PHYSICS

Paper 0625/12
Multiple Choice (Core)

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

General comments

Candidates demonstrated very good knowledge of weight and combined e.m.f.

However, there were some misconceptions about the moment of a force and the image produced in a plane mirror.

It was evident that converting units, the recall and rearrangement of equations and induced e.m.f. were not well understood.

Comments on specific questions

Question 5

The majority of candidates demonstrated very good knowledge about weight, with nearly all stronger candidates choosing the correct answer.

Question 8

This question assessed candidates' knowledge of what is meant by the moment of a force. Although most candidates recalled the correct meaning, a large number of weaker candidates had the misconception that it was the work done by the force.

Question 11

Most candidates found this question challenging with only stronger candidates answering it correctly. Other candidates mainly chose option **C**, as they had not taken the unit conversion into account. Many weaker candidates chose option **B**, indicating that as well as not converting minutes into seconds, they did not apply the correct equation to calculate the useful energy transferred. Candidates would benefit from short activities to practice unit conversions and rearranging equations.

Question 19

Many candidates struggled with this question where they had to identify which change of state was taking place on a density-time graph. Only the strongest candidates correctly identified that the substance was changing from a liquid to a gas. The most common incorrect answer was option **A**.

Question 21

Although nearly all candidates recalled that the equation for the speed of a wave involved frequency and wavelength, weaker candidates' responses were equally distributed between options **C** and **D**, indicating that many had guessed the answer.

Question 25

This question assessed candidates' knowledge of the image formed in a plane mirror. Most candidates knew that the image was the same size as the object but had the misconception that the image was real, so chose option **B**.

Question 28

Most candidates found this question about magnetic poles challenging. Only the strongest candidates answered correctly. Weaker candidates' responses were evenly distributed across the four possible options, indicating that many had guessed the answer.

Question 30

This question required candidates to recognise that the product of current in a resistor and the potential difference across it represented the power dissipated by the resistor. Only stronger candidates gave the correct answer. Weaker candidates' responses were evenly distributed across the other three possible options, indicating that many had guessed the answer.

Question 35

Only the strongest candidates answered this correctly. The majority of candidates showed little understanding of how to induce an e.m.f. in a copper wire in a magnetic field and thought that a power supply was required, resulting in option **A** being chosen.

PHYSICS

Paper 0625/22
Multiple Choice (Extended)

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

General comments

Candidates demonstrated very good knowledge of simple momentum calculations, gas pressure and the process of evaporation. However, there were some misconceptions about energy resources and total internal reflection.

It was evident that most candidates struggled with change in momentum calculations and weaker candidates struggled with calculations involving the combined resistance of resistors in parallel.

Comments on specific questions

Question 5

The majority of stronger candidates identified the limit of proportionality. However, weaker candidates struggled to do this, with a significant number choosing option **B**.

Question 8

In this question, candidates had to use the equation $F\Delta t = \Delta mv$ to calculate the magnitude of the momentum of the ball as it left the tennis racket. Most candidates found this calculation challenging, with only some stronger candidates answering correctly. The most common incorrect answer for weaker candidates was option **B**, indicating that they only calculated the change in momentum. Some other candidates chose option **C**, as they did not consider that the direction of the ball reversed after hitting the racket.

Question 10

This question assessed candidates' knowledge of energy resources. Most stronger candidates chose the correct answer. However, many weaker candidates had the misconception that the Sun is not the main source of energy for oil.

Question 16

In this question, candidates had to use the relationship pV = constant. Most candidates were confident in using this relationship correctly. The most common incorrect option chosen by weaker candidates was option **C**. This indicated that they had misread the information in the question and used the value given for the final volume of the gas as the initial volume instead, and then proceeded to calculate a new value for the final volume of the gas. Candidates could benefit from underlining or highlighting numerical data in questions and writing a clear list of each quantity before substituting into equations.

Question 20

This question assessed candidates' understanding of ultrasound. Nearly all candidates knew that ultrasound has a higher frequency than audible sound, but many weaker candidates had the misconception that ultrasound is a transverse wave.

Question 22

This question about total internal reflection was answered well by stronger candidates who were able to recall the conditions under which the ray of light would be totally internally reflected. Although most weaker candidates knew that the angle of incidence had to be greater than the critical angle, the majority believed that the ray had to be travelling from air into water, and therefore chose option **B**.

