PHYSICS

Paper 0625/11
Multiple Choice Core

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

General comments

Questions 4, **14**, **15**, **16**, **18**, **25**, and **29** were often answered correctly. However, **Questions 1**, **3**, **12**, **17**, **20**, **23**, **34** and **39** proved more challenging for many candidates.

Comments on specific questions

Question 1

The question was challenging for many candidates and only the strongest candidates recognised that there are two changes of direction in each complete oscillation of the pendulum.

Question 3

The most common response was **A** which showed that candidates understood that the ball is slowing down as it rises but did not recognise that the deceleration indicated that the acceleration was in the opposite direction to the speed. The second most common error was to choose option **C,** which shows that candidates thought that the speed increased as the ball rose.

Question 4

Many candidates recognised that the instrument used to measure mass is a balance.

Question 11

Candidates understanding of the term power was not secure, with almost equal numbers of candidates opting for option **A** (the key), **B** and **C**.

Question 12

This question proved challenging with many candidates selecting one of the incorrect options.

Question 15

Almost all candidates recognised that the diagram represented evaporation of a liquid.

Question 17

To solve this problem, candidates needed to recognise that the melting point of the required substance not only needed a boiling point greater than the boiling point of water (0°C) but also a boiling point of greater than the boiling point of water (100°C).

Question 20

Only stronger candidates knew that light travels as a transverse wave, and even amongst those that knew this basic fact, many did not know that the vibrations in a transverse wave are at right angles to the direction of travel of the disturbance.

Question 23

Many candidates did not read the question carefully enough and thought that option **A** was correct. However, candidates who read the question more carefully selected the correct option **B.**

Question 28

Only the strongest candidates answered this question correctly. Many candidates had little idea of the direction of the magnetic field at point near a magnet. Responses were spread across all four options.

Question 29

This was a well-answered question with almost all candidates recognising that a current in a metal wire is due to electron flow.

Question 30

Although most candidates recognised that the longer wires would have more resistance than the shorter wires, few recognised the inverse relationship between the resistance and the diameter of the wire.

Question 37

The structure of the atomic nucleus was not well known, with many candidates unable to identify the correct statement.

Question 39

Many candidates did not appear to take notice of the word 'not' which was emboldened in the question, and so selected an incorrect answer.

PHYSICS

Paper 0625/12
Multiple Choice Core

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

General comments

Questions 1, **2**, **3**, **6**, **8**, **14**, **25 and 27** were answered well. However, **Questions 9**, **11**, **13**, **16**, **17**, **18**, **20**, **21**, **28**, **36**, **37** and **39** were more challenging for many candidates.

Comments on specific questions

Question 1

Candidates did well to correctly read the volumes of liquids in the three measuring cylinders. It was not a straightforward question as each cylinder had different intervals between graduations.

Question 2

Most candidates were able to identify the car with the greatest average speed.

Question 3

Candidates did well to correctly interpret the speed-time graph.

Question 6

Candidates had little difficulty in calculating the density of the metal.

Question 9

This question was challenging for some candidates. They needed to recognise that a wind powered generation of electric energy is dependent on the wind strength while batteries can continuously supply power. Stronger candidates were able to deduce the more efficient supply when given the output per 1000 W input.

Question 11

While most candidates selected the right answer, **A**, large numbers of candidates chose each of the other three options.

Question 13

Many candidates did not read this question carefully enough. The question stated the area of one foot of the man and that he was standing with two feet on the ground. Nevertheless, a majority of candidates found the pressure exerted when the man was standing on one foot.

Question 17

Only the strongest candidates answered this question correctly. Other candidates chose the substance with the greatest temperature rise as the one with the largest thermal capacity rather than the one which had the smallest temperature rise.

Question 18

This question was challenging for many candidates, with most thinking that the greatest temperature difference between the ends of the bar would be the copper bar. In practice, this would have the smallest temperature rise because the energy is passed along the bar, warming the far end. Consequently, the largest temperature difference will be the bar which conducts least energy, where the far end of the bar is at the lowest temperature.

Question 20

Only stronger candidates recalled that light travels as a transverse wave, and amongst these candidates, many did not know that the vibrations in a transverse wave are at right angles to the direction of travel of the disturbance.

Question 21

Many candidates confused amplitude with wavelength and answered this incorrectly.

Question 28

Only the strongest candidates answered this question correctly. All incorrect options were chosen fairly equally by other candidates.

Question 36

The three-dimensional nature of the simple motor effect and the a.c. generator make them conceptually difficult. Nevertheless, the logic of the changes in this question allowed stronger candidates to identify the correct response.

Question 37

The structure of the atomic nucleus was not well known, with many candidates unable to identify the correct statement.

Question 39

This question was not answered well by many candidates.

PHYSICS

Paper 0625/13
Multiple Choice Core

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

General comments

Questions 3, **5**, **6**, **14**, **22**, **26** and **31** were usually answered well. However, **Questions 2**, **8**, **13**, **20**, **21**, **25**, **27**, **28**, **29**, **32**, **34** and **36** proved more challenging for many candidates.

Comments on specific questions

Question 2

Candidates tended to incorrectly think that the downward slope on the distance-time graph indicated deceleration. However, that section of the graph is a straight line indicating that the object is travelling at constant speed.

Question 3

This was a challenging question, but it was often answered well. A common error was to take the two speeds given and take an average of the two. However, this is flawed because the times for which the athlete has these two speeds take are different.

Question 8

Many candidates incorrectly thought that the only forces on the beam are the weights of the two children and missed the idea that the fulcrum applies an upward force on the beam. Stronger candidates recognised that the conditions for equilibrium are zero resultant force and zero resultant moment (or couple).

Question 13

The dimensions of the block are given in centimetres, and the pressure is given in newtons per metre squared. A number of candidates did not convert units into a consistent set and so gave an incorrect answer.

Question 14

Candidates showed a good understanding of the reasons for tyre pressure to decrease when the outside temperature falls.

Question 20

Only stronger candidates recalled that light travels as a transverse wave, and amongst these candidates, nearly half did not know that the vibrations in a transverse wave are at right angles to the direction of travel. of the disturbance.

Question 21

Few candidates were able to demonstrate knowledge of the meanings of terms wavelength and amplitude.

Question 22

This question was answered well, showing candidates were familiar with mirror writing.

Question 25

The majority of candidates did not recognise that the speed in a vacuum for all electromagnetic waves is the same. It is the frequency which determines the properties of a particular portion of a section of the spectrum.

Question 28

Only the strongest candidates answered this question correctly. All incorrect options were chosen fairly equally by other candidates.

Question 29

Candidates who had first-hand practical experience of working with charged rods answered this correctly. However, many others found this question challenging.

Question 31

This question was done well with most candidates recognising that the current through the power supply is greater than the current through each arm of the resistors in parallel.

Question 32

The wide spread of options chosen showed that many candidates had little idea of the operation of a relay.

Question 34

The concept of electromagnetic induction was challenging for many candidates. Many candidates had difficulty with the meanings of potential difference, current and e.m.f.

Question 36

The three-dimensional nature of the simple motor effect and the a.c. generator make them conceptually difficult. Nevertheless, the logic of the changes in this question allowed stronger candidates to identify the correct response.

Question 37

The structure of the atomic nucleus was not well known, with many candidates unable to identify the correct statement.

PHYSICS

Paper 0625/21
Multiple Choice Extended

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

General comments

Questions 1, **4**, **6**, **7**, **11**, **14**, **25, 36** and **39** were usually answered well. **Questions 8**, **10**, **13**, **23**, **27**and **33** proved more challenging for many candidates.

Comments on specific questions

Question 6

This question had several steps to reach the correct answer, and most candidates successfully negotiated these steps.

Question 7

This was usually answered correctly, and candidates had a firm understanding of simple balancing problems.

Question 8

This was not well understood by many candidates. Most candidates simply added the three forces, unaware that when adding vectors direction must also be considered.

Question 10

This question proved challenging and the most common choice of response was option **A**, zero.

Question 11

Candidates showed an excellent understanding of efficiency.

Question 13

Although many candidates gave the correct answer, it was clear that many had difficulty in working with powers of ten. This is a skill which needs regular practise throughout the course.

Question 23

Many candidates did not read the question carefully enough and thought that option **A** was correct. However, candidates who read the question more carefully selected the correct option, **B**.

Question 27

It was apparent that relatively few candidates had seen the experiment in which a steel rod (which has been carefully demagnetised) is placed parallel to the Earth's magnetic field and is hammered. Before hammering the rod will not attract small pieces of demagnetised iron (e.g. pins), but afterwards it will pick them up.

PHYSICS

Paper 0625/22
Multiple Choice Extended

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

General comments

Questions 1, **2**, **6**, **8**, **14**, **28**, **31** and **38** were usually answered well. **Questions 3**, **23**, **27**, **29**, **34** and **36** were more challenging for many candidates.

Comments on specific questions

Question 2

The vast majority of candidates were able to interpret the speed-time graph.

Question 3

This was another speed-time graph, but this time with a much more challenging situation. The concrete block initially accelerates from rest, in the vertical direction. However, the acceleration (the gradient of the graph) decreases as the block's speed increases, which eliminates option **A** and **B**. When it hits the water, it undergoes a fairly rapid deceleration and then continues at a constant speed (its terminal velocity in the water, hence option **C** is the key.

Question 6

Candidates generally had a good understanding of the constancy of mass.

Question 7

Although many candidates answered this question correctly, a number thought that the centre of mass was the point about which the beam rotated when lifted.

Question 8

Candidates showed a good understanding of stability.

Question 18

Quite a lot of candidates seemed to be confused by the fact that a large temperature rise indicates a small specific heat capacity, leading them to choose option **B**.

Question 23

Only the strongest candidates answered this question correctly.

Question 27

It was apparent that relatively few candidates had seen the experiment in which a steel rod (which has been carefully demagnetised) is placed parallel to the Earth's magnetic field and is hammered. Before hammering the rod will not attract small pieces of demagnetised iron (e.g. pins), but afterwards it will pick them up.

Question 27

Most candidates recognised that the key to the answer was in recognising that repulsion meant that a rod is magnetised. However, only stronger candidates who recognised this realised that both rods must be magnetised for this to happen.

Question 28

This was answered well, and most candidates recognised that an unmagnetised iron bar is attracted to both N-poles and S-poles.

Question 29

A number of candidates did not recognise that the magnetic field decreases as you move further away from the current carrying conductor and consequently the field lines become further apart.

Question 36

Although most candidates recognised that the direction of the field at the point is parallel to the axis of the coil, fewer were able to work through the logic to establish that the field is pointing to the right.

PHYSICS

Paper 0625/23
Multiple Choice Extended

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

General comments

Questions 1, **3**, **4**, **19**, **26**, **31** and **38** were usually answered well, whereas candidates found **Questions 9**, **23**, **28**, **29**, **30** and **34** more challenging.

