PHYSICS

Paper 0625/11
Multiple Choice Core

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

General comments

Many candidates answered the questions well. Although there were areas of the syllabus which caused major problems, such as electromagnetism and radioactivity, there was evidence that many candidates had a good understanding of the majority of the syllabus. **Questions 1**, **4**, **5**, **8**, **11**, **20**, **26** and **37** were answered well, whereas **Questions 17**, **19**, **28**, **35**, **39** and **40** proved more challenging.

Comments on specific questions

Question 2

The question was reasonably well answered but a significant number of candidates multiplied the maximum speed by the time taken, rather than using the average speed.

Question 4

Most candidates were able to identify weight as a gravitational force.

Question 5

Candidates showed a good understanding of calculating density, and the majority coped well with the challenging arithmetic.

Question 8

Most candidates recognised that increasing the mass of the base of an object increases its stability.

Question 11

The vast majority of candidates were able to extract the relevant information from the graph.

Question 17

Only stronger candidates realised that a liquid-in-glass thermometer uses the change in volume of the liquid in order to measure temperature. Many candidates thought it was a change in thermal capacity.

Question 19

Only stronger candidates recognised that if the water at the bottom of the container remained cool, then neither the water nor the material, from which the container is made, can be a good conductor.

Question 20

Candidates showed a good understanding that white surfaces reflect radiant energy.

Question 23

Although many candidates got the correct answer here, more candidates read the clock without recognising that the image in a plane mirror is reversed.

Question 25

Although many candidates recognised that the wavelength of the radiations increases going from γ-radiation towards radio waves, a significant number thought it was the frequency that increased.

Question 26

This calculation was done very well indeed.

Question 28

This question was challenging for many candidates. To succeed, candidates needed to recognise that the two magnets in the coil would be magnetised in the same sense. Thus, adjacent poles of the two magnets would be of opposite polarity and they would attract each other regardless of the current direction.

Question 31

Few candidates were able to trace a circuit and recognise circuits which are, in practise, identical.

Question 33

Many candidates answered this question well.

Question 35

A relatively small number of candidates were able to identify the correct answer. A large majority had little idea, most thinking that the maximum e.m.f. is induced when the soft iron rod is moved slowly into the coil. It is likely that they did not understand that any movement of a magnet (in or out) induces an e.m.f.

Question 39

This question was challenging for many candidates. To successfully tackle the question candidates needed to recognise the structure of an α-particle (2 protons and 2 neutrons) and to understand that all isotopes of the same element have the same number of protons and different numbers of neutrons.

Question 40

Candidates did not understand that lead absorbs the radiation from a radioactive source. Most candidates were under the misapprehension that it repels the radiation.

PHYSICS

Paper 0625/12
Multiple Choice Core

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

General comments

Many candidates answered the questions well. Although there were areas of the syllabus which caused major problems, such as electromagnetism and radioactivity, there was evidence that many candidates had a good understanding of the majority of the syllabus. **Questions 8**, **11**, **14**, **15**, **17**, **20**, **23** and **26** were answered well, whereas **Questions 21**, **24**, **28**, **36**, and **40** proved more challenging.

Comments on specific questions

Question 2

This question was answered quite well. However, a significant number of candidates did not realise that the volume of the second piece of steel is equal to the difference between the reading on the measuring cylinder with both pieces of steel in it and the reading with the first piece of steel in it.

Question 3

Candidates need to take particular care in converting units so that they are consistent throughout the question before making calculations.

Question 10

Although a small majority of candidates got this correct, many candidates thought that thermal energy is measured in °C. It is imperative that candidates recognise the difference between thermal energy and temperature.

Question 11

This question was answered well and candidates showed a good understanding of green energy resources.

Question 12

A significant number of candidates were under the misapprehension that the force applied by the point of a drawing pin is greater than the force applied to the flat surface of the pin.

Question 14

Almost all candidates answered this question correctly showing a good understanding of the particle model of matter.

Question 16

Many candidates thought that **only** the water expands when heated and that the container does not expand.

Question 19

This question proved challenging and candidates showed little understanding of the transfer of thermal energy by convection. The hot water rises because as it is heated and as it gets warmer, it expands and becomes less dense. This sets up a circulation of the water (or convection current) as more water is heated.

Question 21

Only stronger candidates recognised the direction of vibrations in transverse wave and were able to identify a transverse wave.

Question 23

Few candidates answered this correctly. In this case the mirror is moving away from the observer and the distance between the observer and the mirror increases by 1.0 m each second. The distance between the mirror and the image of the observer also moves away 1.0 m from the mirror, consequently the distance between the observer and the image increases by 2.0 m each second.

Question 25

Although many candidates recognised that the wavelength of the radiations increases going from γ-radiation towards radio waves, a significant number thought it was the frequency that increased.

Question 26

This calculation was done very well indeed.

Question 27

Many candidates were confused by the diagram and needed to understand that the line of magnetic flux (or field) shows the direction of the field at that place. The compass needle will point along that line with the North Pole pointing in the direction of the field.

Question 28

Only stronger candidates recognised that the two magnets in the coil would be magnetised in the same sense. Thus, adjacent poles of the two magnets would be of opposite polarity and they would attract each other regardless of the current direction.

Question 33

This question was challenging for many candidates and relied on a knowledge of circuit symbols and an understanding of simple circuits.

Question 34

Few candidates answered this question correctly. The fuse in a mains circuit **always** goes in the live wire and the live wire only.

Question 36

Electromagnetism and the motor effect require an understanding of sophisticated concepts and stronger candidates were able to work through this problem.

Question 38

Stronger candidates showed a knowledge and understanding of the meaning of proton number and nucleon number and were able to solve this problem.

PHYSICS

Paper 0625/13
Multiple Choice Core

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

General comments

There were many questions which were answered well but also a considerable number which candidates found more challenging. **Questions 1**, **4**, **6**, **11**, **14**, **15**, **17**, **26**, **30** and **37** were answered well, whereas **Questions 5**, **7**, **8**, **16**, **19**, **23**, **27**, **28**, **33**, **34** and **38** were more challenging for many candidates.

Comments on specific questions

Question 2

The question clearly states that the falling object is near the Earth's surface. Thus any increase in acceleration is negligible. Many candidates either did not notice this, or possibly they confused acceleration with speed.

Question 5

This question was challenging for many candidates. In order for the spheres to sink, their density must be greater than the density of the liquid (0.90 g/cm^3). Simple calculations of $\text{density} = \frac{\text{mass}}{\text{volume}}$ for each sphere leads to the answer.

Question 7

The majority of candidates did not recognise this as a moments problem and assumed that the upward force at the string would be equal to the downward force at the 5 cm mark. Only stronger candidates answered correctly.

Question 8

Most candidates did not recognise that for an object to move at constant speed the resultant force on it must be zero. There is only one diagram in which the resultant force is zero, option **A**.

Question 10

The question was answered well. Most candidates recognised that when a balloon is being blown up, work is done. The work is actually done in both stretching the fabric of the balloon and in compressing the air inside the balloon.

Question 16

Few candidates understood the action of a liquid-in-glass thermometer. It relies on the expansion of the liquid. The glass container also expands but importantly, significantly less than the liquid.

Question 17

The question was answered well. The most frequent mistake was to take the two extreme values marked on the thermometer. These points are marked on the thermometer by extrapolating from the two fixed points (the melting point of pure ice and the boiling point of pure water at 760 mmHg), 0°C and 100°C respectively.

Question 19

Many candidates did not recognise the description of convection (the thermal transfer when the density of the liquid deceases and the liquid moves upward). Most candidates thought that it referred to evaporation.

Question 21

Only stronger candidates recognised the direction of vibrations in a transverse wave and were able to identify a specific transverse wave.

Question 24

Many candidates thought that the process of splitting light into a spectrum as it passes through a prism is diffraction.

Question 25

Many candidates recognised that the wavelength of the radiations increases going from γ-radiation towards radio waves but a significant number thought it was the frequency that increased.

Question 26

This calculation was done very well.

Question 28

A relatively small number of candidates were able to identify the correct answer with most candidates thinking that the maximum e.m.f. is induced when the soft iron rod is moved slowly into the coil. It is likely that they did not understand that any movement of a magnet (in or out) induces an e.m.f.

Question 33

Many candidates answered this correctly.

Question 35

Electromagnetic induction is a very sophisticated concept but many candidates answered this correctly.

Question 36

This question was challenging for many candidates. The first step, which many candidates were able to do, was to identify the shape of the field due to the current carrying conductor. Having achieved that, the second step was to know the right hand screw rule but few candidates knew this.

Question 40

Candidates did not seem to understand that lead absorbs the radiation from a radioactive source. Most candidates were under the misapprehension that it repels the radiation.

PHYSICS

Paper 0625/21
Multiple Choice Extended

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

General comments

The vast majority of candidates were able to answer the questions well. Some questions showed candidates had an excellent knowledge and understanding of the syllabus and there were very few questions which caused major problems. **Questions 1**, **4**, **5**, **15**, **27**, **29**, **30** and **37** were answered well whereas, **Questions 2**, **17**, **28**, **36**, and **39** proved more challenging.

Comments on specific questions

Question 2

This question was challenging for many candidates who thought that the acceleration increased as the object fell. This was probably because they considered the increase in the gravitational field strength as the object got closer to the Earth, without considering the much larger effect of air resistance increasing as the speed of the object increased.

Question 5

The majority of candidates recognised it is the centripetal force which keeps an object moving in a circular path at constant speed, but some candidates were under the misapprehension that a force in the direction of motion is needed to allow an object to maintain a constant speed.

Question 9

Most candidates were able to work successfully through this problem, but there were a significant number of candidates who did not recognise that if the momentum of object X is +5.0 m, the momentum of object Y would be –3.0 m (where m is the mass of the objects).

Question 11

A common error here was to not recognise that the force against which work is being done is equal to the mass of the bricks multiplied by the Earth's gravitational field.

Question 15

The majority of candidates showed an understanding of the microscopic view of evaporation.

Question 17

This question was challenging for most candidates. The most common response was to incorrectly think that a smaller reservoir would make the thermometer more sensitive. However, this would have the opposite effect. It might mean that the thermometer reacts more quickly to changes in temperature but it would make it less sensitive.

A significant number of candidates thought that increasing the length of the thermometer would make it more sensitive, but in practise it will have no effect unless other changes are made (e.g. narrowing the capillary tube / increasing the volume of the reservoir).

Question 21

The most common error on this question was to think that shorter wavelength waves diffract more than longer wavelength waves.

Question 27

The vast majority of candidates recognised that the positive charge on a rod is due to the loss of electrons.

Question 34

A relatively small number of candidates were able to identify the correct answer and most candidates thought that the maximum e.m.f. is induced when the soft iron rod is moved slowly into the coil. It is likely that they did not understand that any movement of a magnet (in or out) induces an e.m.f.

Question 36

Only stronger candidates answered this question correctly. Candidates needed to recognise that a d.c. motor uses a split ring commutator in order to produce continuous rotation of the coil. This should eliminate options A and B as they suggest slip rings allow the continuous rotation. It then becomes a choice between C and D, and this can be established using the left hand rule.

Question 39

The majority of candidates incorrectly thought that the β-particles are deflected towards one or other of the two magnetic poles. At this level candidates should understand this is an example of the motor effect and that the deflection is at right angles to both the magnetic field and the velocity of the particles.

