PHYSICS

Paper 0625/11
Multiple Choice core

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

Key messages

Candidates should be reminded to read the questions carefully to ensure they understand what is being asked.

General comments

Candidates answered questions **4**, **10**, **11**, **15**, **22**, **24** and **28** well but found questions **3**, **5**, **7**, **13**, **18**, **21**, **23**, **26**, **34**, **35** and **40** more challenging.

Comments on specific questions

Question 3

Many candidates failed to work through the problem logically. Most candidates, incorrectly took the total time taken to be the average of the times for the first 300 m and the second 300 m as the average time. They then used this figure to calculate the average speed.

Question 4

Most candidates recognised that weight is measured in newtons.

Question 5

Many candidates did not calculate the mass of the blocks from the weight. Of those who correctly did this, many did not divide their answer by four in order to calculate the mass of a single block, which demonstrated their inexperience in tackling two stage problems.

Question 7

Only the strongest candidates answered this question correctly. Most candidates chose the spring with the greatest extension, ignoring the original length.

Question 11

Most candidates showed an understanding of the term “power”.

Question 13

The majority of candidates incorrectly thought that the width of the tube would alter the height of the liquid column and showed little understanding of this method of measuring pressure.

Question 18

Only the strongest candidates answered this question correctly.

Question 21

Stronger candidates answered correctly. However, many candidates correctly identified the change of direction of propagation of the waves, but incorrectly thought that the wavelength (and hence the speed) of the waves would decrease on entering the deep water.

Question 23

This was a challenging question for many candidates. Candidates needed to identify the principal focus, then trace the two rays from the lens to the screen in order to determine the size of the image.

Question 33

Only the strongest candidates answered this question correctly.

Question 34

Many candidates did not recognise that the role of either a circuit-breaker or a fuse is to disconnect the live wire from the appliance and so did not select the correct answer.

Question 35

Few candidates answered this question correctly. The most common response chosen (the transformer) relies on the alternating magnetic field in an iron core and does not involve movement of any kind.

Question 40

Few candidates understood the term half-life with all options being selected by candidates.

PHYSICS

Paper 0625/12
Multiple Choice core

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

Key messages

Candidates should be reminded to read the questions carefully to ensure they understand what is being asked.

General comments

Candidates answered questions **4**, **5**, **7**, **9**, **10**, **16**, **23**, **28** and **30** well but found questions **2**, **14**, 1**7**, **19**, **21**, **29**, **31**, **32**, **33**, **34**, and **35** more challenging.

Comments on specific questions

Question 2

This question was challenging for many candidates. Most candidates clearly saw the term “distance travelled” and immediately looked at the area under the graph in each section, without noticing that the complete phrase was “distance travelled per second”, which they should have been able to interpret as speed.

Question 4

Most candidates recognised that weight is measured in newtons.

Question 5

Candidates showed a good understanding of the concept that mass is independent of the gravitational field, but weight is dependent on it.

Question 7

This was usually answered correctly.

Question 9
This question was answered well and candidates thought their way through the problem clearly and recognised that the centre of mass of the lamina moved towards the bottom of the page.

Question 14

The majority of candidates incorrectly thought that the width of the tube would alter the height of the liquid column and showed little understanding of this method of measuring pressure.

Question 17

Many candidates thought that the container with the larger thermal capacity would have the higher temperature. They failed to recognise that the larger the thermal capacity of the container, the more energy is transferred from the water to the container.

Question 18

This question was usually answered correctly.

Question 19

This question was challenging for many candidates. Some thought that the density of a fluid did not decrease with rising temperature and others thought that convection does not help an even temperature distribution in a pan of water when it is heated. Few recognised that the phrase, “heat rises”, is an incorrect common belief.

Question 21

Stronger candidates answered correctly. However, many candidates correctly identified the change of direction of propagation of the waves, but incorrectly thought that the wavelength (and hence the speed) of the waves would decrease on entering the deep water.

Question 23

The question was answered well and candidates showed an understanding that the rays from a point on an object converge and intersect at a point after refraction at the lens.

Question 29

The question was not answered well by many candidates. Candidates needed to take care when reading instruments where the scale divisions are not equivalent to 1 or 0.1, etc.

Question 30

The majority of candidates understood how ammeters and voltmeters are connected into a circuit.

Question 31

Only the strongest candidates answered this question correctly.

Question 32

In this question candidates either did not recognise the circuit diagram symbol of the thermistor or did not recognise that the thermistor is a temperature dependent device.

Question 33

The most common error in this question was for candidates to fail to recognise that the transformer is an a.c. device and will not produce an output using d.c.

Question 34

Many candidates did not recognise that the role of either a circuit-breaker or a fuse is to disconnect the live wire from the appliance and so did not select the correct answer.

Question 35

Only the strongest candidates answered this question correctly.

PHYSICS

Paper 0625/13
Multiple Choice core

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

Key messages

Candidates should be reminded to read the questions carefully to ensure they understand what is being asked.

General comments

Candidates answered questions **2**, **4**, **7**, **16**, **19**, and **28** well but found questions **5**, **9**, **11**, **13**, **17**, **21**, **22**, **25**, **26**, **29**, **33**, **34**, **35** and **40** more challenging.

Comments on specific questions

Question 4

Most candidates recognised that weight is measured in newtons.

Question 5

Only the strongest candidates answered this question correctly, with most candidates either forgetting to convert the grams into kilograms or dividing the 100 g by *g* before multiplying by the acceleration due to gravity on Mars.

Question 7

Candidates showed a good understanding of equilibrium and most correctly identified the one block in equilibrium.

Question 9

Some candidates found this question challenging and showed little understanding of the method of determining the centre of mass of a lamina.

Question 11

Some candidates confused work done with power and others thought that useful work is done when an object is held stationary above the ground

Question 13

The majority of candidates incorrectly thought that the width of the tube would alter the height of the liquid column and showed little understanding of this method of measuring pressure.

Question 16

Candidates showed a good knowledge of the relative expansions of solids, liquids and gases.

Question 17

Many candidates were not aware that there is no change in the average speed of the particles as a gas condenses to form a liquid. The only change is a reduction in their potential energy as their separation decreases.

Question 19

Candidates showed a good understanding of energy transfer by conduction.

Question 21

Stronger candidates answered correctly. However, many candidates correctly identified the change of direction of propagation of the waves, but incorrectly thought that the wavelength (and hence the speed) of the waves would decrease on entering the deep water.

Question 22

Only the strongest candidates answered this question correctly, with many candidates thinking that the ray of light would make an angle of 45° with the table.

Question 24

Candidates showed a good knowledge of the regions of the electromagnetic spectrum that are used for specific jobs.

Question 25

Few candidates knew the basic fact that sound is transmitted by longitudinal waves and many were unaware that an echo is a reflection of a sound wave.

Question 26

Only the strongest candidates answered this question correctly.

Question 28

This question was answered well and candidates showed a good understanding of the mutual forces between charged objects.

Question 29

Most candidates were either unaware of what e.m.f. stands for or did not read the responses with sufficient care.

Question 33

Many candidates ignored the presence of the 4 Ω resistor, only using the value of the 2 Ω when calculating the current in the circuit.

Question 34

Many candidates did not recognise that the role of either a circuit-breaker or a fuse is to disconnect the live wire from the appliance and so did not select the correct answer.

Question 35

There was little understanding of the concepts of the motor effect. The spread of the responses indicated that there was widespread guessing.

Question 38

Another question where detailed and careful reading was requires. The question referred to the nucleus of carbon, not the atom itself. Many candidates chose the response which described the complete atom.

PHYSICS

Paper 0625/21
Multiple Choice Extended

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

Key messages

Candidates should be reminded to read the questions carefully to ensure they understand what is being asked.

General comments

Candidates answered **Questions 5**, **7**, **9**, **11**, **14**, **16**, **22**, **29** and **39** well but found **Questions 8**, **12**, **13**, **21**, **31**, **33**, **34**, more challenging.

Comments on specific questions

Question 7

Candidates showed a good understanding of the difference between vectors and scalars.

Question 8

Only the strongest candidates answered this question correctly. The most common error was to fail to recognise that the change in momentum was 50 kg m s^{-1} (25 – (–25)). In addition, a lot of candidates did not notice that the time was given in milliseconds.

Question 12

The majority of candidates incorrectly thought that the width of the tube would alter the height of the liquid column and showed little understanding of this method of measuring pressure.

Question 13

Many candidates did not take sufficient care when considering consistency of units. Only a relatively small percentage recognised that the area of the plug was in cm^2.

Question 14

Candidates showed a good understanding of Brownian Motion.

Question 21

Stronger candidates answered correctly. However, many candidates correctly identified the change of direction of propagation of the waves, but incorrectly thought that the wavelength (and hence the speed) of the waves would decrease on entering the deep water.

Question 22

Most candidates were aware that the image in a plane mirror is virtual.

Question 23

Only the strongest candidates answered this question correctly. Candidates needed to identify the principal focus, then trace the two rays from the lens to the screen in order to determine the size of the image.

Question 24

Candidates showed a good knowledge of the regions of the electromagnetic spectrum that are used for specific jobs.

Question 31

This question proved challenging for many candidates. Candidates needed to recognise that the thermistor's resistance increases as the temperature decreases, thus the current in the circuit decreases, the p.d. across the resistor decreases and therefore the p.d. across the thermistor increases.

Question 33

Stronger candidates answered this question correctly. Weaker candidates did not recognise the logic gates that were being used and failed to work their way through the truth table.

Question 34

Many candidates did not recognise that the role of either a circuit-breaker or a fuse is to disconnect the live wire from the appliance and so did not select the correct answer.

PHYSICS

Paper 0625/22
Multiple Choice Extended

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

Key messages

Candidates should be reminded to read the questions carefully to ensure they understand what is being asked.

General comments

Candidates answered **Questions 2**, **3**, **5**, **7**, **14**, **16**, **30**, **37**, **38** and **39** well but found **Questions 10**, **11**, **12**, **13**, **17**, **18**, **19**, **and 29** more challenging.

Comments on specific questions

Question 2

Candidates showed that they understood that the acceleration is given by the gradient of a speed-time graph.

Question 3

Generally, candidates were able to work correctly to identify the correct response.

Question 7

This was usually answered correctly and candidates understood that the effect of removing the top part of the lamina caused the centre of mass to move to a lower position.

