PHYSICS

Paper 0625/11
Multiple Choice (Core) 11

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

General comments

Many candidates showed significant gaps in their basic knowledge of the syllabus and relatively few candidates showed sufficient depth of understanding to score really well on this paper. **Questions 1**, **5**, **11**, **15**, **19**, **21**, **23**, **28**, **36**, **37**, **39** and **40** were challenging for many candidates. Questions **2**, **6**, **8**, **10** and **38** were usually answered well.

Comments on specific questions

Question 1

Many candidates did not recognise that the volume of the object was 20 cm^3 and that the cross section of the measuring cylinder was irrelevant to the problem.

Question 2

Generally, candidates recognised and interpreted the graph correctly. The most common error was to think that the train was moving only when the value of the speed was changing.

Question 5

Most candidates recognised and used the formula density = mass / volume. However, few had the depth of understanding to use the raw information correctly. Instead of using the increase in the mass and increase in volume of the liquid, they used the increase in the mass and the total volume of the liquid.

Question 8

This question was answered well with most candidates clearly recognising that for an object to move at constant speed the resultant force acting on it must be zero.

Question 10

This was another well-answered question, with a large majority of candidates recognising the formula for the work done by a force.

Question 11

Although most candidates had some familiarity with calculation of pressure, many of them did not recognise that it is the weight of the liquid per unit area not the mass per unit area with weight being equal to mass acceleration of free fall.

Question 19

Some candidates recognised that the water cools more quickly because black is a better radiator than silver. However, nearly as many thought it was due to black being a better conductor.

Question 21

Many candidates showed a lack of understanding of the term “frequency”. These candidates divided the time taken (5 s) for the total number of oscillations (20) to be completed, whereas frequency is defined as the number of oscillations per unit time.

Question 23

This question was challenging for many candidates with all options chosen. To answer it well, candidates needed to draw out ray diagrams to plot the images of the different objects.

Question 28

Although most candidates recognised that the conducting sphere would be attracted to the rod, very few realised that the overall state of charge on the sphere remains the same (uncharged) throughout the experiment.

Question 36

To answer this question, candidates needed to first recognise that the magnetic field around a current carrying conductor is circular. To then solve the problem, candidates needed to look at the arrows showing the field directions.

Question 37

This question required a basic knowledge of the motor effect, but few candidates had this and all options were chosen.

Question 39

The use of half-lives to predict the amount of radiation from a source in the future was challenging for candidates.

Question 40

The concept that the spontaneity of radioactive decay is subtle and was challenging for some candidates. However, stronger candidates answered this correctly.

PHYSICS

Paper 0625/12
Multiple Choice (Core) 12

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

General comments

Many candidates showed significant gaps in their basic knowledge of the syllabus and relatively few candidates showed sufficient depth of understanding to score really well on this paper. **Questions 1**, **5**, **6**, **7**, **14**, **21**, **23**, **24**, **27**, **33**, and **39** were challenging for many candidates. **Questions 9**, **13**, **15**, **26**, **35**, **39** and **40** were usually answered well.

Comments on specific questions

Question 1

Many candidates did not recognise that the volume of the object was 20 cm^3 and that the cross section of the measuring cylinder was irrelevant to the problem.

Question 5

Most candidates recognised and used the formula density = mass / volume. However, few had the depth of understanding to use the raw information correctly. Instead of using the increase in the mass and increase in volume of the liquid, they used increase in the mass and the total volume of the liquid.

Question 9

Most candidates showed a good understanding of the energy changes as a ball falls and rebounds from the floor.

Question 13

Most candidates showed a knowledge of the structure of a gas compared with a solid and also that the average speed of the molecules decreases as the gas cools.

Question 14

The understanding of Brownian motion was very limited. Although some candidates recognised that the pollen particles were moved by water particles, many thought that the water particles are more massive than the pollen particles.

Question 21

Many candidates showed a lack of understanding of the term "frequency". These candidates divided the time taken (5 s) for the total number of oscillations (20) to be completed, whereas frequency is defined as the number of oscillations per unit time.

Question 23

This question was challenging for many candidates with all options chosen. To answer it well, candidates needed to draw out ray diagrams to plot the images of the different objects.

Question 24

Only stronger candidates answered this correctly, with all options chosen by other candidates.

Question 26

Candidates showed a good understanding of magnetic attraction and repulsion.

Question 27

It was apparent that candidates did not understand that copper is not a magnetic metal and will not affect the shape of the magnetic field.

Question 33

This question proved challenging for many candidates. Candidates needed to recognise that the brightness of bulb P is not affected by adjusting the potentiometer. They also needed to recognise that the p.d. across XY increases as the slider is moved to the right and hence the p.d. across bulb Q also increases.

Question 35

This question was answered well showing that candidates understood the basic principles of transforming voltages.

Question 39

The use of half-lives to predict the amount of radiation from a source in the future was challenging for candidates.

Question 40

Candidates showed a good knowledge of the term radioactive decay.

PHYSICS

Paper 0625/13
Multiple Choice (Core) 13

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

General comments

Many candidates showed significant gaps in their basic knowledge of the syllabus and relatively few candidates showed sufficient depth of understanding to score really well on this paper. **Questions 1**, **2**, **18**, **19**, **20**, **26**, **29**, **30**, **32**, **33**, **35**, **36**, **38** and **39** were challenging for many candidates. **Questions 3**, **4**, **8**, **9**, **13** and **16** were usually answered well.

Comments on specific questions

Question 1

Many candidates did not recognise that the volume of the object was $20\,cm^3$ and that the cross section of the measuring cylinder was irrelevant to the problem.

Question 2

Few candidates recognised that the speed was increasing at a constant rate and that therefore, the car was moving with constant acceleration.

Question 3

Most candidates were able to solve this problem successfully.

Question 4

This question required candidates to consider the question carefully and was quite challenging. Many candidates were able to correctly complete the task.

Question 7

For an object to be in equilibrium, both the resultant force on the object and the resultant moment about a point must be zero. Considering bar 1, the resultant force is 2 + 2 – 4 = 0 and the taking moments about the centre of the bar, the resultant moment is $+(2 \times \frac{1}{2}y) - (2 \times \frac{1}{2}y) = 0$, where the clockwise moment is considered positive and the anticlockwise moment is, therefore negative.

In a similar way considering bar 2, the resultant force is 2 – 2 = 0 and the taking moments about the centre of the bar, the resultant moment is $+(2 \times \frac{1}{2}y) + (2 \times \frac{1}{2}y) = 2y$, where both moments act in a clockwise direction. Thus bar 1 is in equilibrium and bar 2 is not.

Question 8

Most candidates showed a basic understanding of the concept of pressure.

Question 9

In this question, most candidates showed that they could identify the energy store for a stretched spring.

Question 13

Almost all candidates were familiar with the properties of different states of matter.

Question 15

Generally, candidates showed a good understanding of expansion/contraction of metals.

Question 18

This question was not answered well with most candidates under the misapprehension that food being cooked under a grill is an example of thermal energy transfer by convection. This is an impossibility as hot air around the grill is less dense than the cooler air near the food and therefore the hot air rises.

Question 19

Familiarity with the basic facts was very limited. Dull surfaces are better absorbers and better emitters of radiation than shiny surfaces and black surfaces are better absorbers and emitters of radiation than light surfaces.

Question 20

Although most candidates correctly identified the amplitude of the wave as being 1.0 cm, very few then went on to realise that the wavelength was 8.0 cm, the distance between identical point on successive waves.

Question 23

This question was challenging for many candidates with all options chosen. To answer it well, candidates needed to draw out ray diagrams to plot the images of the different objects.

Question 25

This was quite a challenging question but many candidates completed it successfully.

Question 26

Candidates should be familiar with this method of making a magnet. They also needed to be aware that iron does not retain its magnetism but steel does. Thus, steel makes the stronger magnet.

Question 29

Few candidates showed sufficient understanding of the simple circuit used to measure current.

Question 30

Few candidates managed to complete this calculation successfully and many showed a lack of understanding of simple calculations involving $V = I R$.

Question 32

Candidates were not aware that connecting resistors in parallel reduces the overall resistance by giving an alternative path through which the electric charge can flow.

Question 36

Although almost all candidates ruled out option **A**, all three other options were chosen by significant numbers of candidates.

Question 37

Stronger candidates showed an understanding that swapping the battery terminal polarity will swap the direction in which the wire will move.

Question 38

Knowledge of the term isotope is fundamental when dealing with nuclear physics but not all candidates knew this.

Question 39

The use of half-lives to predict the amount of radiation from a source in the future was challenging for candidates.

PHYSICS

Paper 0625/21
Multiple Choice (Extended) 21

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

General comments

Most candidates were able to demonstrate basic knowledge, but many did not have a good understanding across the whole syllabus. **Questions 9**, **14**, **22**, **30**, **32**, **35**, **37** and **40** were challenging for some candidates, in particular **Questions 14**, **37** and **40**. Many questions were very well answered by the vast majority of the candidates including **Questions 1**, **2**, **3**, **13**, **15**, **18** and **29**.

Comments on specific questions

Question 9

This question was challenging for some candidates. Many did not realise that when there is a resultant force on an object, the speed of the object will either increase or decrease, thereby altering its momentum.

Question 13

Candidates had very few difficulties with this question, recognising that pressure increases with depth.

Question 14

Many candidates found this question challenging and chose option **B**, indicating that they thought the molecules get closer together as the gas cools. However, the question clearly stated that the volume of the container is fixed and, therefore, the molecules average separation remains unchanged.

Question 15

Candidates showed a good understanding of the factors affecting the evaporation of liquids.

Question 18

Most candidates were able to identify the effect of condensation.

Question 22

This question that was answered reasonably well, but the most common error was to divide the frequency (without changing the units to vibrations per second) by the speed of the sound wave.

Question 29

A large majority of candidates clearly understood the laws of electrostatics.

Question 30

Many candidates were unable to give the alternative unit for the volt.

Question 32

This was a challenging question and although some candidates answered correctly, all three incorrect options were chosen by significant numbers of candidates.

Question 35

This question proved challenging for many candidates. It relied on understanding that an induced e.m.f. will oppose (or tend to oppose) the change causing it. In this case, the pole induced at the top of the coil will be an S pole as it repels the approaching S pole. In diagram 3, an S pole is induced at the bottom of the coil, which attracts the disappearing N pole, therefore at point X an N pole will be induced.

Question 37

Questions testing the use of a split-ring commutator are always challenging because there is a tendency to envisage viewing the process for a rotating frame of reference. In this case, if viewed from a stationary frame of reference there can be no doubt that the aim is to keep the turning effect in the same direction at all times.

Question 40

A significant number of candidates thought that the β-particles would be attracted to one of the magnetic poles.

PHYSICS

Paper 0625/22
Multiple Choice (Extended) 22

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

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

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

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

General comments

Most candidates were able to demonstrate basic knowledge, but many did not have a good understanding across the whole syllabus. **Questions 4**, **12**, **15**, **23**, **24**, **29**, **32**, **33** and **35** were challenging for some candidates. **Questions 1**, **2**, **3**, **11**, **13**, **16**, **30**, **36** and **38** were answered well by most candidates.

