) The majority of candidates gave the correct answers. The most frequent errors were the selection of the aluminium foil as an insulator and the selection of copper wire as a magnetic material.

(b) Most candidates gained credit for naming the thermometer and the measuring cylinder. A significant number also named the manometer but many either called this instrument a barometer, a u-tube or gave no response.

Question 7

(a) Only stronger candidates answered this correctly. A thorough description of the thermal process involved, convection, was required. Most answers were vague or concerned with the candle, or its smoke, heating the metal fan.

(b) (i) Candidates needed to recognise that the bimetallic strip would only be straight at 25°C. Many candidates applied this knowledge correctly, but weaker candidates found the situation more challenging.

(ii) The majority of candidates answered this question well.

Question 8

(a) (i) Only the strongest candidates answered this correctly and “steam” was a common incorrect answer.

(ii) The question was about the energy changes in the generator rather than the whole power station. “Thermal” was therefore an incorrect answer for the input energy. Many correct answers were seen for the output energy.

(b) (i) Many answers were not developed sufficiently i.e. simply stating “pollution” or “environmental friend” were too vague. Comprehensive ideas based on using geothermal as “not contributing to global warming” or “not producing acid rain” were frequently seen.

(ii) Only stronger candidates answered this correctly.

Question 9

(a) Many correct answers were seen here. A common error was selecting the angles between the mirror and the rays rather than the angles between the rays and the normal.

(b) Many correct answers were seen. Other answers lacked accuracy, e.g. the reflected ray missing car B or rays drawn as curves.

Question 10

(a) (i) The physical quantity was required here, not the unit.

(ii) Many correct answers were seen but the most common error was $A_1 = A_2 + A_3$.

(b) (i) Most candidates gained some credit here. The most common errors were drawing incorrect symbols for resistors or short circuiting the two resistors in parallel.

(ii) Many candidates knew an advantage of connecting lamps in parallel. Several answers were too vague for credit, e.g. “same amount of electricity in each lamp”.

(c) Only the strongest candidates answered these parts correctly and many candidates did not give responses. Many answers focused on the use of a resistor to prevent too large a current that would damage the lamp.

Question 11

(a) Some candidates gained at least partial credit with many achieving full credit. A common error was to state “bigger” magnets instead of “stronger” or “more powerful” magnets. A common incorrect answer was “to increase the current” or voltage, showing some confusion with the d.c. motor.

(b) (i) Many correct answers were seen but common incorrect answers were “steel” or “copper”.

(ii) Most candidates answered this question well. Weaker candidates mainly gained credit for recalling the equation.

Question 12

There were a number of nil responses for all parts of this question.

(a) Some confusion between the characteristics of the three kinds of radioactive emission was evident.

(b) Very few correct answers were seen. Candidates did not seem to know the meaning of the term isotope.

(c) Some candidates gained at least partial credit for the idea of dividing by 2 twice, but often incorrectly divided the mass number by 4. However, a number of candidates achieved full credit.

PHYSICS

Paper 0625/33
Core Theory

Key messages

- Candidates should note the number of marks available, and the space allocated for responses, as these factors provide a clear indication of the type of answer expected. For example, for a two-mark question, two distinct points should be given.
- In calculations, candidates should set out and explain their working clearly. Partial credit may be given for correct working even if the final answer is incorrect.
- Before starting their response, candidates are advised to read the question carefully, paying attention to the command words to ensure they focus their answers as required.

General comments

Some areas of the syllabus were better known than others. In particular, the effect of forces on an object, the radiation section of thermal processes, thin converging lenses, series and parallel electric circuits, high-voltage transmission of electricity and the characteristics of the three kinds of radioactive emission were not well understood.

Equations were generally well known by all but the weakest candidates. Many candidates understood how to apply equations to standard situations well.The non-numerical questions posed more of a challenge to many of the candidates than the numerical questions.

Comments on specific questions

Question 1

(a) This was answered very well with most candidates gaining full credit.

(b) It was not fully understood that the area under a speed–time graph determines the distance travelled. There were many incorrect answers based on the equation speed = total distance/total time, but these gained credit for recall of the equation.

Question 2

(a) Most candidates answered this question well with many candidates showing full working.

(b) The vast majority of candidates gave the correct answer often without any working evident.

(c) The majority of candidates gave the correct answer.

Question 3

(a) The vast majority of candidates gave the correct answers for both the resultant force and the direction.

(b) Only stronger candidates fully understood the ways in which a resultant force may change the motion of an object. Many answers were too vague, e.g. "the skateboarder moves forward" or "the motion is constant".

(c) Few correct answers were seen, and candidates did not fully understand that that if there is no resultant force on a moving object, it will continue at constant speed in a straight line. A common incorrect answer was that the skateboarder was stationary.

Question 4

(a) (i) The majority of candidates gave a fully correct answer.

(ii) The majority of candidates gave a correct answer, and many showed the working.

(iii) Many correct answers were seen here. A common error was giving answers relating to the light bulb getting hot rather than the surrounding air.

(b) There was confusion between the types of energy stored by objects or situations and the usual form of energy that this stored emery is transferred into. For example, a mobile phone battery stores chemical energy, not electrical energy which was a common answer, a piece of coal stores chemical energy, not thermal energy which was another common answer.

Question 5

(a) (i) The vast majority of candidates gave the correct answer.

(ii) Most candidates gave the correct answer.

(iii) Few correct answers were seen here. A significant number of candidates thought that a dull black surface stored heat to maintain its temperature.

(b) (i) Very few candidates understood that the block with the shiny white surface would lose heat more slowly than the block with the dull black surface. Therefore, the correct cooling curve was seldom seen, but most candidates gained credit for correctly starting the curve at a temperature of 80 °C.

(ii) There was confusion regarding the effect of colour and texture of a surface on the emission of radiation. Very few correct answers were seen.

Question 6

(a) Candidates generally displayed a good knowledge of the molecular model which was required for all four parts of **(a)**.

(b) (i) Many candidates lacked the knowledge required to answer for this part, but a significant number either knew the name Brownian or were able to describe the motion as random.

(ii) Only stronger candidates understood that the smoke particles would change direction frequently due to collisions with the invisible air molecules rather than just collisions with the walls of the container. A number of candidates did not give an answer to this question.

(iii) Candidates displayed a good knowledge of the molecular model, and most candidates gave the correct answer.

Question 7

(a) The majority of candidates gave the correct answer with many showing full working.

(b) (i) The majority of candidates gave the correct answer.

(ii) The majority of candidates gave the correct answer with most showing full working.

Question 8

(a) (i) A large number of correct answers were seen. Common errors were “refraction” or “ray of light”. Several candidates did not give an answer to this question.

(ii)(iii) Many correct answers were seen here. A common error was selecting the angles between the mirror and the rays rather than the angles between the rays and the normal.

(b) Many candidates answered all three parts of **(b)** well. Weaker candidates did not fully understand how an image was formed by a converging lens.

Question 9

(a) Candidates generally lacked the knowledge for all four parts of **(a)**. There were a high number of candidates who did not give an answer.

(b) Many candidates knew an advantage of connecting lamps in parallel in a lighting circuit. Some answers were too vague for credit, e.g. “same amount of electricity in each lamp”.

(c) Most candidates answered this question well, showing full working and giving the correct unit. Weaker candidates often used an incorrect equation i.e. resistance = current divided by potential difference or gave no response.

Question 10

(a) Only stronger candidates showed the knowledge of high-voltage transmission that was required for this question. Answers were generally vague, and several candidates did not give an answer to the question. A few candidates recognised that the transmission of electricity needs a high voltage and that a lower voltage is required in homes.

(b) Most candidates answered this question well with many showing full working.

Question 11

(a) There was some confusion between the characteristics of the three kinds of radioactive emission. Most candidates gained credit for knowing that an alpha particle carried a positive charge. Several candidates did not give an answer to this question.

(b) (i)(ii) Many correct answers were seen here. However, some candidates gave the answers the wrong way round and others incorrectly gave infra-red and ultra-violet as answers.

(c) (i) Few candidates fully identified the patterns in the data. A correct interpretation of these patterns was required to determine the half-life.

(ii) Candidates were more successful using the data to predict the count rate.

PHYSICS

Paper 0625/41
Extended Theory

Key messages

- Candidates need to be able to rearrange equations accurately and to calculate answers carefully.
- The correct unit for every syllabus quantity needs to be known and given with almost every numerical answer.
- Answers should be rounded correctly to the specified number of significant figures.
- To be awarded full credit, candidates need to answer the question as it has been asked and need to pay close attention to a command word or any other instruction.

General comments

Many candidates answered well and were able to show their subject knowledge in answers to the questions set.

Comments on specific questions

Question 1

(a) This question was extremely well answered with almost all candidates answering fully and correctly. However, the question asked how a vector quantity differs from a scalar quantity. Some candidates gave an answer such as “it has a direction and a magnitude” which did not make it clear that it is the need for a direction that constitutes the difference.

(b) This was usually answered well. There were candidates who gave two correct vectors but did not underline “momentum”. Some of the other quantities were also underlined by a few candidates.

(c) (i) The correct answer was very frequently given. Errors that occurred included the omission of the unit or the use of an incorrect unit. J and kg were the most common of these incorrect units.