Question 10

The question required candidates to equate the loss of gravitational potential energy with the gain in kinetic energy. Relatively few successfully completed the task. The most common error was to ignore the $\frac{1}{2}$ in the formula $E_k = \frac{1}{2}mv^2$.

Question 11

Only the strongest candidates answered this question correctly. The majority of candidates simply calculated the work done against gravity (the gravitational potential energy) ignoring the work done in accelerating the object (the kinetic energy).

Question 12

The majority of candidates incorrectly thought that the width of the tube would alter the height of the liquid column and showed little understanding of this method of measuring pressure.

Question 13

Many candidates did not take sufficient care when considering consistency of units. Only a relatively small percentage spotted that the area of the plug was in cm^2.

Question 17

Although some candidates identified the correct temperature rise, a large number thought the rise would be $\frac{\theta}{2}$.

Question 18

Most candidates thought that the thickness of the wall of the bulb would affect the sensitivity of a thermometer. The effect is that the thermometer reacts more quickly to a change in temperature, but this does not make it more sensitive.

Question 29

Although most candidates recognised that the relationship between the diameter and the resistance of a conductor is an inverse relationship, many did not recognise that the resistance is proportional to the cross sectional area of the conductor, hence it is inversely proportional to the diameter squared.

Question 33

Stronger candidates answered this question correctly. Weaker candidates did not recognise the logic gates that were being used and failed to work their way through the truth table.

Question 34

Many candidates did not recognise that the role of either a circuit-breaker or a fuse is to disconnect the live wire from the appliance and so did not select the correct answer.

Question 38

Although this was a challenging question, many candidates answered correctly.

Question 39

Most candidates had little difficulty in identifying the different radiations, from their penetration through different materials.

PHYSICS

Paper 0625/23
Multiple Choice Extended

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

Key messages

Candidates should be reminded to read the questions carefully to ensure they understand what is being asked.

General comments

Candidates answered **Questions 5**, **6**, **9**, **14**, **15**, **16**, **17**, **19**, **32**, **37**, **39** and **40** well but found **Questions 10**, **13**, **26**, **29**, **30**, **and 31** more challenging.

Comments on specific questions

Question 6

This question required a two part calculation: calculation of acceleration and then substitution into and rearrangement of the formula, $F = m\,a$. Most candidates answered well.

Question 10

The majority of candidates incorrectly thought that the force up the slope was equal to the weight of the barrel, rather than calculating it by equating the work done to the gravitational energy gained and then using the formula, work done = force · distance.

Question 12

The majority of candidates incorrectly thought that the width of the tube would alter the height of the liquid column and showed little understanding of this method of measuring pressure.

Question 13

Many candidates did not take sufficient care when considering consistency of units. Few candidates recognised that the area of the plug was in cm^2.

Question 26

Only the strongest candidates answered this question correctly. Lines of magnetic flux (field lines) show the direction of the force on an isolated north pole when placed in a magnetic field. Consequently, they can neither cross nor touch, otherwise the isolated North Pole would have two different forces, acting in different directions at the same time. Few candidates were aware of this.

Question 29

Few candidates answered this question well. A considerable number thought that the current is proportional to the applied p.d. This is not so because as the current is increased, the lamp filament is heated to white heat and consequently its resistance increases.

Question 36

There was little understanding of the concepts of the motor effect. The spread of responses suggested that many candidates guessed at the answer here.

Question 39

Candidates had little difficulty in identifying the different radioactive emissions.

Question 40

Candidates showed an understanding of the meaning of half-life, and calculated the half-life of this isotope correctly.

PHYSICS

Paper 0625/31
Core Theory

Key messages

In calculations, candidates should be reminded to set out and explain their working correctly. If no working is shown it is not possible for credit to be awarded for any correct calculations even when the final answer is incorrect.
When answering questions requiring a description or explanation, candidates should make sure their answers are clear and precise.
It is important that candidates read the questions carefully in order to understand exactly what is being asked.

General comments

Most candidates were well prepared for this paper. Equations were generally well known but a significant number of weaker candidates struggled to even recall the equations.

Often candidates were able to apply their knowledge and understanding to fairly standard situations. More successful candidates were able to think through the possibilities and apply their knowledge when the question asked for suggestions to explain new situations. Less successful 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 questions on moments, describing how to determine resistance and explaining the effect of increased resistance on size of current in a circuit were generally not well answered. There were a significant number of candidates who either did not read the questions carefully enough, or who gave answers that were related to the topic being tested, but did not answer the question as it had been set in enough detail to receive credit.

There was a very small number of candidates who struggled to express themselves adequately.

Comments on specific questions

Question 1

(a) (i) Most candidates gave descriptions detailed enough to gain full credit.

(ii) Most candidates gained full credit, but weaker candidates sometimes made errors, such as using the wrong times.

(b) The majority of candidates gained at least partial credit for calculating an average speed, but only the strongest candidates correctly added the two distances and divided by the total time.

Question 2

(a) (i) The majority of candidates answered correctly, but a significant number thought that this downward arrow represented an upthrust or friction.

(ii) Most candidates calculated mass correctly, but a significant number divided the correct answer by 100 or 1000.

(b) Almost all candidates correctly determined the size and direction of the resultant force. A significant number gave the direction as east, but did not indicate where east was on the diagram.

Question 3

(a) The majority of candidates gained at least partial credit. A common error was to give the unit as N/m. Many candidates thought that the moment was calculated by dividing the force by the distance from the pivot.

(b) The majority of candidates scored full credit. However, a significant number failed to show any working, and earned no credit. Candidates should be encouraged to state the equation they are using, and then to show substitution of values into the equation.

Question 4

(a) Almost all candidates drew a correct arrangement of particles in gas, and most also gained credit for the arrangement in a solid. However, often candidates left too many gaps between the particles in the particle arrangement.

(b) The majority of candidates gained full credit by giving the correct changes of state.

(c) There were many correct explanations of evaporation. Most candidates showed a good understanding of the physics involved in this process.

Question 5

(a) Most candidates correctly stated that the stored energy was gravitational potential energy, but many others gave answers such as electric energy or hydroelectric energy.

(b) Most candidates gained at least partial credit on this question. The most common error was to not mention that the turbine turned a generator which produced electrical energy. Most candidates seemed to think that the turbine generated electricity.

Question 6

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

(b) Many candidates did not answer this correctly and circled materials that were not good conductors of thermal energy.

(c) Many candidates drew very clear labelled diagrams to assist with their description of a suitable experiment, and often went on to score full credit.

Question 7

(a) (i) Almost all candidates correctly identified ultraviolet as the missing radiation.

(ii) Many candidates correctly identified the property as wavelength, but almost as many thought it was frequency.

(iii) Some candidates stated that the two speeds were the same, but the majority thought that one or the other was faster.

(b) (i) The majority of candidates gave suitable descriptions of checking bags or people for hidden or illegal material.

(ii) Only stronger candidates recognised that the key property involved in the use of X-rays in security checks was their ability to penetrate less dense materials and to be absorbed by more dense materials.

Question 8

(a) (i) Most candidates recognised that the sound was produced by vibrations.

(ii) A significant number of candidates gave the wrong range of frequencies audible to the healthy human ear, or did not give any range at all.

(b) Most candidates gained credit for drawing a quieter sound, but many drew a sound with the same or even higher frequency.

Question 9

(a) Many candidates scored full credit, but a significant number talked about the movement of protons or positive charges.

(b) The majority of candidates were able to explain how to determine the charge on the balloon.

Question 10

(a)(i) Almost all candidates gave the correct symbols, and most had them correctly connected.

(ii) This question was challenging for many candidates. Candidates should be encouraged to practise writing descriptions for experiments covered by the specification.

(b) Only stronger candidates gained full credit for this question. Many candidates believed that because the resistors were connected in series, the size of the current would not be altered.

Question 11

(a) Candidates who set out a correct equation and substituted values often gave correct answers. Candidates who attempted to use some form of ratios often failed to score any credit.

(b) The majority of candidates gave correct descriptions of the coil arrangements in step-up and step-down transformers. Weaker candidates merely stated that they increased or decreased the voltage.

(c) The majority of candidates gained at least partial credit, although weaker candidates thought that the higher voltage helped to prevent the loss of electricity.

Question 12

(a) The majority of candidates answered well and this topic was well understood by most candidates.

(b) Most candidates were able to give at least one similarity and one difference between the two isotopes.

(c) Many candidates found this question challenging. Few candidates attempted to determine the number of half-lives that had passed during the decay from the new to the old wood.

PHYSICS

Paper 0625/32
Core Theory

Key messages

In calculations, candidates must show clear working to support their answers. Where no working is shown, it is not possible for candidates to be awarded marks for any correct working when the final answer is incorrect.
Candidates should use the marks at the end of a question as a guide to the form and content of their answer.

General comments

Many candidates were well prepared for this paper. Equations were well known by the vast majority of candidates.

The questions on the manometer, energy transfers and the generator were generally only answered well by stronger candidates. There were a significant number of candidates who either did not read the questions carefully enough, or who gave answers that were related to the topic being tested, but did not answer the question as it had been set.

Often candidates were able to apply their knowledge and understanding to fairly standard situations. On occasions, when asked to apply their knowledge to a new situation, they displayed a lack of breadth of understanding. More successful candidates were able to think through the possibilities and could apply their knowledge when the question asked for suggestions to explain new situations.

There was a small number of candidates who struggled to express themselves adequately.

Comments on specific questions

Question 1

(a) Most candidates correctly identified YZ as the decelerating section and XY as the constant speed section of the speed time graph.

(b) Most candidates correctly used the area under the graph or average speed · time to calculate distance. Weaker candidates attempted to use the speed formula but did not use average speed. Correct answer 400 (m).

(c) The strongest candidates gave the steeper gradient as their answer. Weaker candidates stated that less time was spent accelerating than decelerating, which was insufficient without an indication that the speed change was the same.

Question 2

(a) Most of the stronger candidates correctly identified the units as kg, m, m^2. Weaker candidates often gave g, cm, cm^2.

(b) (i) The majority of candidates correctly calculated weight. A minority divided mass by 10.

(ii) Most stronger candidates used the pressure formula correctly. Some candidates could not recall the correct formula. Others overlooked the fact that there were four feet. Some candidates did not give the correct unit for pressure.