PHYSICS

Paper 0625/22
Multiple Choice Extended

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

General comments

There were some strong performances on this paper and many candidates showed a wide knowledge and a deep understanding of the syllabus. **Questions 1**, **2**, **4**, **5**, **16**, **21**, **32**, **35** and **38** were answered exceptionally well. The only questions which proved challenging were **Questions 18**, **20** and **39**.

Comments on specific questions

Question 2

This question was well answered and candidates showed a good understanding of kinematics.

Question 3

While most candidates answered correctly, a few candidates forgot to convert the units of time from minutes to hours.

Question 4

Candidates showed an excellent understanding of the difference between mass and weight.

Question 5

The density problem caused very few problems for the vast majority of candidates.

Question 6

Many candidates answered this question correctly. The most common error was to multiply the 100 N force by 40 cm rather than by (40 + 50) cm.

Question 10

Although the question was answered well by most candidates, a number seemed to take the masses of the two objects to be equal resulting in a final speed of 3.0 m/s.

Question 14

The majority of candidates showed good understanding of pressure and force. However, there were some who thought that the force at the point of the pin was greater than the force on the flat surface.

Question 15

Although the majority of candidates correctly calculated the pressure at the bottom of the mercury column, there were some who forgot to multiply by the *g.*

Question 16

Almost all candidate correctly answered this question.

Question 18

This question proved challenging with many candidates thinking that the box with the largest temperature rise was the box with the largest thermal capacity.

Question 20

Only stronger candidates answered this correctly. Many candidates did not realise that after a full night in the cold both the steel handlebars and the plastic grips would be at the same temperature.

Question 22

This question caused some minor difficulties, mainly because candidates were under the misconception that shorter wavelength waves diffract more than longer wavelengths.

Question 28

The vast majority of candidates recognised that the positive charge on a rod is due to the loss of electrons.

Question 31

The most common error on this question was to treat the resistors as though they were in series not parallel.

Question 32

Candidates recognised the circuit symbol and knew the role of the diode in a circuit.

Question 35

Many candidates were able to answer correctly and showed understanding of the topic.

Question 39

This question proved challenging as many candidates did not read it with sufficient care. The question clearly asked for the count rate due to the source after eight days, but most candidates gave the rate due to the source plus that due to the background count rate.

PHYSICS

Paper 0625/23
Multiple Choice Extended

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

General comments

There were some very strong responses and a large majority of candidates scored well on the paper showing a good knowledge and understanding of the syllabus. **Questions 1**, **2**, **3**, **4**, **15**, **20**, **27**, **28**, **29**, **35** and **38** were answered exceptionally well. **Questions 10**, **16**, **19**, **22** and **39** proved more challenging.

Comments on specific questions

Question 2

This question was answered really well showing a good understanding of kinematics.

Question 3

The calculation was done well with almost all candidates remembering to convert the minutes to hours.

Question 5

Most candidates answered this question correctly.

Question 6

Although in general the question was successfully completed by most candidates, there were a significant number who thought that the objects with the smaller masses would sink. In order for the spheres to sink, their density must be greater than the density of the liquid (0.90 g/cm^3). Simple calculations of

$\text{density} = \frac{\text{mass}}{\text{volume}}$ for each sphere lead to the answer.

Question 8

This was a challenging question but many candidates were able to work their way through it successfully.

Question 9

Although many candidates answered this correctly, there was a significant minority who thought that doubling the force and halving the time would increase the change in momentum of an object while in practise the two changes would cancel each other out.

Question 10

Although this question was answered well by some candidates, there were nearly as many who appeared to take the masses of the two objects to be equal, resulting in a final speed of 1.5 m/s.

Question 14

The majority of candidates showed good understanding of pressure and force. However, there were others who thought that the force at the point of the pin was greater than the force on the flat surface.

Question 15

Most candidates showed an understanding of the microscopic structure of liquids and gases.

Question 16

This question proved challenging, partly due to many candidates not reading it carefully enough. It asked for the **change** in pressure (= (250 – 100) kPa) not the new pressure (250 kPa). This emphasises the need for care when reading the question. Also, a lot of candidates took the new volume to be 15 cm^3 rather than 10 cm^3.

Question 18

Many candidates recognised that the thermometer relies on the expansion of the liquid. However, the glass container also expands, but significantly less than the liquid.

Another common error was to think there is a gas in the tube and this plays a significant part in the operation of the thermometer.

Question 19

This question tested candidates' ability to plan an investigation. The scientist was clearly investigating the conductivity of air. Candidates needed to realise that if the bottom surface is heated, all the air will be warmed by convection and it will mask conduction effects.

Question 22

This question was not always answered correctly, mainly because many candidates were under the misconception that shorter wavelength waves diffract more than longer wavelengths.

Question 27

The vast majority of candidates recognised that the positive charge on a rod is due to the loss of electrons.

Question 34

Only stronger candidates answered this question correctly. Although most candidates recognised that the wire needed to be moved in the vertical direction, most chose the incorrect sense (upwards rather than downwards).

Question 37

Although the majority of candidates gave the correct answer, many were under the misapprehension that lead repels the radiation rather than recognising that it is absorbed by the lead.

Question 40

Although many candidates gave the correct answer, there were also many who either totally ignored the background count rate or took it off at the beginning and then forgot to add it back on at the end of the calculation.

PHYSICS

Paper 0625/31
Core Theory

Key messages

- In calculations, candidates must set out and explain their working correctly. Partial credit for any correct working may be awarded even if the incorrect final answer it given.
- Candidates should show greater clarity and precision when answering questions requiring a description or explanation.
- It is important that candidates read the questions carefully in order to understand exactly what is being asked.
- In order to improve their performance candidates should practise applying their knowledge to new situations by attempting questions in support materials or exam papers from previous sessions.

General comments

A very high proportion of candidates were well prepared for this paper. Equations were generally well known by stronger candidates but a significant number of other candidates struggled to recall the equations.

Often candidates knew how to apply their knowledge and understanding to fairly standard situations. On occasions, when asked to apply their knowledge to a new situation, they showed a lack of breadth of understanding. More successful candidates were able to think through the possibilities and apply their knowledge when the question asked for suggestions to explain new situations. Weaker candidates did not show the stages in their working and did not think through their answers before writing.

The questions on total internal reading and using stop watches, relating pressure to force and area, renewable and non-renewable energy sources, refraction of light and water waves, drawing ray diagrams and electromagnetic induction were generally more challenging for many candidates. There were a significant number of candidates who either did not read the questions carefully, or gave answers that were related to the topic being tested, but did not answer the question as it had been set.

The English language ability of the majority of the candidates was adequate for the demands of this paper. However, there were a significant number of candidates who struggled to express themselves adequately.

Comments on specific questions

Question 1

(a) This item was challenging for many candidates, with a significant number using an incorrect form of $\rho = m/V$. This was often compounded by a lack of working meaning that candidates failed to gain credit for the correct equation. Candidates should be encouraged to write down a correct form of the equation and then show its re-arrangement.

(b) The majority of candidates gained partial credit, often as a result of only identifying the plastic as being less dense than seawater.

Question 2

(a) The majority of candidates answered correctly. The most common error was to choose diagram P.

(b) Only the strongest candidates gained full credit on this item. Many candidates failed to correctly convert the stopwatch display to a time in seconds. Those who correctly used a time of 83.37s sometimes failed to convert their final answer to 3 significant figures.

(c) The vast majority of candidates answered this correctly. The most common error was to divide by 10 rather than multiplying.

Question 3

(a) The majority of candidates gave clear and precise descriptions of how to determine the extension of the spring. Weaker candidates often gave vague descriptions or gave descriptions involving the spring constant that could not be credited.

(b) (i) The vast majority of candidates answered this question correctly. The most common error was in misreading the load or extension scale or not using a ruler.

(ii) Most candidates gained credit for this question. The most common error was in misreading the load or extension scale or not using a ruler.

(c) Only stronger candidates answered this correctly, with a significant number of candidates using an incorrect form of $W = mg$. This was often compounded by a lack of working meaning that candidates could not be awarded credit for the correct equation.

Question 4

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

(ii) The majority of candidates gained some credit for this question. A common error was to give the unit as N / m. Many other candidates thought that the moment was calculated by dividing the force by the distance from the pivot.

(b) This question proved challenging for many candidates who gave one or two of the key ideas from: (wide tyres have) greater area (in contact with ground), pressure = force ÷ area and so the bigger the area the smaller the pressure. This means the tractor is less likely to sink in soft ground.

Question 5

Many candidates gained full credit for this question. The most common errors were to state that building hydroelectric power stations has no impact on the environment and that wind turbines are turned using gravitational potential energy.

Question 6

(a) (i) Only the strongest candidates gained credit for this question. The most common error was either drawing an incorrect normal or not drawing a normal.

(ii) Many candidates answered correctly. The most common error was poor precision in estimating the angle of reflection at one or both mirrors.

(iii) Very few candidates were able to state the law of reflection. The most common error was to attempt some form of Snell's law.

(b) Very few candidates were able to draw the three rays correctly. Candidates should be encouraged to use a ruler in all ray diagrams and to practise drawing refraction and total internal reflection of light at different surfaces.

Question 7

(a) (i) Very few candidates were able to draw a ray with sufficient accuracy to gain credit. Centres should encourage candidates to use a ruler in all ray diagrams and to practise drawing ray diagrams to show the formation of an image by a thin converging lens.

(ii) Very few candidates were able to draw an image with sufficient accuracy to gain credit.

(iii) Very few candidates were able to correctly identify the position of a principal focus.

(iv) Very few candidates were able to correctly measure the focal length of the lens.

(b) With error carried forward from the diagram, the majority of candidates gained at least partial credit for this question.

Question 8

(a) (i) The vast majority of candidates gained credit for this question.

(ii) Most candidates answered this correctly. The most common error was to state that a sound wave is a transverse wave

(iii) The majority of candidates gained at least partial credit for this question. Responses that were vague or lacked precision were the main source of error.

(b) (i) Most candidates answered this correctly.

(ii) Very few candidates were able to correctly measure the wavelength. The most common error was to give the total length of the waves in the figure 8.2.

(c) Only stronger candidates answered this correctly. The use of water waves to demonstrate refraction was not well understood by many candidates.

Question 9

(a) The vast majority gave the correct patterns, and a majority had the correct direction of the field.

(b) Most candidates were able to describe the movement of electrons and to correctly describe the electrons moving from the plastic rod onto the cloth. Those candidates who did not answer correctly often attempted to describe the movement of positive electrons or even protons.

(c) The majority of candidates gained full credit. Weaker candidates thought that the magnet would attract the copper bar.

Question 10

(a) (i) Most candidates gave the correct symbols, but considerably fewer had them correctly connected.

(ii) The majority of candidates correctly calculated the resistance of the lamp as 18 ohms. Weaker candidates used an incorrect transformation of $V = IR$.

(b) (i) Most candidates clearly identified the variable resistor. The most common error was to state that component X was a resistor.

(ii) Only the strongest candidates were able to link the use of a variable resistor to a change in the circuit resistance giving an ability to control the current in the circuit.