Question 27

In this question, candidates needed to compare the resistances of wires with different lengths and different cross-sectional areas. It appeared that most candidates were aware that as the cross-sectional area doubled, the resistance halved and therefore the length would have to double in order for the resistance of the wire to remain constant. The most common error made by weaker candidates was to choose option **C**, as they thought that if the cross-sectional area doubled, the length would have to halve.

Question 30

Most stronger candidates were able to use the right-hand rule to correctly determine the direction in which the wire was moved. Although most weaker candidates were able to work out that the movement of the wire was perpendicular to the paper, it appears that they used the left-hand rule instead and therefore chose option **D**.

Question 38

This question assessed candidates' knowledge of decay equations. Most stronger candidates identified that a proton was emitted. The majority of weaker candidates incorrectly identified 'x' as a beta particle.

Question 39

Candidates demonstrated a very good understanding of the effect of the Earth's gravitational field on the mass and the weight of an object as the object is moved further away from the Earth's surface.

PHYSICS

Paper 0625/32
Theory (Core)

Key messages

- In calculations, candidates must set out and explain their working correctly. When a candidate gives an incorrect final answer, it may be possible for some credit to be awarded for any correct working.
- Candidates should ensure their language is 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. Only a few candidates failed to recall most of the equations.

Often candidates could apply their knowledge and understanding to 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 willing to think through the possibilities and apply their knowledge when the question asked for suggestions to explain new situations. Weaker candidates had difficulty in applying their knowledge to new situations, did not show the stages in their working and did not think through their answers before writing.

The questions on energy transfers, describing how thermal energy spreads through a liquid and explaining the effect of changing the position of the sliding contact in a variable resistor on size of current in a circuit were generally not well answered. There were a significant number of candidates who either did not read the questions carefully, or gave answers that were related to the topic being tested, but did not answer the question with enough precision or detail to receive credit.

Comments on specific questions

Question 1

(a) The vast majority of candidates gained credit here. A common error was to give the value of time for a speed of 1.0 m / s.

(b) The majority of candidates correctly described a constant or uniform speed. The most common error was to state that the ball was at rest/stationary.

(c) The majority of candidates correctly calculated the distance as 12 m. Common errors included using an incorrect rearrangement of speed = distance ÷ time, e.g., distance = speed ÷ time or multiplying the speed by the start or the end time, e.g., 4×2 or 4×5.

(d) The majority of candidates scored at least partial credit here with the vast majority correctly identifying the downward force as weight or gravitational attraction. Far fewer candidates identified the upward force. Common errors included resultant force and acceleration.

Question 2

(a) There were many excellent answers here and most candidates scored full credit. Answers not scoring full credit usually lacked detail and precision, e.g., failing to state that the balance is used to find the mass of the empty measuring cylinder.

(b) The majority of candidates gained full credit for this calculation with an answer of 96 g. The most common errors included calculating an incorrect volume for the metal block. Many candidates thought it was 2 + 2 + 3 = 7. Other candidates used an incorrect rearrangement of the equation density = mass ÷ volume, e.g., mass = volume ÷ density.

Question 3

(a) Many candidates found this item difficult. A very common error was to state that the cone had a greater surface area.

(b) The vast majority of candidates correctly evaluated the pressure as 1.5 N / cm^2. The most common error was to multiply the force and the area to give 1536.

(c) The majority of candidates were able to correctly determine the moment of the force as 270 N cm. The most common error was to divide the force by the distance to give 0.83.

Question 4

(a) Although many candidates found this item challenging, there were some candidates who gave excellent answers. Common errors included failing to state that the biofuels are burnt to give the thermal energy used to boil water.

(b) For an advantage, most candidates scored credit by identifying biofuels as a renewable energy source or by stating that biofuels make a much smaller contribution to global warming. Far fewer candidates correctly gave a disadvantage. Answers were often too vague to gain credit, e.g., 'uses a lot of land' instead of 'loss of agricultural land for food production'.

Question 5

(a) Candidates found this item challenging. Many gained partial credit for chemical energy but others gave an incorrect answer of electrical or kinetic energy. Fewer candidates gained further credit with the most common error in the second part of the question being thermal energy and many candidates stated kinetic or electrical.

(b) Many candidates correctly determined the work done as 4.8 J. The most common error was to divide the weight by the distance to give 13.3.

(c) Many candidates had learnt the different arrangements of the energy and power equations. The most common error was to confuse $P = I \times V$ with $R = V / I$ and so some candidates used $P = V / I$ to give an answer of 15.

Question 6

(a) The majority of candidates scored at least partial credit, with some candidates giving excellent descriptions of the arrangement, separation and motion of the particles in liquid water. The most common error was to state that the particles were far apart instead of stating that they are mostly touching one another.