Comments on specific questions

Question 1

Almost all candidates recognised that the zero-error meant that the actual diameter of the wire was 0.02 mm less than the reading on the micrometer.

Question 2

Although most candidates identified object **R** as the only one which moved with constant velocity, many thought that object **Q** (travelling in a circle) also had constant velocity, clearly not understanding that the continuous changing of direction is also a continuous change in velocity.

Question 3

Most candidates understood how to calculate the object's acceleration in this question.

Question 9

There was a lack of understanding in some answers that a vector is direction dependent. The two speeds of the ball were given, and it was clear that the velocities must be in opposite directions. Therefore the change in velocity of the ball was $v_1 - (-v_2) = (v_1 + v_2)$ and the change in momentum = $m(v_1 + v_2)$.

Question 13

Most candidates were aware of the factors which the pressure at a point in a liquid depends on.

Question 19

Candidates showed a good understanding of the density changes in a convection current.

Question 23

The majority of candidates incorrectly chose option **B**. This suggests that they were able to calculate the frequency of the wave (4.0 / 10 = 0.40 Hz), but then multiplied that by the speed (2.0 m/s) rather than using the formula $c = f\lambda$, which when rearranged gives $\lambda = c / f = 2.0 / 0.40$.

Question 28

Although many chose the correct option, other candidates had not seen the experiment in which a steel rod (which has been carefully demagnetised) is placed parallel to the Earth's magnetic field and is hammered. Before hammering the rod will not attract small pieces of demagnetised iron (e.g. pins), but afterwards it will pick them up.

Question 29

This question proved challenging for some candidates. Many thought that the building would be charged negatively. Others, despite recognising that the charge on the building would be positive, failed to understand that the charges which move are negative and they move from the building to the Earth.

Question 30

Only stronger candidates showed an understanding of e.m.f.

Question 34

This was a challenging question for many candidates who chose either option **B** or **C**. Although increasing the magnetic field strength would increase the amplitude of the induced e.m.f., decreasing the number of coils would have the opposite effect, and the frequency would not change. Similarly increasing the number of turns on the coil alone would not alter the frequency.

PHYSICS

Paper 0625/31
Core Theory

Key messages

Some candidates are unclear about what does or does not count as a significant figure. Centres should encourage candidates not to round to 1 significant figure and set practise exercises on this topic.

Centres should encourage candidates to ensure that working and answers to numerical questions are as clear as possible. Candidates should write all answers, particularly those including numbers, clearly to ensure they are legible.

General comments

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

Candidates should ensure their responses are worded as clearly as possible and relate to the content of the questions. In some cases, candidates stated a property had changed but failed to state how it had changed, i.e. increased / decreased.

Comments on specific questions

Question 1

(a) The vast majority of candidates answered this correctly, giving the correct answer as 12.0 s.

(b) The majority of candidates answered this question correctly. The most common error was to forget to subtract 96 from 100.

(c) The majority of candidates scored full credit for an answer of 8.3 m / s. The most common error was to use the wrong time or a wrong distance.

(d) Many candidates found this item challenging. The main source of error was in comparing the whole race rather than between 3.0 s and 6.0 s.

Question 2

(a) The vast majority of candidates answered correctly. The most common error was failing to read the question carefully enough and simply writing the mass reading on the top pan balance.

(b) With allowance for an error carried forward, the vast majority of candidates scored full credit here. The most common error was to recall an inverted form of the equation for density.

(c) Most candidates answered this well. The most common error which resulted in candidates not gaining full credit, was failing to convert the mass from grams to kilograms.

Question 3

(a) (i) The majority of candidates scored full credit. The most common source of error was adding the three forces. Centres should ensure that candidates do not use directions such as east or west as their answer.

(ii) Candidates found this item challenging. Only stronger candidates were able to describe energy transfers from kinetic energy to thermal energy as a result of friction in the brakes.

(b) The vast majority of candidates answered this question well. The calculation of the moment of a force was well understood by most candidates. However, they did not always recall the correct unit, with the vast majority writing N / m or N / cm.

Question 4

(a) Almost all candidates were able to correctly sequence the main stages in the operation of a coal-fired power station.

(b) This question was answered well by many candidates.

(c) (i) and (ii) The concepts of work done and output power were not well understood. Only the strongest candidates gained full credit here.

Question 5

(a) (i) The majority of candidates answered this fully correctly. The most common errors were to either invert the equation for pressure, or to simply multiply the force and the area.

(ii) Candidates found this question difficult, with only the very strongest candidates awarded full credit. The pressure reading on a U-tube manometer was not well understood by most candidates.

(b) This was generally well answered, but often preceded by an answer about what happens to the pressure when the temperature rises. Weaker candidates failed to give an answer about what happens to the pressure when the temperature decreases.

Question 6

(a) The vast majority of candidates scored full credit as the simple kinetic molecular model of matter was well understood.

(b) The majority of candidates answered this fairly well. The most common error was in using the limits of the thermometer rather than the information given in the question in attempting to calculate the temperature indicated by the thermometer.

Question 7

(a) (i) Only the strongest candidates answered this question correctly. The majority of candidates gave an answer of 40° instead of 50°.

(ii) Lack of precision often resulted in only partial credit here. Candidates should be encouraged to use a ruler and protractor for reflection diagrams. A significant number of candidates failed to answer on **Fig. 7.1**, and drew a new diagram in the space below.

(b) (i) Very few candidates were able to identify 12 cm as the focal length of the lens.

(ii) Few candidates calculated the image distance as 21 cm.

(iii) Only the strongest candidates gave two correct properties of the nature of the image. Generally, ray diagrams for thin lenses were not well understood by most candidates.

Question 8

(a) (i) Very few candidates correctly identified microwaves as the electromagnetic wave used for a mobile phone signal.

(ii) The vast majority of candidates answered this correctly.

(b) (i) Most candidates answered this question well. A common error was to give the upper limit of the range as 20 000 kHz.

(ii) The majority of candidates gained at least partial credit here. The most common error was a contradiction such as "*the wave for note B has a lower frequency and a shorter wavelength*".

Question 9

The majority of candidates scored full credit. The most common error was to state that metal bar RS was made from a non-magnetic material.

Question 10

(a) (i) Very few candidates answer this question correctly. The most common error was to draw the voltmeter in series with the wire, whilst those candidates who remembered it should be connected in parallel drew the voltmeter in parallel with the variable resistor.

(ii) The majority of candidates answered this well. The most common errors were to state beta particles or just charged particles.

(iii) The majority of candidates stated that the size of the current would decrease, but only the strongest linked this to an increase in the resistance of wire CD compared to XY.

(iv) This was usually answered correctly. The most common error was to simply write voltage.

(b) (i) The majority of candidates correctly calculated the combined resistance as 16.1 ohms.

(ii) The vast majority of candidates did not realise that the current in the variable resistor was the same as the current in wire CD.

Question 11

(a)(i), (ii), (iii) The majority of candidates gained at least partial credit for this question. The most common error was in determining the nucleon number, with many candidates adding the number of electrons to the number of nucleons to give an answer of 10.

(b) Many candidates found this calculation challenging. The concept of half-life was not well understood by most candidates.

Question 12

(a) The majority of candidates gained at least partial credit for this question. The most common error was in stating that the current in circuit A was somehow transferred to the heater in circuit B.

(b) The vast majority of candidates gained full credit by calculating the output voltage of the transformer as 15 V. The most common error was not to recall the transformer equation, but to try and determine the output using a form of ratios.

PHYSICS

Paper 0625/32
Core Theory

Key messages

Some candidates are unclear about what does or does not count as a significant figure. Centres should encourage candidates not to round to 1 significant figure and set practise exercises on this topic.

Centres should encourage candidates to ensure that working and answers to numerical questions are as clear as possible. Candidates should write all answers, particularly those including numbers, clearly to ensure they are legible.

General comments

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

Candidates should ensure their responses are worded as clearly as possible and relate to the content of the questions. In some cases, candidates stated a property had changed but failed to state how it had changed, i.e. increased / decreased.

Comments on specific questions

Question 1

(a) (i) The majority of candidates answered this well. Weaker candidates did not add the upward force on the box to the upward force on the parachute.

(ii) Many candidates recognised that the upward force would increase, but very few linked this to an increase in air resistance. The most common error was simply to repeat from the stem that the area of the parachute had increased.

(b) (i) The vast majority of candidates answered this question well.

(ii) Candidates found this item difficult. Many candidates gained partial credit for recognising that the speed was constant, but only the strongest candidates identified the resultant force as zero.

(iii) Many candidates gained full credit, but others either failed to calculate the time or to read the speed correctly from the graph. Another common error was to use the formula for the area of a triangle to work out the area of the rectangle.

Question 2

(a) The majority of candidates calculated the moment correctly as 10 000 Nm. The most common error was to divide the force by the distance instead of multiplying.

(b) The majority of candidates gained full credited here. Weaker candidates suggested increasing the force despite being told in the question that this could not happen.

(c) Many candidates found this item difficult. There was considerable confusion between the concepts of work done and power produced.

Question 3

(a)(i) Very few candidates gained full credit for this question. Taking readings of atmospheric pressure from a mercury barometer was not well known.

(ii) Very few candidates identified the space above the mercury as being a vacuum.

(b) Most candidates correctly calculated the pressure on the bench as 0.19 N / cm^2. The most common error was to multiply the force and the area instead of dividing.

Question 4

(a) The vast majority of candidates answered this question well. The simple kinetic molecular model of matter seemed to be well understood by many candidates.

(b) This question was answered accurately by many candidates. Weaker candidates failed to link an increase in speed to an increased rate of collisions with the container walls.

Question 5

(a) Many candidates gained full credit here, but weaker candidates failed to link the escape from the water surface to the most energetic molecules.

(b) Candidates found this item quite challenging. Only the strongest linked the decrease in temperature to the reduction in average kinetic energy of molecules remaining in the water.

Question 6

(a) Many candidates struggled with an explanation of the convection current in the tubes and box. Only stronger candidates linked the upward movement of air to a decrease in the density of the air.

(b) Many candidates answered this question well, but a significant number were unable to describe an experiment comparing the thermal conductivity of the rods.

Question 7

(a) Only the strongest candidates were able to correctly link the movement of the coils to the direction of wave travel.

(b) Very few candidates gave the correct wavelength. The most common error was simply to write down the total length of the spring.

(c) Many candidates gained full credit here, but weaker candidates gave descriptions of wavelength and wave speed.

(d) The majority of candidates correctly calculated the speed of the wave as 125 cm / s. Weaker candidates inverted the equation for speed, or even multiplied the distance and the time.

Question 8

(a) Most candidates correctly determined the object distance as 4.5 cm. The most common error was failing to use the scale and giving an answer of 9 cm.