Question 3

(a) Only stronger candidates were able to identify the manometer. Many other candidates stated that it was a barometer.

(b) Stronger candidates were able to make the link between air pressure and the difference in liquid levels.

(c) This question was challenging for many candidates. Many stated that level A would go down and level B would go up. Some commented on pressure change but did not state what would happen to the levels.

Question 4

(a) Many candidates gave good answers. Some candidates used the term “potential” energy for the first part without specifying it was chemical.

(b) Many candidates struggled to link a large quantity of potential energy with height and small quantity of kinetic energy with low speed.

(c) Only the strongest candidates identified the wasted energy and what happened to it.

Question 5

(a) Only a few of the strongest candidates understood the term thermal capacity.

(b) Almost all candidates demonstrated excellent knowledge of the phase changes.

(c) Many candidates stated the pressure would increase but fewer went on to explain this in terms of the increased kinetic energy of the molecules and more frequent/harder collisions with the container.

Question 6

(a) (i) Many candidates found it challenging to determine the correct direction of the refracted ray at each surface. Normals were often drawn at angles other than at 90° to the surface.

(ii) Stronger candidates answered this well but weaker candidates found it more of a challenge with diffraction and reflection amongst the more frequently seen incorrect answers.

(b) Most candidates correctly showed the rays converging and intersecting.

Question 7

(a) Most candidates correctly identified the colours of the spectrum and placed them in the correct sequence.

(b) (i) Most candidates linked the use to the correct type of radiation. The most frequent error was linking the detection of an intruder at night with visible light.

(ii) Most candidates correctly identified frequency.

Question 8

(a) Most candidates correctly identified 20 Hz–20 000 Hz as the range for a healthy human ear.

(b) Only stronger candidates correctly explained that the term ultrasound was about frequencies above 20 000 Hz. A significant number of candidates described the uses of ultrasound.

(c) Many candidates identified sound P as having smaller amplitude and lower frequency. A minority went on to link this to a quieter and lower pitch sound.

Question 9

(a) Most candidates correctly mentioned a magnetic field. Many stronger candidates went on to say this was changing, resulting in an induced voltage/current.

(b) Most candidates identified at least one way to increase the brightness. Most of the stronger candidates were able to identify three ways.

(c) (i) Only the strongest candidates were able to correctly give the answer “alternating current”. Many candidates put “alternative current” or described what it was.

(ii) Most of the stronger candidates were able to describe how a.c differs from d.c.

Question 10

(a) Most candidates correctly named the variable resistor.

(b) Most candidates gave the correct current.

(c) The vast majority of candidates correctly calculated the resistance.

(d) Although many candidates stated the correct relationship between resistance and current, many stated that a thicker wire would have less current. Stronger candidates correctly stated that there would be more current through the thicker wire.

Question 11

(a) Most candidates correctly drew two circles with a clockwise arrow.

(b) Most of the stronger candidates gave a good description of how the bell worked. Weaker candidates just described the flow of current round the circuit.

Question 12

(a) The vast majority of candidates matched the parts of the atom to the correct descriptions.

(b) (i) Most candidates correctly stated that an isotope has the same number of protons but different number of neutrons.

(ii) Most candidates were able to take information from the graph and calculated the half-life.

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 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

The non-numerical questions were more challenging than numerical questions for many candidates.

Some areas of the syllabus were better known than others. In particular, energy transfers and resources, general waves properties, refraction/dispersion, 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.

Comments on specific questions

Question 1

(a) (i) Many correct answers were seen here. The most common error was to misread the seconds as minutes and the hundredths of a second as seconds giving an incorrect answer of 84, 74 and 76.

(ii) Most candidates were successful in answering this question, often writing the correct answer without any working.

(b) A large number of candidates answered this question well and many showed both the correct equation and full working. Weaker candidates often used an incorrect equation, i.e. speed = distance · time or gave no response.

(c) Many candidates understood that the distance travelled was equal to the area under the graph and also applied this knowledge successfully. However, a significant number of candidates were only able to work out the time for the water to fall or gave no response.

Question 2

(a) Many candidates answered correctly. A common error was to multiply the weight by 10 instead of dividing by 10.

(b) (i) This was answered very well, with many candidates gaining full credit. However some candidates forgot to subtract the original volume of water from the volume of water and metal.

(ii) Many candidates realised that the wood would float/not sink and so would not displace any water.

(iii) The calculation was well answered by the majority of candidates. However, few candidates gave the appropriate unit in their answer.

Question 3

(a) Stronger candidates were able to give a thorough description. However, many candidates just stated "the wind moves the turbine". When more detail was given, candidates often failed to realise that it is the generator that generates electricity not the turbine.

(b) Many candidates simply stated "pollution" or "environmental damage" which was too vague. Fuller answers based on using coal as it is more reliable/not wind dependent and/or non-renewable were frequently seen.

Question 4

(a) (i)(ii) Most candidates gained at least partial credit for this question. The only recurring error seen was "cooling" instead of "condensing". Some candidates did not give an answer for this question.

(b) Many candidates indicated that the particles move randomly in a liquid. The other correct response was seen less frequently. A common incorrect answer given was that the particles are in a regular pattern.

Question 5

(a) Many correct answers were seen but a common error was distance D.

(b) Few correct answers were seen. The majority of the candidates did not show an understanding of the term "frequency".

(c) (i) This question was answered well by most candidates. Transverse was the most common error.

(ii) This question was challenging for many candidates. Common incorrect answers given were "transverse" or "the wave produced by throwing a stone in water". A number of candidates gave no answer for this question.

(iii) Only stronger candidates answered this correctly. Many candidates did not seem to fully understand how to determine the wavelength of a longitudinal wave.

Question 6

(a) (i)(ii) Only stronger candidates understood the terminology associated with ray diagrams, normals and/or the refraction of light. However, many candidates gained partial credit.

(b) (i) The correct answer of "dispersion" was only given by the strongest candidates.

(ii) Most candidates found this question very challenging and the most common answers given were "red" or "green".

Question 7

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

(b) Most candidates gave the correct answer but a noticeable number thought that healthy human ears could hear sounds in the range 2.0 Hz to 2000 Hz.

(c) Most candidates gave the correct answer. However, some thought that increasing the amplitude of a sound wave increased its frequency.

(d) Many candidates answered correctly but a significant number thought that an echo was produced when sound was refracted.

Question 8

(a) This was well answered by the majority of candidates. The only recurring errors were an incorrect or contradictory field direction.

(b) (i) Few candidates knew this was an electromagnet. Many thought it was an a.c. generator or gave no response.

(ii)(iii) Very few correct answers were seen to either parts and many candidates gave no response. The different magnetic properties of iron and steel did not seem to be fully understood.

Question 9

(a) There was some confusion between the current in a series and parallel circuit, and few candidates answered this question correctly.

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

(c) (i)(ii) Few correct answers were seen to either question and many candidates gave no response. Candidates did not seem to fully understand series and parallel circuits.

(d) A number of candidates answered this question well. Weaker candidates often used an incorrect equation, i.e. potential difference = current divided by resistance or gave no response. Units were often incorrectly given.

Question 10

(a) Many candidates knew that the component was a resistor but its purpose was less well known.

(b) (i) Few correct answers were seen. Many candidates stated that the type of supply should be electrical or gave no response.

(ii) Some correct answers were seen but many candidates just said that the lamp would come on or gave no response.

(iii) Some correct answers were seen. However, many candidates said that the fan would stop, go into reverse or gave no response.

(c) Many candidates gained some credit here, usually for the hazard. The safety feature was not fully appreciated. Common incorrect answers were wearing (plastic) gloves or surrounding the metal case with an insulator.

Question 11

(a) (i) Very few correct answers were seen for this question.

(ii) A number of candidates gained at least partial credit with a significant number achieving full credit. A common error was to refer to using bigger magnets instead of stronger or more powerful magnets.

(b) A number of candidates answered this question well. Other candidates did not show an understanding of how to apply the correct equation to this situation. A significant number of candidates did not give an answer to this question.

Question 12

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

(b) Most answers seen described an actual property, i.e. “can pass through paper” rather than a relative property, i.e. “less (ionising) than alpha”.

(c) A number of candidates gained at least partial credit for the idea of dividing by 2 twice, but some incorrectly divided the mass number by 4. A significant number achieved full credit.

PHYSICS

Paper 0625/41
Extended Theory

Key messages

In numerical questions involving the use of a formula, candidates are strongly advised to begin their answer by writing down the formula that they have learnt, e.g. F = ma, I = V / R, and not a transposed version. In many cases, answers started with a wrongly transposed version of a formula or with numbers substituted in the wrong version.

Also in numerical questions, candidates should check that they give answers with the correct unit.

General comments

Many candidates performed well on this paper. They often demonstrated a thorough understanding and recall of a large proportion of what they had been taught, read the questions with great care, and carefully planned their approach before beginning to write. In other cases, candidates did not read the questions carefully enough or in questions requiring explanations and descriptions, the required points were not given in a logical order. Candidates should avoid explaining the same point in different ways to ensure they do not contradict themselves.

For many candidates two topics in particular proved challenging. In **Question 1**, few candidates correctly interpreted the distance-time graph. In **Question 2**, understanding of the concept of moments was weak. Candidates seemed unfamiliar with the idea of the suspension of a plank from two ropes rather than it being balanced at a single fulcrum.

Comments on specific questions

Question 1

(a) (i)1 Most candidates used the correct approach and calculated the average speed correctly.

(i)2 Few candidates calculated the correct speed. Almost all candidates used the coordinates of the graph at time 100 s and gave the answer as 36 m / s, not realising, or forgetting, that this approach would only have been valid if the graph had been a straight line passing through the origin.

(ii) Most candidates incorrectly assumed that the gradient of the graph at 20 s and at 100 s determined the acceleration at these times and answered accordingly.

(b) (i) Many candidates used $F = ma$ and calculated the resultant force correctly. Most stated the formula and gave the unit.

(ii) A number of different meanings of deceleration were acceptable. However, there were some examples of a correct meaning being stated along with an incorrect one such as “decreasing acceleration”, or “rate of acceleration decreases”. Such answers contradicted themselves.

Question 2

(a) Only the strongest candidates answered this question correctly and stated the moment of P about B as $P \cdot 1.5$ or $1.5P$.