(ii) Only stronger candidates answered this correctly. Other candidates drew either a triangle or a parallelogram but only a minority of these included a right angle and few were drawn to scale.

(iii) This test on the conditions for equilibrium was not well understood and few candidates gained credit here.

Question 2

(a) Most candidates realised that heat capacity is related to the energy needed to increase temperature and in general this was answered well with full credit frequently awarded. However, a common omission was to make no reference to the magnitude of the temperature increase (1°C) and some candidates added an incorrect reference to the mass being 1 kg.

(b) (i) A molecular account was asked for and so answers that did not mention molecules or particles in some way did not answer the question fully. The relationship between the kinetic energy of the molecules and the internal energy was not always supplied and the dependence on the molecular potential energy was even rarer. Some answers suggested that it was the internal energy of the ice that was being discussed.

(ii) This was usually fully correct. However, there were some candidates who confused the energy supplied with the specific heat capacity and who obtained an answer that was equivalent to the incorrect expression c / mDT.

(c) (i) Answers needed to refer to energy and the fact that energy is absorbed by the ice as it melts. Many candidates referred to the intermolecular bonds being broken or overcome as the ice became water but not all included a comment on the energy needed to do so.

(ii) There were many references to measuring the temperature as the ice melted and even to timing how long it would take to melt completely. Statements about the change in mass were rarer. Many candidates described the calculation that would need to be carried out or simply wrote down an equation for specific latent heat of fusion.

Question 3

(a) The molecular explanation for the pressure exerted by a gas trapped in an inflated balloon was required here and needed to be in terms of the momentum of the molecules. Only stronger candidates included any comment concerning momentum.

(b) (i) This question was usually correctly answered but some candidates who used the correct approach calculated an answer that was either too large or too small by a factor of ten. This error often occurred when candidates were trying to give an answer in m^3. Answers given in cm^3 were acceptable. Some candidates assumed that the volume of the air was directly proportional to the pressure and obtained a volume greater than that given in the question.

(ii) Many candidates made one or two useful points in their explanations but only a minority were awarded full credit. Very few candidates commented on the outside pressure of the water causing the volume of the air in the balloon to decrease.

Question 4

(a) Although few candidates gave a suitable straight line for **(i)**, correct curves for **(ii)** were much more frequently seen and **(ii)** was in general answered well.

(b) This calculation was usually performed accurately, and the correct final answer was common. Errors included omitting to square the speed even when the term v^2 had been included when the equation or correct expression had been given by the candidate earlier. A minority of candidates calculated the momentum of the train.

(c) (i) This question was only answered correctly by stronger candidates. Many candidates wrote vague comments about energy or force but did not give the exact definition that was required. Some candidates who did realise that an equation or defining expression was required, did not refer to the distance moved being in the direction of the force and just gave force × distance as the answer.

(ii) This was correctly answered by many candidates. Candidates who gave answers that were greater than 600 m (the largest value on the *y*-axis of **Fig. 4.1**) had probably misunderstood the question.

(iii) The easiest route to the correct answer was to use the definition of work done and to divide the kinetic energy by the distance travelled. Very few candidates did this and more obtained a value for the deceleration which was then multiplied by the mass of the train. Credit was commonly awarded for the expression F = ma.

Question 5

(a) Few candidates were able to accurately explain what was meant by “principal focus”. Some answers were very vague and some of the clearer ones defined the position of an image produced by the lens.

(b) Most candidates gave an answer that included a distance. However, some answers suggested that the distance between the principal focus and the focal point or the distance between the focal point and the principal axis was the distance required.

(c) (i) Many candidates drew the ray mentioned in the question but not all of these then drew line L in the correct position.

(ii) Many candidates drew either the correct ray or the ray that related in the same way to their diagram. This often led to a distance for the focal length that was awarded credit.

(iii) Most candidates ticked either the third or fourth diagram. The fourth diagram was correct and those who ticked the third diagram had perhaps only considered the vertical inversion or had not realised that the translucent screen was being observed from P (as shown on **Fig. 5.1**).

Question 6

(a) (i) There were many answers here that gained full credit. Occasionally, the only error was reversing the terms "infrared" and "ultraviolet". Some candidates included other types of electromagnetic radiation, sound or ultrasound or even alpha-particles, beta-particles or gamma rays.

(ii) The answer given here was usually correct either in absolute terms or as an error carried forward from the previous part.

(b) This question was often answered well, and full credit was awarded. There were answers that were approached in a completely correct fashion until the calculation was conducted. Many candidates had difficulty with divisions that included numbers in standard form. The numerical part of answers that could be expressed as 2.5×10^{N}, (where N is not 17) were not uncommon. A second source of inaccuracy arose from misremembering the magnitude of the speed of electromagnetic radiation. Values such as 330 m / s, 3.0×10^{6} m / s and 3.8×10^{8} m / s were unusual.

(c) (i) Almost all candidates chose to describe the use of X-rays in the diagnosis of broken bones and most candidates were awarded some credit.

(ii) Many candidates were able to supply one reason for the need of safety precautions, but a few candidates gave answers that were not sufficiently precise. Stating that X-rays are dangerous was not sufficient here.

Question 7

(a) Many candidates mentioned electrons and stated that they were being transferred in the correct direction from the cloth to the rod.

(b) (i) Few candidates described how the conducting ball became positively charged, and more stated that it was positive and that the attraction of opposite charges led to its jumping up towards the negative rod. The comment that the ball contained positive charges was not the same as stating that it was positively charged.

(ii) There were some good answers here but some answers were given in terms of the motion of positive charges or of protons. This was sometimes instead of the motion of electrons and sometimes in addition to it. Some candidates became confused by what was happening to the rod which in a few descriptions had previously been positive and was becoming negative because of contact with the positive ball.

Question 8

(a) Many candidates answered this question correctly but there were also many answers that did not gain any credit. Some candidates gave answers in terms of potential difference and resistance. This did not reveal what is meant by the term "current".

(b) Only stronger candidates supplied an answer in terms of I_1 and I_2 as required.

(c) Many candidates realised that a current could be calculated from the equation $I = V / R$ and then a power from $P = VI$. Fewer candidates applied these equations correctly in the circuit. Most candidates gained partial credit for this question.

(d) Only stronger candidates answered this correctly. Other candidates started off poorly by stating that the increase in the intensity of the light would result in an increase in the resistance of the (light-dependent resistor) LDR. Even those that gave the correct effect of the brighter light struggled to deduce and explain how this would affect the potential difference (p.d.) across the 450 W resistor.

Question 9

(a) Although the composition of the neutral atom was often described accurately, very few candidates describe the structure. Answers that merely stated the number of protons, neutrons and electrons were only awarded partial credit.

(b) The question asked for the difference between the two atoms to be described but many descriptions were too vague for credit.

(c) The presubscript (38) was often correctly stated but the presuperscript was less often correct. Many candidates did not take the effect of the initial incident neutron into consideration, but other arithmetic errors were also made.

(d) Many candidates realised that during beta-decay, the nucleon number of a nuclide does not change and **(ii)** was answered well by many candidates. The effect on the proton number was more challenging and although stronger candidates answered well, a common incorrect answer was 53.

PHYSICS

Paper 0625/42
Extended Theory

Key messages

- Candidates are advised to read the questions carefully and to think about how to apply their knowledge to them.
- Candidates should look at the total mark for each question when deciding how much detail is required in the answer.
- If a command word in the question is "explain" candidates should make sure that their answer is an explanation and not just a statement.

General comments

Most candidates answered all the questions on the paper. Equations were generally well known but candidates did not always substitute the correct numbers from the question, e.g. **Question 3(a)**.

Where a quantity in a question is not expressed in SI units and the answer is required with an SI unit, candidates need to know how to convert all quantities to SI units, e.g., cm to m (as in **Question 6(c)**), mA to A and minutes to seconds (as in **Question 8(b)**).

When the answer to a question requires drawing a diagram or drawing on a diagram it is important to use a ruler, compasses, and protractor as appropriate. When asked to add labels to a diagram, these should be clear and unambiguous.

Comments on specific questions

Question 1

(a) Most candidates correctly stated that the acceleration increases between 10 s and 30 s. Weaker candidates did gain credit as they gave incomplete or ambiguous answers or answers which did not answer the question, e.g. "the speed increases" or "it accelerates".

(b) Stronger candidates drew a correct tangent at 25 s and correctly calculated the acceleration from the gradient of the tangent. Weaker candidates made no attempt to draw a tangent and attempted to calculate an acceleration from acceleration = change in velocity / time. This indicated a lack of understanding that the acceleration at 25 s was not constant. A few candidates did not place the tangent at 25 s. Candidates should be encouraged to practice drawing tangents. They should know that the gradient of speed-time graphs gives a value of the acceleration at that point and the gradient of distance-time graphs gives a value of the velocity at that point.

(c) The distance travelled by the rocket is determined by calculating the area under the graph or, since the acceleration is constant during the first 10 s, using distance = average speed × time.

Question 2

(a) Hooke's law states that the extension of the spring is proportional to the load applied to the spring (up to the limit of proportionality). This statement was well known by many candidates. Those who were unable to recall the correct statement gave vague statements about stretching springs of the elastic limit of springs, e.g. "extension of a spring increases when the load increase", "Hooke's law determines the extension of the spring".