Question 11

(a) Only the strongest candidates gained full credit, and their answers were often very clear and included precise descriptions, assisted by good diagrams. Most candidates did not show secure knowledge about how to demonstrate electromagnetic induction. The most common answer consisted of a description of how to magnetise a piece of iron.

(b) (i) Most candidates were able to state iron as the material used in the core of a transformer. The most common error was to give steel.

(ii) The majority of candidates correctly identified the increased number of turns on the secondary coil compared to the primary coil.

(iii) Many candidates set out a correct transformer equation and substituted values. Candidates who attempted to use some form of ratios often failed to gain any credit.

Question 12

(a) Many candidates gained credit for identifying 2.5 minutes as the half-life. However, the majority of candidates thought that half way down the column of times, i.e. 3 minutes, was the half-life.

(b) Many candidates gained credit for identifying a count rate higher than the starting count rate of the first sample.

(c) (i) Only the strongest candidates answered correctly, usually by using the nuclide notation for a helium nucleus.

(ii) Many candidates gained credit for identifying alpha as being strongly ionising.

(iii) Many candidates gained credit for identifying alpha as being weakly penetrating. However, many incorrectly stated that alpha particles would penetrate paper.

PHYSICS

Paper 0625/32
Core Theory

Key messages

- In calculations, candidates must set out and explain their working correctly. Partial credit for any correct working may be awarded even if the incorrect final answer it given.
- Candidates should show greater clarity and precision when answering questions requiring a description or explanation.
- It is important that candidates read the questions carefully in order to understand exactly what is being asked.
- In order to improve their performance candidates should practise applying their knowledge to new situations by attempting questions in support materials or exam papers from previous sessions.

General comments

A high proportion of candidates were well prepared for this paper. Equations were generally well known by most candidates.

Often candidates knew how to apply their knowledge and understanding to fairly standard situations. On occasions, when asked to apply their knowledge to a new situation, they showed a lack of breadth of understanding. More successful candidates were able to think through the possibilities and apply their knowledge when the question asked for suggestions to explain new situations. Weaker candidates had difficulty in applying their knowledge to new situations, did not show the stages in their working and did not think through their answers before writing.

The English language ability of the majority of the candidates was adequate for the demands of this paper. However, there was a small minority who struggled to express themselves adequately.

Comments on specific questions

Question 1

(a) (i) The majority of candidates correctly identified the time on the stopwatch.

(ii) Most candidates correctly divided the time by the number of drops. Some candidates were confused about the time between two drops and divided the time by 15.

(iii) Many candidates correctly referenced timing errors or reaction times. Weaker candidates wrote about finding an average.

(b) The majority of candidates correctly stated that the drops were accelerating or speeding up. Weaker candidates gave vague answers, and some referred to gravitational potential energy which was not credited.

(c) Most candidates used the formula: distance = speed · time. Stronger candidates used the average speed formula or area under the speed time graph.

Question 2

(a) The majority of candidates described the correct steps to determine the volume of the piece of metal.

(b) (i) Most candidates correctly gave mass balance or just balance. Some candidates gave weighing scales which was not credited.

(ii) Most candidates used the formula for density and calculated the correct answer with the correct unit.

Question 3

(a) (i) Most candidates answered correctly with 10 N, forwards / to the right.

(ii) Most stronger candidates correctly identified the force as water resistance, drag or friction. Others referred incorrectly to backward or reaction force.

(iii) Many candidates correctly identified that there was no resultant force. The strongest candidates described the motion correctly as constant speed. Weaker candidates stated that the swimmer was slowing down or stationary.

(b) The majority of candidates correctly calculated the moment.

Question 4

(a) Most candidates correctly stated that the centre of mass would be below the point of suspension. A few thought it was to the right.

(b) Only the strongest candidates were able to describe the full, correct sequence of *BADC*.

Question 5

(a) Many candidates were able to identify the two non-renewable energy sources as gas and oil. Weaker candidates only identified one or identified renewable energy sources.

(b) Only the strongest candidates were able to describe how the geothermal power station generated electricity. Some candidates omitted the generator from the sequence. Many weaker candidates just described what was shown in the diagram.

Question 6

(a) (i) Most candidates correctly named mercury or alcohol. A few suggested it was water.

(ii) Most stronger candidates correctly stated the fixed points were 0°C and 100°C. Others gave the extremes shown on the thermometer.

(b) (i) Many candidates did not read the question carefully enough and gave the answer as convection. More careful candidates correctly identified that thermal energy moves through metal by conduction.

(ii) Stronger candidates were able to describe the process of convection in terms of expansion and density changes of the water. Candidates should be careful not to describe molecules as being less dense or expanding.

Question 7

(a) In this question many candidates confused arrangement, separation and motion. This was not penalised, and credit given for correct responses wherever placed.

(b) (i) Most candidates correctly showed short straight lines with abrupt changes in direction.

(ii) Most stronger candidates correctly described the movement as Brownian motion.

Question 8

(a) Many candidates were able to correctly identify the focal length as *C* to F_1.

(b) Stronger candidates were able to extend the rays to show how the image was formed. Candidates should be careful to follow the instructions and extend the rays provided and not draw their own rays.

(c) Very few candidates correctly stated that the image moved closer to the lens or F_2. Many thought that it moved away. More candidates correctly stated that the image would be smaller.

Question 9

(a) (i) Most candidates correctly stated that light is faster than sound.

(ii) Most candidates were able to calculate the speed of sound.

(iii) Some of the stronger candidates were able to identify the wind or reaction times as a possible source for the difference in the speed of sound. A few identified temperature which was credited.

(b) Many candidates were able to explain about the sound reflecting off the cliffs, but fewer were able to name this as an echo.

Question 10

(a) (i) Most candidates drew the correct symbol for a cell.

(ii) Most candidates correctly identified this as a series circuit.

(iii) Only stronger candidates identified the charged particles flowing through wire as electrons.

(b) (i) Most stronger candidates stated correctly advantages of parallel circuits were that if one lamp failed the other would still light and that the bulbs could be controlled independently.

(ii) Most stronger candidates used the correct formula to calculate the current. Weaker candidates inverted the formula.

Question 11

(a) Most candidates correctly identified steel as the metal that can be permanently magnetised.

(b) Many candidates described putting the ends of the rods together and seeing if they attracted. Few went on to state repelling as the definitive indication that both rods were permanent magnets. Weaker candidates described how to test for permanence by dropping, hammering or heating.

(c) (i) Weaker candidates found this question challenging. Some described how to create static charge on the rods. Stronger candidates correctly described how to create an electromagnet using a current flowing through a coil wrapped round an iron rod. Many candidates did not gain full credit as they did not stipulate that the metal rod should be made of iron.

(ii) Candidates who answered **(i)** correctly went on to answer this question well too by identifying the two factors affecting the strength of the electromagnet as the size of the current in the coil and the number of coils.

Question 12

(a) (i) Stronger candidates were able to correctly identify 4 as the nucleon number or mass number.

(ii) The strongest candidates were able to correctly identify 2 as the proton number or atomic number.

(b) (i) Most of the stronger candidates correctly calculated the half-life as 4 minutes.

(ii) Most of these candidates went on to correctly draw a shallower curve.

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

For many candidates the non-numerical questions were more of a challenge than numerical questions. Some areas of the syllabus were better known than others. In particular, evaporation, general wave properties, magnetism, electric circuits, electromagnetics and radioactivity were not well understood. Equations were generally well known by all but the weakest candidates. Many candidates understood how to apply equations to fairly standard situations well.

A noticeable number of candidates struggled to express themselves adequately.

There were a large number of no responses to all of **Question 11**, particularly **parts (a)(ii)** and **(b)(i)**, and also to **Question 12**, except for **part (c)**.

Comments on specific questions

Question 1

(a) Many correct answers were seen here. The most common errors were either omitting the hundredths of a second in the calculation or not converting to seconds.

(b) A considerable number of candidates correctly indicated that the stopwatch should be started when the LED flashed. Many did not fully understand that the period between two flashes was too brief to measure with accuracy. The time interval for a large number of flashes needed to be found.

Question 2

(a) This part was answered well, many candidates showed both the correct equation and full working. Weaker candidates often used an incorrect equation i.e. *speed = distance x time*.

(b) (i) Many candidates understood that the distance travelled was equal to the area under the graph and also applied this knowledge successfully. A common error was omitting the ½ when calculating the area of the triangle.

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

(c) Most candidates attempted this part and many got the correct answer. A common error was to divide the mass by 10 instead of multiplying by 10.

Question 3

(a) (i) Most candidates knew that the model aircraft would continue moving forwards. Common errors were giving the size of the resultant force either as 30 N or 19 N.

(ii) Again most candidates knew that the model aircraft would continue moving forwards. The effect of this resultant force on the aircraft's speed (i.e. the aircraft accelerates or speed increases) was not always understood.

(b) Few candidates understood that either air resistance increasing with speed or a reduction in thrust would enable the horizontal forces to balance. A common error was to state that the aircraft would stop when there was no resultant horizontal force acting on it.

Question 4

(a) (i) A common incorrect answer was kinetic energy. The bag is moving, so it does have kinetic energy; however, it does not gain kinetic energy because '*it is lifted at constant speed.*'

(ii) This part was answered well by most candidates.

(iii) Many candidates realised that the height raised was required but there was a lack of knowledge that the time was also needed.

(b) The majority of candidates gained full credit on this part.

Question 5

(a) This was well answered by the majority of candidates.

(b) Candidates did not fully understand the process of evaporation. Few correct marking points were seen, usually only for the idea that energy transfers from the water to the liquid.

Question 6

(a) (i) Very few candidates understood that a point on a transverse wave moves at right angles to the wave direction. Many candidates gave no response to this question.

(ii) Many correct answers were seen, but a common error was to give the total length of all four waves.

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

(b) (i) Candidates tended to select sound or just radio, and very few selected light and radio.

(ii) Most answers given were correct with many candidates giving sound as their answer. There were a significant number of no response answers.

Question 7

(a) Many candidates gave the correct answer for the unit of temperature. The physical property was more challenging for some candidates. Common errors were: length, mercury, boiling or freezing but many candidates gave no response.

(b) Most answers given were correct. A common error was the omission of the unit after the 0 and 100. There were a significant number of no response answers.

Question 8

(a) Many answers focused on a process, reflection or refraction, rather than just stating the term, normal.

(b) Candidates needed to understand that the required angles were the angles between the ray and the normal. In addition, the direction of the ray needed to be considered. There was also some confusion between reflection and refraction.

(c) Most candidates knew the effect was refraction but few were able to explain why refraction occurred and many gave no response.

Question 9

(a) (i),(ii) The majority of candidates understood the arrangement of the magnetic poles for this effect but fewer were able to recall the term, repulsion.

(iii) Many candidates gave a correct description of what would happen. The term 'attract' was not always used.

(b) (i),(ii) There was considerable confusion between electrostatic charge and magnetism in many answers. Only the strongest candidates gained any credit on this question.

(iii) When answered, responses were often too vague e.g. to attract an object, to pick objects up.

Question 10

(a) This part was answered well but variable resistor or just resistor were common errors.

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

(ii) Many correct answers were seen for this calculation and these often showed both the correct equation and full working. Weaker candidates were unable to rearrange the $V = I \times R$ equation and used the incorrect $I = V \times R$. (0.015 A)

Question 11

(a) (i) Many of the answers seen merely stated that d.c. was the abbreviation for direct current instead of explaining its meaning.