(b)(i) Few candidates correctly identified the focal length of the lens. This topic was not well understood by most candidates.

(ii) Only the strongest candidates answered this question correctly. The description of the image formed by a converging lens was not well understood.

Question 9

(a) Most candidates gained partial credit for this question. The majority of candidates did not recognise that a magnetic but not magnetised sample would be attracted by both the S pole and the N pole of a magnet.

(b) Many candidates answered this question well, but a lack of precision and detail often resulted in candidates only gaining partial credit for this question.

(c) Most candidates gained full credit but in some answers, there was a lack of clarity.

Question 10

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

(ii) Many candidates answered this well, but a lack of precision and detail often resulted in candidates only gaining partial credit for this question.

(iii) The majority of candidates answered correctly. The most common error was to state there was no current in the neutral wire.

(b) Most candidates answered this question correctly. The most common error was to choose the 13 A fuse.

(c) The majority of candidates gave the correct answer of 4.8 ohms. The most common error was remembering an incorrect rearrangement of the equation.

Question 11

(a) The majority of candidates gave the correct answer of 23 V. The most common error was to attempt to use some form of ratio to calculate the output voltage.

(b) The majority of candidates answered this correctly. The most common errors were steel and copper.

(c) Most candidates found this item challenging. Only stronger candidates were able to recall two advantages of high voltage transmission.

Question 12

(a) The majority of candidates answered correctly. Weaker candidates gave answers such as radios or mobile phones.

(b)(i) The majority of candidates gained at least partial credit for a correct use of the half-life graph. Weaker candidates simply gave an answer of 20, i.e. half the maximum time on the *x*-axis.

(ii) The majority of candidates identified a suitable method of storage.

PHYSICS

Paper 0625/33
Core Theory

Key messages

Candidates should note both 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. 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. Work, thermal processes, electric circuits and electromagnetics (the magnetic effect of a current and the force on a current-carrying conductor) 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 were more challenging than the numerical questions for many candidates and a noticeable number of candidates struggled to express themselves adequately when answering the extended writing questions.

Comments on specific questions

Question 1

(a) (i) This was answered very well, with most candidates gaining full credit. A common error was to add all three forces.

(ii) Not all candidates recognised that the lorry would continue at the same speed if there was no resultant force acting.

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

(ii) Often more detailed answers were needed. For example, answers simply stating "friction" or "speed" were too vague. The question asked for a factor that could increase the total stopping distance, so "reduced friction" or "higher speed" would have been sufficient.

Question 2

(a) (i) Most candidates attempted this part with many getting the correct answer and unit. A common error was to multiply the weight by 10 instead of dividing by 10.

(ii) Many candidates answered this question well and showed full working. Weaker candidates often gained partial credit for the moments equation, gave an incorrect answer with no working or gave no response.

(b) Many correct answers were seen for the force. A common incorrect answer was kinetic energy.

Question 3

(a) (i) The majority of candidates gave the full answer of gravitational potential (energy).

(ii) Few correct answers were seen, and many candidates did not seem to fully understand that work done = energy transferred.

(b) Again, candidates did not seem to fully understand that work done = energy transferred. Many recognised that work was being done when moving a chair but fewer understood that energy was being transferred when stretching a spring.

(c) The vast majority of candidates gave the correct answers.

Question 4

(a) Most candidates gained credit for stating that the vehicle did not sink into the mud. For further credit candidates needed to give a more detailed answer based on the idea that pressure = force/area. A number of candidates did not give an answer for this question.

(b) (i) Candidates generally lacked the knowledge for this part, and air was a common incorrect answer.

(ii) There was some confusion between a barometer and a thermometer, and the most common incorrect answer was temperature.

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

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

Question 5

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

(b) (i) Many candidates gave the correct answer. A significant number thought that an increase in temperature would cause the air molecules to move more slowly.

(ii) Most candidates gave the correct answer. However. some candidates either incorrectly repeated or rephrased their answer to the previous part of this question.

(c) (i) Few candidates fully understood the terminology associated with a liquid-in-glass thermometer.

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

(iii) Many candidates were able to describe that the liquid would move up the tube. Very few were able to explain that this was due to the liquid expanding.

Question 6

(a) A more thorough description of the thermal processes involved, particularly convection, was required. Most answers were vague or focused on molecules moving faster.

(b) (i) There appeared to be confusion regarding the effect of colour and texture of a surface on the emission of radiation. Very few correct answers were seen.

(ii) Many candidates were able to suggest a change that would reduce the loss of thermal energy. Very few were able to then explain how their suggestion achieved the reduction. The most common correct suggestion and explanation were to wrap the can in cotton wool to reduce heat lost by conduction.

Question 7

(a) Many candidates gained some credit here. The most common error was thinking blue (or violet) was the colour that was refracted least.

(b) (i)(ii) 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.

Question 8

(a) The majority of candidates gave the correct answer. There was some confusion between the symbol for a fuse and a thermistor.

(b) (i) Many candidates answered this question well. Weaker candidates often used an incorrect equation i.e. potential difference = current divided by resistance or gave no response.

(ii) The majority of candidates gave the correct answer. A common incorrect answer was ammeter. A few candidates did not give an answer for this question.

(iii) Many candidates knew the symbol for a voltmeter but placing it in parallel with the resistor proved to be more challenging. Several candidates did not give an answer for this question.

Question 9

(a) Many candidates knew that magnetism was involved. A fuller explanation was required to gain further credit.

(b) (i) Few correct answers were seen with many candidates offering brief statements or no response. The magnetic properties of iron and electromagnets did not seem to be fully understood.

(ii) Very few candidates recognised that the bell had its own battery.

Question 10

(a) Candidates generally lacked the knowledge needed for this question. There were a considerable number of blank responses. Answers often only gained credit for drawing a wire between the poles of a magnet.

(b) Many candidates correctly recognised that the current needed to be reduced in some way. A number of candidates did not give an answer for this question.

Question 11

(a) Most candidates identified the isotopes, and many gave the correct explanation. However, there was some confusion between the terms proton, neutron and nucleon.

(b) (i) Many correct answers were seen. Other answers were too vague or repeated part of the question i.e. "damages people".

(ii) Candidates were usually able to state how radiographers could be protected. Fewer were able to give an explanation. A common, correct answer was to suggest wearing a lead apron as the apron absorbs X-rays. There was a noticeable number of blank responses.

(c) (i) A few correct answers were seen. There was some confusion between the penetrating abilities of radioactive emissions. Several candidates did not give an answer for this question.

(ii) Only the strongest candidates answered this question correctly. Several incorrect answers accounted for the reading on the meter by naming a region of the electromagnetic spectrum. A number of candidates did not give an answer.

PHYSICS

Paper 0625/41
Extended Theory

Key messages

- For calculations, candidates should be advised to first write the relevant equation in the learned form, then, if necessary, rearrange it so that quantity asked for is the subject, substituting in the numbers from the question or calculated in a previous part and once the calculation is performed, to write down the correct answer to at least the appropriate number of significant figures and following it with the correct unit.
- Sometimes, a quantity given in a question needs to be converted to a base quantity before the substitution is made. This is very commonly the case when the quantities in the question are expressed in centimetres, grams or minutes.

General comments

Occasionally there were candidates who seemed to be familiar with much if not all of the syllabus but who gave answers that did not deal with the specific question that was asked. They indicated an understanding of the topic in general but did not mention the exact points that the question demanded. Candidates should be reminded to the read all questions carefully.

The mark allocation for each part gives an indication of the style of answer that was required and combined with the command word used, provides enough information for candidates to be able to decide what is needed. The more discursive questions can usually be answered with direct and exact statements that need not be complete sentences, provided the meaning is clear and correct.

Comments on specific questions

Question 1

(a) This part was extremely well answered with almost all candidates obtaining the correct answer. The most common error was giving an incorrect unit. Of the incorrect units supplied, the most frequently given was kg / m / s.

(b) (i) This was commonly misunderstood. The command word in the question was 'state'. However, many candidates attempted a calculation of some sort which was unnecessary and did not lead to the correct answer.

(ii) Many candidates did not understand what was required by this question. Some stronger candidates attempted to draw a scale diagram. Some candidates who drew an accurate diagram and made the correct measurements, presented a numerical answer to only 1 significant figure. A greater precision was needed for full credit.

Question 2

(a) Most candidates realised that the velocity of the ball would increase during this period of time, but fewer gave any indication of the significance of the term 'uniformly'. There were candidates who did not understand what was happening and some stated very clearly that the ball would decelerate when it entered the liquid. Answers which described what happened after the short period of time mentioned in the question were ignored provided that they did not contradict a correct answer already offered.

(b) Most candidates were able to gain some credit in this part and some candidates gained full credit. There were candidates who confused the decreasing acceleration of the ball with a deceleration and this often led to a further confusion concerning the variation in the resistance force that was acting. It was not always clear which stage of the motion was being referred to. Some answers did not clearly separate the motion as terminal velocity was being approached, from the motion when the ball was travelling at terminal velocity.

(c) (i) and (ii) There were many completely accurate answers to these two parts and the two equations were well known by nearly all the candidates. The most common reason for full credit not being awarded was not converting the mass in the question to kilograms before calculating the two answers. When using the equation for kinetic energy, there were candidates who either omitted the squared term when substituting the numbers or, having performed the substitution correctly, did not square the speed when calculating the answer. A few candidates did not supply the correct unit for either one or both answers.

(iii) A few candidates realised what was being asked for, but there were many who did not. Common incorrect answers included 'because they are two different quantities' or 'because gravitational potential energy is dependent on g'.

Question 3

(a) Most candidates used the distance 0.200 m in the expression $h\rho g$ rather than the correct value 0.400 m. Other sources of inaccuracy included not adding the atmospheric pressure to hydrostatic pressure or less commonly, finding the difference between these two pressures.

(b) (i) Some candidates calculated either the fully correct answer or used an incorrect value from **(a)** completely correctly, but many did not. A common source of error was to ignore the effect of the atmospheric pressure on the right-hand side of the piston when determining the resultant force.

(ii) There were more fully correct answers to this part, and it was generally quite well answered. There were candidates who either omitted a unit from the final answer or who used an incorrect one and the most common of these was N.

Question 4

(a) This part was quite well answered with the majority of candidates providing two or three molecular differences between a liquid and a gas. Nearly all candidates were able to supply one difference. An occasional error arose when candidates described one molecular feature of a liquid in one part of the answer and then when referring to the opposite feature also attributed this to a liquid. A few candidates listed the differences between a liquid and a solid.

(b) Many candidates stated, in some way, that the molecules speed up when a liquid is heated but a smaller number of candidates made any reference to an increase in the molecular separation.

(c) (i) Many candidates were able to supply a satisfactory answer to this part.