(b)(i) Stronger candidate clearly indicated a region and not just a single point on the graph. In many cases this single point marked the limit of proportionality but did not answer the question. Weaker candidates often indicated a region or a point in the curved section of the graph.

(ii) Stronger candidates realised that the correct answer was obtained from 1 / gradient of the graph and that appropriate units were N / mm or N / m with a corresponding power of ten. These candidates often correctly rearranging the equation $F = kx$.

Weaker candidates just calculated the gradient of the graph and gave that as their answer. Some candidates were unable to read the graph accurately or attempted to use a region where Hooke's law did not apply. The omission of a unit was a common error in this question.

(iii) Candidates who chose to read off the value of the extension for a load of 8.5 N in **Fig. 2.1** and then add this value to the original length of the spring, were the most likely to achieve full credit for this question. This enabled candidates who had incorrectly calculated the value for k in **(ii)** to obtain the correct answer. The extension could be calculated from the value of k calculated in **(i)** but candidates using this method were much more likely to make mistakes, especially with units. Weaker candidates did not add the original length to the calculated or read extension.

(c) Most candidates were correctly able to recall the equations $W = mg$ and could usually rearrange it to obtain the correct answer. Common errors were the omission of a unit or an incorrect unit, and an incorrect rearrangement of the correct equation. The weakest candidates were unable to recall the correct equation and often just multiplied the values given in the question.

Question 3

(a) Many candidates were able to work through this complicated application of the principle of conservation of momentum and showed their working clearly, gaining full credit. Weaker candidates were unable to get beyond equating the momentum before collision to the momentum after collision. There was some confusion between the masses and velocities of the two cars, A and B and some candidates equated the gain in momentum by car A to the loss of momentum of car B, not understanding that car B continued to move. The weakest candidates just manipulated some of the numbers in the question to get an answer that rounded to 0.4 m / s without any physical justification or quoted $F = ma$ or attempted to use changes in kinetic energy.

(b)(i) Candidates needed to know the relationship between impulse and change of momentum to answer this question. Stronger candidates stated the equation impulse = change in momentum and went on to correctly calculate the value using the mass of car A and its change of velocity during the collision. To gain full credit candidates also needed to include the correct unit in their answer. Weaker candidates used the wrong mass or two different masses and did not calculate the change in momentum for one car.

(ii) This question asked candidates to state the impulse of exertion by car B on car A. As the word "state" was given this indicated that no further calculation was required. Stronger candidates gave the same answer to **(ii)** as they had given for **(i)**.

Question 4

(a) Most candidates knew that wind is a renewable source of energy, and many were able to explain why. Weaker answers which were only awarded partial credit where those where candidates made vague statements, e.g. "it is a natural source" or "it comes from the Sun" or where they just repeated the word renewable.

(b) Only stronger candidates answered this correctly. Some of the most common incorrect answers were biomass, fossil fuels, gas, oil, and hydroelectricity.

(c) Stronger candidates answered this well and correctly stated that the energy for fossil fuels was chemical energy and that the water stored behind hydroelectric dams had gravitational potential energy. Common incorrect answers were that thermal energy (heat) was the energy in fossil fuels and that the form of energy in water stored behind dams was kinetic or the word gravitational was omitted. Very weak answers were those with statements that the energy source was electricity.

Question 5

(a) Stronger candidates drew a clearly labelled diagram with one junction clearly in the mixture with ice and the other junction clearly in the liquid mercury. Labels were required for two different metals and a voltmeter, ammeter or galvanometer correctly connected. Weaker candidates drew liquid-in-glass thermometers in the two beakers. This question was completely omitted by a significant number of candidates.

(b) There were many physical properties of a substance that candidates could choose to use to measure temperature, but many candidates found this challenging. Candidates did not always realise what the question was asking, and many referred to methods to determine fixed points, using boiling and melting points. Some candidates referred to specific heat capacity or specific latent heat which was irrelevant.

(c) There were many good answers to this question referring to the measurement of high temperatures, larger range, and speed of response and some referred to remote monitoring or robustness. Weaker candidates incorrectly referred to sensitivity, accuracy, reliability, or lack of parallax error.

Question 6

(a) (i) Most candidates were able to mark the position of the centre of a compression.

(ii) Slightly fewer candidates were able to mark the position of the centre of a rarefaction. Candidates are advised to mark only one position of each unless the question asks for more than one. Those candidates who marked multiple positions, particularly of R, were more likely to make mistakes in their placement. Candidates should also be encouraged to mark positions precisely.

(iii) Stronger candidates drew a line with a ruler in a correct position, and then carefully placed an arrowhead on each end of the line. The phrase “double headed arrow” was not well understood. Weaker candidates did not know how to define a wavelength for a longitudinal wave.

(b) Many candidates correctly identified 1500 m / s as the correct value for the speed of sound in water. When candidates chose the wrong power of ten, they often overestimated rather than underestimated the value. Candidates who cross out work should be advised to make clear which item or items are crossed out and which value is their final answer.

(c) The question required recall of the formula $v = f$ and most candidates successfully stated this. Stronger candidates also correctly rearranged the formula and converted the distance of 12 cm to 0.12 m. Many candidates omitted the conversion from cm to m and weaker candidates were unable to rearrange the equation correctly.

(d) Most candidates were able to correctly state whether their answer to **(c)** was ultrasound or not. Stronger candidates then went on to state that ultrasound frequencies are above 20 000 Hz.

Question 7

(a) (i) To gain full credit, candidates needed to measure the angle between the surface and the incident ray and subtract that value from 90° and then calculate the angle of refraction and draw that the refracted ray accurately on the diagram. Stronger candidates showed all these steps clearly. Weaker candidate drew a refracted ray refracted towards the normal. Some candidates quoted the formula $\sin i / \sin r = n$ but then substituted 30° for the angle of incidence. A significant number of candidates demonstrated that they did not know or could not apply the fact that the angle of incidence and angle of refraction are both measured between the normal and the ray of light.

(ii) This question had fewer correct answers than **(i)**. Very few candidates attempted to calculate the angle of incidence on the face AC. Many candidates correctly extended their refracted ray to the face AC but did not measure the angle of incidence correctly, often measuring the angle between the surface and the ray.

(b) Most candidates correctly drew a ray of light refracted away from the normal as it emerged from the glass. Weaker candidates drew a ray the crossed the normal or a ray that was parallel to the incident ray.

(c) (i) Stronger candidates drew a first reflection with the angle of reflection carefully drawn to be equal to the angle of incidence and then drew just one other reflection, again with angles of incidence and reflection equal and then emerging from the fibre. Most candidates drew a ray that was reflected at the lower surface but with angles of incidence and reflection not equal, resulting in many more reflections within the fibre.

(ii) No credit was awarded for just stating "reflection" in answer to this question. Weaker candidates were confused between reflection and refraction and either stated refraction or reflection.

Question 8

(a) (i) Stronger candidates carefully drew the positive and negative charges so that there were more negative than positive charges on the left inside the object and more positive charges than negative charges on the right inside the object and the total number of negative charges was equal to the total number of negative charges. Weaker candidates indicated the correct charge separation but drew many more negative than positive charges. Other candidates placed charges on one side so that there was a big gap near the edges.

(ii) Stronger candidates stated clearly that electrons flow from earth to the object to balance the excess positive charges on the left-hand side of the object. Weaker candidates correctly stated that positive charge attracts negative charge, but without reference to the negative charges flowing from the earth to the object. Some other candidates referred to positive charges moving or electrons moving to the earth.

(b) Stronger candidates successfully recalled the equation and performed all the steps required. Weaker candidates remembered the equation but were then confused by the terms current and charge and substituted incorrectly. Many candidates were unable to convert mA to A, either not making any conversion or making an incorrect conversion. More candidates realised that they needed to convert minutes to seconds.

Question 9

(a) This question required candidates to know that when two power sources, in this case a cell and a battery, are placed in series in a circuit the combined e.m.f is obtained by adding their e.m.fs. Most candidates added the two values given in the question correctly. Some candidates gave an incomplete answer as they did not give a unit. Weaker candidates made an error in addition or subtracted or multiplied the two values of e.m.f.

(b) (i) Stronger candidates correctly calculated the resistance of the parallel combination of resistors and then added this to the value of the resistor in series with the parallel combination and included the correct unit in their answer. Weaker candidates calculated the resistance in parallel correctly but then did not add on the resistance of the resistor in series. Weaker candidates calculated an overall resistance for three resistors in series or three resistors in parallel. Some candidates forgot that their parallel resistance calculation gave them a value of 1 / R and used that as the resistance which they then correctly subtracted from the overall resistance.

(ii) This question required the use of $V = IR$. Many candidates realised this and those who realised that the combination of the resistors meant the overall combination of the three resistors, as shown in **Fig. 9.2**, gained full credit as they used the value of the resistance as 4.4 Ω. Others used the value they had calculated as the resistance of R in **(i),** and this was awarded credit.

Question 10

(a) Most candidates correctly identified the logic gate as an OR gate.

(b) There were many correct answers here. Weaker candidates gave an answer between 1 and 0 and the weakest candidates used numbers other than 1 or letters or words.

(c) Stronger candidates correctly identified that the effect of earthing the metal case of an appliance was to reduce the chance of electrocution and stated that this benefit was needed if the live wire touched the metal case. Many candidates only referred to the prevention of electrocution but did not explain when that would occur. Weaker candidates stated that the excess charges would flow to earth if the current in the appliance was too high or referred to reducing the risk of a short circuit or of neutralising charges.