(b) Many candidates gained credit here with a correct statement of conduction. A common error was to confuse this question with **(c)** and give an answer of convection.

(c) There were many clear and precise descriptions that scored full credit. However, many candidates incorrectly stated that the heated water particles became less dense instead of stating that the heated water became less dense. Another common error was to describe diffusion as the main method of heat transfer in liquids.

(d) Candidates either knew this answer or they did not. It was simple recall.

Question 7

(a) Many candidates answered correctly with some excellent, carefully drawn diagrams of the path of the ray through the glass block. Common errors included refracting the ray in glass beyond the normal and having the emergent ray refract towards the normal instead of away from the normal.

(b) Most candidates could recall the correct order of the missing colours in the spectrum for visible light.

(c) (i) Almost all candidates could recall the missing region in the electromagnetic spectrum as ultraviolet light.

(ii) Most candidates could recall a correct use for gamma rays. Those who did not answer correctly usually gave a response that was too vague, e.g., “medical purposes” or “in nuclear power stations”.

(iii) Most candidates could recall a harmful effect on people of excessive exposure to gamma rays.

Question 8

(a) The majority of candidates were able to describe the vibration of the tuning forks as the source of the sound heard by the student.

(b) Many candidates were able to recall the normal frequency range of sounds that humans can hear as from 20 Hz to 20 000 Hz. The most common errors involved incorrect recall of one or both of the extremes of the range. A few candidates did not give the correct unit.

(c) Many candidates found this item challenging. Very few gave correct answers describing how the student’s reaction time would be significant when measuring over a relatively short distance.

Question 9

(a) There were a large number of carefully drawn circuit diagrams, but some diagrams lacked care and precision. Candidates should practise drawing circuits using the electrical symbols in the syllabus. The most common errors involved drawing an incorrect symbol for the variable resistor or the lamp or drawing the 3 components in series instead of having the voltmeter in parallel with the lamp.

(b) The majority of candidates correctly determined the resistance of the lamp as 25 Ω. The most common error was to possibly confuse $P = I \times V$ with $R = V / I$ and so to use $R = V \times I$ to give an answer of 4.84.

(c) Candidates found this item challenging, with many not studying the figure carefully enough and so stating that the resistance of the variable resistor increased. These candidates often scored partial credit for knowing that an increase in the circuit resistance would produce a decrease in the current in the circuit.

Question 10

(a) A lack of precision resulted in many candidates not gaining any credit for this question. Candidates needed to make it clear in their responses that there was relative movement between a magnetic field and a conductor. Vague statements such as “put the magnet near the coil” were insufficient.

(b) Most candidates scored at least partial credit here. The most common correct change was to increase the number of turns on the solenoid. Again, lack of detail resulted in vague responses that could not be credited. A common example was “increase the solenoid”. Another common error was to state “increase the current in the solenoid”.

(c) (i) Most candidates were able to recall that (soft) iron was a suitable material for a transformer core. Common errors included copper and steel.

(ii) The vast majority of candidates were able to recall that the output coil of the transformer is known as the secondary coil.

(iii) Most candidates were able to identify the transformer as a step-up transformer. The most common errors were to give step-down transformer or a.c. transformer.

Question 11

(a) Candidates' understanding of atomic structure and nomenclature was often good. Most candidates gained at least partial credit for this question. The most common error was to transpose the charges for a neutron and an electron.

(b) Candidates found this question quite challenging with many failing to identify +2 as the charge on an alpha particle. The most common error was to simply say it was positive, i.e. not giving the relative size of the charge.

(c) The majority of candidates gave clear comparisons of the relative penetrating abilities of alpha, beta and gamma radiations. However, some were very confused and sometimes contradictory. Candidates would have benefited from opportunities to write comparison type responses. A common error was to confuse the abilities of alpha particles and gamma rays.

Question 12

(a) Most candidates were able to identify the force keeping the Earth in orbit around the Sun as gravitational attraction. There were a few who thought it was electromagnetic or just an orbital force. Answers such as "gravitational potential energy" also did not score.

(b) Only stronger candidates were able to explain that the Earth rotating on a tilted axis during its 365-day orbit of the Sun gave rise to the seasons in the northern and southern hemispheres. A very common error was to state that winter was caused by an increase in the distance between the Earth and the Sun.

(c) Many candidates were able to evaluate this difficult calculation well. The majority of candidates were able to determine the correct answer of 490 s. The most common error was to use an incorrect rearrangement of the equation or to add powers of ten instead of subtracting for division.