Comments on specific questions

Question 4

Few candidates chose the correct answer. They needed to realise that $W = mg$ and that $F = ma$. The weight is the driving force causing an object to fall, therefore $mg = ma$ and therefore $a = g$, all objects fall with the same acceleration.

Question 11

Most candidates recognised the energy changes that take place as ball falls to the Earth and as it is deformed when it hits the ground.

Question 12

Of the candidates who answered incorrectly, most either did not convert centimetres into metres or chose incorrectly when deciding whether to multiply or divide the weight by g. In fact, neither action was needed as the weight is given in its correct unit.

Question 13

Almost all candidates answered this correctly.

Question 15

Understanding of Brownian motion was very limited. Although some candidates recognised that the pollen particles were moved by water particles, a significant majority thought that the water particles are larger than the pollen particles.

Question 23

This was quite a challenging question and candidates needed to have suitable geometric tools, in this case a protractor. Without one it is much more difficult to accurately draw construction lines.

Question 24

Many candidates found this question challenging.

Question 30

This calculation was done successfully by the vast majority of candidates.

Question 32

This was a challenging question and although a few candidates got it correct, all three incorrect options were selected by significant numbers of candidates. Candidates need to practise tracing the possible paths of charge to see if it can pass through each diode.

Question 33

This was quite a challenging question. Candidates needed to recognise that the brightness of bulb P is not affected by adjusting the potentiometer. They also needed to recognise that the p.d. across XY increases as the slider is moved to the right and hence the p.d. across bulb Q also increases.

Question 35

This question was only answered correctly by stronger candidates. The easiest way to identify the directions of the deflections is to determine induced polarity of each coil in each response and compare it with the initial example.

Question 38

Most candidates correctly identified the examples of nuclear fission and showed a good understanding of the difference between nuclear fission and fusion.

PHYSICS

Paper 0625/23
Multiple Choice (Extended) 23

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

General comments

Most candidates were able to demonstrate basic knowledge, but many did not have a good understanding across the whole syllabus. **Questions 4**, **6**, **9**, **25**, **28**, **29**, and **40** were more challenging for many candidates. **Questions 1**, **2**, **3**, **11**, **13**, **15**, **18**, and **36** were answered correctly by most candidates.

Comments on specific questions

Question 3

Terminal velocity occurs when the drag forces are equal to the downward force of weight and therefore the resultant force on the object is zero and it travels at a constant speed. More candidates thought that the speed of a falling object continued to increase when it has reached its terminal velocity, than those who knew the correct answer.

Question 6

Most candidates recognised and used the formula density = mass / volume. However, few had the depth of understanding to use the raw information correctly. Instead of using the increase in the mass and increase in volume of the liquid, they used the increase in the mass and the total volume of the liquid.

Question 9

Few candidates knew the definition of impulse with many thinking that it is the change in momentum divided by time.

Question 25

This was a challenging question which required candidates to complete a two-stage calculation. First, to calculate the refractive index of the plastic from 1 / sin 37° = *n*, then to divide the speed of light in air ($3.0 \quad 10^8$) by the calculated refractive index. Only stronger candidates completed this successfully.

Question 28

Candidates found this very challenging with only stronger candidates showing a good knowledge of the procedure. They should also be aware that iron does not retain its magnetism, whereas steel does. Thus, steel makes the stronger magnet.

Question 29

Few candidates recognised that uncharged objects are attracted to charged objects.

Question 35

Almost all candidates recognised the three-dimensional nature of electromagnetic induction but many of those used the left-hand rule rather than the right-hand rule.

Question 40

Candidates needed to recognise that the graph asymptotically approaches a count rate of 30 counts per minute and that this is the background count rate. Only the strongest candidates answered this correctly.

PHYSICS

Paper 0625/31
Theory (Core) 31

Key messages

- In calculations, candidates must set out and explain their working correctly. When candidates give an incorrect final answer and no working is shown, it is often impossible for the examiner to give partial credit for any working that is correct.
- Candidates should ensure they are clear and precise when answering questions requiring a description or explanation.
- It is important that candidates read the questions carefully in order to understand exactly what is being asked.
- In order to improve their performance, candidates should practise applying their knowledge to new situations by attempting questions in support materials or exam papers from previous sessions.

General comments

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

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

There were a very small number of candidates who struggled to express themselves adequately. Candidates should ensure their writing is clear and legible, particularly when writing a number which could be confused with another one.

Comments on specific questions

Question 1

(a) (i) The majority of candidates correctly calculated the volume of one drop as 0.30 cm^3. A common error was to invert the division to give an answer of 3.3 cm^3.

(ii) This question was answered well but several candidates incorrectly rounded the answer to 226. Those who did not get 226.5 almost always used 3×60 somewhere in their answer.

(iii) The majority of candidates correctly calculated the time for one drop as 1.1 s. A common error was to invert the division to give an answer of 0.88 s.

(b) The majority of candidates correctly determined the volume of water as 84 cm^3. A common error was to count each sub-division on the measuring cylinder as 1 cm^3 to give an answer of 82 cm^3.

Question 2

(a) (i) This question was answered well with most candidates reading the correct speed at 10 s to give an answer within the mark scheme tolerance. A small number gave the speed of car B. Candidates should be reminded that when they need to take readings from a graph, they should show clearly how they have arrived at their answer, otherwise credit for working cannot be awarded.

(ii) Almost all candidates selected car A and found a way to justify their choice, most often with reference to the slope of the line but often by comparing speeds appropriately. The most common error was to state that the car with the higher final speed had the greatest acceleration.

(b) (i) The majority of candidates identified the motion of car B as constant speed, but there were quite a few who believed car B was at rest. A common error was to state constant motion, which conveys little about the way the car moves. Only a small proportion of candidates expanded their answer of constant speed by stating that the speed was 16.0 m / s.

(ii) The majority of candidates reached the correct answer of distance travelled as 240 m by determining the area under the graph. A few tried using distance divided by time with the attendant risk of not using the average speed. 480 m was the most common error.

Question 3

(a) (i) The majority of candidates correctly determined the area as 24 cm^2. A common error was to calculate the volume of the block to give an answer of 72.

(ii) This was answered well by almost all candidates. The most common error was to divide the mass by 10 rather than multiplying.

(b) The majority of candidates correctly determined the pressure as 6.0 N / m^2. The most common error was to use an incorrect arrangement of the equation $P = F / A$.

Question 4

(a) This question was answered well and candidates showed an understanding of this difficult concept.

(b) The majority of candidates correctly determined the moment as 50 N cm. The most common error was to use an incorrect arrangement of the equation: moment = force × distance.

Question 5

(a) The majority of candidates stated that the wind turned the turbine, the turbine turned the generator and this generated electricity to gain full credit. Weaker candidates believed that the generation of electricity always involves the heating of water to form steam which drives a turbine and consequently a generator.

(b) This item was answered well with most candidates giving at least one valid advantage. The most common errors were vague answers that did not have the necessary detail, e.g., pollution, eco-friendly and good for the environment, waste gases. These responses lacked the clarity needed for credit.

(c) This item was less well answered than **(b)** but many candidates gave at least one valid disadvantage. There being no or little wind and so no electricity and the large area of land needed for wind farms were the most common creditworthy answers. Several candidates tried, usually unsuccessfully, to answer that the wind is a dilute energy source so that large numbers are needed to match the output of more conventional power stations. Candidates should be made aware that "does not produce much energy" does not give enough detail for this disadvantage.

Question 6

(a) (i) The majority of candidates identified conduction as the process of thermal energy transfer through the metal can. The most common error was to state convection.

(ii) Stronger candidates scored full credit but weaker candidates often confused the melting and boiling points of wax.

(b) The majority of candidates scored well on this item. This is a part of the syllabus that is obviously well understood. Vague answers such as "fixed shape / no fixed shape"; "moves free"; "not far from each other" were common incorrect answers.

Question 7

(a) (i) The majority of candidates gave the correct answer of 8 cm. The most common error was to give an answer of half a wavelength, i.e. 4 cm.

(ii) The majority of candidates gave the correct answer of 1.5 cm. The most common error was to give an answer of 3 cm, i.e. the peak-to-peak value.

(b) (i) Many candidates found this question challenging. Only stronger candidates showed the wavefronts refracting in the correct direction and most of these responses showed the correct change of wavelength.

(ii) The majority of candidates gave the correct answer of refraction. The most common error was to state diffraction.

(c) (i) The majority of candidates gave a correct type of electromagnetic wave. However, almost all waves in the electromagnetic spectrum were given by candidates. The most common error was microwaves.

(ii) This item was answered well by the vast majority of candidates with the uses quoted usually matching the wave given in **(i)**.

Question 8

(a) Only the strongest candidates gave a clear description of a sensible method for plotting the magnetic field, giving sufficient detail for someone to be able to follow. However, there were many candidates who demonstrated a limited knowledge of magnetism.

(b) Only the strongest candidates recognised that the bar was a magnetic material that was unmagnetised, which they knew because it attracted both poles. Many candidates struggled with the concept of induced magnetism.

Question 9

(a) Many candidates gave the correct response that the current increases because resistance decreases. The most common error was to state that current decreases because resistance increases. Other candidates stated that the current increases but with the incomplete explanation of “because the length of wire decreases”.

(b) The majority of candidates correctly determined the current as 0.75 A. The most common error was to use an incorrect arrangement of the equation $V = IR$. The added step of rearranging the equation seems to have been very challenging for many candidates.

(c) The majority of candidates gave the correct answer of 28 Ω. A common error was trying to work out the resistance of parallel resistors. Another common error was 20×2.

(d) Most candidates gained partial credit but only the strongest candidates identified magnetic and heating as the two boxes to tick.

Question 10

(a) Stronger candidates answered this well but few candidates showed a reasonable understanding of how the earth wire ensures that the case stays at ground potential. Most candidates considered the fuse and the earth wire as two separate ways to ensure the safety of the microwave and knew enough about one or other to gain credit.

(b) The transformer calculation was very well done by many candidates. The most common error was an incorrect equation as the starting point. A number who started with the correct equation made errors in rearranging the equation.

Question 11

(a) Many candidates gave the correct response, that the source did not emit alpha-particles, together with a correct explanation that if alpha had been emitted there would be a large decrease in the count rate after the sheet of paper was placed between the source and the detector. A common error was to state that alpha-particles were able to penetrate paper or that the paper emitted alpha-particles.

(b) Many candidates gave the correct response, that the source emitted gamma rays, together with a correct explanation that the count rate was unaffected by paper and aluminium, but after the block of lead was placed between the source and the detector there was a large decrease in count rate. A common error was to state that gamma rays were unable to penetrate aluminium and this was due to confusion with the penetrating ability of beta-particles. Others stated that the lead emitted alpha-particles or gamma rays.

PHYSICS

Paper 0625/32
Theory (Core) 32

Key messages

- In calculations, candidates must set out and explain their working correctly. When candidates give a wrong final answer and no working is shown, it is often impossible for the examiner to give partial credit for any working that is correct.
- Candidates should ensure they are clear and precise when answering questions requiring a description or explanation.
- It is important that candidates read the questions carefully in order to understand exactly what is being asked.
- In order to improve their performance, candidates should practise applying their knowledge to new situations by attempting questions in support materials or exam papers from previous sessions.