(d) (i) Many candidates correctly explained both that the fuse would melt or blow and that it would do so if the current was too high. Weaker candidates identified that the fuse would melt but referred to it limiting or controlling the current or only letting a certain current flow. Some referred to voltage or electricity instead of current.

(ii) Many candidates were correct in their choice of a 13 A fuse but were unable to explain why this was the right choice. Weaker candidates gave a value of 10 A because it matched the current in the kettle or the 3 A fuse because it kept the current low enough, or the 9 A fuse because it was just below the current.

Question 11

(a) Stronger candidates referred to both the structure and the composition of the atom, as asked in the question. Weaker candidates correctly explained the number of electrons, protons and neutrons but made no reference to the structure of a small nucleus containing protons and neutrons with electrons in orbit. There was some confusion between nucleons and the nucleus.

(b) There were some excellent answers showing the correct full decay equation. Most candidates knew the correct nuclide notation for a β-particle. Weaker candidates used the same symbol for different elements or proton number and nucleon numbers were reversed for some elements. Other incorrect answers were those where the β-particle was on the wrong side of the equation.

PHYSICS

Paper 0625/43
Extended Theory

Key messages

- Candidates should look carefully at units to see if they need to convert units with a prefix or non-SI unit to another unit.
- The syllabus symbol for thermal energy has not been Q for many years and candidates should be reminded to use the acceptable symbol, E.
- In calculations, candidates should set out and explain their working clearly. Credit may be given for correct working even if the final answer is incorrect.

General comments

Many candidates performed well on this paper. Two areas of the syllabus stood out as challenging concepts. In **Question 1(c)** candidates were often unclear about their understanding of the concept of a resultant force. In **Question 6(b)** there was confusion over diffraction.

It is essential that candidates write down the equations in the form of symbols and then show their working clearly. Simply writing down a numerical calculation without the equation can lead to errors being made.

In **Question 10(a)** candidates often wrote down an incorrectly transposed version of the transformer equation. Writing out the full equation before attempting to manipulate it will ensure that candidates still gain credit if there is an error in the rearranging of the equation.

Attention should be given to significant figures and candidates should avoid giving their answer to only one significant figure.

Comments on specific questions

Question 1

(a) Many candidates attempted to use the gradient of the straight line to calculate the acceleration but then forgot to make the conversion from minutes to seconds. A few candidates used the co-ordinates of the graph at 60 minutes to obtain an answer of 0.0042 m/s. This approach would only have been valid if the graph had been a straight line passing through the origin. Candidates were able to gain credit for a correct equation for acceleration, but this was only awarded if they indicated a change in velocity in some form.

(b) Most candidates recognised the need to calculate the area under the graph. Most attempted to divide the area into a triangle and rectangles. Common mistakes were to misread the scale on the time axis, particularly between 42 and 60 minutes or to omit the area between 0 and 7.5 m/s. This omission was especially true of those who divided the top section of the graph into a trapezium.

(c) (i) This was answered well and seemed straightforward to many candidates. The equation F=ma was well known and candidates generally stated the formula, showed clear working out, calculated the correct resultant force and gave the unit.

(ii) Stronger candidates were able to identify drag or water resistance acting in opposition to the force from the engine. Others simply suggested resistance or friction but these answers lacked sufficient detail to make it clear they were referring to the friction between the ship and the water/air. The concept of a resultant force did not seem to be fully understood by several candidates and they wrote about more than one resultant force acting on the ship.

Question 2

(a) This question was answered well with most of the stronger candidates giving the correct answer. Common errors were incorrect recall of the gravitational potential energy equation and using incorrect units e.g. m/s or J. J/s was accepted here.

(b) This question was answered well by many candidates. Those who did not get the correct final answer could gain partial credit for the equation. Candidates needed to be aware that the equation needed to include the words “energy” or “power”. Simply stating output/input or useful/total was not clear enough.

(c) There were a range of acceptable answers for this question relating to no production of CO_2 or air pollution for environmental advantages and reduced running costs or use in remote areas or away from a mains electricity supply for a social advantage. An answer simply stating “renewable” did not gain credit as this lacked clarity about how it related to an environmental advantage.

Question 3

(a) (i) Many candidates understood that the pressure in a liquid increases with depth and gained credit for stating this. Only the strongest candidates were able to explain the link with the volume of the bubble increasing. Other answers showed confusion between the pressure in the liquid and the pressure in the gas. When answering a question asking for an explanation, candidates should do more than simply writing down equations but instead should provide a comment about the relationship linked to the question.

(ii) Only stronger candidates answered correctly. Many were able to gain credit for recall of $P = \rho gh$ and $PV = constant$ but omitting atmospheric pressure from their calculation gave them a common incorrect value of 2.4 cm^3. Weaker candidates attempted a ratio calculation using the volume of the bubble and depth below the surface. Many other candidates simply wrote numbers on the page without any equation, and this often did not convey clear understanding of the situation. Credit was given if there was indication that ρg was constant.

(b) There were many good answers here. Common errors included statements that the air will increase the volume or the area of the oil and so this will increase the pressure. Candidates need to give more detailed explanation than “it is less effective” or “the force changes” as these were too vague.

Question 4

There were many good answers that were awarded at least partial credit. Many candidates understood that increasing the temperature would make the molecules move faster or the momentum would increase. If candidates referred to an increase in energy, they needed to stipulate this as kinetic. Other answers went on to say that there would be more frequent collisions. Only the strongest candidates were able to use ideas of momentum to link to an increase in the pressure of the gas, which was asked for in the question. Candidates needed to remember that collisions with the walls of the container would lead to a change in momentum and that a higher temperature would produce a greater change in momentum.

Question 5

(a) (i) This question was generally answered well, and many candidates correctly understood that the two saucepans would have the same volume. These candidates were able to transpose the formula mass = density x volume correctly to gain full credit. A common source of error for weaker candidates was to attempt to use the specific heat capacity in an equation.

(ii) This was answered less well with only stronger candidates recalling and using the correct equation. Some candidates were able to gain partial credit for the equation even though they mistakenly used the mass and specific heat capacity values for steel rather than aluminium. Candidates need to take care not to use a Q for thermal capacity and to remember the correct unit.

(iii) Many candidates answered correctly. Weaker candidates often left the answer blank with no attempt at an equation or calculation.

(b) Most candidates attempted an answer and those who mentioned electrons usually went on to gain full credit.

Question 6

(a) Most candidates made a sensible attempt at a description, often with accompanying diagram. The majority used the echo method well and correctly stated that the distance to the wall should be doubled before calculating the speed. Those who suggested that the experimenters stand 1 or 2 km apart, needed to specify a reasonable method for producing sound which could be heard at that distance e.g. firing a gun. The question asked for details of measurements, so it was important to specify how the distance would be measured and when the stopwatch would be started and stopped. A common error was to omit a distance measuring device when listing the apparatus.

(b) Few correct answers were seen. Many candidates gave answers based on the differences between transverse and longitudinal waves. These were often simply stated differences without any link to diffraction.

Question 7

(a) (i) A small but significant number of candidates gave no answer to this question. Many who answered gained full credit. A few candidates attempted to link the ray of green light to the label arrow for the word prism. Others drew the incident ray coming diagonally downwards from the top of the page which often led to refraction away from the normal inside the prism.

(ii) This question was generally answered well. The syllabus specifies light of a single frequency, so answers relating to a single colour of light did not gain credit.

(b) (i) Common incorrect answers here included the speed of sound, values with 3 raised to the wrong power of ten or the omission of units. The correct answer was acceptable to 1 significant figure due to the approximation in air rather than a vacuum.

(ii) There was good recall and transposition of the wave equation, and the question was generally answered well. A common error was the incorrect cancelling of powers of ten to achieve a magnitude of 10^{-1} resulting in a power of ten error. Candidates would benefit from practice of dividing powers of ten, particularly when a negative power is included.

(iii) Many correct answers were seen. Weaker candidates gave no response.

Question 8

(a) Most candidates produced good answers with straight lines equally spaced apart and arrows pointing upwards on the diagram. Candidates should make sure they draw the specific number of lines asked for in the question and space the lines across the whole width of the plates. Lines must start and stop at the plates without gaps. A small number drew lines parallel to the plates or with significant curvature.

(b)(i) The majority of candidates gave the correct answer.

(ii) This was generally answered well. The most common error was to forget to convert the time from minutes to seconds.

(iii) The majority of candidates answered this correctly.

Question 9

(a) (i) Most candidates understood what a series circuit was and drew a basic circuit usually with four components. Symbols for the lamp and resistor were well known. However, many drew incorrect symbols for the thermistor. Variable resistor symbols were often used instead of the thermistor. Any correct power supply symbol was accepted.

(ii) Many correct answers were seen. A few candidates drew the voltmeter across the lamp instead of the resistor and a few others drew the voltmeter in series.

(iii) This proved challenging for many candidates and some weaker candidates gave no response. Most of those who answered were able to gain credit for reading a current of 0.4 A from the graph for the resistor. Weaker candidates assumed a constant voltage in the circuit rather than current. Many candidates had not made the connection between the series circuit they drew in **(i)** and the graph. Some then attempted to calculate a total current and subsequently total resistance × total current.