PHYSICS

Paper 0625/42
Theory (Extended)

Key messages

Candidates demonstrated good recall of both formulae and definitions across the syllabus. Candidates found it much harder to apply their knowledge in unfamiliar contexts. This was relevant in **Question 1(c)**, **Question 2(c)(ii)**, **Question 3(b)**, **Question 4(b)(ii)** and **Question 9(b)**.

A numerical answer must always be accompanied by the correct unit. Units were often omitted or were incorrect in **Question 1(a)**, **Question 7(a)(ii)** and **Question 10(c)**.

It is important for candidates to read questions carefully and ensure that they answer exactly the question that is being asked. Misinterpretation or misreading of questions was evident in **Question 1(b)** and **Question 3(d)(i)**.

General comments

Candidates were generally well prepared for this examination and demonstrated a good understanding across a range of topics within the physics syllabus. One weak area was the action of a potential divider. Few candidates recognised that the circuit in **Question 5** was connected as a potential divider.

In questions where knowledge is being applied, it is important that candidates select the most relevant physics and apply it to the context. This was important in **Question 3(b)** and **Question 9(b)**. Weaker candidates often just recalled physics content without applying it to the specific context in the question.

Most candidates showed their working in numerical questions. Candidates should always give an equation in words or symbols when asked to show that a quantity has a particular value. This was important in **Question 3(d)(ii)** and **Question 7(b)(i)**.

In questions where candidates are required to draw on a diagram they should use a sharp pencil, drawing thin lines and using a ruler or pair of compasses as appropriate. Drawing a label line to the specific object being labelled improves clarity. This was important in **Question 6(a)** and **Question 7(a)(iii)**.

Comments on specific questions

Question 1

(a) Many candidates correctly recalled $k=F/x$ and most used it correctly to calculate the spring constant. Common errors included omitting the unit from the answer or the use of an incorrect unit, often Nm. Weaker candidates sometimes recalled the equation incorrectly.

(b) This question required a description of how the graph shows that the limit of proportionality has not been reached. Two common correct answers were that the gradient remains constant, or that the line does not curve. Some candidates gave statements about F still being proportional to x, or k remaining constant, which are true but did not answer the question set about how the graph shows that the statement is true.

(c) Most candidates realised that the F, being a vector, has a direction but few realised that this explained the negative numerical final answer. Candidates were given partial credit for stating the magnitude of F on the answer line and adding a clear statement about the direction of F. Many candidates ignored the negative value and simply quoted the magnitude of F as their answer.

(d) The majority of candidates knew and clearly stated that force is a vector as it has direction as well as magnitude. Some weaker candidates incorrectly stated that scalars have direction. Some weaker candidates who had used a minus sign in **(c)** stated here that it is a scalar because it does not have a direction. A few candidates seemed to confuse the words direction and distance in their answers.

Question 2

(a) Most candidates knew that the momentum of trolley B before the collision was zero. There were many ways of explaining this, including stating that $p=mv$, or noting that trolley B was not moving. Candidates needed to ensure that explanations did not just repeat phrases given in the question. Stating that trolley B was stationary was insufficient as an explanation since this phrase was given in the question.

(b) Stronger candidates clearly stated the conservation of momentum and carefully substituted the correct values in the equation. A common error was to calculate the combined mass of trolley A and B (1.8 kg) but then omit to subtract the mass of trolley A to give the mass of trolley B. Other common errors included confusion in rearranging equations or incorrect substitutions of mass and velocity. Weaker candidates often gained partial credit if they made a statement about conservation of momentum or showed that they could correctly state the initial or final momentum.

(c) (i) Candidates who used the equation $F = \Delta p / \Delta t$ usually obtained the correct answer. The use of a combination of $F = ma$ and $a = \{v - u\}/t$ was an alternative correct approach. A common error was to calculate the change in velocity related to **(b)** (0.44 m / s – 0.18 m / s). It is important that candidates write down any formulae that they use. It was sometimes possible to award partial credit for the equation even when the final answer was incorrect.

(ii) Stronger candidates stated the equation $F\Delta t = \Delta(mv)$ and added an explanation that for the same momentum change $F \propto 1 / \Delta t$. A reference to $F \propto 1 / \Delta t$ was also an acceptable explanation for time increases. Some weaker candidates correctly stated that the time taken increased and repeated the statement about a smaller resistive force from the question instead of explaining why this increased the time taken. Some candidates misunderstood the question and stated that the time would decrease because there would be a decrease in friction.