General comments

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

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

There were a very small number of candidates, who struggled to express themselves adequately. Candidates should ensure their writing is clear and legible, particularly when writing a number which could be confused with another one.

Comments on specific questions

Question 1

(a) A significant number of candidates were unsure of either the quantity to be measured or the instrument used to measure the quantity.

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

(ii) The majority of candidates correctly determined the area below the speed–time graph to give the distance travelled. The most common error was simply multiplying the speed by the time to give an answer of 100 m.

(iii) Most candidates gave a correct description of initially accelerating and then travelling at a steady speed of 25 m / s. The most common error was to state that the trolley stopped after 4 s.

Question 2

(a) The majority of candidates correctly divided the total thickness of the sheets by the number of sheets to give an answer of 0.11 mm. The most common error was to divide 270 by 29. Candidates should be made aware that they should write their equation in words before substituting numbers, as failing to do this often means that no credit can be awarded if an incorrect calculation is carried out.

(b) Stronger candidates gained full credit but the majority did not convert the mass in grams to a mass in kilograms.

Question 3

(a) (i) The majority of candidates correctly calculated the resultant force on the aeroplane. The most common error was to add the two forces rather than subtracting.

(ii) Most candidates recognised that the force was friction or air resistance.

(iii) Candidates found this item challenging and many thought that when the forces on the aircraft were balanced whilst it is in flight, it would stop/become stationary.

(b) The majority of candidates correctly calculated the moment as 1200 N cm. The most common error was an incorrect arrangement of the equation: moment = force × distance, usually written as moment = force ÷ distance.

Question 4

(a) (i) Candidates found this question challenging. The stages of electricity production in a power station were not well understood.

(ii) This item was also challenging for many candidates. The most common response was to simply state a form of energy. Very few candidates gave correct energy transfers.

(b) Most candidates calculated the output voltage correctly as 200 000 V. The most common error was an incorrect arrangement of the transformer equation.

(c) This section of the syllabus was not well understood. Only stronger candidates were able to give correct reasons such as reducing the current in cables and reducing energy losses in the cables.

Question 5

(a) (i) Very few candidates gave correct explanations for how shiny surfaces reduce the transfer of thermal energy. Correct answers included statements such as “the shiny surface will reflect thermal energy back into the hot liquid”.

(ii) Only stronger candidates were able to explain that, because a vacuum does not contain any particles, it is impossible for heat to transfer through the vacuum by either conduction or convection.

(b) Only stronger candidates answered this fully correctly but other candidates gained partial credit. The most common error was failing to state that the average energy of the particles remaining in the liquid decreased and so it cooled.

(c) (i) Most candidates recognised this as Brownian motion.

(ii) Only stronger candidates gained full credit by stating that liquid molecules bombarding the small particle produced its random motion.

Question 6

(a) (i) The majority of candidates gained partial credit for this question. The most common error was to either omit infrared, or to put another radiation in its place.

(ii) The majority of candidates answered this correctly.

(b) Many candidates gave answers which were not precise enough. Candidates should be encouraged to practice labelling amplitude and wavelength of waves.

(c) Most candidates scored partial credit for this question. The most common error was to give an incorrect electromagnetic wave used in signals for satellite television and mobile phones.

(d) Only stronger candidates answered this fully correctly.

Question 7

(a) (i) A number of candidates failed to identify the angle of refraction in the diagram as 29°.

(ii) Most candidates correctly identified the normal line in the diagram.

(b) (i) A lack of precision resulted in many candidates not being given credit for their ray diagrams. Candidates should be encouraged to use rulers and to practice drawing ray diagrams.

(ii) Very few candidates correctly drew an image between the principal axis and the point where their two rays crossed.

Question 8

(a) (i) Only stronger candidates gave both insulating materials. The most common error was either a plastic strip or a glass lens, but not both.

(ii) Most candidates identified an iron bar as a magnetic material, but then added another metallic object.

(b) Most candidates correctly identified the poles on the magnets. The most common error was failing to write one of the poles on one of the magnets.

(c) (i) Most candidates recognised that the two metal spheres would attract.

(ii) Most candidates correctly drew a diagram showing repulsion between the two positively charged spheres.

Question 9

(a) Most candidates scored partial credit for this question. The most common error was not giving a correct circuit symbol for a battery or a cell.

(b) (i) Many candidates did not realise that the current in the lamp would be the same as the current in the brass connecting strip.

(ii) Many candidates correctly calculated the resistance of the lamp, but many used an incorrect arrangement of the equation $R = V / I$.

Question 10

(a) Many candidates gave a correct diagram of the magnetic field around the wire. This section of the syllabus was not well understood and there were a significant number of candidates drawing patterns similar to those of a bar magnet.

(b) (i) The majority of candidates identified changes such as increasing the current in the wire by increasing the strength of the magnets as a means of increasing the force on the wire.

(ii) Many candidates recognised that reversing the poles of the magnets or reversing the current direction would change the direction of the force. The most common error was to state the opposite to their answer in **(i)**, i.e., decreasing the strength of the magnets, or decreasing the current in the wire.

Question 11

(a) Many candidates found this question challenging. The most common error was to give a nucleon number of 146, or to have the proton and nucleon numbers reversed.

(b) Only stronger candidates halved a count rate and used the graph to find the time taken for this halving. The most common error was simply to give 650 years, which is half the maximum time on the time axis.

PHYSICS

Paper 0625/33
Core Theory 33

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

Some areas of the syllabus were better known than others. Power, refraction and critical angle, thermal processes, longitudinal and transverse waves and the transformer were less well understood.

Equations were generally well known by all but the weakest candidates. Many candidates understood how to apply equations to standard situations well.

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

Comments on specific questions

Question 1

(a) (i) This question was answered well. A common incorrect answer was to state the unit, often metre, rather than the measuring equipment.

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

(b) Most candidates were aware that the speed of the child was zero at the beginning and that the highest speed achieved was near the end of the race. It was not fully understood that the slowest speed (probably equalling zero) would be when the child picked up the ring.

(c) (i) Most candidates converted the time correctly.

(ii) The majority of candidates gave a correct answer, with many also showing their working.

Question 2

(a) (i) (ii) Many correct answers were seen and most candidates recognised that the blocks would gain kinetic and/or potential energy.

(b) (i) Many candidates realised that the work done on both blocks was the same.

(ii) Candidates needed to recognise that the motor would not be 100 per cent efficient and that energy would be lost to other forms.

(iii) Candidates needed to know that to determine power, the time taken for a task is required as well as the actual work done (force   distance).

(c) Many candidates gave the correct answer, writing the equation and showing full working. There were a number of incorrect answers based on the incorrect equation density = mass   volume.

Question 3

(a) Responses stating that the tracks would prevent the vehicle sinking in the snow were common. More developed answers linking this idea to pressure and area were less common.

(b) (i) Many candidates gave the correct answer, writing the equation and showing full working. Weaker candidates often used an incorrect equation, i.e., $m = W \quad g$

(ii) Only stronger candidates answered this correctly and few correct answers with both working and a unit were seen. Many candidates just wrote an incorrect value for pressure on the answer line. Such answers, without working, could not be awarded credit.

Question 4

(a) Candidates generally lacked knowledge of the applications of thermal expansion. There were a noticeable number of blank responses.

(b) (i) Many correct answers were seen for this question.

(ii) Very few candidates recognised the relationship between the motion of particles and temperature.

Question 5

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

(b) (i) (ii) Few correct answers were seen. Candidates did not seem to be able to apply the processes of radiation and conduction to this situation.

(c) Many candidates recognised that a black or dull surface would increase the energy absorbed by the water in the pipe. Other improvements were not so common.

Question 6

(a) There was some confusion between the dashed lines representing the normal and the full lines representing the actual rays of light. There were a significant number of blank responses.

(b)(i)(ii) Candidates generally lacked the knowledge required for these two parts of the question. Very few correct answers were seen.

Question 7

(a) (i) The majority of candidates identified at least one electromagnetic wave but fewer identified all three.

(ii) Candidates did not fully understand that radio waves had the longest wavelength.

(iii) Many candidates were able to identify waves that would travel through a vacuum.

(iv) Most candidates gave the correct answer.

(b) Most candidates were aware that infrared waves are used in TV remotes. Other uses were much less common and answers were often too vague to credit, e.g., electrical appliances, used for measuring, medical purposes were too vague for heaters, measuring body temperature, measuring blood oxygen levels, etc.

(c) Some candidates were confused between longitudinal and transverse waves.

Question 8

(a) (i) Some candidates answered this question well. Other candidates knew the transformer equation and were often able to substitute the values correctly. Rearranging the equation was more challenging. There were a noticeable number of blank responses.

(ii) There were a large number of blank responses and only stronger candidates answered this question correctly.

(iii) Many candidates answered this correctly.

(b) Many correct answers were seen here. There were also a significant number of blank responses.

Question 9

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

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

(ii) Many correct answers were seen but there was some confusion between ammeter and voltmeter.

(c) (i) Many candidates answered this question well, showing full working. Weaker candidates often used an incorrect equation, i.e., current = resistance   potential difference or gave no response.

(ii) Candidates generally lacked the knowledge that the current at every point in a series circuit is the same. There were a significant number of blank responses.

(iii) A significant number of candidates recognised that the combined resistance in the series circuit remained the same. The current would therefore be unchanged.

Question 10

(a) Candidates generally lacked knowledge of the three types of radioactive emission. Answers often focussed on sources that make a contribution to background radiation.

(b) Candidates generally displayed a good understanding of nuclide notation in all parts of this question.

(c) Most candidates recognised that the number of protons equalled the number of electrons.

PHYSICS

Paper 0625/41
Extended Theory

Key messages

- Candidates should ensure they record their responses clearly in ink in the appropriate spaces on the question paper. Where candidates wish to work in pencil initially, they should ensure they completely erase these answers so that it is clear what their final answer is. They should not write over pencil answers.
- Candidates should be reminded to include units where required in their answers.
- Candidates would benefit from being secure in manipulating numbers in standard form (e.g., 1.6×10^6) especially when used in divisions and when the power of ten is negative.

General comments

Many candidates had prepared well for this examination and clearly some had made use of past examination papers and published mark schemes. Candidates should ensure their answers reflect the exact demands of the questions asked, and not give answers to those which they have practised which may be similar.

Comments on specific questions

Question 1

(a) This was quite well answered, and many candidates scored either partial or full credit. However, some answers were not complete explanations (such as "negative acceleration") and a relatively common error was the incorrect suggestion that a deceleration is an acceleration of decreasing magnitude.

(b) A significant number of candidates attributed this delay to something mechanical or even stated that the car could not decelerate immediately because it was already stationary. Only a minority related it to the reaction time of the driver.

(c) (i) Many candidates were able to relate the speed to the gradient of the distance-time graph but others did not refer to the graph at all.

(ii) Many candidates had a clear understanding of how to obtain the speed of the car using the graph and an appropriate value for the initial speed was often seen. There were also candidates who determined a speed but either used values that were not sufficiently carefully determined or perhaps used the whole graph to deduce an average speed.

(d) (i) In this question candidates needed to state that forces other than the force due to the brakes were being exerted. Candidates who realised this were very often able to name an appropriate force.

(ii) Some credit was available for stating that the additional resistive force varied as the car decelerated but for full credit the manner of the variation was required.