(ii) Few correct answers were seen. The two cells were often drawn in parallel and candidates did not seem to know the symbol for a switch.

(b) (i) Very few correct answers were seen and transformer was a popular incorrect answer.

(ii) A number of candidates gained partial credit here, usually *for* "increasing the current". A common error was to suggest using bigger magnets instead of stronger or more powerful magnets.

Question 12

(a) (i),(ii) The majority of answers were correct.

(b) Many of the answers seen were correct. Common errors were the Sun and/or listing regions of the electromagnetic spectrum.

(c) A number of candidates gained some credit here, usually for the knowledge that when electrons are gained, the atom becomes negatively charged.

(d) The majority of the answers seen were correct. There was no particular error pattern.

PHYSICS

Paper 0625/41
Extended Theory

Key messages

- All but the very strongest candidates would benefit from more practice in applying their knowledge in unfamiliar situations. This would deepen candidates' understanding and improve their performance in the examination. Many candidates, when asked to apply their knowledge to a new situation, were unable to use the knowledge they had.
- The syllabus symbol for thermal energy has not been *Q* for many years and candidates should be reminded not to use it as such.
- Candidates should ensure that they give their answers clearly in the space provided.

General comments

A high proportion of candidates had clearly been well taught and were prepared for this paper. However on occasion, candidates did not provide the units as required by certain questions. Candidates are expected to know the correct unit for all the quantities mentioned in the syllabus and to supply the appropriate unit as a part of the answer. Sometimes a part question gives information with a unit that included a prefix (e.g. cm or mA) or one of the few non-SI units in the syllabus (e.g. minute). When this happens, the correct answer has to take this into account.

Comments on specific questions

Question 1

(a) This part was very well answered with most candidates supplying the correct answer for both the acceleration and the resultant force. The unit for acceleration was sometimes mistakenly given as m / s^{-2}.

(b) This was generally answered well but some candidates confused the decreasing rate of acceleration with deceleration. There were candidates who, having stated that the rate of acceleration was decreasing, went on to explain that this meant that the speed was decreasing. Expressions such as "the acceleration is slowing down" were not precise enough. Stronger candidates referred to the decreasing gradient of the curve. References to its bending or flattening out were usually too imprecise.

(c) The majority of candidates made some reference to air resistance or a resistive force, but only stronger candidates commented on its increasing in size. There were also some vague answers which gained no credit relating to the car reaching its maximum speed or to the power of the engine being unable to make the car travel faster.

Question 2

(a) Most candidates gave two appropriate properties. A common incorrect answer which was not exact enough to be awarded credit was motion.

(b) (i) There were many good answers that were awarded some credit. A common confusion related to the onset of permanent deformation and in some cases the term *elastic limit* was used. The elastic limit where the deformation becomes permanent is not a syllabus learning objective. It should not be confused with the limit of proportionality which is where Hooke's ceases to apply.

(ii)1 Only stronger candidates answered correctly. There were a vast range of calculated and quoted values given.

(ii)2 Many candidates either quoted the correct equation or used appropriate numbers to show that the equation was known. However, a few candidates obtained the correct answer or gave an answer that was awarded full credit because an incorrect value from **(b)(ii)1** was used correctly.

(iii) There were many correct answers here but, in some cases, an incorrect intermediate energy was given. Thermal energy was not an intermediate stage.

Question 3

(a) Although there were many correct answers here, many candidates gave a correct answer but then continued and contradicted the answer already given trying to explain what the answer meant. One example that occurred often was to give the expression $F\Delta t$ to suggest that this is the force acting at a certain time or the force even per unit time. Sometimes, the answer "rate of change of momentum" was given.

(b) (i) The calculation was frequently carried out correctly and full credit was often awarded. There were candidates who supplied the reciprocal of the correct answer or who multiplied the impulse by the mass of the pellet.

(ii) There were a few candidates who did not know how to address this question, but the majority of candidates did. Of these, there were candidates who having written the term v^2 in the equation, omitted the square when substituting numerical values or even if it was written at this stage, omitted to square the speed when calculating the answer. However, many candidates were awarded full credit.

(c) There were many good answers here with varying points about how the molecular structure of a liquid differs from that of a solid being made. Answers that concentrated exclusively on the bulk properties of solids and liquids were not awarded credit.

Question 4

(a) This part proved challenging for many candidates and few obtained full credit. Many candidates gave answers in terms of the loudspeaker receiving sound and did not refer to the loudspeakers being a vibrating source.

(b) This was very well answered. Many candidates obtained full credit. A minority of candidates did not rearrange the equation $v = f\lambda$ correctly and a few gave an answer which was either too large or too small by factors of ten.

(c) Most candidates had a clear idea of what was expected here and full credit was not uncommon. Most candidates drew straight, incident wavefronts and realised that diffraction would take place to the right of the gap. The most common reasons for not obtaining full credit were diagrams where the wavelength varied significantly or where the wavelength was not even approximately consistent with the value given in the question.

Question 5

(a) There were many good answers here and most candidates drew radial field lines. These were not always evenly spaced and occasionally the arrows were not in the correct direction. A small number of candidates drew the lines inside the sphere or drew lines with a significant curvature.

(b) (i) This was well answered with many candidates drawing an equal number of correctly separated opposite charges. Candidates who drew a large number of charges rarely ensured that the numbers of the opposite charges were equal. Those who only draw a few were much more likely to obtain full credit. A minority of candidates drew only positive charges and were perhaps recalling the end point of a classroom experiment.

(ii) Only stronger candidates answered the question well. Many candidates referred to the charges on S and described what had just been drawn in **(i)**. The question asked for what happens to S.

(iii) There were many good answers with a large number of candidates stating that S ends up being positively charged. Fewer candidates described what happens in the wire or some did not describe the direction of the motion of the electrons in the wire.

(c) There were many good answers here and full credit was commonly awarded. This question asked about the structure of the two substances and so candidates who stated that one was a conductor whilst the other was not, did not answer the question.

Question 6

(a) (i) This was almost always answered correctly, and the small minority of answers not awarded full credit included those where the unit was omitted or incorrect or those where only the equation $V = IR$ was used.

(ii) This question was less well answered. Candidates did not always realise that the fuse rating had to exceed the current supplied and answers that were smaller or equal to the answer in **(ii)** were sometimes seen. Sometimes the unit was omitted here or an answer such as 230 V or 9000 W was given.

(b) This question was generally well answered and full credit was awarded frequently. Candidates who did not obtain full credit often obtained partial credit for quoting an equation that defined specific heat capacity but did not then substitute a correct value for the thermal energy. Some used the value 4200 instead.

(c) (i) Many candidates had some idea of the structure of a thermocouple thermometer but many candidates did not state that the wires are made from two different metals or included a meter that was not described or named. Diagrams where the meter had four terminals and where the wires emerging from the two terminals on one side ended in a junction were sometimes seen. Such diagrams and the accompanying descriptions only occasionally gained partial credit.

(ii) The most common suggestion here was that thermocouples are able to measure a wide range of temperatures or very high temperatures. This was not especially relevant to a bathroom shower and could not be credited. Stronger candidates noted the context and were able to answer appropriately.

Question 7

(a) Almost all answers included a straight line of positive gradient beginning at the origin but fewer answers included appropriate numbers on the axes. Many answers did not include any numbers and in some cases, the 1.0 m mark and the 7.6 W mark defined a point that was clearly not on the drawn line.

(b) (i) This part was often answered in terms of force rather than energy and only a minority of candidates were awarded any credit.

(ii)1 This part was almost always answered correctly.

2 There were some correct answers but there were also many incorrect answers and a common inaccurate answer was 12 V.

3 Many candidates answered this question correctly, but a common error was to use the value 5.5 (minutes) without converting it to seconds. Answers that were derived from the expression VIt did not gain any credit.

Question 8

(a) (i) There were many good answers here with full credit being awarded quite often. Answers which included a unit (e.g. °) were not awarded full credit because refractive index does not have a unit.

(ii) This was usually correct but a red ray that refracted so that it travelled up the page as it moved away from the prism was also seen quite often.

(iii) There were many candidates whose answers did not relate to the question or were too vague. However, stronger candidates answered correctly.

(b) (i) Only stronger candidates answered this correctly and many candidates drew a ray that only separated from the red ray as it returned to the air.

(ii) Only a minority of candidates gave answers that related to the question asked. Many candidates stated that the speed of light in glass was greater for higher frequency light and explanations very commonly attempted to use the equation $v = f\lambda$ as part of the explanation.

Question 9

(a) (i) This was often correct. Incorrect answers sometimes had the correct numbers reversed or were some combination of 5 and 3. The numbers should have been to the left of the symbol *Li*.

(ii) Only a minority of candidates drew a diagram such as the one in **Fig. 9.1** and when such a diagram was drawn, the number of shaded and plain circles was only occasionally correct.

(b) (i) The word *random* was rarely used by candidates and when it was, it was occasionally applied to the numbers themselves rather than to the decay process.

(ii) Many candidates were able to suggest a source of background radiation. However, some answers, did not match the context.

(iii) The most common answer that candidates gave was 55. This ignored the background radiation but dealt with the halving correctly. Some candidates who obtained the correct numerical value, supplied the unit *counts / second*.

PHYSICS

Paper 0625/42
Extended Theory

Key messages

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

Q is not the syllabus symbol for thermal energy and candidates must not use it as such.

All but the very strongest candidates would benefit from more practice in applying their knowledge in unfamiliar situations. This would deepen candidates' understanding and improve their performance in the examination. Many candidates, when asked to apply their knowledge to a new situation, were unable to use the knowledge they have.

General comments

A high proportion of candidates had clearly been well taught and were 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. This applied particularly to **Questions 4(a)**, where candidates needed to remember and apply two equations correctly, and **3(b)**.

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. This is most likely to happen in multi-stage calculations such as **4(a)** where some candidates rounded more than one intermediate value which led to considerable inaccuracy

Generally, candidates followed the rubric of the questions. However, candidates must not try to maximise their chances by giving more than one answer to a question or choosing an answer that might cover two situations.

Often candidates simply did not read the questions carefully enough and wrote known standard facts when in fact, the question required the application of these facts.

The use of units by most candidates was good.

Overall the English language ability of the vast majority was adequate for the demands of this paper.

Comments on specific questions

Question 1

(a) Most candidates gained full credit, but a minority inverted the equation during re-arrangement and subsequently divided the area by the volume to give an answer of 3.3 m.

(b) Most candidates gained full credit, but a minority of weaker candidates made an error in the unit or attempted to use the equation $p = F / A$.

(c) Many candidates scored full credit. Weaker candidates usually made an error in the unit or tried to use the wrong equation $p = mgh$. Some candidates used the equation $p = F / A$ successfully but weaker candidates substituted the mass of the water rather than the weight.

(d) Many candidates gained credit, but a large number thought a metre rule was suitable for measuring a length of 44 metres.

Question 2

(a) Stronger candidates usually gained full credit, but many other candidates failed to give two conditions correctly. A typical error was only to state that forces in one direction (e.g. up and down) were balanced. In this question the word *momentum* in place of *moment* could not be accepted.