Question 3

(a) Most candidates correctly identified the infrared region of the electromagnetic spectrum. Common incorrect answers were an incorrect region of the electromagnetic spectrum, usually ultraviolet, microwave or gamma. Some candidates appeared to have misunderstood the question as they gave answers such as ‘heating element’ or ‘shiny surface’.

(b) Only the strongest candidates realised that the key to more thermal energy getting into the room was that a shiny surface is a good reflector of radiation. Full credit was awarded to candidates who were careful to reference ‘good reflector’ and who stated that radiation (or thermal energy) was being reflected. Common incorrect answers mentioned emission and/or absorption or conduction of thermal energy, but not reflection.

(c) The majority of candidates knew that the casing was earthed to prevent electric shocks. There was some confusion with the use of a fuse and prevention of overheating of wires and fires being caused. Few candidates explained that the earth wire carries current to earth if the casing becomes live. It is important that candidates are able to distinguish between the purposes and functions of different electrical safety features.

(d) (i) Candidates who read and understood the question correctly were able to calculate the correct value for the current in one heating element and included the correct unit. Most candidates stated that they used the equation $V = I R$ and rearranged it correctly. A significant number of candidates calculated the value of the total current in the circuit and some weaker candidates doubled the value of the resistance of one heating element.

(ii) In this ‘show that’ question, many candidates stated a correct equation for P in terms of two out of V, I and R. Candidates who used $P = I V$ had an easier calculation. Those using the other equations were more likely to make an arithmetical error or use an incorrect value of I or R. Most

candidates either correctly used the current for the whole circuit or doubled the power of one heater element.

(iii) Many candidates gained full credit here, using both $E=Pt$ and the efficiency equation. Common errors included giving the answer to too many significant figures or an incorrect rearrangement of either of the equations. Some weaker candidates calculated the electrical work done by the heater without any attempt to use the efficiency equation.

Question 4

(a) (i) Most candidates gave a clear, concise definition of acceleration. Candidates should remember that acceleration can be expressed as the rate of change in velocity or the change in velocity per unit time. The inclusion of both rate and per unit time suggested a misunderstanding of the definition. Some weaker candidates gave incomplete definitions or ambiguous answers such as referring to a change in velocity in a given time.

(ii) Since this was a 'show that' question, candidates needed to clearly state the reasons for multiplying or dividing by factors. The strongest answers stated for example, 200 km = 200 000 m. Partial credit was given to candidates who appeared to be recalling the multiplier of 5/18 as a learned fact. Weaker candidates misunderstood the question and tried to apply the formula for acceleration to this question.

(iii) Many candidates correctly rearranged ($a =$) $\Delta v \, \Delta t$, making Δt the subject. Most went on to substitute the maximum speed from **(ii)** with the value of acceleration given in the question to find Δt. Some candidates gained partial credit with working showing that a maximum speed of 20km / h had been substituted into the equation.

(b) (i) The majority of candidates gained full credit by using $F = ma$ correctly and giving their answer to two significant figures with the correct unit . A few weaker candidates rounded their answer incorrectly or gave the answer to only one significant figure.

(ii) Many candidates gave a correct statement about the effect on the motion of the train. Common correct statements were a lower acceleration or a lower speed. The strongest candidates were able to explain that this was because the resultant force on the train decreased. A common insufficient answer was to describe the headwind as drag or air resistance instead of explaining the effect of this force. Some weaker candidates made ambiguous statements that the motion of the train changed, which repeated the word from the question rather than stating how the motion had changed.

Question 5

(a) This question was answered well with most candidates correctly labelling both axes and drawing a line or curve with a negative gradient. Common errors were drawing a straight line with a positive gradient and incorrect labelling of the axes, for example, LDR instead of light intensity or ohms instead of resistance.

(b) (i) Most candidates were able to draw the correct symbol. Some candidates drew the symbol for a thermistor, a variable resistor, a fuse or a light emitting diode. Weaker candidates occasionally drew the component in the wrong place on the circuit.

(ii) The question asked for ideas about potential difference (p.d.) to be used in the answer. Complete answers showed an understanding that the electromotive force (e.m.f.) is shared between the fixed resistor and the LDR. These candidates then linked this to the change in p.d. across the LDR when the resistance of the LDR changed in different light conditions. Some candidates gave good answers in terms of the p.d. across the LDR in each case. Stronger candidates also noted that the p.d. across the LDR would be the same as the p.d. across the lamp as these were connected in parallel. The strongest candidates also clearly stated which component was being referred to when describing p.d.