Question 2

(a) This question was rarely answered well and both kinetic energy and thermal energy were commonly given suggestions. The answer "potential energy" was not sufficiently precise and the comment that the energy is stored as gravitational potential energy was needed for credit.

(b) (i) This question was answered well, and the correct final answer was frequently seen. However, some candidates did not give the unit or used the wrong unit. A common error was not to add on the atmospheric pressure and there were also candidates who realised that the expression $h\rho g$ was used in the calculation but who substituted the atmospheric pressure rather than the density of the water for ρ.

(ii) This question was also answered well, and the correct final answer was common. Some candidates calculated the correct answer to the previous question but then used the calculated value of $h\rho g$ in this question rather than using their previous answer. One error was to rearrange $P = F / A$ to give the incorrect expression of P / A as being equal to the force.

(c) Few candidates recognised what was required here. Some credit was often awarded for stating that the speed of the water in the pipe was constant.

Question 3

(a) Many candidates were able to give an accurate answer. A large number of candidates discussed the escape of the higher energy molecules and the leaving behind of the lower energy molecules. Fewer candidates related this to the reduction in temperature of the water. The question asked for an explanation "in terms of molecules" and answers that made no reference to molecules were not complete.

(b) The mechanism by which energy is conducted through metals by electrons was not well understood and many candidates gave an explanation in terms of lattice vibrations which, in some cases, made no reference to electrons or which suggested that the electrons behave in the same way as the molecules or ions of the structure. There were answers that were not restricted to energy transmission through the metal of the can.

Question 4

(a) (i) Although some candidates knew exactly what a thermocouple is and were able to gain full credit with a relatively straightforward diagram, there were others who were not as familiar with this. Some candidates simply drew a liquid-in-glass thermometer or a commercial thermometer of some sort which may or may not have been a thermocouple. Credit was not awarded for junctions that were not actually joined and some candidates did not put the hot junction in the sulfur. Another common error was to draw two junctions connected entirely separately to a meter with four terminals.

(ii) This question was not answered well. Although some candidates realised that the temperature could be deuced from the reading on the meter, very few candidates made any reference to how this is done. Some candidates interpreted the word deduced, to mean reduced. Deduce is a command word given in the syllabus.

(b) Many candidates gave one advantage of using a thermocouple rather than a liquid-in-glass thermometer.

Question 5

(a) The full answer here required a reference both to the boiling point being a temperature and to the change of state to which it relates. Many candidates supplied one of these, but few candidates supplied both.

(b) (i) The question was a direct application of the equation energy = voltage × current × time. Many candidates applied this equation correctly and obtained the correct answer. There were candidates who used the information given in the question differently and either calculated the resistance, the charge that flowed, the power or a quantity that did not have a meaning in this context.

(ii) This calculation involved more than one stage and there were many candidates who gained partial credit even though they did not reach a final answer. There were also some good answers, and many candidates reached the final answer in a clear and straightforward manner.

(c) The way in which the earth wire and a fuse in an electric appliance offer protection was not always understood and here, few candidates were awarded full credit. In general, weaker answers tended to be vague and conversational rather than exact and carefully targeted. Expressions such as "electricity is directed to earth" or "the earth wire prevents electric shock" were not precise enough for credit.

Question 6

(a) This question asked about the transmission of energy from the Sun to the road and some good answers were seen. Candidates who discussed the transmission of energy within the road moved beyond what was wanted and did not gain any credit from these parts of their answers.

(b) Many candidates were able to answer this question correctly.

(c) (i) This question specifically asked about the effect of heating the air on the molecules of the air. More general answers did not necessarily gain any credit.

(ii) Candidates found this question challenging and they needed to apply their understanding of convection to a specific case. Some candidates were able to deduce what was happening, but other answers suggested explanations that involved evaporation, convection in the sea and the breeze being due to the motion of the cyclist.

Question 7

(a) This question required a description of the effect of a converging lens on parallel rays of light. Some candidates were awarded full credit for complete and detailed descriptions but there were also candidates whose answers were not related to the parallel rays and who described the action of the lens on the three standard rays that are used to locate the image formed by light from an object. Candidates did not always distinguish clearly between the terms "focus" and "principal focus". Focus cannot be used as a shortened form of principal focus.

(b) There were many good answers to this question. It was not always clear why the marked and labelled points were drawn carefully on the principal axis at distances from the optical centre that were not equal to 3.0 cm. There were a few candidates who had very little understanding of what was required and who placed the labelled points at what seemed to be random positions on the grid.

(c) (i) Many candidates were well practised with this type of construction and drew at least two of the required rays and then drew in the image asked for. A few others had some recognition of what was wanted but drew rays which were not correctly positioned and images which were more often real than virtual.

(ii) Although many candidates correctly stated that the image was virtual, fewer gave the explanation asked for here.

(iii) Many candidates were able to recall the term "magnifying glass" but there were many other incorrect answers seen relating to the study of light and lenses.

Question 8

(a) The speed of the falling magnet as it reached the lower end of the plastic tube was not stated in the question and this proved challenging for many candidates. Many wrote down the expression $\frac{1}{2}mv^2$ but then made no more progress. The acceleration of free-fall is given in the instructions on the front cover of the question paper.

(b) (i) Only stronger candidates answered this correctly. Weaker candidates did not recognise the focus of the question as being on electromagnetic induction and were generally awarded little or no credit.

(ii) The application of the Lenz law is challenging, and only stronger candidates answered this fully correctly. Although the current in the copper tube produces a magnetic field surrounding the tube, copper is not itself a magnetic material. Many candidates stated that it is.

Question 9

(a) For this question there were many answers given that despite being partially correct, were too vague for full credit. In general, candidates found describing an analogue signal difficult and the diagrams that represented a digital signal were often poorly drawn and inaccurate.

(b) This was a test of knowledge and candidates who knew both the truth table for a NOR-gate and the symbol used to represent it answered correctly.

(c) This proved challenging as candidates needed to be able to deduce that a NOR-gate with its two input terminals connected acts as a NOT-gate and then they needed to join this to the output terminal of another NOR-gate. There was also another possible solution using NOR-gates. Candidates offered a variety of incorrect circuits with some that had the output terminals from different NOR-gates connected together and circuits that used other logic gates.

Question 10

(a) (i) This was answered well with many candidates knowing the similarity between the nuclei of the two isotopes. Some candidates made reference to the electrons in atoms of the two isotopes. However, the question was about their nuclei.

(ii) This was also answered well, and many candidates gained credit. A small number of candidates confused neutrons and protons and were awarded no credit.

(b) (i) This proved challenging and only stronger candidates were awarded full credit. Many others realised that a high temperature is needed to supply a great quantity of energy, but many answers referred to the energy needed to split the hydrogen nuclei and few candidates realised that energy was needed to force two positively charged particles very close to each other.

(ii) A common error was to forget that the reaction releases a neutron and the answer ${}^{5}_{2}He$ was frequently given. There were many correct answers but there were also incorrect answers, some of which did not balance. Other errors included supplying the letter H (for hydrogen) in a nuclide symbol with a proton number of 2.

PHYSICS

Paper 0625/42
Extended Theory 42

Key messages

Candidates should be advised to read the questions carefully, and to take note of command words and the number of marks allocated to the questions.

Questions with the command word "explain" or "describe" require some detail and not just a statement.

When candidates are required to draw a diagram or draw on a diagram, they should use a sharp pencil and a ruler to draw straight lines.

Candidates should look carefully at the units, including any prefixes and ensure that their answer has the correct unit. They should also show their working and attempt to set it out logically.

Candidates should relate their knowledge to the context of the questions.

General comments

Most candidates attempted to answer all questions on the paper. Equations were generally well known. Stronger candidates wrote down the equation in its usual form before rearranging it or substituting numbers. A triangle with symbols in it did not gain any marks and was ignored. Candidates should use syllabus symbols for quantities e.g., t for time, T or θ for temperature, Q for charge, I for current.

Some candidates only gave their answers correct to 1 significant figure. Sometimes this appeared to be due to them considering that the zero before the decimal point in an answer less than one counted as a significant figure.

Comments on specific questions

Question 1

(a) (i) Many candidates were able to recall the formula P = E/t. Weaker candidates were unable to correctly rearrange the equation and did not calculate the time in minutes correctly.

(ii) Many candidates were able to correctly identify that the energy stored in the battery was chemical or chemical potential energy. Common incomplete or incorrect answers were potential energy, electrical energy or kinetic energy.

(b) The correct answer was obtained when candidates realised that that they needed to use the energy calculated in **(a)(i)** and the power given in this part of the question to calculate the time. Answers in minutes (144 minutes) or hours (2.4 hours) were acceptable. Many candidates tried to use ratios with a common wrong answer being 25 minutes.

(c) Stronger candidates gave more precise answers to this question. Less gaseous or air pollution, less noise (pollution), less use of fossil fuels and a lowering of the emission of carbon dioxide were responses given by many candidates. Vague answers of less pollution, eco-friendly, battery can be recharged or less fuel used did not gain credit.

Question 2

(a) Most candidates were able to answer this question correctly and weaker candidates were able to gain partial credit by writing down the equation F = ma. No credit was given for the use of mg as the object was not moving vertically.

(b) Many candidates gained partial credit, either for calculating mg, the force downwards as 30 N or the resultant force of 12 N, using the same acceleration as in **(a)** with a mass of 3 kg. Some obtained both those answers and if they subtracted them, they obtained the correct answer. A common incorrect answer of 42 N was obtained by adding these forces.

(c) (i) Some candidates wrote down the equation in the form, $\Delta v = at$, and substituted the numbers correctly. Weaker candidates gained partial credit when the equation was written as $a = \Delta v/t$ but not rearranged, either with or without the numbers substituted into it. Some candidates attempted to use speed = d/t and a circular argument to obtain the correct answer. This question required candidates to show their working.

(ii) Stronger candidate realised that the equation needed was v = d/t, rearranged it correctly and converted cm to m correctly. Weaker candidates omitted the conversion from cm to m or tried to use a different value for the speed. The question stated that candidates should use the speed given in **(c)(i)**.

Question 3

(a) Most candidates gained partial credit for choosing a suitable scale. Weaker candidates chose a scale which was too small or did not give the units of their scale. Stronger candidates were able to draw a correct vector diagram, drew the correct vectors for the water moving and the canoe and drew the correct resultant. Weaker candidates drew the wrong resultant. Candidates should be given practice at drawing vector diagrams. No credit was given for calculating answers using trigonometry as the question asked for a diagram.

(b) Most candidates recalled the correct equation for kinetic energy. Those who were only awarded partial credit forgot to square the velocity when they substituted numbers or gave the wrong unit or omitted the unit.

Question 4

(a) The question asked for statements and explanations of the two features of a liquid-in-glass thermometer that are necessary for linearity. Candidates found this challenging. Only the strongest candidates understood what the question was asking. Weaker answers included ideas about improving the thermometer e.g., using thin glass walls, whilst others referred to finding suitable fixed points for calibration. There were many answers relating to sensitivity or range rather than linearity. Those who correctly chose constant diameter or uniform expansivity often did not clearly link the increase to a constant change in volume to a constant change in length. Candidates needed to take care to fit their answer to the context of the question. Many gave answers referring to sensitivity, e.g., referring to a narrow capillary, rather than linearity. Some weaker candidates just restated phrases from the question without further explanation. Responses often stated that the expansion was linear. Explanations referring to a linear scale in some way, e.g., equal distances between each degree number, were too vague.