(b) (i) Some candidates stated the moment of W about B as 210 Nm but some answers did not included the unit.

(ii) Only the strongest candidates answered this question correctly.

(iii) Two approaches were possible and the easier one required the idea that total upward force = total downward force. The other method, using moments, was less successful.

Question 3

(a) Most candidates answered this well.

(b) (i) Partial credit was awarded for giving the change of chemical energy to kinetic energy (in the initial throw). However, some candidates referred to potential energy rather than chemical energy.

(ii)1 The formula *mv* for momentum was well known and most candidates gained credit for this or for $4.0 \cdot 12$. The unit was more often stated as kg m / s than as Ns. However, some candidates omitted a unit or wrote kg / m / s.

(i)2 Many successful calculations of the average resultant force were seen.

Question 4

(a) Many candidates gained credit for this question. However, some candidates used the wrong formula for the volume of a cylinder or stated a wrong unit for the density they had found.

(b) (i) Few candidates were able to name the device. The most common incorrect answer was barometer.

(ii) The correct formula was usually written down and used. Some candidates failed to convert the 2.0 cm level difference to 0.02 m. Others made their final step the subtraction of their answer from the atmospheric pressure.

(iii) This question proved challenging for many candidates. Having used the correct formula in **(ii)**, candidates needed only to state that the area of cross-section of the tube had no bearing on the value of *h*, or that the pressure of a liquid column depends only on the values of the quantities in the formula.

Question 5

(a) Some candidates seemed to have no knowledge of a thermocouple and attempted to draw another kind of thermometer.

(ii) Candidates gave a range of answers and full credit was frequently awarded.

(b) The sensitivity of a thermometer was not a well-known concept for many candidates. In **(i)**, most candidates could suggest higher sensitivity for partial credit but few could make a statement equivalent to “the mercury thread moves further for a given temperature change”. Similarly in **(ii)**, again greater sensitivity was suggested for partial credit, but a minority of candidates correctly suggested greater expansion or more liquid expanding.

Question 6

(a) Most candidates gave at least two factors that determine the rate of evaporate.

(b) The most common approach required the ideas of higher energy or faster molecules evaporating, leaving behind the lower energy or slower molecules. References to hotter or colder molecules were not acceptable. There was sometimes confusion in answers, with sweating mentioned or with convection being involved.

Question 7

(a) Most candidates mentioned a single or one colour, frequency or wavelength and gained credit.

(b) Many candidates answered this question well. The most accurate drawings were seen on scripts where the reflected and refracted rays had been drawn first. A few candidates drew the reflected and refracted wavefronts in the glass, making drawings less clear.

(c) Many candidates gained full credit for this question. Where candidates gained only partial credit, this was usually for errors in the drawing or labelling of the amplitude.

Question 8

(a) Many candidates stated that vibration takes place in the direction of travel of the wave. However, very few made the required point that it is particles that vibrate. Credit was also awarded to many candidates for stating that the wave consists of compressions and rarefactions.

(b) (i) Most candidates gave a value for the speed in the range 900 to 2000 m / s.

(ii) Many candidates gained full credit for this question. However, some candidates omitted the unit or transposed the formula wrongly.

Question 9

(a) Many candidates answered correctly but a few drew a circuit with the lamps in series.

(b) Most candidates gained for credit for both parts of this question.

(c) Most candidates gained credit for writing down E = IVt or E = Pt. Subsequent credit depended on correct substitutions and correct arithmetic. Many candidates made errors in one or other of these.

Question 10

(a) Most candidates correctly suggested iron or soft iron for the material of the core.

(b) (i) The magnetic field set up by the primary coil was sometimes not described as alternating or changing. Few candidates stated that this field was cut by or linked with the secondary coil. Candidates also needed to state that a voltage was induced in the secondary coil. The required word “induced” was sometimes absent.

(ii) Most candidates calculated the generator voltage correctly. However, some candidates failed to state a formula and so used the numbers incorrectly.

(c) Candidates who suggested that current would be lower gained partial credit. Following this, many went on to the conclusion that this leads to less heat production. Those who suggested changes in resistance were unsuccessful.

Question 11

(a) Many totally correct nuclide equations were given. However, in some cases candidates wrote “C” rather than “N” as the symbol for the product nucleus.

(b) Only the strongest candidates gained full credit for this question. For each type of radiation, many candidates failed to state clearly whether or not the emission takes place. Even if a correct statement was offered, explanations were often incorrect.

PHYSICS

Paper 0625/42
Extended Theory

Key messages

- It is essential that candidates show their working and write down the equations they are using. In particular, candidates sometimes remember the symbols for three quantities of an equation as a triangle. Such symbol triangles are not acceptable as evidence of working and are ignored by examiners.
- 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, become confused and unable to use what knowledge they have.

General comments

Most candidates were well prepared for this paper. Equations were generally well known but the use of equations and the quantities represented were not always understood. There were frequent examples where candidates substituted numbers from the question in the wrong place in equations. This applied particularly to **Questions 2(a)** and **4(b)** where candidates needed to remember and apply two equations correctly.

Generally candidates followed the rubric of the questions. However, candidates must not give more than one answer to a question if only one is asked for. Similarly candidates in nearly all situations need to commit to an answer.

Often candidates did not read the questions carefully enough and wrote known standard facts when, in fact, the question required the application of these facts. Candidates sometimes repeated the stem of the question rather that answering the question and could not be credited.

Teachers are strongly advised to make their candidates aware of the symbols and units in the Appendix to the Syllabus. For example in **Question 6(b)** Hzm may be dimensionally equivalent to m/s but is not an acceptable unit for speed. Often the use of inappropriate symbols leads to candidates confusing themselves.

Comments on specific questions

Question 1

(a) (i) The majority of candidates scored full credit. However, many failed to make it clear in their working that the speed of the lorry was equal to the gradient of the distance-time graph at 30s. Therefore, they gained no credit for the question if they made any error.

(ii) This was generally well answered. Most candidates who made an error gained some credit for a correct indication of distance/time.

(b) (i) Many candidates failed to appreciate that as the speed was constant, the acceleration must be zero. There were many instances of unexplained incorrect working, which frequently led to an answer of 1 m/s^2.

(ii) Many stronger candidates gained full credit. Following on from the previous answer, weaker candidates often did not realise that zero acceleration means zero resultant force and hence that the forward force on the lorry is equal to the given resistive force.

(c) The majority of candidates correctly interpreted the graph, but a significant number treated the distance-time graph as a speed-time graph, and gave statements such as “acceleration is decreasing” thinking that this meant the same as reducing speed. There were also often contradictions such as candidates writing of speed increasing at a lower rate and then that speed is constant.

Question 2

(a) Most candidates were able to gain some credit on this question but full credit was rare. Knowledge of the essential equations was generally good but numerous errors were made in substitution especially with units. Poor setting out and working contributed to some errors. Some candidates were confused by the weight of the empty cylinder, and failed to convert to 250 g or 0.25 kg or to subtract the mass instead of adding it to the mass of the liquid.

(b) (i) A number of candidates stated that the device was a barometer not a manometer.

(ii) Many candidates remembered the correct equation but they did not use the correct pressure of 400 Pa. A significant number of answers were seen involving the addition of atmospheric pressure to 400 Pa. Again there were problems with units and in particular, a lack of recognition that 50 mm must be converted to 0.05 m. Answers of 0.8 kg/m^3 were common.

(iii) Candidates generally understood the idea of liquid rising at the left but only the strongest candidates scored full credit. Vague or inaccurate explanations were common. A clear comparative statement about the pressure difference between the sides was rarely seen.

Question 3

(a) This question was generally well answered.

(b) (i) Most candidates used the correct equation but as with some earlier calculations, failure to use the correct unit, e.g. in converting from 6 ms to 0.006 s, often led to incorrect answers. Weaker candidates did not use force in their calculation of impulse and used a mass of 40 kg instead.

(ii) Stronger candidates gained full credit here.

(iii) There was a wide variation in the quality of the responses. Many candidates did not read the question carefully enough and did not write about a conversion, merely stating one type of energy in each case.

Question 4

(a) (i) This was generally well answered although some candidates stated that metals make good insulators or thought the question was about absorption/emission of thermal energy. Answers were seen involving materials used as absorbers or reflectors, e.g. paint iron block black or use a reflective material.

(ii) Many candidates answered correctly, but weaker candidates merely paraphrased the stem, with statements such as “use more of the material”.

(b) Many candidates gained full credit, but a common error was to give an incorrect unit. A considerable proportion of candidates used incorrect symbols and made errors. The basic cause was the use of the symbol Q for thermal energy and then introducing Q for charge into their working. The use of Q for thermal energy was discontinued some years ago and does not appear in the syllabus. Centres are strongly advised to stop teaching Q for thermal energy and, if students have access to older textbooks that contain this use of Q, to advise their students accordingly.

Again many candidates did not set out of their working clearly. This error was sometimes compounded by confusing C for coulombs with c for specific heat capacity.

Question 5

(a) (i) The majority of candidates gave the correct answer but common incorrect answers were “diffraction” and “refraction”.

(ii) The majority of candidates gained credit, but weaker candidates sometimes put the colours in the reverse order.

(iii) Only a small proportion of candidates recognised that it was different speeds/refractive indices, etc. that was the required property. Most candidates just stated that glass had a different refractive index from air, was denser or made vague references to the shape of the prism.

(b) (i) Many candidates produced an answer showing multiple reflections from wall to wall of the fibre as shown in textbooks without considering the diagram presented to them. Stronger candidates took care over their diagrams and demonstrated that the ray has one total internal reflection on the upper wall and none on the lower wall.

(ii) The majority of candidates gained full credit for this standard situation. Weaker candidates incorrectly attempted to use some version of sin i/sin r.

(iii) Most candidates gained some but not complete credit on this question. Some candidates gave vague or inaccurate descriptions.

Question 6

(a) Stronger candidates gained full credit here. Often weaker candidates did not take enough care with their working, did not mark the positions of C and R clearly or indicated the distance 0.90 m imprecisely. Some exchanged the positions of C and R and many weaker candidates failed to recognise that two wavelengths were required.

(b) This orthodox $v = f\lambda$ question was generally well answered. The most common error was to use 0.90 m as the wavelength. Many candidates quoted strange units for velocity. Candidates should use the units quoted in the Appendix to the Syllabus.