Some candidates answered, often using incorrect physics, in terms of current and this was ignored. Very few responses referred to the proportion of e.m.f. being received by a specific resistor. Many weaker candidates included statements in their answer which contradicted information given in the question.

Question 6

(a) (i) Many candidates used a label line to clearly show what was being labelled P. Most candidates chose to label a portion of the principal axis that was distant from the object and lens to avoid any ambiguity. Some weaker candidates placed P in the centre of the lens and it was not clear what was being labelled.

(ii) Most candidates were able to place a letter X 3.0 cm away from the centre of the lens. The X needed to be either on the principal axis or have some kind of marking on the principal axis to indicate the position of X. Some candidates drew an X floating above the axis or below and this was too vague. A common incorrect position was with X 3.0 cm from one edge of the lens. Placing an additional X on the other side of the lens was accepted if it did not contradict a correct X.

(iii) The majority of candidates knew how to construct two correct rays and continue them until they intersected to locate the image. Most constructions were neat, with good use of rulers and careful measurements. These candidates ensured that rays meant to be parallel to the principal axis were very close to parallel.

(iv) Many candidates gave fully correct answers to this question. Common incorrect responses were stating that the image was the same size as the object or that the image was virtual. Some weaker candidates ticked contradictory responses suggesting that they did not understand the terms listed.

(b) Many candidates correctly identified that the new image was now virtual and upright. References to any change in size were ignored as the question did not place the object in an exact position and therefore the size of the image could not be known or determined by construction. A few weaker candidates did not state that the image was upright.

Question 7

(a) (i) Diffraction was correctly stated by most candidates. Weaker candidates gave a variety of incorrect responses, such as refraction, dispersion or refraction.

(ii) Candidates needed to measure one wavelength on **Figure 7.1** and then use the scale to determine that actual wavelength in m. Many candidates omitted the unit from their answer. Some weaker candidates attempted to use $v = f\lambda$, while others incorrectly measured the length of a single crest.

(iii) Stronger candidates realised that as the gap size was approximately equal to the wavelength, maximum diffraction would occur, and carefully drew semi-circles centred on the gap. The use of compasses was very helpful.

Wavefronts that were mainly straight with curved edges were one common incorrect answer. Another common error was to draw semi-circles with a centre far away from the centre of the barrier. Some candidates drew wavefronts that were only part semi-circles and which did not extend far enough away from the centre. Some candidates did not use a ruler to ensure correct spacing of the diffracted wavefronts and so did not show that the wavelength was unchanged.

(b) (i) In this question, candidates were asked to state any equation they used in words or symbols. Candidates who only showed manipulation of the numbers given in the question gained no credit as they had not demonstrated understanding of the physics. Many candidates who recalled $v=f\lambda$ went on to rearrange the formula and substituted numbers correctly to gain full credit. Some candidates omitted the line of working 330/380 and then stated $\lambda = 0.86$ (m).

(ii) Many correct answers with the correct unit were seen here. Weaker candidates sometimes forgot to convert 2.5 km to 2500 m or incorrectly rounded their numerical value to 7.5 s.

Question 8

(a) Stronger answers included a clear statement that the directions of magnetic field, current and force are mutually perpendicular. Clearly stating the actual direction of the magnetic field and the current gained further credit and a complete answer then identified the force as acting downwards for full credit. Many candidates mentioned the left-hand rule which was accepted for mutually perpendicular. Some candidates mentioned that magnetic field and current were perpendicular

without any reference to force direction and this was insufficient. Weaker candidates often mentioned only the direction of the magnetic field or current, not both. Some candidates gained credit for marking directions correctly on the diagram.

(b) The majority of candidates gained credit here, including those that had given an incorrect direction in **(a)**, because they realised that the direction reverses. Candidates need to read questions carefully as some weaker candidates answered in terms of what happens to the current rather than what happens to the force.

(c) The strongest candidates were able to clearly describe the functions of each labelled part of a motor. Most chose to explain that part J connected the cell to the coil or maintained a continuous connection of the circuit. Weaker candidates sometimes gave unclear answers stating only that the coil was connected without saying what it was connected to. Many candidates knew that the coil rotates due to the current in it interacting with the magnetic field. Weaker candidates were often confused between a motor and a generator when describing the function of K.