(b) A common error was to explain how a thermocouple worked rather than answering the question. Those who did refer to heat capacity often just gave the definition without stating whether it should be high or low. Candidates should always relate their knowledge of a concept to the particular context of the question. Just giving a definition in this question was not enough. There needed to be a physics link between the heat capacity value and the rapid measurements. The small amount of energy required to raise the temperature provides that link. A significant number of candidates chose a high heat capacity as a way of preventing damage to the thermocouple.

(c) There were many correct final answers for this part. However, it was clear from the working out that many candidates were not aware of the difference between heat capacity and specific heat capacity. A significant number of candidates attempted to calculate the energy using the specific heat capacity equation despite there being no value for the mass. Only the equation $(E =)C\Delta T$ was accepted for partial credit.

Question 5

(a) (i) Stronger answers stated that the sound was ultrasound and that its frequency was above 20 000 Hz. Weaker answers only stated that the frequency was outside the audible range or stated that it was infrasound. Some candidates read this question as if it was asking about the nature of sound waves and described longitudinal waves. Other candidates stated that they were X rays or other forms of electromagnetic radiation.

(ii) Most candidates gained partial credit for identifying that they needed to use the equation $v = f\lambda$. Further credit was awarded if candidates rearranged the equation correctly to obtain the answer. As the velocity was in km/s and the frequency in MHz, two correct changes of prefix were needed to obtain the correct answer. There were errors in significant figures and units.

(b) Stronger candidates gave a correct description of one use of X-rays in medicine but did not always give sufficient detail to be awarded full credit. Vague answers of "for scanning" or "to examine bones" were not precise enough for credit.

Question 6

(a) A large number of candidates did not give a correct answer for the focal length. They measured the image distance, object distance, distance between object and image or height of object or height of image. Where candidates measured the correct distance, they usually did so accurately.

(b) Many candidates gained full credit and showed that they were able to interpret a ray diagram. The most common mistakes were to select "virtual" as the image was enlarged or "inverted" as the image was real. Some candidates selected two contradictory answers.

(c) Stronger candidates stated that the image could be projected on a screen or that the light rays did not actually meet. Weaker candidates stated that the image was real or that it could be projected on a screen. Answers such as "upright" or "on the same side as the lens" were not awarded credit as the question was referring to virtual images in general.

Question 7

(a) Most candidates correctly identified the N and S poles. No credit was given for positive and negative.

(b) This question and **(c)** required candidates to draw arrows carefully using a ruler. Full credit was awarded if the arrow was vertical and pointing up. Some candidates drew two sets of arrows at right angles to each other. These were not awarded credit unless the force arrows were clearly labelled as such. Other incorrect answers showed the arrow along the wire in the opposite direction to the direction of the current or towards the N or S pole or in a circular direction.

(c) In this question another common error was to show a line curving downwards showing the path of a β-particle in a magnetic field instead of the force on it.

Question 8

(a) Candidates who knew that the time period is 1/f and were able to calculate 1/60 to 2 significant figures were awarded credit. Common errors were not converting the fraction to a decimal, incorrect rounding to 0.016 s resulting in a significant figure error, attempting to measure the length of the time period on the diagram and assuming that was the time in seconds and omitting the unit.

(b) (i) Most candidates correctly identified the component as a diode.

(ii) A significant number of candidates were able to identify that they needed to use the equation $Q = It$. Only the strongest candidates realised that they needed to use the value calculated in **(a)** for t and the number of electrons multiplied by the charge of the electron for Q. Many other candidates just divided the numbers given in this question. Candidates needed to be familiar with mathematical operations with numbers in standard form. The use of the symbol C for current is ambiguous as C is the unit of charge.

(c) Most candidates were awarded partial credit for indicating that E and I were in opposite directions. Fewer candidates realised that the direction of the arrow on the diode gave the correct direction for the current.

(d) Candidates who knew that P = VI were usually able to calculate the correct value for the power. Some did not include the correct unit. Many weaker candidates confused the equation for power with that for resistance.

Question 9

(a) (i) Many candidates identified that there was an open circuit and that the current would be 0. Weaker candidates tried to use V = IR. A common wrong answer was 6 A.

(ii) Most candidates were awarded at least partial credit, for the use of V = IR. A common mistake was to use a resistance of 3Ω instead of 4Ω.

(iii) Candidates who realised that in this arrangement the 3Ω and 2Ω resistors were in series usually obtained full credit. A common error was to attempt to find a resistance for a parallel combination.

(b) The formula for calculating the value of resistance in parallel was well known by most candidates. Some candidates used $R = 1/R_1 + 1/R_2$ or wrote down the correct equation and then forgot to take the reciprocal to get their final answer. Candidates should be advised to write down the equation in symbols before substituting numbers, and not just the left-hand side of the equation, in questions like this one.

Question 10

(a) This was generally well answered. Some candidates found working out the effect of the NOT gate challenging. Candidates who made mistakes in the values for the output of X were often successful in using their values to find the output of Y and were awarded credit for error carried forward.

(b) Stronger candidates gave an unambiguous answer of high humidity and dark. Low light was not accepted as equivalent to dark as it suggests that there is some light present or some sort of continuous variability. Candidates who did not have the correct answer in **(a)** were awarded partial credit for error carried forward if they had one '1' in the Y column.

(c) Many candidates correctly identified the component needed as a relay. Weaker candidates often attempted to explain the use of two or more components. The phrase "ring the component" means that only one should be selected so careful reading of the question was needed. Stronger answers went on to identify that the relay was needed because the output of the logic gate was low voltage and that a higher voltage was provided by the relay. Candidates who gave explanations about the operation of a relay using an electromagnet did not receive credit. Stronger candidates ensured that they applied their knowledge to the context of the question.

Question 11

(a) (i) Most candidates could correctly complete the path of the α-particle which was undeviated and many were awarded full credit. Care needed be taken when drawing to avoid discontinuities. Weaker candidates drew diagrams where the paths did not continue after they reached the gold nuclei. The path where the α-particle was deflected to the left was the least well known.

(ii) Most candidates correctly stated that the charge was positive. Some candidates wrote down the nuclide notation for an α-particle but did not include a sign.

(b) There were many correct answers. Weaker candidates gave 198, the nucleon number, as at least one of their answers, usually for the number of neutrons or did not realise that the number of protons is equal to the number of neutrons.

PHYSICS

Paper 0625/43
Extended Theory 43

Key messages

Candidates should be advised to read the questions carefully, ensuring that they answer exactly the question that is being asked. The paper tests the full breadth of the syllabus and candidates should be ready to recall and state clearly basic definitions as well as applying their physics knowledge to new situations.

It is important that candidates note the units used with data provided in a question and always state numerical answers with the correct unit. The ability to both recall and manipulate formulae and conversion of data is a feature of good answers to complex calculation questions.

In answers requiring an explanation, candidates should be guided by the total marks available in a question to give an appropriate level of detail in their answer.

Where candidates are required to draw diagrams, they should always use a sharp pencil and draw straight lines using a ruler.

General comments

Where candidates perform complex calculations, they benefit from writing down formulae in words or symbols first. This provides an opportunity to gain some credit even if the final numerical answer is incorrect. Candidates should use the symbols given in the syllabus for the terms in formulae. Please note that Q is the symbol for charge and E is the symbol for thermal energy. T is the symbol for temperature while t is the symbol for time

Some candidates gave final numerical answers to 1 significant figure. Unless the question explicitly states otherwise, it is expected that final answers are given to 2 or 3 significant figures. Candidates should avoid rounding (or truncating) intermediate calculations which can alter the value of a final numerical answer.

Candidates should be taught the correct SI units used along with formulae so that they can convert data given in questions as appropriate and provide correct numerical answers to questions.

In a question worth one mark, one clear statement is sufficient to gain credit whereas a question worth four marks requires several different points to be made.

Candidates need to be precise when stating terms.

Questions that require candidates to draw reflected rays, or refracted waves are testing that candidates understand the physics of these processes. Therefore, care in ensuring that the angle of incidence = angle of reflection or that the direction of travel of a wave is perpendicular to the wavefront is important to convey a good understanding of the physics involved.

Comments on specific questions

Question 1

(a) (i) Many candidates correctly recalled the formula a = (v – u)/t and were able to rearrange and substitute values to calculate the time taken to reach a speed of 28 m/s. Information at the start of **(a)** was not all needed in **(i)** and a few weaker candidates tried to use the mass of the car in this question.

(ii) Most candidates completed a correct numerical calculation using F = ma to find the force. Some weaker candidates gave an incorrect unit or omitted the unit in their answer. A few candidates recalled the formula incorrectly.

(iii) Most candidates correctly recalled and used KE = $\frac{1}{2}$ mv^2. Only the very weakest candidates made no attempt at this question and many weaker candidates gained some credit for writing the formula down correctly. A variety of different calculation errors were seen including use of incorrect data from the question, addition instead of multiplication of terms and use of an incorrect unit.

(b) A fully correct answer here required candidates to recall the formula Q = It and then convert the given time to seconds in order to calculate charge in coulombs. Correct answers in other units, e.g., Ah gained full credit. A common incorrect response was to calculate charge in coulombs without converting time to seconds.

(c) Stronger candidates often made suggestions relating to variations in the journey, e.g., travelling uphill, stopping and starting at traffic lights. Others suggested additional drains on the use of the car battery such as use of heating or air conditioning.

Question 2

(a) Many correct answers to this question were seen. However, a reference to potential energy, without mention of 'gravitational' was insufficient for credit. A common incorrect response was kinetic energy and a few weaker candidates repeated the word hydroelectric from the question, which is not a form of energy.

(b) (i) To arrive at the correct answer candidates had to recall and use E = mgh for the energy transfer of the falling water and then recall that rate is energy per second. Candidates needed to have a clear understanding of the term 'rate' and be able to apply it to different situations. Since the data in the question gave the rate of falling water in kg/s, stronger candidates found the substitution straightforward. A missing or incorrect unit with the final answer was a common mistake.

(ii) Many candidates calculated the power supplied by the power scheme. There was some confusion in identifying the total power in and the useful power out when attempting to calculate the efficiency. Many assumed that the electrical power was the input to the scheme. When candidates write down the word equation for efficiency, they need to include the word power or energy, and not just write a shorthand out/in as this did not convey adequate understanding of the terms.

(c) (i) There were some good answers to this question e.g., damage to habitats or the need to flood land when creating the dam. Cost of construction was also an acceptable disadvantage. Candidates needed to avoid vague answers. For example, "it's expensive" was insufficient since the running costs of a hydroelectric scheme are one of its advantages. Likewise, "it needs a lot of water" was too vague but stating "there are limited sites with both water supply and the necessary vertical height for HEP" was creditworthy.

(ii) Almost all candidates recalled renewable energy sources. While the Sun was an acceptable alternative name for solar energy, candidates needed to reference tidal or waves rather than stating the more general term "water", which did not adequately distinguish another source from the HEP in this question. Candidates should always be encouraged to use the terms listed in the syllabus for absolute clarity.