(b) Many candidates understood that a thermistor was used in a situation relating to heat or temperature. Candidates needed to note the command word, "describe", and give adequate detail in their answer. Answers of the single word "heater" were too vague to be given credit. A few candidates became confused with thermocouples. Air conditioning systems were often given as a correct answer along with a brief description of how the temperature of the air affects the device.

Question 10

(a) (i) Candidates would have benefitted from writing down the full equation before attempting any manipulation in this question. They then could have gained credit for the equation even if they had made an error in the rearranging. A common error was to have the turns ratio inverted.

(ii) In this part, some candidates were confused with the comment in the question about the transformer being 100 per cent efficient and incorrectly assumed therefore that the output current would be equal to the input current. A few tried to use the efficiency formula.

(b) (i) Most candidates followed the instruction to draw an arrow on the wire clearly but fewer drew it correctly showing an anticlockwise direction.

(ii) Many candidates gained credit for stating that the wire could now move upwards. However, fewer were able to give an answer with enough detail for further credit with some just stating "due to Fleming's left-hand rule". Candidates should be aware that use of the word "changes" (e.g. "the direction of the force changes") is ambiguous in these situations. They needed to be more specific e.g. "the force reverses or is upward".

(c) There were many different answers to this question. The most common acceptable answers were either that the split-ring commutator is needed to change the direction of the current in the coil every half turn, or that without the commutator the coil will not continue to rotate in the same direction. Some candidates referred to it keeping the current flowing in one direction, presumably a reference to d.c. and a few thought it is used to stop the wires getting tangled. If using words like "turn" or "move", candidates needed to make it clear that they meant continuously in one direction rather than oscillating.

Question 11

(a) (i) Many candidates were able to suggest a source of background radiation. As this question was set in a laboratory, suggestions of food, drink or medical equipment did not gain credit.

(ii) This question was less well answered. The word "random" was rarely used by candidates. Weaker candidates often did not give a response.

(b) Stronger candidates gained full credit. Weaker candidates used the neutron numbers in place of mass numbers or got the mass number and atomic number the wrong way up. Many candidates were able to correctly recall the numbers for the alpha particle.

(c) This was generally answered well and most candidates realised that there were three half-lives and were awarded full credit. A few miscounted the number of half-lives as four.

PHYSICS

Paper 0625/51
Practical Test

Key messages

- Candidates need to have a thorough grounding in practical work during the course, including reflection and discussion on the precautions taken to improve reliability and control of variables.
- Candidates should be aware that, as this paper tests an understanding of experimental work, explanations and justifications need to be based on practical rather than theoretical considerations.
- Numerical answers should be expressed clearly, to the appropriate number of significant figures and with a correct unit where applicable. Candidates should know that these techniques will be tested at some point in the paper.
- Candidates should be ready to apply their practical knowledge to different situations.
- Questions should be read carefully to ensure that they are answered appropriately.

General comments

The aim of the examination is to enable candidates to display their knowledge and understanding of practical physics techniques, including the following:
- plotting graphs
- tabulating readings
- manipulating data to obtain results
- drawing conclusions
- dealing with possible sources of error
- controlling variables
- handling practical apparatus and making accurate measurements
- choosing the most suitable apparatus.

It is assumed that, as far as possible, the IGCSE course will be taught so that candidates undertake regular practical work as an integral part of their study of physics.

Questions on experimental techniques were answered much more effectively by candidates who showed evidence of undertaking similar practical work. Some candidates appear to have learned sections from the mark schemes of past papers and gave written responses that were not appropriate to the questions set.

The practical nature of the examination should be kept in mind when explanations, justifications or suggested changes are required, for example in **Questions 2(d)**, **3(f)** and **3(g)**.

Comments on specific questions

Question 1

(a) The majority of candidates successfully recorded the top and bottom scale readings in mm. Some appeared to have taken the measurement from **Fig. 1.1** instead of from their apparatus. Most candidates successfully calculated the length of the spring.

(b) Some candidates calculated the increase in extension for each load rather than the total extension. Most produced realistic readings for the increasing length of the spring.

(c) Most candidates labelled the graph axes correctly and drew them the right way round. Some candidates chose a scale that resulted in the plots occupying too small a proportion of the graph grid. Plotting was generally accurate, but a significant number of candidates did not include the plot at the origin. Candidates should use neat crosses for the plots, or neatly circled dots so that the accuracy of the plotting is clear. Many candidates drew a well-judged straight line, but some drew a dot-to-dot line and others drew a straight line that did not match the plots.

(d) Here candidates needed to show clearly the distances. Some candidates drew very careful lines that showed exactly what was required. Most candidates successfully showed the original and stretched lengths but some then gave a confusing indication of the extension.

Question 2

(a) Most candidates recorded realistic values for current and potential difference and calculated the resistance correctly.

(b) Candidates who had rearranged the circuit correctly obtained a value for V_{XY} greater than V_X. Correct use of the units A, V and Ω was credited here.

(c) (i) The diagram required two resistors in parallel and a complete circuit with correctly positioned ammeter and voltmeter with all the correct circuit symbols used and the third resistor in series.

(ii),(iii) Candidates were credited for completing the third set of readings with V_{XZ} less than V_X and then obtaining the value of R_{XZ} within $\pm$ 10 per cent of $R_X / 2$. Candidates who had carefully followed the instructions and rearranged the circuit correctly each time produced a result within tolerance.

(d) Candidates gained credit for suggesting the use of at least four additional resistors. Values between 1 Ω and 20 Ω were expected with a range such that the largest value was at least twice the smallest value. Many candidates gave responses that were too vague and some produced a theoretical explanation of the combined resistances of resistors in parallel and series that did not address the question.

Question 3

(a) Most candidates drew the normal and incident rays accurately.

(b) Many candidates drew neat and accurate lines. Fewer candidates placed the pins P_1 and P_2 correctly at a distance of at least 5 cm apart.

(c) Most candidates measured the angle α accurately.

(d) A significant number of candidates drew the second reflected ray in a position that indicated that they had not moved the mirror to the new position specified in the instructions.

(e) Most candidates included the unit ° for the angles and carefully followed the instructions with accurate line drawing, producing angles within the accepted tolerance.

(f) Candidates were expected to suggest at least three additional angles of incidence with a range of at least 30° and all less than 90°.

(g) Some vague responses were seen here and some that appeared to have been learned from past mark schemes that were not appropriate for this question. This included references to doing the experiment in a darkened room. Stronger responses mentioned difficulty in lining up the pins and the thickness of the mirror.

Question 4

Candidates who followed the guidance in the question were able to write concisely and addressed all the necessary points. Some candidates copied the list of apparatus and other information given in the question. This was unnecessary and often introduced a vague explanation of the investigation.

Candidates needed to include a stopwatch (or other timing device) to gain initial credit.

A concise explanation of the method was required. Candidates should have concentrated on the readings that must be taken and the essentials of the investigation. It may benefit candidates to plan their table of readings before writing the method to help them to think through the measurements that must be taken to address the subject of the investigation. Candidates were expected to explain that water is to be heated in a container to a specific temperature. Some chose boiling point which was acceptable, and others chose a suitable fixed temperature, for example 80°C. Candidates then needed to make it clear that the procedure is repeated with at least two additional containers. A vague reference to repeats was not sufficient as it was not clear whether the candidate was referring to using different containers or repeating the measurements with the same container.

Candidates were expected to identify that the volume of water should be kept constant. Also, they were expected to note that starting temperature should be constant.

Many candidates drew a suitable table. They were expected to include columns for type of container and time with the unit s.

Candidates were expected to explain how to reach a conclusion by comparing the times for the various containers. The question did not ask for a prediction. Some candidates wrote a prediction but no explanation of how to reach a conclusion.

PHYSICS

Paper 0625/52
Practical Test

Key messages

- Candidates need to have a thorough grounding in practical work during the course and should have as much personal experience of carrying out experiments themselves as possible. The practical work should include reflection and discussion of the significance of results, precautions taken to improve reliability and control of variables.

- The ability to record readings to an appropriate precision, usually reflecting the measuring instrument being used, or to quote a derived result to an appropriate number of significant places, caused difficulty for many candidates.

- Some candidates had difficulty in choosing an appropriate scale to plot their graphs and in drawing a best-fit line to display their data.

- Many candidates were not able to derive conclusions backed up by evidence, or to present well thought out conclusions.

- Centres are provided with a list of required apparatus well in advance of the examination date. Where centres wish to substitute apparatus, it is essential they contact Cambridge to check that the change is appropriate and that candidates will not be disadvantaged. Any changes must be recorded in the Supervisor's report.

General comments

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

- handling practical apparatus and making accurate measurements
- tabulating of readings
- graph plotting and interpretation
- manipulating data to obtain results
- drawing conclusions
- understanding the concepts of results being equal within the limits of experimental accuracy
- dealing with possible sources of inaccuracy
- control of variables.

Most candidates were well prepared and able to demonstrate some ability and understanding across the range of practical skills being tested. All parts of every practical test were attempted and there was no evidence of candidates running short of time. The majority of candidates were able to follow instructions, record observations clearly and perform calculations accurately and correctly.