The function of part L was the most difficult to describe clearly. In **Figure 8.2** it was shown as an axle that allows the coil to rotate. Credit was given to candidates who described a motor they had perhaps seen in action where the central shaft is part of the rotating motor and drives a device such as a fan. Some candidates incorrectly answered that L is a handle used to turn the coil. These candidates appeared to be confusing motors and generators. Many candidates knew that part M allowed the coil to rotate in one direction. There were several different acceptable ways of expressing this.

Question 9

(a) (i) Most candidates gave a clear precise description of an isotope. Those candidates not gaining credit often gave insufficient rather than incorrect answers e.g., “isotopes are elements that have a different number of neutrons”. Candidates needed to be clear that isotopes are versions of the same element, that is they have the same number of protons, with a different number of neutrons.

(ii) Most candidates completed the table correctly. The most common error was an incorrect calculation of the number of neutrons.

(b) (i) Stronger candidates realised that since β-particles can pass through thin metal but not pass through thick metal, the thickness of a metal sheet can be determined by the number of β-particles passing through the metal. Even the strongest candidates had difficulty expressing this clearly. Some candidates gained partial credit for statements about β-particles being stopped by thick metal or passing through thin metal. Weaker candidates often simply stated the relative penetration of α-particles, β-particles and ɣ-radiation.

(ii) Stronger candidates used **Figure 9.1** to extract information about the amount of strontium-90 remaining after 15 years. This information was then used to explain why the quantity remaining would not produce a sufficient difference in count rate to distinguish between different thicknesses of metal. Many candidates either did not use data from the figure in their answer or referred to the half-life which was not relevant here. Candidates would benefit from being given several different examples of uses of radioactivity so that when they find an unfamiliar context, they can apply their knowledge to the specific situation.

Question 10

(a) Most candidates gave a correct answer with a good explanation. 90 days was a common incorrect answer. Some candidates confused the time taken to orbit the sun with the time taken for the earth to spin on its axis and mentioned 24 hours. Other were less precise and wrote ‘3 months’ rather than a fourth of a year. Some candidates misinterpreted the diagram and thought that the Earth was rotating in the opposite direction, giving an answer of a third of a year.

(b) (i) Very few candidates identified F as the position of the Earth during summer for a point in the northern hemisphere. Many were distracted by position E where the diagram showed the Earth in full sunlight, i.e., illuminating the side of the Earth currently in daylight.

(ii) Many more candidates gained credit here, choosing the position of the Earth as either H or the letter half an orbit further round than their answer in **(i).**

(c) Most candidates correctly recalled $v = 2\pi r / T$, and many correctly rearranged and substituted values to calculate r. Common mistakes were to omit the unit or to substitute an incorrect value for time. Some weaker candidates wrote that the distance was πr^2 rather than $2\pi r$, confusing area with circumference. Stating the formula, $v = s / t$ without explaining that $s = 2\pi r$ was insufficient to gain credit.

(d) Asteroids and comets were the most common correct answers. The question asked for objects other than planets in the Solar System, so credit was not given for a named planet or star. Some candidates contradicted themselves by writing more answers than were required with some of these being incorrect such as stars or galaxy or Milky Way. Candidates need to read questions carefully and should not give too many answers where a specific number is requested.

PHYSICS

Paper 0625/52
Practical Test

Key messages

Candidates should be given practice in a wide range of practical work in the classroom and should be familiar with the apparatus involved. They should be given opportunities to write plans for experiments, detailing steps logically, allowing them to follow their plans so they can reflect upon the quality of their explanations.

General comments

Candidates showed a good knowledge of the experiments included on the paper, including the methods and the apparatus. They were able to use the equipment provided and followed written instructions to make accurate measurements, analyse data, form conclusions and critically evaluate their work. Throughout, candidates should ensure that they record data to the level of detail of the measuring instrument, e.g. measurements with a ruler with mm markings must be recorded to the nearest mm so 15.0 cm is appropriate, and 15 cm is not appropriate. In **Question 1**, the graph was often plotted using dots or blobs. Candidates should use crosses instead.

Comments on specific questions

Question 1

(a) Most candidates recorded 5 values of the stretched length of the spring successfully. A few did not record all their measurements to the nearest mm.

(b) Many candidates gained partial credit here. There was some confusion about the word 'technique' and some candidates suggested measuring the spring with a metre rule or tape or measuring the length before and after adding the load. Some answers were very vague, e.g. "use a set square" without describing how it should be used. The most frequent correct response was looking perpendicular to the rule. Many candidates were awarded partial credit for their diagrams, rather than from a written answer.