Question 3

(a) (i) Candidates were often able to choose and record a sensible scale for their diagram. They should be reminded to include units in a scale, e.g., 1 cm:10 N. The few candidates who were able to produce a correct vector diagram, with the start of the second vector joined to the end of the first vector, with the correct angle between the vectors and the resultant joining the start of first with end of second vector, usually also measured angles and lengths carefully enough to find the magnitude and direction of the resultant force. The simplest way to express the direction of the resultant force was with respect to the ceiling, i.e., vertically upwards towards ceiling. However, many candidates were unable to produce the vector diagram which limited their access to the available credit for magnitude and direction of resultant. Since the question asked for a diagram, calculating the vector did not gain credit. A few candidates were unable to, or forgot to use their scale to convert their measured resultant vector length back to a force.

(ii) Most candidates correctly realised that the magnitude of the vector in **(i)** was equal to the weight of the boat and so used W = mg to determine the mass of the boat in kg.

(b) Candidates demonstrated a good knowledge of vector quantities with even many weaker candidates correctly identifying both acceleration and momentum. Where candidates did not gain full credit there was often evidence of changing their selection before deciding on a final answer.

Question 4

(a) (i) Good drawings showed an obvious randomness with a path made up of straight-line segments of different lengths, zig zagging in different directions. A common mistake was to show the path inside a box, only changing direction when it hit the sides of the box. Candidates needed to understand that the smoke particle was colliding with invisible air particles. Some drawings appeared to show multiple particles each with a small arrow showing their direction. Stronger candidates drew one continuous path of a single particle and show at least 4 changes in direction so that different lengths of path in different, random directions were demonstrated. Curved lines were not given credit.

(ii) There were many well written answers which showed good understanding of Brownian motion describing the air molecules as small and fast moving. Weaker answers often failed to mention air molecules and talked about the particles colliding with themselves and the sides of the container. Candidates needed to take care to use the key words "molecules" and "particles" given in the question appropriately so that it was clear when they were referring to air and when they were referring to smoke.

(b) (i) Many candidates correctly explained that an increase in the temperature of the air means that the kinetic energy of the air molecules increases or that the molecules move faster. Either statement gained full credit here.

(ii) To explain why the air pressure in the sealed container increases, candidates needed to mention both an increase in the frequency of collisions between air molecules and the walls of the container and either an increase in the change of momentum of each collision or harder/more forceful collisions. Weaker candidates gave the vague answer "more collisions" which was not precise enough to describe more frequent collisions.

Question 5

(a) The specific heat capacity of a substance is defined as the energy required to raise the temperature of 1 kg of the substance by 1 °C. Candidates still gained credit when they used terms such as unit mass, but they should be encouraged to be precise to show that it is the energy required to raise the temperature not just to change the temperature. Some candidates confused specific heat capacity with the energy required to bring about a change of state of the substance.

(b) (i) Most candidates were able to recall d = m/V and were able to substitute numerical data from the question and rearrange the equation to find mass. Many candidates struggled with manipulating a volume in cm^3 to give a mass in kg. Candidates would benefit from practice in converting data from different units into SI units for use in calculations.

(ii) Candidates gaining full credit here recalled $E = mc\Delta\theta$ and E = mL and were able to systematically break down the calculation into the energy given out cooling the water, changing the water into ice at 0 °C and then cooling the ice, before adding all three components for a correct final answer. Candidates who were unable to break the calculation down most often scored partial credit for clearly writing down the equations first in symbols. Some candidates only calculated energy due to cooling of water and ice without the energy given out during the change of state. Some candidates were confused about whether they were adding or subtracting the energy due to water solidifying. Some weaker candidates calculated one energy change for the total temperature change from 5 °C to – 18 °C.

Question 6

(a) (i) Candidates did well on this question when they clearly attempted to draw semi-circular crests, centred on the gap in the barrier and retaining the same wavelength as the plane waves before the barrier. Some weaker candidates drew waves centred a long way to the left of the barrier and some candidates also drew crests with an increased wavelength to the right of the barrier.

(ii) Candidates understood that the wave would refract or change direction as it crossed the boundary, but most candidates were unsure about how it would refract. Some answers showed the new wave fronts as a mirror image of the incident wavefront and others drew them parallel to the boundary. Candidates may have found it more helpful to draw the direction of the wave first and then add perpendicular wavefronts rather than the other way around. Candidates needed to remember that the new wavelength in the shallow water would be shorter. Care needed be taken to get the wave direction perpendicular to the wavefronts. Some arrows were carelessly drawn.

(b) Stronger answers included precise differences between the two wave types, noting that it is the particles in the wave that vibrate and not the wave itself and that it is the vibrations which are perpendicular (transverse) or parallel (longitudinal) to the direction of travel or energy transfer of the wave. Weaker candidates often knew that something was perpendicular or parallel but were unable to give a precise difference.

(c) (i) Some candidates were able to give a sensible value for the speed of sound in water. Common incorrect answers were either the speed of sound in air or the speed of electromagnetic waves in a vacuum.

(ii) The majority of candidates correctly stated that sound travels faster in water than air either due to water having a greater density or by stating that molecules are closer together in water.

Question 7

(a) To gain full credit, candidates needed to realise that a ray from X to the left-hand edge of the mirror would produce the reflected ray that intersects AB closest to A. Many candidates drew rays to the centre of the mirror and gained some credit for showing clearly that angle of incidence = angle of reflection. Candidates should always use a ruler and sharp pencil to draw neat rays. A ray should also include at least one arrow to show the direction in which light is travelling along the ray.

(b) Many candidates gained full credit providing two of several correct properties to describe the image. A common mistake was to say that the image is inverted (which could mean upside down or back to front) without being specific that it is laterally inverted.

(c) (i) (ii) Candidates generally either got both questions correct or incorrect here suggesting that they knew the relative positions of the different waves in the electromagnetic spectrum well, even when they are unsure of the order of increasing wavelength.

Question 8

(a) (i) Most candidates correctly identified component X as a light dependent resistor (LDR). A common incorrect answer from weaker candidates was resistor, which was too imprecise to gain credit.

(ii) Almost all candidates drew the correct symbol for a voltmeter connected in parallel with Y on the figure. A small number of candidates made no attempt at this question.

(iii) This question required candidates to add together resistors in series and then use total resistance in V = IR and calculate a value for current in the circuit. Many candidates gained full credit. Some weaker candidates simply used one of the resistance values given in the question and others were unable to rearrange and substitute correctly into the equation V = IR. Some candidates correctly used their value for current to work out the p.d. across Y. Several different mistakes were made by weaker candidates including the use of the resistance of X instead of Y or the omission of a unit with the final answer.

(iv) When the resistance of component X is very large this causes an increased share of the p.d. to be across X and therefore the p.d. across component Y decreases.

(b) Many sensible practical uses for an LDR were given. The most common was to turn on streetlights at night. Candidates needed to give a sufficiently detailed answer. Candidates who wrote “as a light sensor” were not giving a practical use and others who wrote “automatic lights” were not describing a use for an LDR precisely enough.

Question 9

(a) (i) Stronger candidates realised that the motion of the magnet in the coil is an example of electromagnetic induction and causes a current to flow in the galvanometer. Knowledge that the direction of induced current is reversed when the direction of motion of the magnet is reversed allowed candidates to identify a galvanometer needle which will oscillate as the magnet oscillates up and down. There was confusion in some answers that suggested candidates may have thought that the needle was part of a small plotting compass and that, as shown on the diagram, it was pointing upwards because that is the direction of the North Pole.

(ii) Those candidates who identified electromagnetic induction in **(i)** were often able to state that the needle gives a larger deflection. Common incorrect answers included faster deflection or the idea that the galvanometer needle was more sensitive. Neither of these described a bigger deflection and so were not given credit.

(b) Most candidates who were able to recall the equation $N_p/N_s = V_p/V_s$ were also able to rearrange it correctly, substitute in the data and calculate the correct number of turns on the primary coil. Weaker candidates often wrote the original equation down incorrectly and so gained no credit. Candidates should be encouraged to write down any formula they intend to use in the learned format first before attempting a rearrangement of the terms as they may be awarded partial credit for this.

Question 10

(a) To obtain full credit candidates needed to state either that background radiation is included in the table or that it had been removed from the graph. Many weaker candidates made no reference to background radiation in their answer with some repeating information from the question that the graph showed the count rate due to the sample. Candidates should be encouraged to avoid repeating phrases from the question and should read questions carefully for any clues they provide about the required physics knowledge.

(b) The majority of candidates knew how to determine the half-life from the graph. Some weaker candidates attempted to calculate half-life using values from the table. Candidates should be encouraged to show their working on a graph so that if they misread the scale they can still gain credit for knowing how to determine the half-life from a graph.

(c) This was generally answered well. Some weaker candidates knew the formula for the β-particle but put it on the left-hand side of the equation. Since the β-particle is released during the decay it should be to the right of the arrow.

PHYSICS

Paper 0625/51
Practical Test

Key messages

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

General comments

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

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

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

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

The practical nature of the examination should be kept in mind when explanations, justifications or suggested changes are required, for example in **Questions 1(a)(ii)**, **1(e)**, **2(e)**, **3(d)** and **3(e)**.

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

Comments on specific questions

Question 1

(a) (i) The majority of candidates successfully recorded the top and bottom scale readings in mm. Most candidates successfully calculated the length of the spring. Candidates were expected to record all three distances to the nearest mm.

(ii) Candidates familiar with the use of a set square to aid accurate measurement were able to draw a diagram that clearly showed how to use the set square.

(b) Most candidates recorded a realistic new length and calculated the extension correctly. The calculation of *k* was done accurately by most candidates, but fewer recorded the appropriate unit.

(c) Most candidates recorded a realistic new length and carried out the calculations correctly. Those candidates that did the experiment with care were able to obtain a second value for *k* that was within 10% of the first value.

(d) Candidates were expected to show their understanding of results being equal within the limits of experimental accuracy by stating that their two values were close enough to be considered equal or too different to be considered equal. The statement and explanation had to match the results to gain credit. Some candidates gave a statement that was contradicted by their results.

(e) Candidates were expected to suggest the use of additional masses and to realise that this would enable them to calculate an average or plot a graph.

Question 2

(a) Most candidates recorded a realistic room temperature.

(b) (i) Most candidates recorded decreasing temperatures expressed to the nearest 1°C. Some entered room temperature instead of the initial temperature of the hot water at time t = 0 s.

(ii) Many candidates entered the correct units in the table but a number appeared to miss the instruction and did not complete the column headings.

(c) Most candidates carried out the calculations correctly but fewer worked out the unit °C / s successfully.

(d) Candidates were expected to suggest a lid for one experiment and insulation for the other experiment.

(e) (i) A volume matching the approximate volume of the can specified in the Confidential Instructions was expected.

(ii) Candidates were expected to state that the measuring cylinder should be read at right angles to the scale. Some responses were too vague to gain credit here. Also, the reading should have been taken in line with the bottom of the meniscus.

Question 3

(a) Most candidates recorded a suitable current to at least two decimal places.

(b) Candidates were expected to record increasing potential differences to at least one decimal place and then to correctly calculate the resistances giving their results to a consistent and sensible number of significant figures for the experiment.

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

(d) Many candidates gave an accurate reading, to within half of a small square and indicated clearly with horizontal and vertical lines how the information was obtained.