(ii) A significant majority of candidates were able to score full credit for this part. A common error was what is essentially the power-of-ten error of calculating the mass of the liquid in grams but using the unit J / kg for the final answer. There were also other unit errors, and these included supplying a final answer unit of J / (kg°C) which is the unit of specific heat capacity.

Question 5

(a) This question proved challenging and many candidates interpreted conduction to mean any thermal energy transfer process. Answers in terms of convection and radiation were more common than those that referred to conduction using free electron movement. A few candidates who recognised that free electron conduction was being asked for gave an answer that described the conduction process by which vibrating atoms collide with their neighbours but substituted the word electron for atom.

(b) Only the strongest candidates answered this question correctly. Even though the temperature of the cooking oil was 120°C, many candidates supplied answers in terms of the thermal absorption property of a brightly polished, shiny surface rather than in terms of its emission property. Some candidates took the shiny surface to be the inside of the cooking container.

(c) Only a few candidates answered the question by stating that the energy would be lost at a smaller rate. Answers in terms of evaporation were not unusual but were rarely correct.

Question 6

(a) Although many candidates correctly stated that the wave speed decreased as the wavefronts crossed the boundary and were awarded some credit, a much smaller number of candidates were able to explain how the decrease in speed resulted in a change of direction. Those who did gained full credit.

(b) (i) Most candidates approached this part in the correct way and scored some credit. Two common errors were using the speed in m / s but keeping the wavelength in cm and using the distance from the diagram as the complete wavelength rather than half of it.

(ii) Many candidates found this question challenging and only a minority realised that the two angles could be used to supply the ratio of the speeds in the two sections of the shallow tank. There were candidates who attempted to use the equation $v = f\lambda$ again even though the new wavelength was not supplied. This often led to the original speed being given as the final answer. There were candidates who made the correct calculation but then gave the answer to 1 significant figure and were not awarded full credit.

Question 7

(a) The correct material was almost always underlined or indicated in some other way. Where credit was not awarded, it was usually because at least one other material had also been underlined. In this situation, soft iron was the most frequent incorrect selection.

(b) (i) Few candidates stated what is meant by the direction of a magnetic field. The most frequent suggestion was that it was the direction of the force on a positive charge. Presumably such an answer is the consequence of a magnetic field being confused with an electric field.

(ii) Many candidates were able to suggest that the beam of electrons would be deflected by the magnetic field, but few candidates were able to apply the Fleming left-hand rule (or any other appropriate rule) correctly. Common answers suggested a deflection towards one of the magnetic poles and a deflection out of the page was more frequently suggested than a deflection in the correct direction.

(c) Many candidates had a clear idea of what was expected in this part and full credit was often awarded. A small number of candidates offered explanations in terms of the penetration properties of the different types of radiation. Such an approach did not answer the question as it was set.

Question 8

(a) Although some candidates were able to give a definition equivalent to the one in the syllabus, many candidates were not.

(b) (i) and (ii) The calculations in both parts were almost always approached in a suitable manner and they were very often completely correct. When candidates were not awarded full credit, it was most frequently because the equation $V = IR$ was rearranged incorrectly or because the unit supplied with the answer in **(ii)** was not suitable. Sometimes the unit given was the J and on other occasions, it was because the prefix did not correspond to the numerical value. An example of the latter would be the answer *1920 kW*.

(iii)1 The approach to this part was often correct but answers were not always sufficiently quantitative, and answers highlighted a few common misunderstandings involving current. Some candidates stated that the original current would now be shared equally between the two parallel resistors and other stated that the current in both of the parallel resistors would be equal to the original current.

(iii)2 Very few candidates deduced a value for the maximum total current that the electric heater would require and then went on to use it when suggesting a suitable fuse rating. The majority of candidates felt that a fuse rating greater than 20 A would be needed and gave explanations that suggested that the purpose of the fuse in a circuit was not in fact understood.

Question 9

(a) (i) This was often correct, but many candidates did not give an answer that was an observation.

(ii) The answers given to this part were of variable accuracy. Some candidates stated the two conditions accurately and succinctly. Other candidates were uncertain of what was required and produced answers that were either not related to what was being asked or were a mixture of one correct and one irrelevant answer.

(b) Many candidates were awarded some credit for indicating how light or infrared radiation travels along an optical fibre or for making an accurate reference to total internal reflection. Many candidates gave no more details and made no reference to the use of such fibres in communication technology. Occasionally candidates mentioned the light or infrared signal being encoded or carrying a message.

Question 10

(a) There were some good answers here with many candidates able to state what was meant by background radiation and almost all candidates suggested one source. A few candidates offered incorrect explanations in terms of microwave ovens or radio signals or thermal radiation.

(b) (i) Almost all candidates realised that alpha-particles were being emitted by the sample and most of these gave an acceptable explanation. An answer such as '*because alpha-particles are weakly penetrating*' did not relate directly to the question as it had been set and was too vague for credit.

(ii) There were many good answers and full credit was often awarded. Sometimes an error occurred when the daughter isotope was given the symbol Po rather than Pb. There were candidates who positioned the nuclide symbol for the alpha-particle on the same side of the equation as the nuclide symbol for the polonium-208 nucleus and added them.

PHYSICS

Paper 0625/42
Extended Theory

Key messages

It is essential that candidates show their working and write down the equations.

All but the very strongest candidates would benefit from more practice in applying their knowledge in unfamiliar situations and in answering ‘show that’ questions. This would deepen candidates’ understanding and improve their performance in the examination.

General comments

Many candidates were well prepared for this paper. Equations were generally well known but the use of equations and the quantities represented were not always understood. There were frequent examples where candidates substituted numbers from the question in the wrong place in equations.

Unless otherwise stated it is expected that candidates should round their final answer to 2 significant figures. However, intermediate values should not be rounded or truncated as this frequently leads to an inaccurate final answer. A noticeable number of candidates made significant figure errors, either incorrectly rounding or rounding to 1 significant figure e.g. in **Question 2(b)** also in **Question 4(b)**.

Generally, candidates followed the rubric of the questions, but this was not always the case in **Question 7(c)**.
Often candidates did not read the questions carefully enough and wrote known standard facts when, in fact, the question required the application of these facts.

The symbol Q has not been the syllabus symbol for thermal energy for many years and should not be used.. Centres should also be aware that the syllabus and question papers no longer use the term heat but instead use thermal energy.

The use of units by most candidates was generally good but there were occasional errors, especially in **Question 2(b)**.

Comments on specific questions

Question 1

(a) (i) This was correctly answered by nearly all candidates.

(ii) Most candidates correctly marked Y and Z on horizontal parts of the graph. A significant minority incorrectly marked them on curved parts just away from the horizontal.

(b) Strong candidates gained most or all of the credit showing a strong understanding of the concept of upwards and downward forces becoming balanced leading to terminal velocity. However, weaker candidates did not read the question carefully enough and answers included what happened after the parachute was opened. Some candidates did not give the directions for weight or air resistance. Candidates need to be made aware of the fact that forces are vectors and hence direction is necessary.

(c) Only a minority of stronger candidates gained full credit. Many other candidates divided the change of speed by time, which is an acceleration not an average speed.

Question 2

(a) This was generally answered well but many weaker candidates did not specify perpendicular distance.

(b) (i) This was correctly answered by nearly all candidates. The most common error was to give the unit as kilograms.

(ii) This was answered well by stronger candidates. Many candidates answered by using trigonometry, failing to realise the required perpendicular distances were on the diagram.

(iii) Many weaker candidates did not realise that as the rod was held stationary, the moment of force F had to be the same as the moment of force W.

(iv) Many candidates managed to complete this calculation correctly. Weaker candidates made a wide variety of different errors, especially using the wrong perpendicular distance e.g. 0.5 m.

(c) This was only well answered by a minority of strong candidates. Many other candidates thought that the perpendicular distance of force F from the pivot was increased or failed to give sufficient detail as to which distance was increasing/decreasing. Ohers stated that the distance of the centre of mass from the pivot changed.

Question 3

Many candidates successfully answered this complex multi-stage calculation. Typical errors from other candidates were confusion about power and energy and about input and output. Weaker candidates, who could have gained partial credit by correctly quoting the efficiency equation, often did not do so because they merely quoted output/input and did not mention energy or power.

Question 4

(a) This was usually answered well but a common answer from weaker candidates was electrical thermometer, which was too vague.

(b) Most stronger candidates gained full credit. Errors among weaker candidates were using $\frac{1.7}{5.4}$ upside down and confusion with adding and subtracting 20.

(c) Most stronger candidates gained credit here.

Question 5

(a) (i) This was generally answered well but many candidates did not mention unit mass or confused specific heat capacity and introduced a temperature change.

(ii) Most candidates stated that molecules would be separated, or bonds broken but many stated that the kinetic energy would increase.

(b) All but the weakest candidates knew how to approach this problem. However, errors were often made such as incorrectly calculating the mass that changed state or incorrectly transposing the original equation. There were a significant number of power of ten errors. Many candidates may not have been familiar with the multiplier M mega, which is clearly listed in the syllabus.

(c) This was generally answered well but for full credit candidates were expected to mention a reduction of thermal energy losses.

Question 6

(a) (i) This was answered well by many candidates. However, there was often a lack of precision with the start and finish of labelled lines. Many candidates were not secure in their knowledge of amplitude and labelled the full vertical distance between peak and trough.

(ii) This was generally well answered but a number of candidates did not offer an answer for the question.

(b) This was generally answered well but many candidates incorrectly used ways of combining the numbers to give a result of 2 or used circular arguments. In a 'show that' question it is essential that candidates show full working. A common error was to use the time period in place of the frequency, often compounded by a lack of clear labelling in the working.

(c) Stronger candidates gained full credit but there was often a lack of precision in answers. Some candidates referred to horizontal and vertical assuming that the waves travelled horizontally, which is not necessarily the case. Others referred to wave motion, possibly meaning direction of travel of the wave not realising that the oscillation is also motion.

Question 7

(a) (i) This was generally answered well. Reflection on its own was an insufficient answer. Weaker candidates mentioned refraction or even reflaction. Reflaction will never be acceptable to gain credit.

(ii) Most stronger candidates gained full credit but there was a wide range of errors made by others. Some candidates rounded their final answer up to 47°, perhaps incorrectly thinking of grazing refraction.

(b) There were many good responses gaining full credit but many candidates exclusively described total internal reflection in optical fibres, which was not the focus of this question.

(c) This question tested the syllabus definition of monochromatic as light of a single frequency. Many candidates did not gain credit because they only referred to light of one colour. This is true but did not answer the question as colour was not one of the quantities given.

Question 8

(a) and (b) Some credit was gained by most candidates in both parts but often answers were too vague. A significant minority of candidates talked about fuses as their answer to **(a)**.

In **(b)** a common misconception amongst candidates was that somehow fuses or circuit breakers were there as current control device allowing the required current to flow.