(c) Many candidates gave a correct medium, but then gave an incorrect reason, with statements such as “sound is slowest in air” quite commonly seen. Some weaker candidates suggested that a vacuum might be the medium through which sound waves could travel.

(d) (i) Many candidates gained credit, but frequent inadequate statements included paraphrases of the stem, i.e. “they both have compressions and rarefactions” did not gain credit.

(ii) Many candidates wrote vague statements such as “the pitch of sound is different from that of ultrasound”, which was insufficient.

Question 7

(a) (i) The majority of candidates gained full credit. A common error made by weaker candidates was to calculate the current correctly and then to divide it or multiply it by three. Other weaker candidates tried to use V = IR instead of P = IV.

(ii) This question was usually answered well.

(iii) Most candidates gained credit here. A common error was to attempt a calculation using incorrect data from **(i)**. Many incorrect answers of 330 V were seen.

(b) (i) Many candidates gained full credit here.

(ii) Most candidates correctly identified the link between resistance and length, but only the strongest identified the link between resistance and cross-sectional area. A small minority of candidates ticked boxes that were contradictory.

Question 8

(a) (i) The majority of candidates correctly identified the movement, but explanations were sometimes lacking in detail. It should be noted that different charges are not equivalent to opposite or unlike

charges. Weaker candidates sometimes did not think through the question carefully and referred to different poles, which did not gain credit.

(ii) Stronger candidates were able to identify the movement of the piece of wood. However, very few candidates gave an adequate explanation in terms of moments, turning effect or non-aligned forces in opposite directions.

(b) Almost all candidates were able to describe the differences between conductors and insulators using a simple electron model.

(c) Most candidates drew a correct field pattern carefully and accurately gaining full credit.

Question 9

(a) Most candidates gained credit. Candidates who did not answer correctly often gave iron as a metal used for permanent magnets.

(b) (i) Many candidates gained full credit.

(ii) Stronger candidates recognised that the end Q of the coil would be a north pole as it was repelling the approaching north pole of the magnet. Many explanations were far too vague. Many candidates merely stated Lenz's Law and did not go on to explain how it applied in this case.

(c) Many candidates gave vague or inaccurate statements, e.g. references to "change the pole" or "change the direction".

Question 10

(a) (i) Many candidates failed to give two correct possible sources of background radiation or gave two that were effectively the same, e.g. rocks and building materials. Many seemed to confuse this question about ionising radiation with background electromagnetic radiation and referred to computers/laptops/televisions, etc.

(ii) Many candidates failed to clearly identify the random variation of background radiation as being the cause of the different readings.

(b) Many good answers were seen. However, a significant number of candidates failed to recognise the significance of the background count to this calculation but did gain partial credit if they made no further errors. Weaker candidates did not answer the question well through lack of understanding of half-life calculations, e.g. subtracting the background from one count rate but not the other. It was also clear that there was confusion amongst weaker candidates about the difference between the number of half-lives and half-life**.**

(c) The majority of candidates correctly linked the different ionising radiations to a correct property, but were much less successful at linking the properties to the correct uses.

PHYSICS

Paper 0625/43
Extended Theory

Key messages

- Candidates should ensure they make their answers as clear as possible.
- Candidates should use the command word in the question and the number of marks available as a guide when answering questions.

General comments

The questions in this paper are drawn from all parts of the syllabus and all the questions are compulsory. It is essential that candidates are familiar with all topics. Stronger candidates were able to show this on this paper.

Almost all the quantities referred to in the syllabus have a specific unit and numerical answers should always include an appropriate unit. Candidates need to be aware that numerical information supplied is usually given to 2 significant figures and that answers given to 1 significant figure are usually not accepted. Similarly, answers that are rounded off to an appropriate number of significant figures should be rounded off correctly.

A few candidates rearranged expressions such as $V = IR$ to give an erroneous expression, say $R = I / V$.

Comments on specific questions

Question 1

(a) This was usually correct with P marked at an appropriate position. Some candidates marked other points on the line when answering subsequent parts of the question and if the label P was omitted, this led to a lack of clarity.

(b) (i) This was often correctly answered although often no working was shown.

(ii) A common incorrect approach was to calculate a value for a speed using the coordinates for the car at t = 30 s and a second value at t = 45 s and then to average the two values.

(c) There were many good answers here and most candidates obtained at least partial credit. However, there were also answers that were drawn with very little care and some of the lines were very thick.

Question 2

(a) The answer “force” in the first space was common but “impulse” or “change of momentum” were given less frequently. A small number of candidates supplied only units and gave answers such as “N” and “N s”.

(b) (i)1 There were many correct calculations but the answer was often given as 3 (kg m / s). Some correct numerical answers were spoiled by the use of a unit such as kg / m / s or even kg / m s^{-1}.

(i)2 Although there were many correct answers here, there was also a range of incorrect answers. Some candidates who attempted to use the equation F = ma, substituted the value 65 as the acceleration.

(ii) This was often correct although answers such as “potential energy”, (which was not sufficiently precise) or “kinetic energy” were also given quite regularly.

Question 3

(a) (i) There was a large number of candidates who did not name this device although the correct answer was also quite common.

(ii) Candidates gave the answer “air” as often as the answer “vacuum” or gave no answer. A few candidates stated that there wold be some mercury vapour present.

(iii) The length 760 mm was sometimes used directly or sometimes converted to centimetres rather than to metres. Candidates whose answers were obtained without the use of a value for *g* (the acceleration of free fall) were awarded no credit.

(b) Some candidates used the diameter rather than the radius in the equation $V = \pi r^2 h$. Some answers did not involve p. There were a variety of fractional multipliers which gave inaccurate equations such as $V = 1/3\pi r^2$. Additionally, there were inaccurate conversions of units and inaccurate rearrangements of equations.

Question 4

(a) The calculation was often correct. Some candidates supplied the correct unit for frequency but there were also many incorrect units given and it was often omitted altogether.

(b) (i) Many answers were not detailed enough and there were a lot of very vague comments involving expressions such as “It is a wave that moves up and down” or “a wave that travels at right-angles to its motion”. The word vibration was rarely seen and when it was seen, it was not always clear what was vibrating. There was little reference to the transmission of energy.

(ii) A carefully constructed labelled diagram was not necessary here and there were some good answers which showed what was needed without any measurements or time-consuming details being supplied. However, some answers were too poorly constructed with waves that showed an inconsistent wavelength or amplitude and some poor arrows which stopped well short of the correct positions. The arrow that indicated the amplitude, occasionally marked the vertical distance between a crest and a trough.

Question 5

(a) The equation that defines specific heat capacity was very often supplied although the energy term and the specific heat capacity itself were sometimes confused. Most candidates referred to the need to determine the change in temperature although some simply referred to the temperature of the block. Candidates could have used the equation as the basis for stating what other equipment and which other measurements were needed. Few candidates commented on how the energy supplied could be determined.

(b) (i) Most candidates gave answers that showed that they knew what was required here. Two common sources of inaccuracy were a reference to a mass of 1 kg and the omission of a reference the magnitude of the temperature rise expected.

(ii) The numerical value was very frequently correct but the correct unit was only occasionally supplied. The most common unit given was the joule.

Question 6

(a) (i) This was often correctly answered and the light passing through the prism was very commonly shown correctly. Where full credit was not awarded, it was the light emerging from the prism into the air that was drawn incorrectly.

(ii) **“**Red” and “violet” were given with a similar frequency.

(b) (i) Most answers referred to a single wavelength, frequency or colour. Only answers that referred to the two simply measurable quantities were awarded credit.

(ii) The expression “Total Internal Reflection” was seen quite often. Few candidates explained the cause and answers such as “The ray is less than the critical angle” were considered too vague for credit.

(iii) Many candidates referred to partial reflection and refraction but fewer made any comment about the angle of incidence. There were several references to the occurrence of both Total Internal Reflection and refraction.

Question 7

(a) (i) This was often correctly answered although the suggestion that there are no electrons in an insulator is not correct.

(ii) The first point was commonly made. However, few candidates gave clear answers about why passing an electric current through the doctor would be a problem.

(b) There were some good answers here and these often obtained full credit. However, some candidates explained how the charged contacts cause a current in the dummy rather than how the contacts become oppositely charged.

(c) This calculation was very frequently correct even though a division by numbers with negative powers of ten was required.

Question 8

(a) Some candidates omitted any comment concerning the chemical (potential) energy that is stored in the battery.

(b) (i) This was often correct and was awarded full credit.

(ii) This was often correct but answers of 9.0 V and 2.4 V were given by some candidates.

(iii) This calculation was usually correct.

(c) Only stronger candidates answered fully correctly. Many candidates realised that increasing the length of the wire, increased its resistance and multiplied the answer to **(b)(iii)** by 5. The effect of halving the diameter of the wire was less well understood. A few candidates realised that the effect depended on the square of the diameter and divided by 4. However, more candidates realised that the effect was an inverse one and multiplied by a further 2. Very few candidates used the inverse proportion of the square of the diameter and full credit was only very occasionally awarded.

Question 9

(a) Most candidates supplied a correct difference between d.c. and a.c.

(b) (i) This question was well answered and full credit was often awarded.

(ii) Many candidates supplied and used the correct equation for power although some did not read the value from the graph correctly.

(c) (i) This was usually correctly drawn.

(ii) The incorrect answer, “B to A” was by far the most common response and this was usually stated to be a consequence of the Fleming left-hand rule or was just left unexplained. The correct answer of “A to B” was not often seen and neither was any reference to the right-hand rule. When this was mentioned, it was only very occasionally clear how this rule had led to the correct conclusion. It is, of course, possible to use the left-hand rule (or indeed the right-hand slap rule) combined with the Lenz law to obtain the correct answer but this was rarely done successfully.

(iii) Some candidates answered this question correctly. A common misunderstanding was suggested by answers such as “increase the magnetic field strength” or “supply more turns on the coil”.

Question 10

(a) The decay equation was often correctly completed and full credit was awarded. The most common incorrect answers were to give the atomic number (proton number) of protactinium as 89 or the equivalent number for the beta-particle as 1 rather than –1.

(b) This was often correct and awarded full credit. Even the answer 620 counts / s (which comes from miscounting the number of half-lives) was rare.