Comments on specific questions

Question 1

(a) Most candidates recorded sensible values for the length, width, and height of the block of wood. Only a minority of candidates did not record their answers to the nearest millimetre. The calculation of the volume of the block was almost always correct. However, answers were occasionally incorrectly rounded in the final answer. The density of the wooden block was usually calculated correctly. Most candidates followed the instruction to give their answers to a suitable number of significant figures for the experiment, and correctly gave their answers to two or three significant figures. Despite being asked to supply a unit for the answer, a minority of candidates did not do this and so did not gain full credit for their answers.

(b) The estimation of the volume of the floating block of wood below the water surface proved to be difficult for many candidates. Many candidates produced sensible answers, but in many cases the volume estimate was given to a precision of one-hundredth of a cubic centimetre, or even greater. Candidates should be advised that in estimation problems of this kind, it is sufficient to supply an answer to the nearest 1, 5 or even 10 cm^3. In a small number of answers, the estimate of the volume of the block of wood below the surface was greater than the total volume of the block which had been calculated previously.

(c) The difference *d* between the measured value *m* of the mass of the block of wood and the calculated value m_W was almost always calculated correctly. Many candidates had difficulty in deciding whether this difference in mass was small enough to conclude that *m* and m_W were equal. Many candidates were unable to give a convincing justification for their statements. The idea of experimental tolerances, and whether the difference between two measured quantities is close enough to zero for them to be considered equal was not well understood by most candidates. Generally, if two values differ by 5 per cent or less, the expected answer is "yes, they are the same". If the values differ by more than 10 per cent the expected answer is "no, they are different". Between the values of 5 per cent and 10 per cent, either answer is acceptable if it is qualified by a phrase, such as "yes, it is close enough to zero to be equal" or "no, they are too far away to be equal".

(d) This final more demanding part of the question was only answered completely correctly by stronger candidates. Candidates were asked how a more accurate value of the volume of the block of wood below the water surface could be obtained by measurement rather than by estimation. Stronger candidates realised that they needed to mark the water level on the side of the block and then remove it from the water. The volume of the wood below the water surface could then be calculated by measuring this submerged depth and multiplying it by the cross-sectional area of the block. Another acceptable method, described by fewer candidates, was to use a measuring cylinder and/or a displacement can, to measure the volume of water displaced by the floating block.

Question 2

(a) The potential difference V_S across the resistor and the current I_S in the resistor were usually recorded to the precision required. The calculation of the resistance of the resistor posed few problems. However, a small number of candidates incorrectly rounded the calculated resistance value.

(b) Most candidates followed the instructions to replace the resistor with the lamp and repeated the measurements of potential difference and current. The resistance of the lamp was usually calculated correctly. Occasionally the units of one or more of the measured quantities were missing.

(c) The circuit diagram drawn of the resistor connected in series with the lamp often indicated that candidates had not understood the question. The instruction given was to connect the voltmeter to measure the potential difference across the series combination of the resistor and the lamp. It was common to see circuits drawn where the voltmeter was connected across just the resistor or just the lamp and not the series combination of both. The measurements recorded by candidates often confirmed that they had not set up the circuit correctly.

(d) Many candidates repeated the words in the question and stated that the values of (R_S + R_L) and R_C were not the same within the limits of experimental accuracy. Candidates needed to compare (R_S + R_L) with R_C and to give a simple statement that the two quantities were close enough to be considered equal or that they were too far apart to be considered equal. Many stronger candidates calculated the percentage difference between the two quantities and based their comparison on this.

Question 3

(a) Most candidates performed the experiment correctly and produced a fully completed table of results showing that the image distance *v* decreased, as the distance *u* of the illuminated object from the lens increased. The calculated values of the ratio *u* / *v* were usually correct, but occasionally candidates did not record them to a number of significant figures consistent with the rest of the data provided for them in the table.

(b) Despite the instruction given in the question to start the *y*-axes at *u* = 15.0 cm, many candidates did not do this. Only a few candidates used scales that increased in inconvenient increments, such as 3 or 7. Choosing such scales makes the points much harder to plot clearly. There were many excellent, carefully drawn best-fit lines. However, there were a number of graphs where the best-fit line resulted in all points which did not lie on the drawn line, being on the same side of the line. A sizeable minority of the lines drawn were forced through the origin. There were also some graphs where the points were joined dot-to-dot. The concept of best fit was clearly not well understood by all candidates.

(c) The use of the graph to find the value of *u* when the ratio *u* / *v* = 1.0 was done well by most candidates. The instruction to show clearly on the graph how the necessary information had been obtained was often missing and only partial credit could then be awarded for the question.

(d) Most candidates were able to describe one practical difficulty experienced while performing the experiment. There were also many good attempts at explaining how candidates would try to overcome their named difficulty to obtain accurate results.

Question 4

Credit was available for candidates listing three suitable metals for the wires to be used in the experiment. Despite the instruction to write a list of metals, many candidates did not. Occasionally candidates were able only to list one or two metals.

Credit was also available for giving a brief explanation of how the investigation would be set up and carried out. Most candidates understood what the investigation entailed and described a set-up where a clamped metal wire was loaded until it broke. This was then repeated for the other metal wires. Far fewer candidates suggested repeating the procedure for each individual wire and obtaining an average value of the breaking force.

Most candidates gained the credit available for listing one control variable in this investigation, usually that the diameter / thickness of the metal wires used should remain constant.

Most candidates drew an appropriate table of results and gave relevant headings with units. Only two columns, labelled metal and load/mass/weight were required. Frequently, extra columns with reference to the extension of the wires were included. These were ignored. Fewer candidates satisfactorily explained how they would use their results to reach a conclusion, because they made predictions about the outcome. The explanation given needed to refer to breaking force and not mass because in the question, candidates were asked to plan an experiment to investigate the force required to break the wires. Candidates who had loaded the wires with loads expressed in grams or kilograms needed to explain the breaking force could then be deduced by using the equation $W = mg$.

Answers indicating that the wire that requires the greatest force/load/weight to break it, is the strongest metal, were awarded full credit. Many stronger candidates also suggested drawing a bar graph of metal against breaking force and using the graph to draw a conclusion.

PHYSICS

Paper 0625/53
Practical Test

Key messages

Candidates need to have a thorough knowledge of practical work during the course and should have had significant experience in performing experiments themselves. This should include what is needed to improve reliability in experimental work and how to identify which variables need to be controlled.

This paper tests an understanding of experimental techniques and explanations need to be based on data with practical rather than theoretical considerations being taken.

Direct measurements should always be taken to the relevant accuracy, with calculations stated to the required, and consistent, number of significant figures. Clear working, with the correct units, should always be shown.

Candidates should be reminded to read questions carefully so that responses are appropriate.

General comments

The aim of the examination is to enable candidates to display their knowledge and understanding of practical physics techniques, including the following:

- graph plotting
- manipulating data to obtain results
- drawing conclusions
- tabulating readings
- control of variables
- dealing with possible sources of error
- understanding the concept of results being equal within the limits of experimental accuracy
- choosing the most suitable apparatus
- taking accurate measurements.

It is assumed that as far as possible the course will be taught so as to enable candidates to have had regular experience of practical work as a main part of their study of physics.

All parts of all questions were attempted and were successfully completed within the allotted time. Most candidates followed the instructions correctly and performed the calculations to the required accuracy.

Each practical examination will include a question where candidates will be asked to plan an investigation. Answers should be based on careful reading of the question and a logical application of good experimental practice.

Comments on specific questions

Question 1

(a) Most candidates took a correct set of readings.

(b) (i)(ii) Most candidates took a correct set of readings and added the correct units to the table.

(c) Many candidates gained partial credit, but some did not make clear reference to the values in their results.

(d) (i)(ii) Most candidates successfully carried out both calculations, but a few did not give the correct unit.

(e) (i) Many candidates gave imprecise answers with confusing responses about which beaker they were referring to. Several candidates described repeating the experiment with a lid. This was an example where careful reading of the question was needed.

(ii) Most candidates gained partial credit for stating that the starting temperature must be the same with many gaining full credit for correctly explaining that the cooling rate was different at different temperatures.

Question 2

(a) Many candidates successfully recorded the result for 90 cm of wire A and calculated R.

(b) (i) Many candidates correctly completed the table but a few did not record their results to the consistency of either 2 or 3 significant figures that was required.

(ii) Most candidates correctly identified all the units needed.

(c) (i)(ii) Most candidates correctly calculated the values of P and Q from their results.

(iii) There were many correct statements with the justification of being within the limits of experimental accuracy frequently seen.

(d) Only stronger candidates gained credit with others giving answers referring to human error which was not what was asked.

Question 3

(a) Most candidates successfully completed the table.

(b) Most candidates calculated the values of $1/h_I$ correctly.

(c) Nearly all candidates attempted the graph with most labelling the axes correctly and using suitable scales. The plotting of points was generally very good but some candidates' points were too large. They should be no larger than half of a small square on the graph. There were many good lines of best fit with an even distribution of points on either side if necessary. Lines should not automatically be extended to the origin.

(d) (i) Many candidates correctly read u_o from their graph and were within range.

(ii) Many candidates correctly drew the triangle on the graph to identify how they would calculate the gradient.

(iii) Many candidates correctly calculated the focal length but some were out of range.