Question 9

(a) Both parts were usually answered well but in **(i)** many candidates only drew the arrows approximately horizontal.

(b) This was generally answered well but many weaker candidates wrote pass a.c. through the magnet.

(c) (i) Many candidates, including stronger ones, showed a lack of precision. Nearly all drew circles around the wire. To gain full credit it was essential that it was clear that the circles were closer to each other near the wire. Poorly drawn freehand circles usually had such variable spacing that no credit could be awarded.

(ii) This question was generally answered well.

Question 10

(a) (i) Many candidates gained full credit but a significant number of weaker candidates drew a voltmeter symbol in CD or EF.

(ii) Almost all candidates gained partial credit for drawing the voltmeter symbol and most drew it correctly across the 4.0 Ω resistor.

(iii) Many stronger candidates produced correct and clearly set out working. Almost all gained partial credit for some aspect of the calculation. A common error was to calculate the voltage across the two-ohm resistor and then to use this as the voltage across the six-ohm resistor.

(b) Most candidates correctly drew a wire in CD, but many had the diode the wrong way round in EF.

Question 11

(a) Many candidates gained full credit and referred to the splitting and joining together of nuclei. However, references to molecules or particles or even elements were too vague as that could have applied to any number of processes.

(b) (i) There were many vague answers and these candidates did not read the question carefully enough and referred to therapy not tracing. Many candidates also did not realise that exposure to γ-rays for any length of time is dangerous.

(ii) This was generally very well answered.

(iii) Most candidates answered this well, but many responses of X-rays, chemotherapy or tracing clearly could gain no credit.

PHYSICS

Paper 0625/43
Extended Theory

Key messages

- Candidates are advised to write down equations in their usual format using symbols before substituting numerical values or rearranging the equations.
- Candidates are advised to read questions carefully and to think about how they can apply their knowledge to answer them.
- It is advisable to look at the total mark allocated for each question when deciding how much detail is required in the answer.

General comments

Although some candidates left several part questions or whole questions blank there was no evidence that this was due a shortage of time to complete the paper.

Questions which seemed to prove more challenging for candidates were **Questions 7**, **9**, **10** and **11**. **Questions 1(a)(i)**, **3(b)(i)**, **4(a)** were well answered by almost all candidates.

In multistage calculations, as in **9(b)** (usually with a maximum mark of 4 or 5) candidates should write down equations which may help them to answer the question correctly. They can do this by writing down the symbols for the quantities that they are given numerical values for in the question and for the answer required. This may help them to select the correct equations to use and they will be able to gain partial credit for correctly stated equations.

Comments on specific questions

Question 1

(a) (i) Almost all candidates understood what the dots on the tape showed and were able to express this clearly by stating that the dots were equally spaced.

(ii) Most candidates recognised that the trolley would accelerate when the slope was made steeper. Many were only able to offer an explanation in terms of the slope being steeper or that there was more gravitational potential energy of the trolley. Stronger answers related the steepness of the slope to a greater resultant force or a greater effect from the force of gravity.

Weaker candidates used the formula $v = d / t$, not realising that the velocity was not constant during the time period. This resulted in the most common incorrect answer of 0.38 m. The unit was usually correct, but occasionally the unit was omitted or was incorrect.

(b) This question part was answered well by some candidates.

(c) Stronger candidates carefully referred to the changes in forces which occurred as the metal ball fell through the liquid and accurately related these to acceleration. Weaker answers stated that the acceleration increased as the ball travelled down the tube. These answers suggested candidates did not understand that the resistance of the liquid increased as the ball was falling, resulting in a decrease in resultant force.

Question 2

(a) The realisation that the kinetic energy gained by the ball could be equated to the gravitational potential energy of the ball at the start. Those candidates who did equate potential energy lost to kinetic energy gained usually went on to correctly calculate the value of the vertical speed of the ball.

There were some arithmetical errors, usually in taking the square root of v^2. Common incorrect answers included 1.6 m / s (obtained by multiplying mass in kg by acceleration due to gravity) and 184 m / s, obtained by calculating the gravitational potential energy.

(b) Most candidates correctly remembered the formula for momentum. Some candidates forgot or did not realise that if their answer was going to be in kg m / s that they needed to convert the mass in g to mass in kg.

Question 3

(a) (i) Many candidates were able to accurately identify a scalar quantity. A few gave the answer of speed which was already given in the question.

(ii) Most candidates also correctly identified a vector quantity. A few gave the answer of velocity which was already given in the question.

(b) (i) Almost all candidates accurately calculated the value for the time taken, including the correct unit, by using the equation $t = d / v$.

(ii) This was usually answered correctly. The most common mistakes were the arrow pointing outwards instead of towards the centre of the circle or a curved arrow around the track. A few candidates did not take care to show that their line was directing towards the centre of the circle.

(iii) Many candidates were able to accurately draw a tangent to the circle with an arrow pointing in the direction it would travel. Few were able to give a correct explanation of the reason for the car not continuing to travel in a circular path. Most tried to explain this by referring to forward force being larger than frictional force or referred to driving force or a force away from the centre.

Question 4

(a) Most candidates were able to identify the molecular structure of solids, liquids and gases.

(b) Most candidates gained partial credit, usually for referring to the difference in the strength of the forces. Fewer accurately referred to the average distance between molecules. Weaker answers made no reference to forces and made irrelevant references to speed of molecules.

(c) (i) Candidates who correctly remembered the formula pV = constant usually calculated the volume correctly. Weaker candidates tried to use a direct proportionality instead of an inverse proportionality. Candidates are advised to write down the equation in symbols before rearranging it or substituting numbers, ensuring that they gain at least partial credit. Some candidates made the calculation more complicated by converting cm^3 to m^3. They usually did this correctly, but it will have taken them more time and was a possible source for error.

(ii) Nearly all answers correctly stated that the pressure increased. There were many partially correct molecular explanations for this but only the strongest answers included a correct statement about the rate of collision of the force exerted by individual molecules. Weaker answers did not answer the question as they did not give a molecular explanation.

Question 5

(a) Stronger candidates answered the question with both an explanation and a statement of what happened to the cork. It was insufficient to state that the wax on side B melted sooner without specifically stating that the cork on that side would fall off first. Weaker answers only referred to absorption of heat without specifically stating that it was radiation or infrared radiation.

(b) Most candidates correctly stated that the name of the transfer of energy in solid metals was conduction. Weaker candidates gave answers such as electronic transfer, convection, thermal transfer, induction, etc.

Question 6

(a) Stronger answers clearly stated the spacing of molecules and the pressure for compressions and rarefactions in a sound wave. Weaker candidates gave a vague statement about spacing e.g. "the molecules are more compact" or "there are more molecules" or made a reference to spacing between waves, etc., or made no reference to pressure. No credit could be given for answers which did not relate to compressions and rarefactions, e.g. statements about frequency, loudness.

(b) (i) This question required the use of the equation $v = f\lambda$. The correct statement and/or rearrangement of this equation caused problems for a significant number of candidates. Other mistakes were an incorrect or missing unit and a failure to convert kHz to Hz. Stronger candidates knew this equation and wrote down the equation using the correct symbols. These candidates noted the units given and used them correctly.

(ii) Stronger candidates correctly stated that the effect on speed (stays the same) and wavelength (decreases) when the frequency of the sound increases, and the amplitude remains the same. Weaker candidates sometimes assumed that if one increased, the other decreased or stated increase for both speed and wavelength. With questions of this type candidates should be aware that "stays the same" is an option as well as increase or decrease.

Question 7

(a) Most candidates were able to select at least one use of infrared radiation. Detail was unnecessary and the most common correct suggestions were thermal imaging (often expressed as night vision cameras), remote controls or sensors/alarms. Incorrect answers included reference to medical procedures, due to a confusion between infrared and X-rays or γ-rays, or other components of the electromagnetic spectrum, e.g. radio waves.

(b) The question asked for both a suggestion and an explanation of three precautions of the safe use of X-rays. There were many correct suggestions. However, few candidates went on to give a satisfactory explanation in terms of absorption of radiation, reduction of intensity of radiation, amount of radiation/exposure or limitation of dose. Other candidates gave precautions more relevant to laboratory samples of radiation than to X-rays.

(c) (i) Relatively few candidates realised that the answers to **Parts 1** and **2** of this question were the same. This question was testing the ability of the candidates to recognise that both microwaves and X-rays are electromagnetic waves and that they would therefore both have the same value. The unit was often omitted, and some candidates confused the correct value with the speed of sound in air.

(ii) Many candidates realised that the value of the frequency of ultrasound was above the range of human hearing. Some weaker candidates omitted the unit or gave a value that was too low.

Question 8

(a) (i) Most candidates answered this question correctly. A few did not remember the equation $V = IR$ correctly or made a mistake in rearranging it or omitted the unit or gave a wrong unit.

(ii) Stronger answers correctly stated that the reading on the voltmeter would be 0 V and then went on to explain that the diode did not allow the current to pass in the reverse direction. Weaker answers made no reference to the diode by name or gave vague or incorrect reasons, e.g. the circuit is blocked, or the current is reversed.

(b) Almost all candidates correctly identified the logic gate as an AND gate. Weaker candidates often did not answer this question.

(c) (i) Most candidates were awarded at least partial credit, and this was usually for the correct value of 0 for the first row of column E. A few weaker candidates did not fill in values of 1 or 0 in each of the gaps suggesting that they did not remember how logic gates work.

(ii) Although an error carried forward from **(i)** was allowed here, weaker candidates were unable to work out the single gate needed to replace the combination of gates. Some gave the impossible answers of a NOT gate which would have required only one input.

Question 9

(a) Many candidates realised that the main reason for transmitting electrical power at high voltage was to reduce energy losses. Stronger answers clearly stated that the explanation for this was that the current would be lower (due to higher voltage) and that thermal energy loss was lower with a lower current. Weaker answers confused change in current with change in resistance.

(b) Candidates who correctly remembered that efficiency as a percentage is equal to the ratio of output power to input power × 100 and that power is voltage × current, could often use these to calculate the value of the input current correctly. Weaker candidates confused input and output power and/or used the equation for a perfectly efficient transformer. Candidates could improve their answers and gain more credit if they wrote down the equations they were going to use. Very few candidates wrote down an equation for efficiency which meant that they were unable to gain much credit if they confused input and output power.

Question 10

(a) Many candidates clearly understood the operation of a relay and gave a good explanation for their answer. Some candidates misunderstood how the current flowed in circuit B and stated that the current flowed from circuit A via the iron armature to circuit B. Other weaker answers suggested that the current in B was produced by induction.

(b) Stronger candidates correctly identified that the motor or circuit B would continue working if the soft iron armature was replaced with a steel one as the steel would remain magnetised. Common incorrect answers included circuit B being switched off, either immediately or after a short time interval.