(c) Most candidates gained at least partial credit, but full credit was quite rare for this question.

PHYSICS

Paper 0625/51
Practical Test

Key messages

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

General comments

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

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

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

Questions on experimental techniques were answered much more effectively by candidates who clearly had regular experience of similar practical work and much less successfully by those who, apparently, had not. Some candidates appeared to have studied sections from the mark schemes of past papers and wrote responses that that were on the topic set but were not appropriate to the questions as they had been set.

Comments on specific questions

Question 1

(a) The majority of candidates successfully recorded the length of the spring but a few gave an answer in cm instead of mm.

(b) Most candidates recorded suitable values for this question and obtained a correct value for the spring constant.

(c) Most candidates recorded a realistic value for t and correctly calculated the period T. Relatively few candidates realised that the unit of T^2 is s^2.

(d) In this question candidates were required to make a judgement based on their own results. The statement needed to be clear, saying that either the results support the assertion that the two values for k are the same within the limits of experimental accuracy or that they are not. The

justification then needed to match the statement with wording that gave a clear explanation of why the results were judged to be within, or beyond, the limits of experimental accuracy.

(e) Partial credit was awarded to candidates who suggested at least three additional values of mass. Further credit was awarded for using a range of masses that were realistic for this experiment in a school laboratory setting (between 50 g and 600 g).

Question 2

(a) Most candidates recorded the current to at least 2 decimal places. They also recorded the potential difference values in the table to at least 1 decimal place and increasing with the length of resistance wire.

(b) Most candidates labelled the graph axes correctly and drew them the right way round, choosing a suitable scale. 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.

(c) Many candidates clearly showed the triangle method on the graph, with a large triangle using at least half the distance between the extreme plots. The value of *R* was expected to be correctly calculated and given to 2 or 3 significant figures with the unit Ω.

Question 3

(a) Most candidates drew the normal and incident ray correctly.

(b) Candidates were expected to know that greater accuracy is achieved in this experiment when the pin separation is large. Candidates were given credit here for using a pin separation of at least 5.0 cm. Some candidates sensibly used a pin separation well in excess of 5.0 cm.

(c) Many candidates measured *a* and *b* accurately and therefore obtained a value of refractive index within the tolerance allowed. Candidates were expected to realise that an answer to two or three significant figures was required here. They were also expected to work out that *n* has no unit.

(d) Many candidates carried out the second part using an angle of incidence of 45° with care and so obtained a value of *n* within 10 per cent of the first value.

(e) Successful candidates made relevant suggestions from their experience. However, some candidates suggested precautions rather than identifying difficulties.

Question 4

Many candidates answered this planning question well. Those who followed the guidance in the question were able to write concisely and addressed all the necessary points. Most candidates explained a relevant experiment, although some described an investigation that appeared to be based on a question from a recent past paper. A significant number of candidates drew a circuit diagram in which the voltmeter was in series with other components. Candidates needed to state clearly the readings that must be taken. In this investigation, many candidates did not specify measurement of current and potential difference. Candidates needed to explain that the time taken for a specific temperature rise must be measured. Many missed this point and wrote about measuring the temperature every 30 s. Construction of a table of readings helped candidates to organise their thoughts and to write clearly about how to carry out the investigation. The table needed to include columns relevant to the description. Typically these were columns for time, potential difference, current and power, with appropriate units.

Credit was awarded for sensible suggestions of possible variables that should be kept constant. For example, the starting temperature of the water, volume of water used and same finishing temperature.

Candidates were expected to explain how to reach a conclusion from their readings. Candidates should be aware that this is not the equivalent to making a prediction about the expected results.

PHYSICS

Paper 0625/52
Practical Test

Key messages

For this paper 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.

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
choosing the most effective way to use the equipment provided.

Most candidates were well prepared for this paper and demonstrated 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. Units were well known and were almost always included and ideas were expressed logically. However many candidates seemed less able to give conclusions backed up by evidence, or to present well thought out conclusions.

The gathering and recording of data presented few problems for any candidates. There was evidence of some candidates not having the use of a calculator.

The ability to record readings to an appropriate precision, usually reflecting the measuring instrument being used, or to quote a derived result to an appropriate number of significant places, caused difficulty for many candidates. There were also many examples of candidates repeating a measurement and overwriting their first answer. Candidates should be encouraged to cross out completely and to rewrite their answers so that there is no ambiguity. Some candidates had difficulty in choosing an appropriate scale to plot their graphs and in drawing a best-fit line to display their data.

Comments on specific questions

Question 1

(a) Only stronger candidates answered this question well. Most candidates did not record the readings actually taken from the metre rule in order to determine the length l_0 of the coiled part of the spring,

as the question asked. Candidates were expected to record the reading of the metre rule at each end of the spring, but most candidates recorded the subtraction that they had made, but did not include the readings they had taken.

The table of results was usually completed correctly with the stretched lengths of the spring for the different loads and the corresponding correct values of extension.

(b) Candidates nearly always chose horizontal and vertical scales that made use of at least half of the given grid. Occasionally candidates used scales that increased in inconvenient increments, such as 3 or 7. Choosing such scales makes the points much harder to plot. On this graph, one of the points to be plotted was (0, 0). However, many candidates did not plot this point and so could not gain full credit for the graph plotting exercise.

There were many excellent, carefully drawn, best-fit lines produced by candidates. However, there were also many graphs where the best-fit line was forced through the origin. This did not produce a line of best fit.

There were also many graphs where the points were joined dot-to-dot. The concept of best-fit was not understood well by all candidates.

(c) The gradient of the graph was usually correctly determined. Occasionally candidates did not follow the instruction given in the question, to show clearly on their graphs how they obtained the information necessary to calculate the gradient. 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 answers cannot be credited if these points do not.

(d) Candidates were told that the gradient of the graph they had drawn was numerically equal to the spring constant *k* and were asked to write down a value for *k* to a suitable number of significant figures for this experiment. Many candidates gave an answer to only 1 significant figure. Candidates should write down the calculated numerical answer in an experiment to the same number of significant figures as the data collected. Only answers quoted to 2 or 3 significant figures were accepted for this question.

Question 2

(a) The potential difference across the lamps and the current in the circuit were usually recorded precisely. The total power produced by the lamp filaments was calculated correctly by most candidates. However, occasionally when the calculated value of the power was truncated, rounding errors occurred.

(b) Most candidates followed the instruction given, disconnected the voltmeter and then reconnected it correctly to produce a potential difference across lamp X which was less than the potential difference recorded in **(a)**. The power dissipated by lamp X was usually calculated correctly and correct units for current, potential difference and power were given.

(c) Most candidates followed the instruction given, disconnected the voltmeter and then reconnected it correctly to produce a potential difference across lamp Y which was less than the potential difference recorded in **(a)**. Credit was awarded for accuracy here if the sum of the individual powers dissipated in the lamps were within 10 per cent of the value of the total power recorded in **(a)**.

(d) Many candidates did not answer the question set and just repeated the words in the stem of the question, stating that the two values of power dissipated in the individual lamps were the same within the limits of experimental accuracy. Candidates needed to compare the two powers, and to give a simple statement that the two calculated values were close enough to be considered equal or that they were too far apart to be considered equal.

(e) Most candidates gained full credit for this question. All circuits drawn by candidates showed the two lamps connected in parallel, but some candidates drew two voltmeters connected in parallel with the lamps, thinking that each lamp in the parallel connection needed a voltmeter to record the potential difference across it.

Question 3

(a) The normal to the glass block was nearly always drawn at 90° to **AB** and at the centre of **AB**, as required.

(b) Most ray traces were correct and drawn neatly. Many diagrams did not have the two pins P_1 and P_2 sufficiently far apart. Candidates needed to place the two sighting pins as far apart as the ray trace sheet will allow – certainly at least 5 cm apart.

(c) The values of the distances *a* and *b* were usually measured on the ray-trace diagram to a tolerance of $\pm$1 mm. A few candidates did not include a unit with their measured lengths.

The refractive index of the material of the block was usually calculated correctly. Most answers were recorded to 2 or 3 significant figures and were within the tolerance allowed.

(d) Most candidates repeated the exercise using a different angle of incidence and obtained a value of refractive index that was within 10 per cent of their value in **(c)**. Credit was awarded here for the accuracy of the ray diagrams drawn.

(e) Most candidates did not read the question carefully enough and commented on the difficulties involved in experiments of this type. The majority of answers focussed upon precautions that should be taken when performing a ray-trace experiment instead of aspects of the procedure that were difficult to perform with precision.

Question 4

Credit was given for a brief explanation of how candidates would set up the investigation. Many candidates did not state that the room temperature and/or the initial temperature of the water in the container needed to be measured.

Most candidates realised that the time taken to raise the temperature of the water to its boiling point in the containers needed to be measured. Occasionally, candidates misread the brief and found the time taken to heat the water to some arbitrarily chosen temperature.

Most candidates gained credit for stating that the experiment would be repeated with the other two containers.

Many candidates were able to gain at least partial credit for listing the control variables in this investigation. The two most popular control variables chosen were the volume of water added to the container and the initial temperature of the water.

Only stronger candidates mentioned keeping the Bunsen burner flame constant or keeping the distance from the flame to the bottom of the beaker constant.

Most candidates drew an appropriate table of results and gave relevant headings with units. A common error was to use the unit ‘m’ for minutes, if the minute was their chosen unit of time.

Few candidates read the purpose of the investigation carefully enough to explain exactly how they would use their results to reach a meaningful conclusion. The purpose of the investigation was to determine if the material a container is made from affects the time for water in it to be heated from room temperature to boiling. Most answers to this part described the relative conducting properties of the materials of the containers, which although often correct, did not answer the question. Stronger candidates gave a simple statement to indicate that if the times taken to boil the water in the three containers are different, then the type of container does affect the time taken to boil the water.

PHYSICS

Paper 0625/53
Practical Test

Key messages

- Candidates should be advised to read the questions through very carefully to ensure that they are answering the question as written, and not simply recalling the answer to a similar question that may have appeared in a previous question paper.
- Candidates need a thorough grounding in practical work during the course, including reflection and discussion on the precautions taken to improve reliability, and the 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.