(e) The most common correct answers for a difficulty were either putting something (e.g. a ruler) in the way of the light or the image having blurred edges. Using a larger object or marking the image on the screen were the most common improvements to make.

Question 4

Careful reading of the question and the use of the bullet points usually enabled candidates to provide a successful plan. Many candidates identified current as the independent variable but then did not state that an ammeter would be needed to measure it. The other correct independent variable most commonly seen was to change the number of turns of wire on the coil.

Some candidates did not realise that a controlled variable was one that remained the same throughout the experiment.

Most candidates gave a reasonable account of how to do the experiment. It would be good practice if they then returned to this account, read it through and made sure that they could do the experiment successfully using their account. There were some unnecessarily vague methods stated. The majority of candidates stated that the experiment should be repeated for further values of the independent variable, but many did not realise that at least five different values are required for a graph to be plotted and that all results should be repeated and then the average for each one taken.

Many candidates drew correct tables but then some did not indicate what units the headings required, even though they had seen tables elsewhere in the paper.

Only stronger candidates successfully described how their readings enabled them to explain the relationship between the independent and dependent variables, with many just stating a basic conclusion. The use of a correctly labelled graph was the most common way that candidates described their use of their readings.

PHYSICS

Paper 0625/61
Alternative to Practical

Key messages

- Candidates need to have a thorough grounding in practical work during the course, including reflection and discussion on the precautions taken to improve reliability and control of variables.
- Candidates should be aware that as this paper tests an understanding of experimental work, explanations and justifications need to be based on practical rather than theoretical considerations.
- Numerical answers should be expressed clearly, to the appropriate number of significant figures and with a correct unit where applicable. Candidates should know that these techniques will be tested at some point in the paper.
- Candidates should be ready to apply their practical knowledge to different situations and should read questions carefully to ensure that they are answered appropriately.

General comments

The aim of the examination is to enable candidates to display their knowledge and understanding of practical physics techniques, including the following:

- plotting graphs
- tabulating readings
- manipulating data to obtain results
- drawing conclusions
- dealing with possible sources of error
- controlling variables
- handling practical apparatus and making accurate measurements
- choosing the most suitable apparatus.

It is assumed that, as far as possible, the IGCSE course will be taught so that candidates undertake regular practical work as an integral part of their study of physics.

Questions on experimental techniques were answered much more effectively by candidates who showed evidence of having regular experience of similar practical work. Some candidates appeared to have learned sections from the mark schemes of past papers and written responses that were not appropriate to the questions in this paper.

The practical nature of the examination should be considered when explanations, justifications or suggested changes are required, for example in **Questions 2(e)**, **3(e)**, **3(f)** and **3(g)**.

Comments on specific questions

Question 1

(a) The majority of candidates successfully recorded 439 mm and 454 mm, but some gave the readings in cm. Some appeared to have taken the measurement from **Fig. 1.1** instead of from the information in the question. Most candidates calculated the difference correctly

(b) Most candidates calculated *e* correctly. Some candidates left the column heading blank but most of those who completed it correctly inserted mm.

(c) Most candidates labelled the graph axes correctly and drew them the right way round. Some candidates chose a scale that resulted in the plots occupying too small a proportion of the graph grid. Plotting was generally accurate but a significant number of candidates did not include the plot at the origin. Candidates should use neat crosses for the plots, or neatly circled dots so that the accuracy of the plotting is clear. Many candidates drew a well-judged straight line but some incorrectly drew a dot-to-dot line whilst others drew a straight line that did not match the plots.

(d) Here candidates needed to show the distances clearly. Some candidates drew very careful lines that showed exactly what was required. Most successfully showed the original and stretched lengths but some then gave a confusing indication of the extension.

Question 2

(a) Most candidates recorded correct values for current and potential difference and calculated the resistance successfully. The units A, V and Ω were required and most candidates included these correctly.

(b) Candidates were expected to realise that the values were too different to be accepted as equal within the limits of experimental inaccuracy.

(c) The diagram required candidates to draw two resistors in parallel and to have a complete circuit with a correctly positioned ammeter and voltmeter with all the correct circuit symbols used and the third resistor in series.

(d) Many candidates wrote the resistance correctly to two significant figures but some gave it to two decimal places.

(e) Candidates gained credit for suggesting the use of at least four additional resistors. Values between 1 Ω and 20 Ω were expected with a range such that the largest value was at least twice the smallest value. Many candidates gave responses that were too vague and some produced a theoretical explanation of the combined resistances of resistors in parallel and series that did not address the question.

Question 3

(a) Most candidates drew the normal correctly and the lines with the correct length. Fewer drew the lines at the correct angles.

(b) Many candidates showed pin positions that were too close to each other. Candidates were expected to indicate positions at least 5 cm apart. Candidates who intended to show the pins exactly 5.0 cm apart risked the distance being just too short.

(c) Candidates were expected to have drawn the correct line and to measure the angle at 70° to within $\pm$ 2°.

(d) Most candidates successfully included the unit ° for the angles.

(e) Candidates were expected to suggest at least three additional angles of incidence with a range of at least 30° and all less than 90°.

(f) Some vague responses were seen here and some that appeared to have been learned from past mark schemes that were not appropriate for this question, for example references to doing the experiment in a darkened room. Stronger responses included difficulty in lining up the pins and the thickness of the mirror.

(g) Candidates were expected to tick boxes 2, 3 and 5.

Question 4

Candidates who followed the guidance in the question were able to write concisely and addressed all the necessary points. Some candidates copied the list of apparatus and other information given in the question. This was unnecessary and often introduced a vague explanation of the investigation.

Candidates needed to include a stopwatch (or other timing device) in order to gain initial credit.

A concise explanation of the method was required. Candidates needed to concentrate on the readings that were required and the essentials of the investigation. It may have benefited candidates to plan their table of readings before writing the method to help them to think through the measurements that needed to be taken to address the subject of the investigation. Candidates were expected to explain that water was to be heated in a container to a specific temperature. Some chose boiling point which was acceptable, and others chose a suitable fixed temperature, for example 80°C. Candidates then needed to make it clear that the procedure was repeated with at least two additional containers. A vague reference to repeats was not sufficient as it was not clear whether the candidate was referring to using different containers or repeating the measurements with the same container.

Candidates were expected to identify that the volume of water should be kept constant. Also, they were expected to note that starting temperature should be constant.

Many candidates drew a suitable table. They were expected to include columns for type of container and time with the unit s.

Candidates were expected to explain how to reach a conclusion by comparing the times for the various containers. The question did not ask for a prediction. Some candidates wrote a prediction but no explanation of how to reach a conclusion.

PHYSICS

Paper 0625/62
Alternative to Practical

Key messages

- Candidates need to have a thorough grounding in practical work during the course and should have as much personal experience of carrying out experiments themselves as possible. The practical work should include reflection upon, and the discussion of the significance of results, precautions taken to improve accuracy and reliability and control of variables.

- Candidates should be advised to read the questions very carefully to ensure that they are answering the question as written, and not simply recalling the answer to a different question.

- The ability to record readings to an appropriate precision, usually reflecting the measuring instrument being used, or to quote a derived result to an appropriate number of significant places, caused difficulty for many candidates.

- Some candidates also had difficulty in choosing an appropriate scale to plot their graphs and in drawing a best-fit line to display their data.

General comments

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

- handling practical apparatus and making accurate measurements
- tabulating of readings
- graph plotting and interpretation
- manipulating data to obtain results
- drawing conclusions
- understanding the concepts of results being equal within the limits of experimental accuracy
- dealing with possible sources of inaccuracy
- control of variables.

The majority of candidates were well prepared and the range of practical skills being tested proved to be accessible. Most candidates demonstrated that they were able to draw upon their own personal practical experience to answer the questions. No parts of any question proved to be inaccessible to candidates and there was no evidence of candidates running short of time. Most candidates were able to follow instructions correctly, record measurements clearly and perform calculations accurately and correctly. Units were well known and were usually included. Writing was legible and ideas were expressed logically

Comments on specific questions

Question 1

(a) The length and the width of the block were almost always measured correctly. The calculation of the volume of the block was also almost always correct. However, answers were occasionally incorrectly rounded. Most candidates correctly wrote down the balance reading in the figure to the nearest gram, as requested. A sizeable minority of candidates did not understand what the phrase "to the nearest gram" meant and gave 63.9 g or 63.92 g as their answer.

The density of the wooden block was usually calculated correctly. Most candidates followed the instruction to give their answers to a suitable number of significant figures for the experiment, and correctly gave their answers to two or three significant figures.

(b) The estimation of the volume of the floating block of wood below the water surface proved to be difficult for many candidates. Many candidates produced sensible answers, but in some cases the volume estimate was given to a precision of one-hundredth of a cubic centimetre, or even greater. Candidates should be advised that in estimation problems of this kind, it is sufficient to supply an answer to the nearest 1, 5 or even 10 cm^3.

(c) The difference *d* between the measured value *m* of the mass of the block of wood and the calculated value m_W was almost always calculated correctly. Many candidates had difficulty in deciding whether this difference in mass was small enough to conclude that *m* and m_W were equal. Many candidates were unable to give a convincing justification for their statements. The idea of experimental tolerances, and whether the difference between two measured quantities is close enough to zero for them to be considered equal, was not well understood by most candidates. Generally, if two values differ by 5 per cent or less, the expected answer is “yes, they are the same”. If the values differ by more than 10 per cent the expected answer is “no, they are different”. Between the values of 5 per cent and 10 per cent, either answer is acceptable if it is qualified by a phrase, such as “yes, it is close enough to zero to be equal “or “no, they are too far away to be equal”.