Question 11

(a) The question asked candidates to draw the paths of α-particles, β-particles and γ-rays between the plates and after leaving the plates. However, many candidates did not read the question carefully enough. Very few answers showed paths after leaving the region between the plates and some candidates showed γ-rays stopping when they reached the end of the region instead of continuing undeflected. There was some confusion about the direction of deflection of α-particles and β-particles. Most candidates knew that α-particles and β-particle were deflected in opposite directions to each other. Few showed a greater deflection for β-particles than for α-particles. Most showed γ-rays undeflected.

(b) There were some good answers to this part of the question. Those who gave the answer of sterilisation of medical equipment or treatment of cancer found their explanation easier than those who tried to describe the use of γ-rays in detecting leaks in underground pipes. Some weaker candidates confused X-rays with γ-rays or stated that γ-rays were used in chemotherapy.

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 will 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 having experience of similar practical work. Some candidates appear to have learned sections from the mark schemes of past papers and produced 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 1(c)**, **2(d)(ii)**, and **2(e)**. Justifications should be based on the results obtained by the candidate and not on a theoretical consideration.

It is expected that numerical answers will be expressed to a number of significant figures which is appropriate to the data given in the question or a measurement carried out by the candidate.

Comments on specific questions

Question 1

(a) (i)–(iv) The majority of candidates successfully recorded the l, w and h values in cm. The volume calculation was usually correct, and the mass value was within the expected range. The density needed to be given to two or three significant figures and with the unit g/cm^3. A few candidates tried to convert to kg/m^3 which would have been acceptable but most who attempted the conversion did so incorrectly.

(b) (i) Most candidates recorded realistic volumes and completed the calculation correctly.

(ii) Candidates were expected to have carried out the experiment with care to obtain a second value of density within 10 per cent of the first value of density.

(c) Candidates were required to make a judgement based on their own results. The justification needed to be clear and consistent with the results to gain credit. Most candidates gained partial credit but many made a vague comment without showing any understanding of the concept of results being beyond the limits of experimental inaccuracy.

(d) Candidates were expected to know the best way to read a value from a measuring cylinder but significant numbers of candidates did not tick the appropriate boxes "perpendicular to the scale" and "in line with the bottom of the meniscus".

Question 2

(a) Most candidates recorded a realistic value for room temperature.

(b) (i)–(iii) Many completed tables were seen with the expected pattern of results. Some candidates recorded room temperature at time $t = 0$ in place of the initial hot water temperature. Most candidates calculated the drop in temperature correctly and the average rate of cooling. Candidates were expected to be able to work out the unit, °C / s, from the units for temperature and time.

(c) (i) and (ii) Candidates were awarded credit for completing the second set of readings and then carrying out the calculations, with further credit available to those candidates who obtained a value of R_2 less than the value of R_1.

(d) (i) and (ii) In **(i)** some candidates missed the unit °C. In **(ii)**, candidates were expected to realise that when the temperature difference *D* was higher, the average rate of cooling *R* was greater. The justification required the values to be quoted in support of the conclusion.

(e) (i) and (ii) Most candidates knew that reading the scale at right angles is a precaution taken for accuracy. Some candidates explained the need to thoroughly mix the hot and cold water clearly and concisely. Other explanations were less well argued but were sufficient. Some candidates gave a response that was too vague or missed the point.

Question 3

(a) Most candidates gave a value for the height that was within the tolerance permitted and with the appropriate unit.

(b) Most candidates were able to complete the table with correct calculations, but some had *v* values that would not produce a focused image on the screen.

(c) Most candidates labelled the graph axes correctly and drew them the right way round. Some candidates ignored the instruction to start the *y*-axis at 20.0 cm and chose a scale that resulted in the plots occupying too little of the graph grid. Plotting was generally accurate. Candidates should use neat crosses for the plots, or neatly circled dots so that the accuracy of the plotting can be assessed. Many candidates drew a well-judged curve although some drew a 'dot-to-dot' line and others drew a straight line that did not match the plots.

(d) Candidates needed to show the method clearly on the graph and many did this by carefully drawing a horizontal line and a vertical line in the correct places. Most were able to read off the correct *u* value.

(e) Candidates who had carried out the experiment with care obtained a value for the focal length within the permitted tolerance.

Question 4

Candidates who followed the guidance in the question were able to write concisely and to address all the necessary points. A significant number of candidates copied the list of apparatus given in the question. This was unnecessary and often introduced a vague explanation of the investigation time.

Most candidates drew the correct symbols for the ammeter and voltmeter, but the voltmeter was placed in series with the other components by some candidates. Candidates needed to clearly show (using a simple label) the position in the circuit of the test wire.

Many candidates correctly suggested three, four or five different metals that could be tested. Some lists consisted of only two metals or included an insulator, e.g. plastic.

A concise explanation of the method was required. Candidates were not expected to list apparatus or standard precautions (for example, avoidance of parallax). Candidates needed to concentrate on the readings that must be taken. It may help candidates to plan their table of readings before writing the method to allow them to consider the measurements that must be taken in order to address the subject of the investigation. Candidates were expected to include measurement of current and potential difference and the calculation of resistance. Candidates then needed to make it clear that the procedure was repeated with at least two more wires of different metals. A vague reference to repeats was not sufficient as it was not clear whether the candidate was referring to using different wires or repeating the measurements with the same wire.

Candidates were expected to identify at least one variable to keep constant. The length or diameter of the test wire were correct suggestions. Some candidates incorrectly suggested keeping the potential difference and current constant.

Many candidates drew a suitable table. They were expected to include columns for type of wire, V (or potential difference), I (or current) and resistance with the last three including the appropriate units. Some candidates confused the symbol with the unit, for example heading a column current / I.

PHYSICS

Paper 0625/52
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 will 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 having experience of 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 in this paper.

The practical nature of the examination should be considered when explanations, justifications or suggested changes are required. Justifications should be based on the results obtained by the candidate and not on a theoretical consideration.

It is expected that numerical answers will be expressed to a number of significant figures which is appropriate to the data given in the question or a measurement carried out by the candidate.

Comments on specific questions

Question 1

(a) (i) and (ii) Most candidates recorded a sensible value for the length of the coiled part of the spring. Only a minority of candidates did not record their answer in millimetres, as requested.

Some candidates used a ruler to draw the diagram to show how they used the set square provided to obtain an accurate reading from the metre rule. These candidates gave better answers than those who drew freehand sketches. The set square needed to align with the top and/or bottom of the coiled part of the spring and to span the gap between the rule and the spring.

(b) The table was almost always filled in correctly, with the spring length values increasing and all values greater than the unstretched length of the spring.

(c) Despite the instruction given in the question to start the axes from the origin, many candidates ignored this request.

Most candidates selected scales that increased in suitable increments. There were many excellent, carefully drawn, best-fit lines produced. However, there were many graphs where the attempt at a best-fit line resulted in all points which did not lie on the drawn line, being on the same side of the line. A number of the lines drawn were forced through the origin. This led to problems with **(d)** and **(e)** where candidates needed to use the value of the positive *y*-axis intercept in a calculation. There were also some graphs where the points were joined dot-to-dot. The concept of best fit was not well understood by these candidates.

(d) The *y*-axis intercept of the graph was usually correctly determined to a tolerance of $\pm\frac{1}{2}$ a small grid square. Occasionally the instruction given in the question, that candidates show clearly on their graphs how they obtained the information necessary to determine the intercept, was ignored.

(e) Candidates were asked to calculate the value of $L - l_0$ from measurements made in earlier parts of the question. If candidates had carried out this experiment with care, the value obtained from this subtraction should have been zero. Candidates who gave an answer within 2 mm of this value were awarded credit.

Question 2

(a) The normal to the transparent block was usually drawn, as instructed, in the centre of side AB and at right angles to it. Points F and G were usually labelled correctly.

(b) (i)–(iii) In many answers the two pins P_1 and P_2 were too close together. Generally, candidates should be encouraged to place the locating pins as far apart from each other as space allows, and certainly at least 5 cm apart.

Most candidates followed the detailed instructions given, and produced neat, sensible ray diagrams. The values recorded for the distances GH and FH were almost always within $\pm$ 1 mm of those measured by the examiner on the candidates' ray trace sheet.

(c) The acute angle between the lines NL and JK was usually measured correctly. Most values recorded were within the allowed tolerance of $\pm$ 2°. Sometimes, the unit for the angle was not given.

(d) The precautions needed for accuracy in ray trace experiments were well known. Most candidates listed one sensible precaution that they would take to obtain accurate readings.

(e) Many candidates did not understand what a range of values for θ meant. Often a list of random unconnected values was given. A range of values, symmetrical about 30°, e.g. 27°–33° was expected.

(f) Most candidates realised that to test the suggestion that $i = \theta$ for all possible values of *i*, the experiment should be repeated using different *i* values. Only the strongest candidates suggested for how many more values of *i* the experiment should be repeated, or listed values of different angles they would choose.

Question 3

(a) The current in the circuit was usually recorded to the correct precision with the correct unit.

The potential differences across sections BC, CD and DE of the resistance wire were usually measured correctly and recorded in the table, to 1 or 2 decimal places.

The resistance of sections BC, CD and DE were usually calculated correctly. Occasionally when the calculated values were truncated, rounding errors occurred.

(b) (i) and (ii) Most candidates' results showed that the resistance of a section decreased as the number of wires increased. Candidates usually ticked the correct box from the list of options provided.

The justification of the conclusion proved to be more challenging. Candidates were asked to justify the conclusion they had made with reference to their results. Only a few candidates quoted calculated values from their table of results to justify the statement they had made. To obtain credit here, all three calculated values of resistance needed to be quoted in the justification.

(c) Most candidates realised that if the experiment were changed so that the relationship between the length of a sample of wire and its resistance were investigated, then different lengths of the wire sample would be needed and the resistance of each length determined.

Question 4

Credit was available for listing any additional apparatus needed to carry out the investigation and for giving a brief explanation of how the investigation would be set up.

Many candidates realised that a stopwatch would be needed, but they did not say that some means of heating the water would also be required.

Some candidates did not think about the sequence in which they would carry out the operation. The temperature of the water in the beaker needed to be measured before the ice cubes are added to the water and this was not always clear in the method described.

Most candidates stated that the experiment would be repeated using water at different temperatures.

Most candidates gained at least partial credit for listing one control variable in this investigation, usually that the mass (or volume) of the ice cubes used should remain constant. The next three most popular control variables chosen were usually the number of ice cubes, the room temperature and the volume of water in the beaker.

Most candidates drew an appropriate table of results and gave relevant headings with units. Only two columns labelled temperature and time (to melt) were required. Frequently, extra columns with reference to temperature were included. These were ignored.

Fewer candidates explained satisfactorily how they would use their results to reach a conclusion, because they made predictions about the outcome.