(b) (i) Only stronger candidates gained full credit. A significant number of candidates thought that the reaction force acted downwards.

(ii) This was correctly answered by only a small minority of candidates. The main issue was that candidates did not set out their working in a clear and logical manner. Frequently one of the moments was omitted or one of the forces multiplied by the incorrect distance from the pivot. Even candidates who gave correct expressions for all the moments sometimes put one moment in the wrong direction.

(iii) Many candidates failed to realise that the simplest approach to answering this question was to equate upwards and downward forces. A very few candidates successfully took moments about Q but most who attempted to use moments only produced confused, poorly set out and incorrect working.

Question 3

(a) There were a number of clear and accurate responses, but the vast majority lacked precision and detail. Most candidates only scored partial credit for this question. Many answers were too vague in terms of particles colliding and did not state that they were colliding with the walls. Momentum change was often mentioned, but not linked to force.

(b) Of those who knew the correct equation, most gained full credit. Some weaker candidates attempted to use the equation $p = F / A$. Others made an incorrect transformation of the equation or attempted a cross multiplication that was usually incorrect.

Question 4

(a) Many stronger candidates gained full credit, but a common error was to give an incorrect unit, especially giving the unit for specific heat capacity. Often working was confused, poorly set out and impossible to follow. This meant that candidates were unable to be awarded partial credit for incorrect final answers. Many candidates whose working was partly correct failed to make the conversion from minutes to seconds and ended up with the value 16 J/°C. There was a major issue for many candidates who used the symbol Q for thermal energy and then tried to use the same symbol for electric charge. This contradiction could not be given credit and, in many cases, candidates confused themselves.

(b) 1 Many candidates scored partial credit for identifying that the larger sphere emits more radiation, but fewer could give a valid explanation.

2 A significant proportion of candidates thought that the increase in temperature would make no difference. Weaker candidates gave with explanations in terms of thermal capacity.

Question 5

(a) (i) The majority of candidates gained full credit. Weaker candidates often attempted an explanation in terms of wavelengths being closer or further apart.

(ii) Many candidates had the idea that parallel and perpendicular were involved in the answers. However, they failed to realise that oscillations or vibrations were needed for correct answers. Consequently, answers such as “wave moves parallel to wave” or “motion is parallel to wave” could not be credited.

(b) (i) The majority of candidates gained full credit. Weaker candidates either gave an incorrect equation or inverted the equation during re-arrangement and subsequently divided the frequency by the speed or multiplied the frequency and the speed. There were many errors converting 0.120 kHz to Hz and many candidates gave an incorrect unit.

(ii) Many candidates gained credit for saying that the sound would be audible and quoting the correct audible range. However, not many mentioned that the frequency would not change.

Question 6

(a) (i) Only stronger candidates gave precise, accurate answers that gained full credit. There was rarely any correct indication of the direction of the path of light, and often candidates thought the light travelled from the eye to the coin.

(ii) This question was generally correctly answered but answers such as *reflaction* gain no credit.

(iii) There were many correct answers but also many vague statements that gained no credit.

(b) Generally, the numerical answer was correct but there were also many missing units.

(c) This was well answered by stronger candidates, but many multiplied the speed of light in air by 1.3 to give an impossible answer.

Question 7

(a) (i) Most candidates gained full or partial credit. Stronger candidates linked the deflection of the galvanometer to the change of magnetic flux. A common error from weaker candidates was to state that an e.m.f. or current was induced by the field lines of the coil being cut. Centres should emphasise that the word *induced* must be used when describing electromagnetic induction.

(ii) Many stronger candidates linked the increased deflection of the galvanometer to the increased (rate of) change of magnetic flux. Weaker candidates thought that the deflection would be in the opposite direction or gave vague statements that were not worthy of credit.

(b) Candidates often gave confusing answers to this question. Nearly all were able to identify at least one of the hazards, but most answers were too vague about what could cause the electric shock, etc. often referring to the grass. Often answers did not contain the detail required to gain credit. For example, the crucial fact that the grass was damp was often omitted.

Question 8

(a) Many stronger candidates were able to identify that the key to this question was the proportionality between resistance and length and the inverse proportionality between resistance and cross-sectional area. Very few were able to convert this knowledge into a successful calculation. Very often there were confused criss-cross lines, which were impossible to interpret and gained no credit for working. In addition, some otherwise correct answers gave the final answer to 1 significant figure.

Although resistivity is not on the syllabus this route was acceptable and was successfully followed by a small number of very strong candidates.

(b) (i) This question was generally well answered.

(ii) The vast majority of candidates realised that a NOR gate was required but many then failed to gain full credit through careless or ambiguous representations of a NOR gate.

Question 9

(a) Very few candidates knew the correct definition.

(b) The main reason for answers not gaining full credit was that lines were narrowly spaced with no indication of the field in much of the space. Some candidates who had the correct spacing had the wrong direction.

(c) Many candidates did not know the correct equations for both parts of the question. Of those who could recall the equations, many could not correctly convert mA into A.

Question 10

(a) Many candidates gained full credit, but a significant number did not read the question carefully enough and gave incorrect answers.

(b) Many good answers were seen with candidates showing a good understanding of what was required in terms of handling, using and storing radioactive isotopes. Weaker candidates simply listed the penetrating power of the three radiations which did not answer the question asked.

PHYSICS

Paper 0625/43
Extended Theory

Key messages

- Candidates are advised to read all questions carefully to make sure that they are answering the question that is asked.
- Candidates should look carefully at units to see if they need to convert units with a prefix or non SI unit to another unit.
- Candidates should be reminded that Q is not the syllabus symbol for thermal energy. The accepted syllabus symbol is E.
- Candidates should be careful to distinguish between the symbol t, for time and T for temperature as this was an issue for some candidates in some questions. Similarly the use of theta for temperature should be discouraged as that is easily confused with Q

General comments

Many candidates were well prepared for this paper and performed well. There was no evidence that candidates had insufficient time to complete this paper.

In numerical questions, candidates are advised to write down the equation in the form of symbols before rearranging or inserting numbers to ensure that credit is gained if there is an error in rearranging the equation.

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

When asked to draw diagrams or add information to diagrams, as in **Questions 6(a)**, **6(b)**, **7(a)**, **8(a)** and **9(a)**, candidates should be advised to make their intentions very clear and to draw carefully, using a ruler where appropriate.

Comments on specific questions

Question 1

(a) This question was generally well answered. Most candidates realised that they needed to calculate the area of two rectangles and then multiply the area by the depth. Weaker candidates did not use the correct dimensions for calculating area. There were some unit errors – usually m^2 or m instead of m^3 and some candidates only gave an answer correct to 1 significant figure rather than 2.

(b) This was usually answered correctly with most candidates recognising that they needed to use the equation density = mass / volume. Some candidates were unable to correctly rearrange the equation to give the mass.

(c) Most common mistake in this part of the question was to fail to realise that the new depth needed to be calculated by subtracting 0.8 m from 2.0 m. Some candidates failed to identify the equation they needed to use or misremembered the equation, using mass instead of density or forgetting to include g.

Question 2

(a) (i) Good answers followed the instruction to write an equation in words. Incomplete answers only referred to force times distance and did not note that the distance must be a perpendicular distance. Some candidates confused moment with momentum.

(ii) Stronger candidates referred to the turning effect of a force. Many candidates gave a vague answer and stated that the moment of a force was a turning force.

(iii) There were many good answers here stating that a vector was a quantity with both magnitude and direction. Some candidates omitted to include that a vector had magnitude.

(b) Stronger candidates stated that the counterweight provided a moment and that it was equal and opposite to the moment provided by the load. Some candidates just referred to unbalanced or balanced forces.

Question 3

(a) (i) Candidates needed to make sure that they use correct terminology in answering this question i.e. gravitational potential energy to kinetic energy. As an energy change was asked for, credit could not be given for the statement of a single energy. Weaker candidates sometimes stated that kinetic energy changed to gravitational potential energy.

(ii) Stronger candidates were able to identify that they needed to equate kinetic energy to gravitational potential energy. Many candidates assumed that it took 1 s for the water to fall and then used the equation $v = d / t$ to obtain an answer of 21 m.

(iii) Few candidates realised that they had to assume that no energy was converted to any other form or lost to surroundings. Many candidates stated that they had made assumptions about the value of g or that the velocity or mass of water did not change.

(b) There were only three answers to choose from – geothermal, nuclear and tidal. Some candidates gave answers of fossil fuels, wind power, waves.

Question 4

Candidates who noted carefully that the question asked for explanations in terms of arrangement of molecules and the forces between them answered this question well. The most common omissions were a lack of reference to the lattice arrangement of solid molecules and to the separation of gas molecules. Weaker answers made no reference to the forces between molecules.

Question 5

(a) This question was generally answered correctly. Stronger candidates were able to identify that they needed to use the equation: energy = power · time and that power in kW needed to be converted to W and time in minutes to seconds. Weaker candidates could identify the correct equation to use but omitted to change one or both units. Some candidates confused time with temperature. The unit given for the answer was usually correct.

(b) This was often answered correctly. Some candidates omitted to use the mass in kg and again there was some confusion with time and temperature for weaker candidates.

(c) Candidates who answered **(a)** and **(b)** correctly usually went on to get full credit for this part of the question. Candidates who had calculated incorrect values for the previous two parts sometimes gave a correct equation for this part in symbols or numbers but failed to realise that they should have been alerted to the impossibility of the useful output energy being greater than the input energy. Sometimes they gave an equation in numbers which had the energies the wrong way up.

Question 6

(a) (i) This was usually correctly answered but some candidates did not recognise the representation of a longitudinal wave and gave answers of ‘crest’ or ‘trough’. Some candidates made no attempt to answer this question.

(ii) Similar misconceptions were made as in **(i)** and another incorrect answer was ‘amplitude’. Again some candidates did not attempt this question.

(b) Candidates who used a ruler and drew their answer carefully were far more likely to be awarded credit.

(c) Correct answers referred to the effect of the change of amplitude on the pattern of wavelengths. Many candidates were confused between amplitude and pitch and some made statements about pitch which were inconsistent with the statement in the question that the pitch was the same.

(d) Stronger candidates referred to the speed of sound in the water being higher than in the air, often giving the reason, and went on to state that the wavelength increased and that the pattern was more spread out. Weaker candidates correctly identified the change of speed but went on to state the frequency increased. There was some confusion between sound travelling in water and light rays being refracted and slowing down in water.

Question 7

(a) Stronger answers had carefully drawn rays, one passing through the centre of the lens and another parallel to the principal axis passing through F. Some candidates did not realise that the ray parallel to the axis went through F. Correct answers showed both rays being extended backwards to show the image, represented by a vertical line and the label I. There were many attempts to locate an image on the right hand side of the lens

(b) Many candidates identified that the image was virtual even though their diagram did not show that. Few went on to say that the image was both enlarged and upright, even when their diagram showed that.

(c) Stronger candidates referred to different colours having different wavelengths or being refracted by different amounts or showed a knowledge of the term ‘dispersion’. Weak answers were too vague just referring to different colours appearing or light being split into a rainbow.

Question 8

(a) Most candidates realised that the pattern was one of radial lines. Careless drawing resulted in some candidates not showing the lines as radial or spacing them unevenly. Some candidates drew arrows in the wrong direction.