Question 4

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

Candidates needed to clearly state the variable being investigated. Most chose either the sand/cement mixture or the length of beam.

A concise explanation of the method was required. Candidates needed to concentrate on the readings to be taken and the essentials of the investigation. It may benefit candidates to plan their table of readings before writing the method to help them to think through the measurements that must be taken to address the subject of the investigation. Candidates were expected to describe loading a beam until it broke and then repeating this with other different beams. A vague reference to repeats was not sufficient as it was not clear whether the candidate was referring to using different beams or repeating the measurements with a beam with the same mixture or length.

Candidates were expected to identify the variable that should be kept constant. This was the length of beam if mixture was investigated or mixture if length was investigated.

Many candidates drew a suitable table. They were expected to include columns appropriate to the method including correct units.

Candidates were expected to explain how to reach a conclusion by comparing the variable under test with the breaking force. The question did not ask for a prediction. Some candidates wrote a prediction but no explanation of how to reach a conclusion.

PHYSICS

Paper 0625/52
Practical Test 52

Key messages

To do well in this examination, 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 and able to demonstrate some ability and understanding across the whole of the range of practical skills being tested. All parts of the 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. Writing was neat and legible, and ideas were expressed logically. However, many candidates seemed less able to derive conclusions backed up by evidence, or to present their conclusions in a clear way.

The gathering and recording of data presented few problems for 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 they are clearly legible. 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) Many candidates recorded measurements taken directly from the metre rule scale instead of determining *a* and *b*, the distances of the masses from the pivot. Candidates were expected to take readings from the scale of the metre rule to the nearest 0.1 cm; a few candidates recorded distances to the nearest centimetre.

(b) Many candidates chose scales which meant that the *a*-axis did not span at least half of the given grid. The instruction that candidates did not need to start their graphs from the origin was very often not followed. There was occasionally evidence of the use of scales that increased in inconvenient increments, such as 3 or 7. Choosing such scales makes the points much harder to plot by candidates and more difficult for candidates' plotted points to be seen clearly.

There were many excellent, carefully drawn, best-fit lines produced by candidates. However, there were too many graphs where the best-fit line was forced through the origin.

The most common sources of error were:

- missing labels and/or units on the axes
- a choice of scales which meant that the plotted points did not occupy at least half of the grid
- dots that were wide which made it difficult to judge the accuracy of the plotted point
- dot-to-dot lines, instead of a single best-fit line.

(c) As expected, candidates who drew a large triangle to determine the gradient of their graphs obtained the most accurate values for the gradient of the line. There were many responses which showed no clear indication on the graph of how the information to determine the gradient had been obtained, despite the instruction given to do so.

Question 2

(a) The practical side of this question was generally done well, with most candidates obtaining sensible values for the currents and voltages. The use of a single cell as the power supply in some centres produced some very low current values.

(b) The circuits for the rearranged components were usually drawn well. Correct electrical symbols were expected and answers with lines drawn through resistors and meters could not be credited. Occasionally, all three resistors were connected in series

(c) Candidates had little difficulty in calculating resistance values for the different combinations of resistors. However, occasionally candidates left the resistance values as improper fractions. The requirement to give the resistance value to a suitable number of significant figures was often not followed. Candidates should be encouraged to give their answers for calculated quantities to the same precision as the readings from the meters had been recorded.

(d) There were many good attempts at suggesting how to use the apparatus provided to see if the three resistors had the same values of resistance. Candidates who approached the problem by taking each resistor individually and measuring the current, voltage and then calculating and comparing the resistance values were usually successful. However, many candidates did not give sufficient detail and did not even state what readings they would need to take.

Question 3

(a) Most candidates followed the instructions and obtained sensible values for the object and image distances from the converging lens. The instruction to start with the lens close to the illuminated object was often not followed and values for the object distance for the focussed image greater than 50 cm were obtained. These candidates had obtained a focussed diminished image instead of the focussed magnified image that they needed.

(b) The instruction to increase the object to screen distance and to refocus the image was usually followed correctly.

(c) A few candidates did not show their working in this question and therefore could not be awarded partial credit when their final answer was incorrect.

(d) Some candidates did not focus on the precautions needed to ensure the accuracy of the readings, as required. Many candidates wrote about the need to line up the object lens and screen, without explanation or gave vague, unqualified references to parallax.

(e) Only stronger candidates answered this part correctly. Many candidates did not seem to realise that they were being asked to suggest a suitable number of sets of readings that needed to be taken, so that a graph could be plotted. Only stronger candidates recognised that by drawing a graph, an average value of the focal length could be obtained, or that any anomalous results could be identified and ignored, or measurements repeated.

Question 4

Most candidates obtained at least partial credit for describing how they would carry out the investigation. A common omission here was to not state the obvious, that is that the insulating disc must be placed between the heated metal cylinder and the lower metal cylinder.

The time for the lower cylinder to reach a certain temperature was the usual approach by candidates, but a minority opted for the temperature reached by the cylinder in a fixed time of heating.

Most candidates recognised the need to repeat the measurements for the other insulating discs. Often candidates gave examples of the materials from which the insulating discs could be made. These lists often included metals such as copper, aluminium, and gold.

Most candidates were able to state one suitable variable they would need to keep constant whilst investigating the effect of the different insulators.

Many candidates wrote about the size, volume, or mass of the discs but only a few candidates realised that it was the thickness of the discs that it was important here. Many candidates referred to the same room temperature, which was not appropriate here, and often irrelevancies such as the use of the same thermometer or stopwatch were seen.

The table was usually drawn correctly. Common errors were not including units in the headings or the inclusion of named metals in the insulator column.

The conclusions were done well, but often the confusion between conductors and insulators was seen again here. A common incorrect conclusion was that the disc which produced the greatest temperature rise in the metal cylinder was the best insulator.

PHYSICS

Paper 0625/53
Practical Test 53

Key messages

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

This paper tests an understanding of experimental techniques and explanations need to be based on data with practical, rather theoretical, considerations being taken. These techniques will be tested in the paper.

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

All questions should be read carefully so that candidates have a clear understanding of the requirements so that they can provide appropriate responses.

General comments

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

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

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

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

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

Comments on specific questions

Question 1

(a) Most candidates recorded a correct set of readings and gave their values to the required precision of 1 decimal place.

(b) Most candidates correctly labelled the *x*-axis. Unless stated, it is not necessary for axes to begin at the origin. Many candidates did not gain full credit because the plots did not occupy more than half of the available space on the graph. Very few inappropriate scales were seen, e.g., going up in threes or sevens. Most candidates correctly plotted their points, but some made their points too large on the graph. Points should not be larger than half of a small square and plotted to at least this accuracy. There were many good, well-judged, thin lines drawn with correct intersections of the two lines.

(c) Many candidates determined the correct value for F_0 and W_R within the acceptable range, but some omitted units or did not give their answer to either 2 or 3 significant figures.

(d) Few candidates gave a precise enough answer to gain credit. Either measuring the height at both ends of the ruler and stating that they were equal or using a set square or protractor were acceptable.

(e) Very few candidates answered this correctly because they did not read the question carefully and did not realise that the answer needed to relate to the newton meter itself.

Question 2

(a) Most candidates successfully recorded the thermometer reading.

(b) (i) Most candidates successfully recorded the thermometer readings and showed that they were decreasing more quickly.

(ii) Many candidates did not give a response to this question. Only s or °C were acceptable.

(c) Most candidates correctly stated how the volumes affected the cooling rate but did not justify their answer with reference to their results over 180 seconds.

(d) (i) Many correct answers were given but some candidates gave an incorrect unit.

(ii) Many candidates correctly stated that the cooling rate would be lower or less but did not explain that this was because the temperature difference between the beaker and the room was less.

(e) Most candidates identified the need for insulation or a lid in the additional experiment, but many did not mention a comparison of the cooling rates.

Question 3

(a) (i) Many candidates correctly measured the focal length and gave the correct unit.

(ii) Many candidates did not gain credit here as they either did not refer to the lens or that it needed to be moved slowly back and forth.

(b) (i) Most candidates correctly measured h_o and h_I to the required accuracy of the nearest millimetre.

(ii) Some candidates gave an unnecessary unit for W and did not give their value of f_2 to 2 or 3 significant figures.

(iii) Many candidates realised that there was a difficulty if you blocked the light reaching the screen (e.g., a hand gets in the way) and suggested a way round the problem (e.g., make a mark on the screen and read it later).

(c) The values of f_1 and f_2 should support the suggestion and be within experimental accuracy (10 per cent), with values quoted to justify this statement.

(d) Many candidates stated a suitable precaution to take to gain credit here.

Question 4

Careful reading of the question and the use of the bullet points as a guidance as to what was expected in the plan enabled candidates to better address what was required to gain full credit. It is always a good idea for candidates to go back and read their method to see if they could actually carry out the experiment.

Most candidates completed the circuit correctly with the voltmeter in parallel with the LDR. The most common independent variables identified were either the distance from the LDR or the light intensity and some candidates quoted current which was acceptable. There were many good descriptions of how to carry out their experiment, but many omitted how they would calculate the resistance. Most candidates stated the need to have new values for the independent variable and correctly identified a control variable. Many candidates drew a table with the correct quantities but some did not include the required units. Few candidates successfully analysed what their results would show. The use of a graph, with specified axes, was the most common way that candidates gained credit.

PHYSICS

Paper 0625/61
Alternative to Practical

Key messages

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

General comments

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

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

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

The practical nature of the examination should be kept in mind when explanations, justifications or suggested changes are required, for example in **Questions 1(e)**, **2(e)**, and **2(f)**.

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

Comments on specific questions

Question 1

(a) (i) The majority of candidates successfully recorded the top and bottom scale readings in mm. Most candidates successfully calculated the length of the spring.

(ii) Candidates familiar with the use of a set square to aid accurate measurement were able to draw a diagram that showed clearly how to use the set square.

(b) Most candidates calculated the extension correctly. The calculation of *k* was done accurately by most candidates but fewer recorded the appropriate unit.

(c) Candidates were asked to give the value of *k* to two significant figures, but a number of candidates gave three significant figures.

(d) Candidates were expected to show their understanding of results being equal within the limits of experimental accuracy by stating that their two values were close enough to be considered equal or too different to be considered equal. The statement and explanation had to match the results to gain credit. Some candidates gave a statement that was contradicted by their results.

(e) Candidates were expected to suggest the use of additional masses and to realise that this would enable them to calculate an average or plot a graph.

Question 2

(a) Most candidates recorded room temperature correctly, but some gave 20.3°C.

(b) Many candidates entered the correct units in the table, but a number appeared to miss the instruction and did not complete the column headings.

(c) (i) Candidates were expected to state that the measuring cylinder should be read at right angles to the scale. Some responses were too vague to gain credit here. Also, the reading should have been taken in line with the bottom of the meniscus.

(ii) Candidates were expected to realise that the measuring cylinder will only read to the nearest 1 or 2 cm^3. Some candidates explained that an error of 1 cm^3 is small compared with the total volume being measured and this explanation also gained credit.

(d) Most candidates carried out the calculations correctly but fewer worked out the unit °C / s successfully.