The most common correct answer was that the times taken for the ice to melt in water at different temperatures would be compared, and if the times are different, then the initial temperature of the water does affect the time taken for the ice cubes to melt. Many stronger candidates also suggested drawing a graph of water temperature against the time taken for the ice cubes to melt and using the graph to draw a conclusion.

PHYSICS

Paper 0625/53
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 will 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 having experience of 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 in this paper.

The practical nature of the examination should be considered when explanations, justifications or suggested changes are required. Justifications should be based on the results obtained by the candidate and not on a theoretical consideration.

It is expected that numerical answers will be expressed to a number of significant figures which is appropriate to the data given in the question or a measurement carried out by the candidate.

Comments on specific questions

Question 1

(a) Most candidates recorded temperatures that showed the expected trend. There were some candidates who started reading the thermometer too early – before it had reached thermal equilibrium with the water and therefore initial readings increased before decreasing. In a small number of cases, candidates recorded the room temperature as their first temperature reading.

(b) (i) and (ii) A number of candidates only completed the time column and did not complete the headings to the table by writing the units in the relevant spaces. A small proportion of candidates wrote units in the body of table instead of, or in addition to, the heading.

(c) Only a simple statement giving a conclusion was required. Candidates should not use theory to arrive at a conclusion or to explain a conclusion. They should only use the values in the results table.

(d) (i)–(iii) Candidates were required to calculate the rate of cooling using the equation provided and to state the units which can be determined from the calculation. Many candidates were able to complete this part successfully and those that did not often omitted the units.

Candidates needed to use their calculated values to determine whether more thermal energy was transferred from the surface of the water than from the sides of the beaker. Only the strongest candidates were successful in their response. It required candidates to recognise that the difference between the two cooling rates represented the thermal energy transferred from the surface of the water.

(e) Many unsuitable responses were given for this question and candidates often referred to a change to only one of the beakers rather than both, for example, "wrap insulation around one of the beakers". However, it was possible for candidates to refer to increasing the thickness of the lid which was an acceptable response that only applied to one beaker.

Question 2

(a) and (b) Most candidates were able to manipulate the circuit successfully to obtain sensible values for V and I.

(c) Table headings were often completed correctly but some candidates left the table headings blank.

(d) (i) Resistance calculations were also often correct though many candidates did not record the resistance values to a sensible and consistent number of significant figures.

(ii) The correctly obtained R values were very close to each other and this was recognised by most candidates. It is important to note that candidates need to reference values from the results and therefore numerical values were required in candidate responses.

(e) The most common response was to draw the three resistors in parallel although other arrangements were possible. A small number of candidates incorrectly drew the three resistors in series.

(f) (i) and (ii) The majority of candidates drew a correct variable resistor symbol but many ended up drawing a thermistor symbol or a fusion between a thermistor and variable resistor.

Only the strongest candidates were able to clearly give a suitable advantage of using a variable resistor. Simply stating that it could allow for more current values was not sufficient.

Question 3

(a) (i) and (ii) Many candidates were able to measure the height of the illuminated object accurately, but some did not record the measurement to the nearest millimetre. This was sometimes the case with the heights of the images too.

(b) Candidates often calculated the value W correctly, but some recorded the value to only one significant figure. Where errors were made, it was mainly due to dividing the height of the image by the height of the object instead.

(c) For graph questions, candidates need to be aware that the scales do not have to start from '0' unless this is stated as a requirement in the question. Truncating the x-axis would have allowed some candidates to obtain an appropriate scale. A minority of candidates attempted to plot the values for the height of the image instead of the values of u or plotted the correct values but reversed the axes. It is important that the line of best fit takes all plots into consideration. Most candidates used small crosses when plotting.

(d) A number of candidates did not clearly indicate on their graph how they obtained the necessary information to determine the gradient. A large triangle drawn against the line of best fit is usually the clearest way of doing this.

(e) This was a challenging question and therefore only the strongest candidates successfully recognised the effect of larger values of *u* on the height of the image and thus the values for *W*.

Question 4

Candidates who used the bullet points in the question to structure their answer were more likely to end up with a successful response. The first of the bullet points was to clearly state the factor to be investigated but some candidates either failed to make this clear or presented more than one factor that they would investigate, for example, the mass and the diameter of the ball. This then made it difficult to follow the rest of the response. However, most candidates identified a suitable factor and went on to describe how that factor could be investigated.

Describing how readings should be used to reach a conclusion was one of the most challenging aspects of this planning question. It is important that candidates do not make a prediction using theoretical knowledge to address this point and are instead explicit about how they would see the relationship between the independent and dependent variables.

Only a few candidates wrote a full-length plan and therefore nearly all kept to the elements required by the question. For example, this particular question did not ask for an outline of the data table to be drawn and therefore no credit was available for drawing one. Nonetheless, some candidates still went on to draw one.

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 will need to be based on data from the question and practical experience 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 unusual 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
- 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. This examination should not be seen as suggesting that the course can be fully and effectively taught without practical work. Some of the skills involved in experimental work, including graph plotting and tabulation of readings, can be practised without doing experiments. However, there are parts of this examination in which the candidates are asked to answer from their own practical experience.

Questions on experimental techniques were answered much more effectively by candidates who showed evidence of having experience of similar practical work. Some candidates appeared to have learned sections from the mark schemes of past papers and wrote responses that were not appropriate to the questions in this paper. For example, see **Questions 2(d)(ii)** and **3(f)**.

The practical nature of the examination should be kept in mind when explanations, justifications or further developments are asked for. For example, see **Questions 1(c)**, **2(d)**, **2(e)** and **3(f)**.

It is expected that numerical answers will be expressed to a number of significant figures which is appropriate to the data given in the question or a measurement carried out by the candidate.

Comments on specific questions

Question 1

(a) (i)–(iv) The majority of candidates successfully recorded the *l* and *w* values in cm. The volume calculation was correct in most answers. Most candidates gave the mass to the nearest g. The density needed to be given correctly and with the unit g / cm^3. A few candidates tried to convert to kg / m^3 which would have been acceptable but most who attempted the conversion did so incorrectly.

(b) (i) Most candidates recorded the volume correctly.

(ii) Candidates were expected to give the value of density to two or three significant figures.

(c) Here candidates were required to make a judgement based on their own answers. The justification needed to be clear and consistent with the results to score credit. Most candidates scored partial credit, but many made a vague comment without showing any understanding of the concept of results being beyond the limits of experimental inaccuracy.

(d) Candidates were expected to know the best way to read a value from a measuring cylinder but significant numbers of candidates did not tick the appropriate boxes "perpendicular to the scale" and "in line with the bottom of the meniscus".

Question 2

(a) Most candidates recorded room temperature correctly.

(b) (i)–(iii) Many correctly completed tables were seen. Most candidates calculated the drop in temperature correctly and the average rate of cooling. However, there were some incorrectly rounded values for the rate of cooling.

(c) (i) and (ii) Most candidates completed the second table successfully. Candidates were expected to be able to work out the unit for the rate of cooling, °C/s, from the units for temperature and time.

(d) (i) and (ii) In **(i)** most candidates correctly calculated the temperature differences. In **(ii)**, candidates were expected to realise that when the temperature difference D was higher, the average rate of cooling R was greater. The justification required the values to be quoted in support of the conclusion.

(e) (i) and (ii) Most candidates knew that reading the scale at right angles is a precaution taken for accuracy. Some candidates explained clearly and concisely the need to thoroughly mix the hot and cold water. Some candidates gave a response that was too vague or missed the point.

Question 3

(a) Most candidates measured the height correctly, but some missed the unit, cm.

(b) Most candidates were able to complete the table with correct calculations for m. Candidates were required to give their values to two or more decimal places.

(c) Most candidates labelled the graph axes correctly and drew them the right way round. Some candidates ignored the instruction to start the y-axis at 20.0 cm and chose a scale that resulted in the plots occupying too small a proportion of the graph grid. Plotting was generally accurate. Candidates should use neat crosses for the plots, or neatly circled dots so that the accuracy of the plotting can be assessed. Many candidates drew a well-judged curve although some drew a 'dot-to-dot' line and others drew a straight line that did not match the plots.

(d) Candidates needed to show the method clearly on the graph and many did this by carefully drawing a horizontal line and a vertical line in the correct places. Most were able to read off the correct u value.

(e) Candidates who had carried out the calculations and graph plotting with care obtained a value for the focal length within the permitted tolerance.

(f) Candidates were expected to answer this part from their experience of lens experiments. Some suggested responses indicated a lack of familiarity. However, others were able to describe precautions, such as using a darkened room or ensuring the object lens and screen are vertical, with confidence.

Question 4

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

Most candidates drew the correct symbols for the ammeter and voltmeter, but the voltmeter was placed in series with the other components by a significant number of candidates. Candidates needed to show clearly (using a simple label) the position in the circuit of the test wire.

Many candidates correctly suggested three, four or five different metals that could be tested. However, some candidates only listed two metals or included an insulator, e.g. plastic.

A concise explanation of the method was required. Candidates are not expected to list apparatus or standard precautions (for example, avoidance of parallax). Candidates should concentrate on the readings that must be taken. It may benefit candidates to plan their table of readings before writing the method to help them to consider the measurements that must be taken in order to address the subject of the investigation. Candidates were expected to include measurements of current and potential difference and the calculation of resistance. Candidates then needed to make it clear that the procedure is repeated with at least two more wires of different metals. A vague reference to repeats was not sufficient as it is not clear whether the candidate was referring to using different wires or repeating the measurements with the same wire.

Candidates were expected to identify at least one variable to keep constant. The length or diameter of the test wire were correct suggestions. Some candidates suggested keeping the potential difference and current constant. This meant that the experiment would not work.

Many candidates drew a suitable table. They were expected to include columns for type of wire, V (or potential difference), I (or current) and R (or resistance) with the last three including the appropriate units. Some candidates confused the symbol with the unit, for example heading a column current / I.

PHYSICS

Paper 0625/62
Alternative to Practical

Key messages

- Candidates need to have a thorough grounding in practical work during the course. Candidates 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 had difficulty in choosing an appropriate scale to plot their graphs and in drawing a best-fit line to display their data.

- Candidates were less able to derive conclusions from given experimental data and justify them.

General comments

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

- 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 the practical skills being tested were accessible. Most candidates demonstrated that they were able to use their own personal practical experience to answer the questions. There was no evidence of candidates running short of time. Many 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) Candidates who used a ruler to show how they would use a set square to obtain an accurate reading of the position of the bottom of the coiled part of the spring from the metre rule, answered much better than those who drew freehand sketches. The set square needed to align with the bottom of the coiled part of the spring and to span the gap between the rule and the spring.

(b) The majority of candidates measured the length *L* of the coiled part of the spring to the nearest millimetre correctly. The most common error was to include the hooks at each end of the spring in the measurement.