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 and justifying conclusions
- dealing with possible sources of error
- controlling variables
- making accurate measurement
- 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 clearly had experience of similar practical work and much less successfully by those who apparently had not. The breadth of candidates' experience of experimental work was apparent in the quality of their analysis of results and their comments on procedures. This was seen in the clear practical details given by some candidates in **Questions 1(b)**, **1(f)** and **1(g)(ii)**, **Question 2(d)** and **Question 3(f)**.

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. These points were demonstrated in many of the responses to **Question 1(d)** and **Question 2(c)(iii)**. Candidates need to be aware that use of a recurring symbol, does not indicate the intended number of significant figures and this may not be credited.

Each Practical Test includes a question in which candidates will be asked to outline a plan for an investigation. Candidates can answer these question with careful reading of the brief and the logical application of experimental practice. Many candidates showed good practical knowledge when answering **Question 4** but it was clear that a number had not been prepared for this or had limited experience of basic experimental work.

Comments on specific questions

Question 1

(a) Most candidates made suitable measurements to the nearest millimetre. The subsequent volume calculation was carried out well by nearly all candidates.

(b) Many candidates recognised the irregularity of the modelling clay shape as a source of inaccuracy, but very few could describe a suitable improvement to the procedure. A number of candidates suggested changing the shape of the modelling clay to make it more regular but this wouldn't improve the procedure itself.

(c) Nearly all candidates were able to record the weight of the modelling clay correctly.

(d) Most values for the density were within range although some candidates omitted the unit.

(e) The vast majority of candidates recorded suitable values for V_2 and V_3.

(f) Many responses correctly indicated that the scale should be read perpendicularly. Candidates either gave a written description or a diagram or mentioned that the reading should be taken at the lower meniscus. A very small number of candidates believed that the reading should be taken from the top of the meniscus.

(g) Many candidates obtained a value for density that was within range. When justifying which procedure was likely to give a more accurate value, most candidates correctly and clearly referenced the irregular shape of the modelling clay when choosing the displacement method. The small number of candidates that chose the first method managed to either describe the inaccuracy due to the string or the resolution of the measuring cylinder. Weaker candidates had difficulties wording their response and tended to repeat the question in their justification.

Question 2

(a) Most candidates had values of V that followed the correct trend and were recorded with suitable precision.

(b) Many well-drawn graphs were seen. Most candidates labelled the axes correctly. However, credit for the scale was frequently not awarded due to plots not covering at least half of the grid. Whilst plotting was generally accurate, some candidates had plots that were too large and therefore using small crosses is always recommended. The graph line should have been straight and well-judged with roughly an even distribution of plots either side.

(c) In general, candidates used a triangle on their graph line to show how they obtained the necessary information. It was noted that a number of these triangles were less than half of the graph line. It is good practice to ensure most of the graph line is used when obtaining the gradient.

Measurements of l were mostly correct. However, it appeared that some candidates had measured the resistance wire instead.

Most values of R were within range. However, some candidates did not give units or gave answers that were not to 2 or 3 significant figures.

(d) This proved to be a more challenging question for many candidates. Common correct answers suggested lowering the voltage or using an external resistor to lower the current. Some candidates recognised the importance of switching off the circuit in between readings.

Question 3

(a) and (b) Most candidates drew the normal well and constructed the line **CD** at the correct angle.

(c) and (d) Candidates generally used a large pin separation. However, it should be understood that 5.0 cm is accepted as the minimum pin separation rather than the correct or optimum separation – larger separations are recommended.

Most candidates were able to follow the instructions well and produced an accurate ray-trace sheet. A small number had difficulties getting their lines to pass through the point where the normal meets line **AB**. This could have been due to candidates not using large separations for their pins or not positioning the reflective surface of their mirror on the line correctly.

Some measured angles of θ were not correct despite the ray-trace being accurate. In these cases, it would appear candidates had read the wrong scale on their protractor or measured the wrong angle altogether.

(e) Candidates who read and interpreted the question carefully were able to compare the difference between the two α values and the difference between the two θ values. Most candidates then concluded that the student's suggestion was correct using the values quantitatively to justify their answer. There were many candidates who incorrectly compared the α value with the θ value for each mirror position instead of the change in each due to the change in mirror position.

(f) Many candidates incorrectly referred to the accuracy of protractors and rulers instead of genuine precautions. It appeared that where candidates had solid experience of conducting reflection or refraction experiments using pins, they were able to clearly articulate the precautions that would lead to accurate results.

Question 4

In answering this question candidates were expected to describe the method with one side of the metal in hot water, the other in cold water with the time taken to increase the temperature of the cold water to compare the metals. However, credit was given to candidates who described valid alternatives. Unfortunately, many candidates went on to describe a procedure that would be better suited to an investigation on specific heat capacity rather than thermal conductivity.

Candidates who used the bullet points given in the question normally gave full answers covering all areas of the question. Some candidates did not include a diagram and/or did not specifically state the precautions for reliable results as required in the question. Candidates are recommended to use the bullet points given to help structure their response.

PHYSICS

Paper 0625/61
Alternative to Practical

Key messages

- Candidates need 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.
- 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 clearly had experience of similar practical work and much less successfully by those who apparently had not. Some candidates appeared to have learned sections from the mark schemes of past papers and wrote responses that were not appropriate to the questions set on this question paper.

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 length of the spring but a few gave an answer in cm instead of mm.

(b) Most candidates successfully calculated *e* and obtained a correct value for the spring constant.

(c) Many candidates recorded *t* suitably although some of those incorrectly calculated the period *T*. Relatively few candidates realised that the unit of T^2 is s^2. Most were able to calculate the second value for the spring constant.

(d) In this question, candidates were required to make a judgement based on their own values for *k*. The statement needed to be clear, saying that either the results support the assertion that the two values for *k* are the same within the limits of experimental accuracy or that they are not. The justification then needed to match the statement with wording that gave a clear explanation of why the results were judged to be within, or beyond, the limits of experimental accuracy.

(e) Partial credit was awarded to candidates who suggested at least three additional values of mass. Further credit was awarded for using a range of masses that is realistic for this experiment in a school laboratory setting (between 50 g and 600 g).

Question 2

(a) Most candidates recorded the current correctly.

(b) Most candidates recorded the correct potential difference in the table.

(c) A significant number of candidates did not complete the table headings.

(d) Most candidates labelled the graph axes correctly and drew them the right way round, choosing a suitable scale. 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 although some drew a 'dot-to-dot' line whilst others drew a straight line that did not match the plots.

(e) In this question candidates needed to clearly show the triangle method on the graph, with a large triangle using at least half the distance between the extreme plots. Many candidates achieved this. The value of *R* was expected to be correctly calculated, within the acceptable range and with the unit Ω.

Question 3

(a) Most candidates drew the normal and incident ray correctly. Candidates were expected to know that greater accuracy is achieved in this experiment when the pin separation is large. Candidates were given credit here for using a pin separation of at least 5.0 cm. Some candidates sensibly used a pin separation well in excess of 5.0 cm.

(b) Many candidates drew the line joining P3 and P4 with care and extended it to the normal. They went on to measure *a* and *b* accurately and therefore obtained a value of refractive index within the tolerance allowed. Candidates were expected to realise that an answer to two or three significant figures was required here.

(c) Many candidates calculated *n* correctly. They were also expected to work out that *n* has no unit.

(d) Successful candidates made relevant suggestions from their experience. Some candidates appeared to be relying on answers they had learned from past papers that were not appropriate for this question. This usually resulted in candidates suggesting precautions rather than identifying difficulties.

(e) The correct response, "View base of pins" was chosen by many candidates but all responses were chosen by some candidates. Candidates should be aware that viewing the bases of the pins is a very useful precaution in this type of experiment as it overcomes the problem of ensuring that all four of the pins are vertical.

Question 4

Many candidates coped well with this planning question. Those who followed the guidance in the question were able to write concisely and addressed all the necessary points. Most candidates explained a relevant experiment, although some described an investigation that appeared to be based on a question from a

recent past paper. A significant number of candidates drew a circuit diagram in which the voltmeter was in series with other components. It is important that candidates state clearly the readings that must be taken. In this investigation, many candidates did not specify measurement of current and potential difference. Candidates needed to explain that the time taken for a specific temperature rise must be measured. Many missed this point and wrote about measuring the temperature every 30 s. Construction of a table of readings helped some candidates to organise their thoughts and to write clearly about how to carry out the investigation. The table needed to include columns relevant to the description. Typically there were columns for time, potential difference, current and power, with appropriate units.

Credit was awarded for sensible suggestions of possible variables that should be kept constant. For example, the starting temperature of the water, volume of water used and same finishing temperature.

Candidates were expected to explain how to reach a conclusion from their readings. Candidates should be aware that this is not the equivalent to making a prediction about the expected results.

PHYSICS

Paper 0625/62
Alternative to Practical

Key messages

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

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

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
choosing the most effective way to use the equipment provided.

The majority of candidates 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. Ideas were expressed logically but candidates seemed less able to derive conclusions from given experimental data and justify them.

There was evidence of some candidates not having the use of a calculator.

The ability to record readings to an appropriate level of precision, usually reflecting the measuring instrument being used, or to quote a derived result to an appropriate number of significant places, caused difficulty for many candidates. There were also examples of candidates repeating a calculation and overwriting their first answer. Candidates should be encouraged to cross out completely and to rewrite their answers so that there is no ambiguity. Some candidates had difficulty in choosing an appropriate scale to plot their graphs and in drawing a best-fit line to display their data.

Comments on specific questions

Question 1

(a) Most candidates recorded the unstretched length of the spring correctly as 23 mm.

(b) Only stronger candidates were able to position a set-square correctly to take the necessary readings from the metre rule to determine the unstretched length of the spring. The set-square was

usually drawn facing the wrong way and on the right hand side of the metre rule instead of on the other side.

(c) The table of results was usually completed correctly with the stretched lengths of the spring for the different loads and the corresponding correct values of extension.

(d) Candidates nearly always chose horizontal and vertical scales that made use of at least half of the given grid. Very few candidates used scales that increased in inconvenient increments, such as 3 or 7. Choosing such scales made the points much harder to plot. On this graph, one of the points to be plotted was (0, 0). However, many candidates did not plot this point and so could not gain full credit for the graph plotting exercise.

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

(e) The gradient of the graph was usually correctly determined. Occasionally candidates did not follow the instruction given in the question, to show clearly on their graphs how they obtained the information necessary to calculate the gradient. 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 answers cannot be credited if these points do not.