(b) This question was generally well answered with most candidates being able to identify the correct equation to use. Some candidates had the terms transposed. This was the question with the most unit errors.

Question 9

(a) (i) This question was usually answered correctly. Weaker candidates placed the voltmeter in the wrong part of the circuit or in the correct position for the ammeter.

(ii) Many candidates answered this question correctly. Some candidates placed the ammeter in series in the circuit but left the gap in the wires.

(b) Stronger candidates were able to identify that they needed to calculate the p.d. across the two parallel resistors and the current in the circuit and then double the value for the resistance of the combination of resistors. Most candidates recognised that they needed to use the equation $V = IR$. Common mistakes included not calculating the p.d. across the resistors and halving the resistance instead of doubling it. Some candidates forgot that $1/R + 1/R$ gives the reciprocal of the resistance and not the resistance itself. Some candidates used the correct method but introduced a rounding error in the intermediate part of the calculation.

Question 10

(a) (i) Many stronger candidates correctly stated that due to the motion of the magnet an emf and hence a current was induced in the coil. Few went on to explain why the indicator went off again.

(ii) This question was challenging for many candidates. Few candidates identified that the current in the indicator was higher because of the faster movement of the door and even fewer correctly stated that the door or the magnet was moving for a shorter length of time.

(b) Stronger candidates referred to the protection against electric shock or overheating or to the fact that (unlike fuses) circuit breakers could be easily re-set. Some answers were too vague and did not refer to protection or suggested that the circuit breaker made it easy to switch the lawnmower on and off.

Question 11

(a) There were many correct, well-drawn answers. Most candidates correctly drew the path of the particle heading straight for the nucleus. Weaker answers often showed the particles not in direct line with the nucleus going into orbit round the nucleus.

(b) This was generally well answered. Many candidates correctly subtracted background from the initial reading, but fewer remembered to add background on to the value they calculated to give the final answer. Weaker answers showed confusion in the number of half lives that took place.

(c) Stronger candidates referred to the need for storing radioactive waste securely or safely and the cost involved. Some referred to the necessary containment and stated the environmental disadvantages if there was a leak. Other answers made general statements about the positioning of nuclear power stations or the waste of money in producing waste when radioactive isotopes were expensive. Some candidates simply referred to disposal of radioactive waste or sending it to landfill.

PHYSICS

Paper 0625/51
Practical Test

Key messages

- Candidates need to have had 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 regular experience of similar practical work. Some candidates appear to have learned sections from the mark schemes of past papers and written responses that were not appropriate to the questions in this question paper.

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

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) The majority of candidates successfully recorded the *a* and *b* values. Some appeared to have misread the rule. Calculations of *a*/*b* were negotiated successfully by most candidates resulting in decreasing values given to two or more significant figures.

(b) Most candidates labelled the graph axes correctly and drew them the right way round. Some candidates ignored the advice '*you do not need to begin your axes at the origin*' 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 straight line but some drew a 'dot-to-dot' line and others drew a straight line that did not match the plots, usually by forcing the line to go through the origin or false origin.

(c) In this question candidates needed to clearly show the triangle method on the graph. Many candidates achieved this. Credit was awarded to those candidates who drew a triangle that used at least half of the line between the extreme plots.

(d) The correct value of W was equal to the value of G and was expected to be given to 2 or 3 significant figures. Further credit was awarded to those candidates who gave the unit N.

Question 2

(a) (i) Most candidates recorded the potential difference to at least 1 decimal place and the current to at least 2 decimal places. Few candidates recorded an unrealistic potential difference or current.

(ii) Most candidates calculated the resistance correctly.

(b) In this question most candidates recorded sensible readings showing that they had correctly set up the circuit. When this was the case, I_2 was less than I_1.

(c) Credit was awarded for recording the values showing that R_3 was less than $3 \cdot R_1$.

(d) In this question 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 at least partial credit but many merely explained that $3 \cdot R_1$ was greater than R_3 without showing any understanding of the concept of results being beyond the limits of experimental inaccuracy.

(e) Most candidates drew the three lamps in parallel. One voltmeter in parallel with the lamps was often seen but the correct symbol for a variable resistor was less well-known.

Question 3

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

(b) 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. Some candidates recorded readings at 30 s intervals instead of 60 s intervals as required in the question. A consistent use of significant figures was expected for the temperature readings.

(c) Most candidates calculated the temperature decreases correctly.

(d) (i) Here candidates were required to make a judgement based on their own results.

(ii) The justification needed to be clear and consistent with the results to gain credit. Correct reference to the temperature differences and time intervals were required.

(e) Successful candidates were able to analyse the question well and to give relevant answers such as use of insulation and use of a lid. Some candidates appeared to be relying on answers they had learned from past papers that were not appropriate for this question. For example, suggesting that room temperature should be kept constant.

(f) Most candidates correctly drew a line perpendicular to the surface of a measuring cylinder to show the line of sight. Fewer included sufficient detail to show that the reading should be taken at the bottom of the meniscus.

Question 4

Candidates who followed the guidance in the question were able to write concisely and 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.

Candidates were expected to realise that the balls would move from left to right and back again along the track as viewed in **Fig. 4.1**.

Candidates were expected to briefly describe releasing a ball from a set position on the track and to measure the time taken for the ball to come to rest. This was then to be repeated several times with one factor being changed each time. Most chose to use balls of different masses but varying the curvature of the track was an alternative approach. In either case candidates needed to be clear about the possible variables that were kept constant.

The table needed to include columns for mass (or the alternative variable chosen) and time with appropriate units.

Candidates were expected to explain how to reach a conclusion from their readings. The most straightforward response was to suggest a graph of mass (or the alternative variable chosen) against time. Candidates should be aware that they are being asked how to reach a conclusion and not to make a prediction about expected results.

PHYSICS

Paper 0625/52
Practical Test

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 and discussion of the significance of results, precautions taken to improve reliability and control of variables.

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

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

Many candidates seem less able to derive conclusions backed up by evidence, or to present well thought out conclusions.

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

General comments

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

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

Comments on specific questions

Question 1

(a) Most candidates recorded the times for 20 oscillations for the five different pendulum lengths to at least 1 decimal place, and their results correctly indicated a sequence of increasing times as the length of the pendulum increased.

The values for the period T and for T^2 were usually correctly calculated and rounded to a sensible number of significant figures.

The table of results was usually completed correctly with very few candidates omitting any of the required calculations.

(b) Candidates did not always choose horizontal and vertical scales that made use of at least half of the given grid. Despite the instruction given in the question that there was no need to start the axes from the origin, many candidates ignored this.

Few candidates used scales that increased in inconvenient increments, such as 3 or 7. Choosing such scales makes the points much harder to plot by the candidates.

There were many excellent, carefully drawn best-fit lines produced by candidates. 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. There were also some graphs where the points were joined dot-to-dot. The concept of best fit was not well understood by all candidates.

(c) The gradient of the graph was usually correctly determined. Occasionally the instruction given in the question, that candidates show clearly on their graphs how they obtained the information necessary to calculate the gradient, was not noted. A minority of candidates used data points from their table to calculate the gradient of the line. Candidates should be made aware that this is an acceptable method if the data points lie on the best-fit line, but this cannot be awarded credit if these points do not.

(d) Candidates were asked to calculate the acceleration of free fall by substituting their value of the gradient of the graph into a given equation. They were then asked to write down the value for g to a suitable number of significant figures for this experiment. Although the calculation and subsequent rounding of the answer was usually correct, the number of significant figures quoted was often incorrect. Candidates must be encouraged to write down any calculated numerical answer in an experiment to the same number of significant figures as the data they have collected. Only answers quoted to 2 or 3 significant figures were accepted here.

Question 2

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

The potential difference across the resistance wire was usually measured correctly and recorded in the table supplied, to 1 or 2 decimal places. In most cases the potential differences recorded by candidates, as expected, increased as the length of resistance wire increased. Occasionally when the calculated values of the different lengths of resistance wire were truncated, rounding errors occurred.

(b) Most candidates' results showed that within the limits of experimental accuracy the value of the resistance of the wire was directly proportional to its length. These candidates usually ticked the correct box from the list of options provided.

The justification of the conclusion proved to be more challenging for many candidates. The majority of candidates incorrectly thought that because the resistance of the wire increased as its length increased, that this was sufficient to deduce that the two quantities were directly proportional. Only stronger candidates were able to show or state that the ratio of resistance to length was constant within the limits of experimental accuracy. Another acceptable justification was that doubling the length, doubled the resistance of the wire.

(c) Most candidates were able to estimate the potential difference across a 50.0 cm length of resistance wire by using other values from the table of results. Most of these candidates went on to calculate a correct value for the resistance of the length of wire that they had estimated.

Candidates were also asked to record their answer to a suitable number of significant figures for the experiment and to include a unit. Candidates must be encouraged to write down any calculated numerical answer in an experiment to the same number of significant figures as the data they have collected. Only answers quoted to 2 or 3 significant figures were accepted here. The unit of the answer was sometimes omitted, despite candidates being told to include it.

Question 3

(a) The object distance and the image distance from the lens when a clearly focussed image was formed on the screen were usually recorded and these distances were usually within the tolerance allowed. The focal length of the lens was usually calculated correctly by substitution in the equation provided, although occasionally truncated answers were incorrectly rounded.

(b) Candidates were then required to move the lens slowly away from the screen until a second clearly focussed and now magnified image was seen. The new object distance and the image distance from the lens were again usually recorded within the tolerance allowed. The focal length of the lens was usually calculated correctly by substitution into the equation provided, although occasionally truncated answers were incorrectly rounded.

(c) The average of the two calculated values of the focal length of the lens was usually calculated correctly. Again, answers which were incorrectly rounded or quoted to more than 2 or 3 significant figures could not be fully credited.

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

(e) This simple calculation of the new distance between the illuminated object and the screen, when the screen was moved a further 40.0 cm away from the object was challenging for many candidates.

The calculation of a third value of the focal length of the lens from the given data was straightforward and was done well by most candidates.

Candidates were asked to compare this value for the focal length of the lens with the value that they had calculated in **(c)** and to state whether their answers were the same within the limits of experimental accuracy. Most candidates were able to state whether or not their results supported the statement given. Far fewer candidates were able to give a convincing justification for their statements. The idea of experimental tolerances and whether two measured quantities are close enough to be considered equal was not well understood by the majority of candidates. Generally, if the values differ by 5 per cent or less, the expected answer is “yes, they are the same”. If the values differ by more than 10 per cent the expected answer is “no, they are different”. Between the values of 5 per cent and 10 per cent, either answer is acceptable provided that it is qualified by a phrase, such as “yes, they are close enough to be considered to be equal” or “no, they are too far apart to be considered to be equal”.

Question 4

Credit was available for a brief explanation of how candidates would set up the investigation. Most candidates drew a diagram of the apparatus used. The minimum acceptable diagram was a container containing ice cubes, but most candidates showed insulation around the container and a thermometer as well. Many candidates did not gain further credit for method because they used an external source of heat, such as a Bunsen burner to melt the ice cubes. A large number of candidates recorded the temperature of the ice at fixed intervals of time, which was not required. Candidates only needed to state that the time taken for the ice cubes to melt was measured. Most candidates gained credit by stating that the experiment would be repeated with at least two other insulating materials. Materials such as aluminium foil were not accepted.