(e) Candidates were expected to realise that the results support the suggestion and to quote the cooling rates for the higher and lower temperatures. Credit was given for a response that was correct in relation to a candidate's incorrect answer to **(d)**, if appropriate.

(f) Candidates were expected to suggest a lid for one experiment and insulation for the other experiment.

Question 3

(a) Most candidates placed the variable resistor correctly in series but some placed it on the resistance wire and others in series with the voltmeter.

(b) Most candidates recorded the correct current.

(c) Most candidates recorded the potential difference correctly.

(d) Most candidates calculated the resistance correctly and many recorded the correct units. Some gave incorrect units and some appeared to miss the instruction to enter the units in the table.

(e) Most candidates labelled the graph axes correctly and drew them the right way round. Some candidates chose a scale that resulted in the plots occupying too small a proportion of the graph grid. Plotting was generally accurate. Candidates should use neat crosses for the plots, or neatly circled dots so that the accuracy of the plotting can be assessed. Many candidates drew a well-judged straight line but some candidates drew a 'dot-to-dot' line whilst others drew a poorly chosen straight line of best fit that did not match the plots.

(f) Many candidates gave an accurate reading, to within half of a small square and indicated clearly with horizontal and vertical lines how the information was obtained.

Question 4

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

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

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

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

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

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

PHYSICS

Paper 0625/62
Alternative to Practical 62

Key messages

To perform well in this examination, candidates need to have a thorough understanding of 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 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 different question.

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 concept of results being equal to 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 most candidates. Most candidates demonstrated that they were able to draw upon their own personal practical experience to answer the questions. No parts of any question proved to be inaccessible to candidates and there was no evidence of candidates running short of time. The majority of candidates were able to follow instructions correctly, record measurements clearly and perform calculations accurately and correctly. Units were well known and were invariably included. Writing was legible and ideas were expressed logically. However, candidates seemed less able to derive conclusions from given experimental data and justify them.

Most candidates finished the paper and there were few papers with substantial numbers of blank responses to the questions set. There were some responses which showed an exemplary understanding of practical skills but equally, there were those which demonstrated a lack of graph skills, poor understanding of significant figures and a lack of comprehension of good practice in carrying out experiments.

Comments on specific questions

Question 1

(a) Most candidates were able to describe a method of ensuring that the centre of object P was placed directly over the 10.0 cm mark on the rule. The most common method was to determine and mark the position of the centre of object P and align this mark with the 10.0 cm mark on the rule. Another method, often seen from stronger candidates was to ensure that the mean of the readings on the metre rule on either side of object P was 10.0 cm.

(b) The use of the diagram to determine of the distance *b* between the centre of object Q and the pivot presented no problem for most candidates. Despite the instruction to show their working, many candidates did not do this and so could not earn credit for method.

(c) Many candidates chose scales, such that the *a*-axis did not span at least half of the given grid. The instruction that candidates did not need to start their graphs from the origin was very often not followed.

There was some evidence of the use of scales that increased in inconvenient increments, such as 3 or 7. Choosing such scales makes the points much harder to plot and more difficult to clearly see.

There were many excellent, carefully drawn, best-fit lines produced by candidates. However, there were many graphs where the attempt at a best-fit line was forced through the origin.

The most common sources of error were:
- missing labels and/or units on the axes
- a choice of scales which meant that the plotted points did not occupy at least half of the grid
- dots that were too wide, which made it difficult to judge the accuracy of the plotted point
- dot-to-dot lines, instead of a single best-fit line.

(d) As expected, candidates who drew a large triangle to determine the gradient of their graphs obtained the most accurate values for the gradient of the line. In some cases, candidates gave no clear indication on the graph of how the information to determine the gradient had been obtained, despite the instruction given to do so.

(e) The use of the word ratio in this question confused many candidates. Candidates were required to record the ratio *R* of the masses P and Q as a decimal expressed to a suitable number of significant figures. Many candidates tried to convert their answers into a ratio, and this was nearly always incorrect.

Question 2

(a) Candidates were required to annotate the given circuit diagram with an X to indicate a suitable position to connect a variable resistor. Many candidates did not give an answer to this question.

(b) The values of current and potential difference were read correctly from the scales provided by most candidates. Common incorrect answers were 0.22 A and 2.1 V.

(c) Most candidates calculated the resistance of the series combination of resistors correctly. Occasionally the answer was incorrectly rounded. The unit ohm for resistance was well known.

(d) (i) The circuit for the rearranged components was usually drawn well. Correct electrical symbols were expected, and candidates needed to avoid drawing lines through resistors and meters. Occasionally, all three resistors were connected in series.

(ii) The value of the resistance of the new combination of resistors was usually calculated correctly.

(e) The calculation was usually correct. Most candidates gave their answers to a suitable number of significant figures.

(f) (i) There were many good attempts to suggest how to use the apparatus provided to see if the three resistors had the same values of resistance. Candidates who answered by taking each resistor individually and measuring the current, voltage and then calculating and comparing the resistance values were usually successful. Many candidates did not give sufficient detail and did not even state what readings they would need to take.

(ii) The idea of experimental tolerances, and whether two measured quantities are close enough to be considered equal was not well understood by most candidates. Generally, if the values differ by 5 per cent or less, the expected answer is "yes, they are the same". If the values differ by more than 10 per cent the expected answer is "no, they are different". Between the values of 5 per cent and 10 per cent, either answer is acceptable if it is qualified by a phrase, such as "yes, they are close enough to be considered to be equal" or "no, they are too far apart to be considered to be equal".

Question 3

(a) **(i)** The measurements of the three distances from the diagram provided were usually calculated accurately. Answers were expected to be given to the nearest millimetre, which was usually the case, except for the length of distance *y*. Distance *y* was exactly 2 centimetres long, so candidates were expected to record an answer of 2.0 cm. Only a minority of candidates did so and most wrote 2 cm.

(ii) Most candidates realised that the scaling factor was $\times 10$ and correctly calculated the actual object and image distances from the lens.

(iii) The calculation of focal length by substitution into the given equation was usually correct.

(b) The calculation of the average value of the focal length of the lens, from the two values already calculated, proved to be challenging for many candidates. Many candidates tried to use the given focal length formula again, instead of adding up their values and dividing by two.

(c) Some candidates did not focus on the precautions needed to ensure the accuracy of the readings, as required. Many candidates wrote about the need to "line up" the object lens and screen, without explanation or gave vague, unqualified references to parallax.

(d) Many candidates did not seem to realise that all they were being asked to do was to suggest a suitable number of sets of readings that needed to be taken so that a graph could be plotted. Only stronger candidates recognised that by drawing a graph, an average value of the focal length could be obtained, or that any anomalous results could be identified and ignored or measurements repeated.

Question 4

Most candidates obtained at least partial credit for describing how they would carry out the investigation. A common omission here was to neglect to state that the insulating disc must be placed between the heated metal cylinder and the lower metal cylinder.

The time for the lower cylinder to reach a certain temperature was the usual approach taken but a few candidates opted for the temperature reached by the cylinder in a fixed time of heating.

Most candidates recognised the need to repeat the measurements for the other insulating discs. Often candidates gave examples of the materials from which the insulating discs could be made. Such lists included metals such as copper, aluminium and gold. There was evidence of confusion here between conductors and insulators.

Most candidates were able to state one suitable variable they would need to keep constant while investigating the effect of the different insulators. Many wrote about the size, volume or mass of the discs but only a small proportion of candidates realised that it was the thickness of the discs that it was important here. Many candidates referred to the same room temperature, which was not appropriate here, and often irrelevant points such as the use of the same thermometer or stopwatch were seen.

The table was usually drawn correctly. Common errors were not including units in the headings or the inclusion of named metals in the insulator column.

The conclusions were done well, but often the confusion between conductors and insulators arose again here.

A common incorrect conclusion was that the disc which produced the greatest temperature rise in the metal cylinder was the best insulator.

PHYSICS

Paper 0625/63
Alternative to Practical 63

Key messages

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

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

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

All questions should be read carefully so that candidates have a clear understanding of the requirements so that they can provide appropriate responses.

General comments

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

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

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

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

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

Comments on specific questions

Question 1

(a) Few candidates gave a precise enough answer to gain credit. Either measuring the height at both ends of the ruler and stating that they were equal or using a set square or protractor were acceptable.

(b) Most candidates stated the correct values for both parts of this question to the required 2 or 3 significant figures.

(c) Most candidates correctly labelled the *x*-axis. Unless stated, it is not necessary for axes to begin at the origin. Many candidates did not gain full credit because the plots did not occupy more than half of the available space on the graph. Very few inappropriate scales were seen, e.g., going up in threes or sevens. Most candidates correctly plotted their points, but some made their points too large on the graph. Points should not be larger than half of a small square plotted to at least this accuracy. There were many good, well-judged, thin lines drawn with correct intersections of the two lines.

(d) Many candidates determined the correct value for F_0 and W_R within the acceptable range, but some omitted units or did not give their answer to either 2 or 3 significant figures.

(e) Very few candidates answered this correctly because they did not read the question carefully and did not realise that the answer needed to relate to the newton meter itself.

Question 2

(a) (i) Most candidates correctly read the value from the thermometer with only a few incorrectly giving 10.9 °C as their answer.

(ii) Many candidates gave an acceptable precaution that needed to be taken (e.g., take the reading perpendicular to the scale).

(b) Many candidates did not give a response to this question. Only s or °C were acceptable.

(c) Most candidates correctly stated how the volumes affected the cooling rate but did not justify their answer with reference to their results over 180 seconds.

(d) (i) Many correct answers were given but some candidates gave an incorrect unit.

(ii) Many candidates correctly stated that the cooling rate would be lower or less but did not explain that this was because the temperature difference between the beaker and the room was less.

(e) Most candidates identified the need for insulation or a lid in the additional experiment, but many did not mention a comparison of the cooling rates.

Question 3

(a) (i) Many candidates correctly measured f_1 and F_1.

(ii) Many candidates did not gain credit here as they either did not refer to the lens or that it needed to be moved slowly back and forth.

(b) (i) Many candidates correctly measured h_o and h_I to the required accuracy.

(ii) Many candidates realised that there was a difficulty if you blocked the light reaching the screen (e.g., a hand gets in the way) and suggested a way round the problem (e.g., make a mark on the screen and read it later).

(iii) Some candidates gave an unnecessary unit to *W* and did not give their value of F_2 to 2 or 3 significant figures.

(c) The values of F_1 and F_2 should support the suggestion and be within experimental accuracy (10 per cent), with values quoted to justify this statement.

(d) Many candidates stated a suitable precaution to take to gain credit here.

Question 4

Careful reading of the question and the use of the bullet points as a guidance as to what was expected in the plan enabled candidates to better address what was required to gain full credit. It is always a good idea for candidates to go back and read their method to see if they could actually carry out the experiment.

Most candidates completed the circuit correctly with the voltmeter in parallel with the LDR. The most common independent variables identified were either the distance from the LDR or the light intensity and some candidates quoted current which was acceptable. There were many good descriptions of how to carry out their experiment, but many omitted how they would calculate the resistance. Most candidates stated the need to have new values for the independent variable and correctly identified a control variable. Many candidates drew a table with the correct quantities but some did not include the required units. Few candidates successfully analysed what their results would show. The use of a graph, with specified axes, was the most common way that candidates gained credit.