(f) Candidates were told that the gradient of the graph they had drawn was numerically equal to the spring constant *k* and were asked to write down a value for *k* to a suitable number of significant figures for this experiment. Many candidates gave an answer to only 1 significant figure. Candidates should write down the calculated numerical answer in an experiment to the same number of significant figures as the data collected. Only answers quoted to 2 or 3 significant figures were accepted for this question.

Question 2

(a) The potential difference across the lamps and the current in the circuit were usually read correctly from the scales of the diagrams provided. Common incorrect answers seen were 2.45 V and 1.8 A.

The total power produced by the lamp filaments was calculated correctly by the majority of candidates. Occasionally when the calculated value of the power was truncated, rounding errors occurred.

(b) Most candidates followed the instructions given and arrived at correct numerical values for the power dissipated in each lamp. However, many of these candidates did not supply units for the quantities.

Many candidates did not answer the question set and just repeated the words in the stem of the question, stating that the two values of power dissipated in the individual lamps were the same within the limits of experimental accuracy. Candidates needed to compare the two powers, and to give a simple statement that the two calculated values were close enough to be considered equal or that they were too far apart to be considered equal.

(c) This question proved challenging and only stronger candidates answered well. Many candidates believed that it was possible for one of the lamps in a series circuit to remain alight if the filament of another lamp in the circuit is broken. The stronger candidates concluded that although one of the two lamps in series did not light, its filament could not be broken because there was still a current flowing.

(d) Many candidates gained partial credit but few candidates gave completely correct circuits. Most circuits drawn showed the two lamps correctly connected in parallel, but some candidates drew two voltmeters connected in parallel with the lamps, thinking that each lamp in the parallel connection needed a voltmeter to record the potential difference across it.

The ammeter was usually positioned correctly, but the variable resistor was often connected incorrectly. Even when the variable resistor was connected correctly, the symbol used for the variable resistor was frequently incorrect.

Question 3

(a) The normal to the glass block was nearly always drawn at 90° to **AB** and at the centre of **AB**, as required. Occasionally the normal was not produced to cross **CD**, as requested.

Most ray traces were correct and drawn neatly. The most common error was to read the protractor incorrectly and use an angle of incidence of 60° instead of 30°. Many diagrams did not have the two pins P_1 and P_2 sufficiently far apart. Candidates should be advised to place the two sighting pins as far apart as the space provided will allow – certainly at least 5 cm apart.

(b) The required straight line was almost always drawn in the correct position.

(c) The values of the distances *a* and *b* were usually measured correctly on the ray-trace diagram to a tolerance of ± 1 mm. A minority of candidates failed to include a unit with their measured lengths.

The refractive index of the material of the block was usually calculated correctly. Most answers were recorded to 2 or 3 significant figures and were within the tolerance allowed. Candidates who included a unit for refractive index did not gain the final mark as refractive index is a ratio and has no unit.

(d) Most candidates listed two or more suitable additional values for the angle of incidence that could be used to repeat the experiment in order to improve reliability. Angles of incidence greater than 60° were not accepted.

(e) Most candidates gave a sensible precaution that should be taken to obtain an accurate result in this type of experiment. Other candidates incorrectly stated that these types of experiments should be carried out in a dark room. When carrying out optics experiments using pins, the room needs to be as bright as possible.

Question 4

Credit was available for a brief explanation of how candidates would set up the investigation. Many candidates did not state that the room temperature and/or the initial temperature of the water in the container needed to be measured.

Most candidates realised that the time taken to raise the temperature of the water to its boiling point in the containers needed to be measured. Occasionally, candidates misread the brief and found the time taken to heat the water to some arbitrarily chosen temperature.

Most candidates gained credit for stating that the experiment would be repeated with the other two containers.

Many candidates were able to gain at least partial credit for listing the control variables in this investigation. The two most popular control variables chosen were usually the volume of water added to the container or the initial temperature of the water.

Only stronger candidates mentioned keeping the Bunsen burner flame constant or the distance from the flame to the bottom of the beaker constant.

Most candidates drew an appropriate table of results and gave relevant headings with units. A common error was to use the unit ‘m’ for minutes, if the minute was their chosen unit of time.

Few candidates read the purpose of the investigation carefully enough to explain exactly how they would use their results to reach a meaningful conclusion. The purpose of the investigation was to determine if the material from which a container is made affects the time for water in it to be heated from room temperature to boiling. Most answers to this part described the relative conducting properties of the materials of the containers, which although often correct, did not answer the question. Stronger candidates gave a simple statement to indicate that if the times taken to boil the water in the three containers are different, then the type of container does affect the time taken to boil the water.

PHYSICS

Paper 0625/63
Alternative to Practical

Key messages

- Candidates should be advised to read the questions through very carefully to ensure that they are answering the question as written, and not simply recalling the answer to a similar question that may have appeared on a previous question paper.
- Candidates need 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 be ready to apply their practical knowledge to unusual situations.

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 and justifying conclusions
- dealing with possible sources of error
- controlling variables
- making accurate measurement
- 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 clearly had experience of similar practical work and much less successfully by those who apparently had not. The breadth of candidates' experience of experimental work was apparent in the quality of their analysis of results and their comments on procedures. This was seen in the clear practical details given by some candidates in **Questions 1(b)**, **1(e)(ii)** and **1(f)(ii)**, **Question 2(d)** and **Question 3(e)**.

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. These points were demonstrated in many of the responses to **Question 1(d)** and **Question 2(c)(iv)**. Candidates need to be mindful that use of a recurring symbol does not indicate the intended number of significant figures and this may not be credited.

Each Alternative to Practical examination includes a question in which candidates will be asked to outline a plan for an investigation. Candidates can answer these question with careful reading of the brief and the logical application of experimental practice. Many candidates showed good practical knowledge when answering **Question 4** but it was clear that a number had not been prepared for this or had limited experience of basic experimental work.

Comments on specific questions

Question 1

(a) The vast majority of candidates made the correct measurements. Very few tried to record their values to a precision greater than their ruler and these answers were given credit providing they could be rounded to the correct values. The subsequent volume calculation was carried out well by nearly all candidates.

(b) Many candidates recognised the irregularity of the modelling clay shape as a source of inaccuracy but very few could describe a suitable improvement to the procedure. A number of candidates tried to suggest changing the shape of the modelling clay to make it more regular but this wouldn't improve the procedure itself.

(c) Nearly all candidates were able to record the correct weight of the modelling clay.

(d) Most candidates obtained the correct value for density although some omitted the unit.

(e) Most candidates were able to read the volume V_2 correctly, with only a small number reading the upper meniscus at 165 cm^3 or misinterpreting the scale and choosing 152 cm^3 or 153 cm^3.

Most candidates either gave a written description or a diagram or mentioned that the reading should be taken at the lower meniscus. Some responses did not include this and only mentioned that the reading should be taken at the lower meniscus.

(f) Most candidates obtained the correct value for density. When justifying which procedure was likely to give a more accurate value, most were able to correctly and clearly reference the irregular shape of the modelling clay when choosing the displacement method. The small number that chose the first method either described the inaccuracy due to the string or the resolution of the measuring cylinder. Weaker candidates had difficulties wording their response and tended to repeat the question in their justification.

Question 2

(a) A number of candidates showed the voltmeter connected in series or actually on wire **X**. A small number of candidates correctly identified the voltmeter connected in parallel, but the connecting leads were not at or beyond the end of wire **X**.

(b) Most candidates recorded the reading of the ammeter correctly.

(c) Many well-drawn graphs were seen. Most candidates labelled the axes correctly. However, many candidates gave answers where plots did not cover at least half of the grid. Whilst plotting was generally accurate, some candidates had plots that were too large and therefore using small crosses is always recommended. The graph line should have been straight and well-judged with roughly an even distribution of plots either side.

In general, candidates used a triangle on their graph line to show how they obtained the necessary information. It was noted that a number of these triangles were less than half of the graph line. Candidates should note that it is good practice to ensure most of the graph line is used when obtaining the gradient.

Measurements of l were mostly correct. Some candidates divided their length by three instead of multiplying it to get the actual length of the wire.

Most values of R were within range. However, many candidates omitted units or gave answers that were not to 2 or 3 significant figures.

(d) This was a challenging question for many candidates. Common correct answers were to either lower the voltage or to use an external resistor to lower the current. Some candidates recognised the importance of switching off the circuit in between readings.

Question 3

(a) Most candidates drew the normal well and measured the angle correctly at 20°. In less accurate answers pins P_1 and P_2 did not have a large separation. Candidates should understand that 5.0 cm is accepted as the minimum pin separation rather than the correct or optimum separation – larger separations are recommended.

(b) Lines were often well drawn, and many gained credit for accuracy for the correct α angle.

(c) Lines were often well drawn but sometimes there was a lack of accuracy in measuring the angle. The common incorrect response of 70° was likely due to candidates rounding the angle to fit patterns they had identified in the data.

(d) Candidates who read and interpreted the question carefully were able to compare the difference between the two α values and the difference between the two θ values. Most were able to then conclude that the student's suggestion was correct using the values quantitatively to justify their answer. There were many candidates who incorrectly compared the α value with the θ value for each mirror position instead of the change in each due to the change in mirror position. A number of candidates wrote about the student's suggestion being wrong just because the values weren't the same despite the fact there was only a difference of 1° or 2°.

(e) Many candidates incorrectly referred to the accuracy of protractors and rulers instead of genuine precautions. A few candidates overlooked the fact that this investigation uses pins in replacement of light-ray boxes. Therefore, responses about conducting the investigation in a room with minimal lighting will not help. It appeared that where candidates had the experience of conducting reflection or refraction experiments using pins, they were able to clearly articulate the precautions that would lead to accurate results.

Question 4

In answering this question candidates were expected to describe the method with one side of the metal in hot water, the other in cold water with the time taken to increase the temperature of the cold water to compare the metals. However, credit was given to candidates who described valid alternatives. Unfortunately, many candidates went on to describe a procedure that would be better suited to an investigation on specific heat capacity rather than thermal conductivity.

Candidates who used the bullet points given in the question normally gave full answers covering all areas of the question. Some candidates did not include a diagram and/or did not specifically state the precautions for reliable results as required in the question. Candidates are recommended to use the bullet points given to help structure their response.