(c) Despite the instruction given in the question to start the axes from the origin, many candidates ignored this request.

Most candidates selected scales that increased in suitable increments. There were many excellent, carefully drawn, best-fit lines produced by candidates. However, there were some graphs where the attempt at a 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. This led to problems with **(d)** and **(e)** where candidates needed to use the value of the positive *y*-axis intercept in a calculation. There were also some graphs where the points were joined dot-to-dot. The concept of best fit was clearly not well understood by these candidates.

(d) The *y*-axis intercept of the graph was usually correctly determined to a tolerance of $\pm\frac{1}{2}$ a small grid square. Occasionally the instruction given in the question, that candidates show clearly on their graphs how they obtained the information necessary to determine the intercept, was ignored.

(e) Candidates were asked to calculate the value of $L - l_0$ from measurements made in earlier parts of the question. If candidates had drawn a good line of best fit, the value obtained from this subtraction should have been zero. Candidates who gave an answer within 2 mm of this value were awarded credit.

Question 2

(a) The normal to the transparent block was usually drawn, as instructed, at the centre of side AB and at right angles to it. Points F and G were usually labelled correctly.

(b) Most candidates followed the instructions given and drew the line EF in the correct position and at an angle of 30° to the left of the normal.

In many answers the two pins P_1 and P_2 marked on the line EF were too close together. Generally, candidates should be encouraged to place the locating pins as far apart from each other as space allows, and certainly at least 5 cm apart.

(c) (i)–(iii) Most candidates followed the detailed instructions given, and produced neat, sensible ray diagrams. The values recorded for the distances GH and FH were almost always within ± 1 mm of the expected values of 13 mm and 42 mm.

(d) The acute angle between the lines JF and JK was usually measured correctly. Most values recorded were within the allowed tolerance of ± 2° of the expected answer. Some candidates did not give the unit for the angle.

(e) The precautions needed to be taken for accuracy in ray trace experiments are well known. Most candidates listed one sensible precaution that they would take to obtain accurate readings.

(f) Many candidates did not understand what a range of values for θ meant. Often a list of random unconnected values was given. A range of values, symmetrical about 30°, e.g. 27°–33° was expected.

(g) Most candidates realised that to test the suggestion that $i = \theta$ for all possible values of *i*, the experiment should be repeated using different *i* values. Only the strongest candidates suggested for how many more values of *i* the experiment should be repeated, or listed values of different angles they would choose.

Question 3

(a) (i)–(iii) The potential difference V_1 across section BC of the resistance wire and the current I in the circuit were usually read correctly from the given diagrams.

The resistance of section BC was usually calculated correctly. Occasionally when the calculated value was truncated, rounding errors occurred.

(b) The resistance of section DE was also usually calculated correctly.

(c) Many candidates did not notice this part of the question and did not include the units for the readings in **(b)**. Of those who did answer this part, most gave the correct units for the measured quantities.

(d) (i) and (ii) Most calculations showed that the resistance of a section decreased as the number of wires increased. Candidates usually ticked the correct box from the list of options provided. The justification of the conclusion proved to be challenging. Candidates were asked to justify the conclusion they had made by reference to their results. Only a minority of candidates quoted calculated values from their table of results to justify the statement they had made. To obtain credit here, all three calculated values of resistance needed to be quoted in the justification.

(e) Most candidates realised that if the experiment were changed so that the relationship between the length of a sample of wire and its resistance were investigated, then different lengths of the wire sample would be needed and the resistance of each length determined.

(f) (i) and (ii) Many candidates correctly named the component that could be connected into the circuit to vary the current. Of those candidates who correctly identified the component as a variable resistor/rheostat, not all were able to recall and draw the circuit symbol for this component. Common incorrect symbols drawn were those for fixed resistors, thermistors and diodes.

Question 4

Credit was available for listing any additional apparatus needed to carry out the investigation and for giving a brief explanation of how the investigation would be set up.

Many candidates realised that a stopwatch would be needed, but they did not say that some means of heating the water would also be required.

Some candidates did not think about the sequence in which they would carry out the operation. The temperature of the water in the beaker needed to be measured before the ice cubes are added to the water and this was not always clear in the method described.

Most candidates stated that the experiment would be repeated using water at different temperatures.

Most candidates gained at least partial credit for listing one control variable in this investigation, usually that the mass (or volume) of the ice cubes used should remain constant. The next three most popular control variables chosen were usually the number of ice cubes, the room temperature and the volume of water in the beaker.

The majority of candidates drew an appropriate table of results and gave relevant headings with units. Only two columns labelled temperature and time (to melt) were required. Frequently, extra columns with reference to temperature were included. These were ignored.

Fewer candidates explained satisfactorily how they would use their results to reach a conclusion, because they made predictions.

The most common correct answer was that the times taken for the ice to melt in water at different temperatures would be compared, and if the times are different, then the initial temperature of the water does affect the time taken for the ice cubes to melt.

Many of the stronger candidates also suggested drawing a graph of water temperature against the time taken to melt and using the graph to draw a conclusion.

PHYSICS

Paper 0625/63
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 will need to be based on data from the question and 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 unusual situations. Questions should be read carefully to ensure they are answered appropriately. Planning questions require candidates to design an experiment to investigate a given brief.

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
- understanding the concept of results being equal within the limits of experimental accuracy
- dealing with possible sources of inaccuracy
- control of variables
- making accurate measurements.

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. This examination should not be seen as suggesting that the course can be fully and effectively taught without practical work. Some of the skills involved in experimental work, including graph plotting and tabulation of readings, can be practised without doing experiments. However, there are parts of this examination in which the candidates are asked to answer based on their own practical experience.

Questions on experimental techniques were answered more effectively by candidates who showed evidence of having experience of similar practical work. Some candidates gave responses that were not appropriate to the questions as they were set. The practical nature of the examination should be considered when descriptions, explanations, justifications or further developments are asked for.

It is expected that numerical answers will include a matching unit and will be expressed to a number of significant figures which is appropriate to the data given in the question or a measurement carried out by the candidate.

Each Alternative to Practical examination will include a question in which candidates will be asked to outline a plan for an investigation. Answers to these questions should be based on careful reading of the brief and the logical application of good experimental practice. Many candidates showed good practical knowledge when answering this question, but in the strongest responses, candidates had clearly identified the independent and dependent variables and used the bullet point list from the question to structure their response.

Comments on specific questions

Question 1

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

(b) A number of candidates only completed the time column and did not complete the headings to the table by writing the units in the relevant spaces. A small number of candidates wrote units in the body of table instead of, or in addition to, the heading.

(c) Most successful candidates gave either a description of how to avoid parallax errors or how to ensure the thermometer had reached equilibrium before taking temperature readings. Other common responses included stirring the water to ensure an even distribution of heat or making sure the thermometer was not in contact with the sides of the beaker. Candidates that did not receive credit for their responses either made irrelevant points or were not clear enough in their answers.

(d) (i) Only a simple statement giving a conclusion was required here. Candidates should not use theory to arrive at a conclusion or to explain a conclusion. They needed to use the values in the results table.

(ii) Many candidates found this item more challenging and struggled to identify the pattern in the cooling of water in both beakers. Some candidates repeated the statement in the question and just said that the temperature of the water was decreasing.

(e) (i)–(iii) This item required candidates to calculate the rate of cooling using the equation provided and to state the units which could be determined from the calculation. Many candidates were able to complete this part successfully but those that did not often emitted the units.

Candidates were required to use their calculated values to determine whether more thermal energy was transferred from the surface of the water than from the sides of the beaker. Only the strongest candidates were successful in their responses. It required candidates to recognise that the difference between the two cooling rates represented the thermal energy transferred from the surface of the water.

(f) Many unsuitable responses were given for this question and candidates often referred to a change to only one of the beakers rather than both, for example, “wrap insulation around one of the beakers”. However, it was possible for candidates to refer to increasing the thickness of the lid which was an acceptable response that only applied to one beaker.

Question 2

(a) The ammeter was nearly always drawn correctly but a significant proportion of candidates did not get full credit as they drew the voltmeter in series too.

(b) Nearly all candidates were able to make a correct reading from the voltmeter. However, there were some incorrect readings from the ammeter, especially being recorded as 0.81 A instead of 0.82 A.

(c) (i) and (ii) Table headings were often completed correctly but some candidates left the table headings blank. Resistance calculations were also often correct, but many candidates did not record the resistance values to a sensible and consistent number of significant figures.

(d) The correctly calculated *R* values were very close to each other and this was recognised by most candidates. It is important to note that candidates need to reference values from the results and therefore numerical values were required in candidate responses.

(e) The most common response was to draw the three resistors in parallel although other arrangements were possible. A small number of candidates incorrectly drew the three resistors in series.

(f) (i) and (ii) The majority of candidates correctly drew a correct variable resistor symbol but many drew a thermistor symbol or a fusion between a thermistor and variable resistor.

Only the strongest candidates were able to clearly articulate a suitable advantage of using a variable resistor. Simply stating that it could allow for more current values was not enough.

Question 3

(a) Candidates were able to measure the height of the illuminated object accurately, but many did not record the measurement to the nearest millimetre.

(b) (i) and (ii) Candidates measured and recorded the value of the height of the image and went on to correctly calculate the value *W* too. Where errors were made, it was mainly due to dividing the height of the image by the height of the object instead.

(c) For graph questions, candidates need to be aware that the scales do not have to start from '0' unless this is stated as a requirement in the question. For this graph, candidates needed to truncate their *x*-axis to obtain a suitable scale, but many did not. A few candidates attempted to plot the values for the height of the image instead of the values of *u* or plotted the correct values but reversed the axes. It is that important that the line of best fit takes all plots into consideration. Most candidates used small crosses when plotting.

(d) A number of candidates did not clearly indicate on their graph how they obtained the necessary information to determine the gradient. A large triangle drawn against the line of best fit is usually the clearest way of doing this.

(e) This was a challenging question and therefore only the stronger candidates successfully recognised the effect of larger values of *u* on the height of the image and thus the values for *W*.

Question 4

Candidates who used the bullet points in the question to structure their answer were more likely to produce a successful response. The first of the bullet points was to clearly state the factor to be investigated but some candidates either failed to make this clear or presented more than one factor that they would investigate, for example, the mass and the diameter of the ball. This then made it difficult to follow the rest of the response. However, most candidates identified a suitable factor and went on to describe how that factor could be investigated.

Describing how readings should be used to reach a conclusion was one of the most challenging aspects of this planning question. It is important that candidates do not make a prediction using theoretical knowledge to address this point and are instead explicit about how they would see the relationship between the independent and dependent variables.

Only a few candidates wrote a full-length plan and therefore nearly all kept to the elements required by the question. For example, this particular question did not ask for an outline of the data table to be drawn and therefore no credit was available for drawing one. Nonetheless, some candidates still went on to draw one.