(d) This final more demanding part of the question proved to be challenging. Only stronger candidates gained full credit. Candidates were asked how a more accurate value of the volume of the block of wood below the water surface could be obtained by measurement rather than by estimation. Stronger candidates realised that they needed to mark the water level on the side of the block and then remove it from the water. The volume of the wood below the water surface could then be calculated by measuring this submerged depth and multiplying it by the cross-sectional area of the block. Another acceptable method described by fewer candidates was to use a measuring cylinder and/or a displacement can to measure the volume of water displaced by the floating block.

Question 2

(a) The potential difference V_S across the resistor and the current I_S in the resistor were usually recorded correctly. Common incorrect answers were 1.4 V and 0.29 A. The calculation of the resistance of the resistor caused few problems. A small number of answers were incorrectly rounded for the calculated resistance value. Some candidates did not give the units of the measured quantities or gave incorrect units.

(b) The resistance of the lamp was usually calculated correctly, and the answer was given to two or three significant figures.

(c) The circuit diagram of the resistor connected in series with the lamp often indicated that candidates had not understood the question. The instruction given was to connect the voltmeter to measure the potential difference across the series combination of the resistor and the lamp. It was common to see circuits drawn where the voltmeter was connected across just the resistor or just the lamp and not the series combination of both.

(d) The combined resistance of the lamp and the resistor was usually calculated correctly.

(e) Many candidates unnecessarily repeated the words in the question and stated that the values of ($R_S + R_L$) and R_C were not the same within the limits of experimental accuracy. A comparison of ($R_S + R_L$) with R_C was required along with a simple statement that the two quantities were close enough to be considered equal or that they were too far apart to be considered equal. Many stronger candidates calculated the percentage difference between the two quantities and based their comparison on this.

Question 3

(a) The ratio *u* / *v* was usually calculated correctly.

(b) Despite the instruction given in the question to start the y-axes at u = 15.0 cm, many candidates did not do this. Only a few candidates used scales that increased in inconvenient increments, such as 3 or 7. Choosing such scales makes the points much harder to plot clearly. There were many excellent, carefully drawn best-fit lines. However, there were a number of graphs where the best-fit line resulted in all points which did not lie on the drawn line being on the same side of the line. A sizeable minority of the lines drawn were forced through the origin. There were also some graphs where the points were joined dot-to-dot. The concept of best fit was clearly not well understood by all candidates.

(c) The use of the graph to find the value of u when the ratio u / v = 1.0 was done well by most candidates. The instruction to show clearly on the graph how the necessary information had been obtained was often missing and only partial credit could then be awarded for the question.

(d) The calculation of the value of f, the focal length of the lens was almost always correct. Almost all candidates gave their answer to a suitable number of significant figures.

(e) Most candidates were able to describe one practical difficulty experienced while performing the experiment. There were also many good answers explaining how candidates would try to overcome the difficulty to obtain accurate results.

Question 4

Credit was available for candidates listing three suitable metals for the wires to be used in the experiment. Despite the instruction to write a list of metals, many candidates did not do this. Occasionally candidates were able only to list one or two metals.

Credit was also available for giving a brief explanation of how the investigation would be set up and carried out. Most candidates understood what the investigation entailed and described a set-up where a clamped metal wire was loaded until it broke. This was then repeated for the other metal wires. Far fewer candidates suggested repeating the procedure for each individual wire and obtaining an average value of the breaking force.

Most candidates gained the credit available for listing one control variable in this investigation, usually that the diameter / thickness of the metal wires used should remain constant.

Most candidates drew an appropriate table of results and gave relevant headings with units. Only two columns, labelled metal and load/mass/weight were required. Frequently, extra columns with reference to the extension of the wires were included. These were ignored. Fewer candidates satisfactorily explained how they would use their results to reach a conclusion because they made predictions about the outcome. The explanation given by candidates needed to refer to breaking force and not mass, because in the question candidates were asked to plan an experiment to investigate the force required to break the wires. Candidates who had loaded the wires with loads expressed in grams or kilograms needed to explain that the breaking force could then be deduced by using the equation $W = mg$.

Answers indicating that the wire that requires the greatest force/load/weight to break it, is the strongest metal were awarded full credit. Many stronger candidates also suggested drawing a bar graph of metal against breaking force and using the graph to draw a conclusion.

PHYSICS

Paper 0625/63
Alternative to Practical

Key messages

Candidates need to have a thorough knowledge of in practical work during the course and should have had significant experience in performing experiments themselves. This should include what is needed to improve reliability in experimental work and how to identify which variables need to be controlled.

This paper tests an understanding of experimental techniques and explanations need to be based on data with practical rather than theoretical considerations being taken.

Direct measurements should always be taken to the relevant accuracy, with calculations stated to the required, and consistent, number of significant figures. Clear working, with the correct units, should always be shown.

Candidates should be reminded to read questions carefully so that responses are appropriate.

General comments

The aim of the examination is to enable candidates to display their knowledge and understanding of practical physics techniques, including the following:

- graph plotting
- manipulating data to obtain results
- drawing conclusions
- tabulating readings
- control of variables
- dealing with possible sources of error
- understanding the concept of results being equal within the limits of experimental accuracy
- choosing the most suitable apparatus
- taking accurate measurements.

It is assumed that as far as possible the course will be taught so as to enable candidates to have had regular experience of practical work as a main part of their study of physics. This examination should not be seen as a way that the course can be effectively taught without practical work

All parts of all questions were attempted and were successfully completed within the allotted time. Most candidates followed the instructions correctly and performed the calculations to the required accuracy.

Each Alternative to Practical examination will include a question where candidates will be asked to plan an investigation. Answers should be based on careful reading of the question and a logical application of good experimental practice.

Comments on specific questions

Question 1

(a) Nearly all candidates were able to record a correct reading from the thermometer.

(b) Most candidates correctly identified the units, but some failed to give any response.

(c) Many candidates gained full credit, but some made incorrect reference to the heater. This is an example where careful reading of a question was needed.

(d) Many candidates only gained partial credit as they made no reference to values from the results.

(e) (i) (iii) Most candidates successfully carried out both calculations but a few failed to give the correct unit.

(f) (i) Many candidates gave imprecise answers with confusing responses about which beaker they were referring to. Several candidates described repeating the experiment with a lid. Again, this was an example where careful reading of the question was needed.

(ii) Most candidates gained partial credit for stating that the starting temperature must be the same with many gaining full credit for correctly explaining that the cooling rate was different at different temperatures.

Question 2

(a) Many candidates correctly inserted the ammeter in series with the rest of the circuit but fewer connected the voltmeter across the terminals XY correctly. Some candidates also left a gap in the circuit.

(b) (i) Nearly all candidates correctly read both meters, with only a very few incorrectly reading the ammeter as 0.26.

(ii) Most candidates correctly calculated the values of R but inconsistent significant figures were often seen.

(iii) Most candidates correctly completed the headings in the table**.**

(c) (i) Most candidates correctly calculated the values of P and Q

(ii) There were many correct statements with the justification of being within the limits of experimental accuracy frequently seen.

(d) Only stronger candidates answered this correctly.

Question 3

(a) Most candidates correctly measured the height of the object.

(b) Many candidates gained credit, but some referred to moving the lens rather than moving the screen back and forth which gained no credit.

(c) Most candidates correctly completed the table.

(d) Nearly all candidates attempted the graph with most labelling the axes correctly and using suitable scales. Candidates should not assume that a graph must start from the origin unless specifically instructed to do so. The plotting of points was generally very good, but some candidates' points were too large. They should be no larger than half a small square on the graph. There were many good lines of best fit with an even distribution of points on either side if necessary. Lines should not automatically be extended to the origin.

(e) (i) Many candidates correctly drew the triangle on the graph to identify how they would calculate the gradient.

(ii) Many candidates correctly calculated the focal length, but some were out of range.

(f) The most common correct answers for a difficulty were either putting something (e.g. a ruler) in the way of the light or the image having blurred edges. Using a larger object or marking the image on the screen were the most common improvements to make.

Question 4

Careful reading of the question and the use of the bullet points usually enabled candidates to provide a successful plan. Many candidates identified current as the independent variable but then did not state that an ammeter would be needed to measure it. The other correct independent variable most seen was to change the number of turns of wire on the coil.

Some candidates did not realise that a controlled variable was one that remained the same throughout the experiment.

Most candidates gave a reasonable account of how to do the experiment. It would be good practice if they then returned to this account, read it through and made sure that they could do the experiment successfully using their account. There were many unnecessarily vague methods stated. Most candidates stated that the experiment should be repeated for further values of the independent variable, but many did not realise that at least five different values are required for a graph to be plotted and that all results should be repeated and then the average for each one taken.

Many candidates drew correct tables but then some did not indicate what units the headings required, even though they had seen tables elsewhere in the paper.

Only stronger candidates successfully described how their readings enabled them to explain the relationship between the independent and dependent variables, with many just stating a basic conclusion. The use of a correctly labelled graph was the most common way that candidates described their use of their readings.