Few candidates gained credit for listing the key control variables in this investigation, namely that the mass (or volume) of the ice cubes used should remain constant. However, most candidates were able to give other control variables and the most frequently chosen were the thickness of the insulation, the room temperature and the size or shape of the ice cubes.

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

Many candidates explained satisfactorily how they would use their results to reach a conclusion. The most common correct answer was that the times taken for the ice to melt would be compared and the longer the time, the better the insulator. A sizeable minority of candidates were under the incorrect impression that the ice would melt more quickly if the container was covered with a good insulator.

PHYSICS

Paper 0625/53
Practical Test

Key messages

- Candidates need to have had 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
- handling practical apparatus and making accurate measurements
- choosing the most suitable apparatus.

It is assumed that, as far as possible, the IGCSE course will be taught so that candidates undertake regular practical work as an integral part of their study of physics. Questions on experimental techniques were answered much more effectively by candidates who showed evidence of having regular experience of similar practical work.

Each Practical Test will include a question in which candidates are asked to outline a plan for an investigation. Answers to these questions should be based on careful reading of the question and the logical application of good experimental practice. Many candidates showed good practical knowledge when answering this question, but the strongest responses were where 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 recorded sensible potential difference and current values in the table with suitable precision. Occasionally, candidates recorded their values for potential difference in the column for current and vice versa.

(b) In general, values for resistance were calculated and rounded correctly.

(c) Most candidates labelled the axes correctly and most chose suitable scales, but many graphs with scale intervals of three were seen. Where candidates did not gain full credit for their graph, it was often due to the inaccuracy of plotting or a poorly drawn curve. Many candidates would have benefitted from more practice at drawing curved lines of best fit. Curves are not expected to pass through all plots and should be smooth. Some candidates did not recognise the need for a curve and drew a straight line of best fit instead.

(d) This proved to be a challenging question item for most candidates. Stronger candidates recognised that resistance increased with increasing temperature and were able to make this link from observing the increased brightness when increasing the length of the slide wire. Candidates were required to refer to the key terms of resistance, temperature, brightness and length in order to answer the question successfully.

(e) Candidates were given credit for drawing the correct symbol for a variable resistor and many were able to do this. However, fewer recognised that this had to be connected in series. Of those candidates that did not receive credit for their diagram, many had drawn a potentiometer circuit instead of using the variable resistor as stated in the question.

Question 2

(a) (i) Nearly all candidates manipulated apparatus correctly and as a result obtained, measured and recorded a sensible value for *v*.

(ii) The focal length was often correctly calculated but some candidates did not give a unit, and some gave an answer to 4 or more significant figures and therefore could not be fully credited.

(iii) Many candidates described how the screen should be manipulated, usually by moving it backwards and forwards. Some did not read the question carefully and instead went on to describe how they would avoid parallax error when measuring.

(b) Many candidates recorded sensible heights for the image and object and then correctly calculated the magnification and focal length. Some candidates incorrectly gave units of length for the magnification value.

(c) Candidates were often successful in answering this question. Most were able to recognise whether their two focal length values were close enough to be considered equal or not. A small number of candidates stated that their results did not support the suggestion even though they were very close as they did not recognise that the values are unlikely to be exactly the same due to experimental error.

(d) There were many alternative responses that could be awarded credit, but most candidates opted for an explanation of how to avoid parallax error. There were a number of candidates who referred to taking readings at eye level to avoid parallax error but this terminology is not always suitable in lens experiments. Therefore, candidates were required to describe that they would view the scale perpendicularly.

(e) Stronger candidates made references to uncertainty and how this affects large and small measurements, whilst others referenced difficulties in measuring to the centre of the lens or difficulties in measuring the image height as the image edges are sometimes not well-defined.

Question 3

(a) (i) Although most candidates were able to record the length of the spring successfully, some did not record this to the nearest mm.

(ii) Many candidates did not read this question carefully enough and despite the question stating that the spring was stationary, they went on to write that the spring must be kept still. The most common correct response was describing how to avoid parallax error. Those that drew a diagram were often able to gain credit for a ruler being drawn close to or in parallel with the spring.

(b) & (c) In general, candidates successfully measured and recorded the new lengths for each load and subsequently calculated correct extension values using the original length of the spring.

(d) Many candidates chose to use a calculation involving proportions to estimate the value of W_X, but this was not required. Candidates received credit for explaining that length l_X was closer to the length with a load of 2.0 N attached than with a load of 3.0 N and therefore the estimated value should have been around 2.2 N.

(e) Candidates were able to recognise the features of a directly proportional relationship on a graph but lacked understanding of the concept when interpreting tabulated data. Although most candidates stated that the data showed *e* to be directly proportional to *L*, most thought this was because the difference between the *e* values were all the same. Candidates needed to refer to the proportions and the fact that when *L* is doubled, *e* becomes double as well.

Question 4

Most candidates were able to associate this investigation with previous water-cooling experiments they had done as part of their course. This allowed them to consider important details in their plans and all candidates wrote with some confidence. This demonstrated the value of candidates being exposed to a wide variety of investigations that use all the skills outlined in the syllabus. Those candidates who followed the order of the bullet point list in the question often gave very relevant answers as they were less likely to miss out any of the required details and they did not waste their time including information that was irrelevant to the question. It was rare to see responses from candidates who had planned the wrong investigation but those that did make this error planned to investigate beaker thickness instead of lid thickness.

A minority of candidates overlooked the requirement to use a stopwatch even though they referred to measurements of time in their response.

A significant number of candidates did not achieve credit for their table either because they did not include a column where they would record the thickness of the lids being used, or they did not include units in the table headings.

Many candidates also did not get credit for their explanation as to how they would reach a conclusion, often because they wrote a prediction as opposed to how they would draw a conclusion from the results they would obtain.

PHYSICS

Paper 0625/61
Alternative to Practical

Key messages

- Candidates need to have had 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 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 experience of similar practical work. Some candidates appear to have learned sections from the mark schemes of past papers and gave responses that were not appropriate to the questions as they were set in this paper.

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(e)**, **1(f)**, **2(c)** and **3(e)**.

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) Many candidates appeared to have measured the distance *b* on the diagram which was not what the question asked for.

(ii) The calculation of *a*/*b* was carried out successfully by most candidates.

(b) Most candidates labelled the graph axes correctly and drew them the right way round. Some candidates ignored the advice that they didn't need to begin the axes at the origin 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 is clear. Many candidates drew a well-judged straight line but some drew a 'dot-to-dot' line whilst others drew a straight line that did not match the plots, usually by forcing the line to go through the origin or false origin.

(c) Here candidates needed to clearly show the triangle method on the graph. Many candidates achieved this. Further credit was awarded to those candidates who drew a triangle that used at least half of the line between the extreme plots.

(d) The correct value of *W* was equal to the value of *G* and was expected to be given to 2 or 3 significant figures. Further credit was awarded to those candidates who gave the unit N.

(e) Candidates were expected to explain that the rule should be balanced on the pivot with no load and that the centre of mass is then at the balance point. A significant number of those who did this did not add the detail required for full credit.

(f) Candidates were expected to record an aspect of the experiment that proved difficult in practice. Many sensibly chose to comment on the difficulty of achieving balance or the problem of the loads obscuring the reading on the rule.

Question 2

(a) (i) Most candidates recorded the potential difference and the current correctly and also included the appropriate units.

(ii) Most candidates calculated the resistance correctly.

(b) Here, the majority of candidates calculated the resistance correctly and included the unit Ω.

(c) In this question candidates were required to make a judgement based on the results. The justification needed to be clear and consistent with the results to gain credit. Most candidates gained partial credit, but many merely explained that $3 \times R_1$ was greater than R_3 without showing any understanding of the concept of results being beyond the limits of experimental inaccuracy.

(d) Most candidates drew the three lamps in parallel. One voltmeter in parallel with the lamps was often seen but the correct symbol for a variable resistor was less well known.

Question 3

(a) Most candidates recorded room temperature correctly.

(b) (i)&(ii) Many completed tables were seen with the expected time values and units. Some candidates recorded readings at 30 s intervals instead of 60 s intervals as required in the question.

(c) Most candidates calculated the temperature decreases correctly.

(d) (i) Here candidates were required to make a judgement based on the results.

(ii) The justification given needed to be clear and consistent with the results to gain credit. Correct reference to the temperature differences and time intervals were required.

(e) Successful candidates were able to analyse the question well and to give relevant answers. Use of insulation and use of a lid was often seen, for example. Some candidates appeared to be relying on answers they had learned from past papers that were not appropriate for this question. For example, some suggested that room temperature should be kept constant.

(f) Most candidates correctly drew a line perpendicular to the surface of a measuring cylinder to show the line of sight. Fewer included sufficient detail to show that the reading should be taken at the bottom of the meniscus.

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.

Candidates were expected to realise that the balls would move from left to right and back again along the track as viewed in **Fig. 4.1**. They were expected to briefly describe releasing a ball from a set position on the track and to measure the time taken for the ball to come to rest. This was then to be repeated several times with one factor being changed each time. Most chose to use balls of different masses but varying the curvature of the track was an alternative approach. In either case, candidates needed to be clear about the possible variables that were kept constant.

The table needed to include columns for mass (or the alternative variable chosen) and time with appropriate units.

Candidates were expected to explain how to reach a conclusion from their readings. The most straightforward response was to suggest a graph of mass (or the alternative variable chosen) against time. Candidates needed to be aware that they were being asked how to reach a conclusion and not to make a prediction about expected results.

PHYSICS

Paper 0625/62
Alternative to Practical

Key messages

- Candidates need to have had 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 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.

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

Some candidates had difficulty in deriving conclusions from given experimental data and justifying them.

Comments on specific questions

Question 1

(a) Most candidates quoted a sensible precaution to take to measure the length of the pendulum as accurately as possible. The most popular choice was to view the ruler scale perpendicularly. Avoiding parallax was not credited unless candidates stated what they would do to avoid such an error. Other correct acceptable answers that were not seen as frequently were to place the rule as close to the pendulum as possible, or to use a horizontal fiducial aid, such as a set square.`

(b) The reading shown by the stopwatch was usually recorded correctly in the table. Occasionally, the decimal point was replaced by a colon and this was not given credit. The values of T and T^2 were also usually calculated correctly, but some answers had incorrect rounding of truncated values.

(c) Candidates did not always choose horizontal and vertical scales that made use of at least half of the given grid. Despite the instruction given in the question that there was no need to start the axes from the origin, many candidates ignored this.

There was only a little evidence of the use of scales that increased in inconvenient increments, such as 3 or 7. Choosing such scales made the points much harder to plot by the candidates and more difficult for them to be seen clearly.

There were many excellent, carefully drawn, best-fit lines produced by candidates. However, there were some graphs where the candidates' attempts 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. There were also some graphs where the points were joined 'dot-to-dot'. The concept of best fit was clearly not well understood by all candidates.

(d) The gradient of the graph was usually correctly determined. Occasionally the instruction given in the question that candidates show clearly on their graphs how they obtained the information necessary to calculate the gradient was not followed. A minority of candidates used data points from the table to calculate the gradient of the line. Candidates should be made aware that this is an acceptable method if the data points lie on the best-fit line, but is not awarded credit if these points do not.

(e) Candidates were asked to calculate the acceleration of free fall by substituting their value of the gradient of the graph into a given equation. They were asked to write down their value for *g* to a suitable number of significant figures for this experiment. Although the calculation and subsequent rounding of the answer was usually correct, the number of significant figures quoted was often incorrect. Candidates must be encouraged to write down any calculated numerical answer in an experiment to the same number of significant figures as the data in the table. Only answers quoted to 2 or 3 significant figures were accepted here.

Question 2

(a) The current in the circuit was usually read correctly from the scales of the diagram provided. Common incorrect answers seen were 0.53 A and 0.64 A.

(b) The value of the resistance of 20.0 cm of the resistance wire was usually calculated correctly, but rounding errors were made by some candidates. Further credit for this question was awarded for quoting the resistance value to a sensible number of significant figures. Answers given to 2 or 3 significant figures were given credit.

The units given by candidates for the column headings were usually correct, but a number of candidates did not appear to have read this part of the question and omitted to give them.

(c) Most candidates realised that within the limits of experimental accuracy the results showed that the value of the resistance of the wire was directly proportional to its length. These candidates usually ticked the correct box from the list of options provided.

The justification of the conclusion proved to be far more difficult. The majority of candidates incorrectly thought that because the resistance of the wire increased as its length increased, that this was sufficient to deduce that the two quantities were directly proportional. Only stronger candidates were able to show or state that the ratio of resistance to length was constant, within the limits of experimental accuracy. Another acceptable justification was that doubling the length, doubled the resistance of the wire, etc.

(d) Most candidates were able to estimate the potential difference across a 50.0 cm length of resistance wire by using other values from the table of results. Most of these candidates went on to calculate a correct value for the resistance of the length of wire that they had estimated. Candidates were also asked to record their answer to a suitable number of significant figures for the experiment and to include a unit. Candidates should write down any calculated numerical answer in an experiment to the same number of significant figures as the data they have been provided with. Only answers quoted to 2 or 3 significant figures were accepted here. The unit of the answer was sometimes omitted, despite candidates being told to include it.

(e) Many candidature were able suggest a simple way to minimise the rise in temperature of the resistance wire in the experiment. The most common correct answers seen were to use a smaller current/voltage in the experiment or to switch off the circuit between readings to give the wire a chance to cool down. Other acceptable answers were to add a series resistor to the circuit or to use a thinner wire. Common answers which were not accepted were to take the readings quickly or to immerse the apparatus in water.

Question 3

(a) Candidates were required to measure the distance between the illuminated object and the screen on the diagram provided. However, most candidates gave the distance as 8 cm instead of 8.0 cm. Candidates must be taught to quote to the resolution of the ruler used when measuring the length of a line. If a ruler graduated in millimetres is used, and a line is an exact number of centimetres, such as 8 cm long, then its length must be quoted as 8.0 cm.

Candidates were then told that the diagram was $\frac{1}{10}$ full size. In attempting to determine the actual distance between the object and the screen. A number of candidates divided their measured distance by 10 instead of multiplying by 10.

(b) The focal length of the lens was usually calculated correctly by substitution into the equation provided but occasionally truncated answers were incorrectly rounded.

(c) The new value for the focal length of the lens was usually calculated correctly by substitution into the equation provided but occasionally truncated answers were incorrectly rounded.

The average of the two calculated values of the focal length of the lens was usually calculated correctly. Again, answers which were incorrectly rounded or not quoted to 3 significant figures could not be credited.

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

(e) This calculation of the new distance between the illuminated object and the screen, when the screen was moved a further 40.0 cm away from the object proved challenging for many candidates.

The calculation of a third value of the focal length of the lens from the given data was straightforward and was done well by most candidates.

Candidates were asked to compare this value for the focal length of the lens with the average value that they had calculated in **(c)(ii)** and to state whether their answers were the same within the limits of experimental accuracy. Most candidates were able to state whether or not their results supported the statement given. Far fewer candidates were able to give a convincing justification for their statements. The idea of experimental tolerances and whether two measured quantities are close enough to be considered equal was not well understood by the majority of candidates. Generally, if the values differ by 5 per cent or less, the expected answer is ‘yes, they are the same’. If the values differ by more than 10 per cent the expected answer is ‘no, they are different’. Between the values of 5 per cent and 10 per cent, either answer is acceptable provided that it is qualified by a phrase, such as ‘yes, they are close enough’ to be considered to be equal or ‘no, they are too far apart’ to be considered to be equal.

Question 4

Credit was available for a brief explanation of how candidates would set up the investigation. Most candidates gained partial credit by drawing a diagram of the apparatus used. The minimum acceptable diagram was a container containing ice cubes, but most candidates showed insulation around the container and a thermometer as well.

Many candidates did not gain further credit for method because they used an external source of heat, such as a Bunsen burner to melt the ice cubes. A large number of candidates recorded the temperature of the ice at fixed intervals of time which was not necessary. All that was required was for candidates to state that the time taken for the ice cubes to melt was measured.

Most candidates gained credit for stating that the experiment would be repeated with at least two insulating materials. Materials such as aluminium foil were not accepted.

Few candidates gained credit for listing the key control variables in this investigation, namely that the mass (or volume) of the ice cubes used should remain constant. However, most candidates were able to give other control variables and the most frequently chosen were the thickness of the insulation, the room temperature and the size or shape of the ice cubes.

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

Many candidates explained satisfactorily how they would use their results to reach a conclusion. The most common correct answer was that the times taken for the ice to melt would be compared and the longer the time, the better the insulator. However, a sizeable minority of candidates were under the incorrect impression that the ice would melt more quickly if the container was covered with a good insulator.

PHYSICS

Paper 0625/63
Alternative to Practical

Key messages

- Candidates need to have had 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
- 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 gave responses that were not appropriate to the questions as they had been set. The practical nature of the examination should be kept in mind 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 question and the logical application of sound experimental practice. Many candidates showed good practical knowledge when answering this question, but the strongest responses were where 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) Whilst most candidates drew a voltmeter in parallel with the lamp, a significant number drew the symbol in various other places including on the slide wire.

(b) The vast majority of candidates read the displays of the ammeter and voltmeter correctly and subsequently calculated the resistance correctly. A common error was to record the reading from the ammeter as 1.4 A instead of 0.14 A.

(c) Most candidates labelled the axes correctly and most chose suitable scales, but many graphs with scale intervals of 3 were seen. Where candidates did not get full credit for their graph, it was often due to the inaccuracy of plotting or a poorly drawn curve. It appeared that many candidates would have benefitted from more practice at drawing curved lines of best fit. Curves are not expected to pass through all plots and should be smooth. Some candidates did not recognise the need for a curve and drew a straight line of best fit instead.

(d) This proved to be a challenging question. Often candidates were able to recognise the relationship between resistance and temperature but were unable to justify this with reference to the graph. Some candidates just stated the relationship between resistance and length without any reference to temperature, as required by the question.

(e) Candidates were given credit for drawing the correct symbol for a variable resistor and many were able to do this. However, fewer candidates recognised that this had to be connected in series. Of those candidates that did not receive credit for their diagram, many had drawn a potentiometer circuit instead of using the variable resistor as stated in the question.

Question 2

(a) (i) Generally, candidates measured and recorded the lengths of *u* and *v* correctly. The exact length to the nearest millimetre was required and therefore candidates needed to take measurements with care. There were some candidates who gave values a millimetre too large or small.

(ii) Often candidates were able to apply the scale correctly to obtain the actual distances. However, there were some incidences where candidates had divided instead of multiplying by 5.

(iii) Whilst most candidates correctly calculated the focal length, some candidates did not give a unit, and some gave an answer to 4 or more significant figures and therefore could not gain full credit.

(iv) Many candidates described how the screen should be manipulated mostly by moving it backwards and forwards. Some did not read the question carefully and instead went on to describe how they would avoid parallax error when measuring or gave a description about moving the lens instead of the screen.

(b) (i) Generally, candidates measured and recorded the lengths correctly. The exact length to the nearest millimetre was required and candidates needed to take measurements with care since there were some candidates who gave values a millimetre too large or small.

(ii) The vast majority of candidates calculated the magnification correctly. Candidates often did not gain credit due to incorrectly giving a unit of length with their answer, e.g. centimetres.

(iii) The second focal length was correctly calculated by most candidates.

(c) Candidates were often successful in answering this question. Most were able to recognise whether their two focal length values were close enough to be considered equal or not. A small number of candidates stated that their results did not support the suggestion even though they were very close as they did not recognise that the values are unlikely to be exactly the same due to experimental error.

(d) There were many alternative responses gained credit, but most candidates chose an explanation of how to avoid parallax error. There were a number of candidates who referred to taking readings at eye level to avoid parallax error but this terminology is not always suitable in lens experiments. Candidates were required to describe that they would view the scale perpendicularly.

(e) Stronger candidates made references to uncertainty and how this affects large and small measurements whilst others referenced difficulties in measuring to the centre of the lens or difficulties in measuring the image height as the image edges are sometimes not well-defined.

Question 3

(a) Many candidates did not read the question carefully and despite the question stating that the spring was stationary, they went on to write that the spring must be kept still. The most common correct response was to describe how to avoid parallax error. Candidates who drew a diagram were often able to gain credit for a ruler being drawn close to or in parallel with the spring.

(b) In general, candidates successfully calculated extension values using the original length of the spring.

(c) (i) Generally, candidates measured and recorded the length correctly. The exact length to the nearest millimetre was required and therefore candidates needed to take measurements with care since there were some candidates who gave values a millimetre too large or small.

(ii) Many candidates chose to use a calculation involving proportions to estimate the value of W_X, but this was not required. Candidates would have received credit merely by explaining that length l_X was closer to the length with a load of 2.0 N attached than with a load of 3.0 N and therefore the estimated value should have been around 2.2 N.

(d) Whilst most candidates recognised that the value had been quoted to too many significant figures, they were often unsure about why it was too many. The strongest candidates were able to link this back to the number of significant figures used for the previous values given in the question.

(e) Candidates were able to recognise the features of a directly proportional relationship on a graph but lacked understanding of the concept when interpreting tabulated data. Although most candidates stated that the data did show *e* to be directly proportional to *L*, most thought this was the case because the difference between the *e* values were all the same. Candidates needed to refer to the proportions and the fact when *L* is doubled *e* becomes double as well.

Question 4

Most candidates were able to associate this investigation with previous water-cooling experiments they had done as part of their course. This allowed them to consider important details in their plans and all candidates wrote with some confidence. This demonstrated the value of candidates being exposed to a wide variety of investigations that use all the skills outlined in the syllabus. Those candidates who followed the order of the bullet point list in the question often gave very relevant answers as they were less likely to miss out any of the required details and they did not waste their time including information that was irrelevant to the question. It was rare to see responses from candidates who had planned the wrong investigation but those that did make this error planned to investigate beaker thickness instead of lid thickness.

A minority of candidates overlooked the requirement to use a stopwatch even though they referred to measurements of time in their response.

A significant number of candidates did not achieve credit for their table either because they did not include a column where they would record the thickness of the lids being used, or they did not include units in the table headings.

Many candidates also did not get credit for their explanation as to how they would reach a conclusion, often because they wrote a prediction as opposed to how they would draw a conclusion from the results they would obtain.