(c) Most graphs had suitable scales but there were some scales of 3 or 7 seen. There were very few instances of candidates using the data points for the scales. Points were generally well plotted. There were some points just over half a square out, and quite a few candidates used blobs. Candidates should be encouraged to avoid plotting with dots or blobs and should instead use crosses for points. Few candidates gained credit for the line of best fit, with many just joining the first and last points, leaving two points below the line and none above the line. Candidates should be encouraged to ensure there are a balance of points above and below their line of best fit.

(d) Most candidates read their intercept correctly.

(e) Some candidates just drew a small mark on the line. This was difficult to see and could be missed. Candidates should ensure that lines are clearly drawn, horizontally across from the y axis and then vertically down to the x axis. The value given was usually within the correct range for further credit.

(f) Many candidates thought that 132.6 g was the more accurate answer because it had more significant figures, so therefore must be more precise. Of those who chose 130 g, many gave reasons such as "it is easier to do calculations", "it is easier to plot on a graph". Some candidates gained credit by referring to the number of significant figures in the table or that one square on the graph represented 10 g, so it was impossible to give an answer to the nearest 0.1 g.

Question 2

(a) Almost all candidates gained credit here. Some gave room temperature as the starting temperature.

(b) Almost all candidates answered fully correctly and their temperature readings for beaker B decreased more quickly than for beaker A.

(c) Many candidates did not gain the initial credit. They stated that insulation did affect the rate of cooling but not how it affected it. Some candidates went on to state that the temperature decrease for B was greater than for A, but they did not gain credit because they did not quote any values. Others did not compare temperatures over the whole duration of the experiment, while some just compared the final temperatures, ignoring the difference in starting temperature.

(d) (i) This question was generally answered well, with just a few candidates incorrectly rounding or truncating their answers.

(ii) Most candidates gave the correct answer of °C / s with just a few candidates using 'sec' instead of 's' or changing the order of the degrees symbol with respect to the C or the slash.

(e) Some candidates thought that the starting temperature was not relevant as they were looking at the overall change in temperature. Stronger candidates stated that the cooling rate was higher at higher temperatures. Very few candidates gained further credit as they were required to state that the starting temperature had to be the same so that it was only the insulation that was influencing the cooling rate.

(f) (i) Many candidates referred to adding a lid. Few mentioned this was required for both beakers.

(ii) Significantly more candidates referred to both beakers in this question. Many correctly stated that the cooling rate decreases in both beakers.

Question 3

(a) This question was answered well by most candidates.

(b) Most candidates read the instructions carefully and drew the first set of lines in the correct place. The mark for the pin separation was often not correct. Candidates should ensure their pins are placed at least 5 cm apart.

(c) (i) This was answered well. There were a small number of candidates who measured the angle between the ray and the normal to **CD**.

(ii) Most candidates were able to say that their values were close enough or within experimental accuracy. Stronger answers showed a calculation of the percentage difference to reinforce their statement.

(d) Most candidates drew a second set of lines in the correct location with the displacement between **F** and **H** being less than for the set of lines drawn in **(b)**.

(e) Most candidates chose at least one of the acceptable answers, with thin lines and thin pins being the most common correct response.

(f) Very few candidates were able to state that it was difficult to place the pins in the correct place. Most incorrect answers referred to poor experimental practice, e.g., thick lines, not observing the base of the pins. Stronger candidates noted the part of the question which said that the experiment was done carefully.

Question 4

Marking point 1: The voltmeter was usually drawn in an acceptable place with only a few candidates drawing it in series or with a continuous straight line through the symbol.

Marking point 2: Candidates often repeated the list of available apparatus and omitted to say that a ruler was also needed.

Marking point 3: Good details on the method were given by most candidates. However, many candidates did not state that the length of the wire was measured.

Marking point 4: There was a choice of factors to keep constant and most candidates were able to state at least one of them, with material of wire and diameter of wire being the most common.

Marking point 5: Candidates needed to note that this was a results table. This meant that any measurements they made should have been recorded in this table. Some candidates drew a table showing just length and resistance, with no mention of current and voltage. Other candidates just wrote “ammeter reading” or “voltmeter reading”. These are not quantities, and candidates needed to write ‘current’ and ‘voltage’ here. Units were generally correct in the table with a few candidates giving the current unit as I rather than A.

Marking point 6: The most common way to gain credit here was to draw a graph with the axes stated, rather than stating “draw a graph of the results”. Another way was to suggest looking at the results to see if the resistance changes as the length increases. Some candidates gave a prediction instead of a conclusion, e.g. “as the length increases the resistance will increase” and so did gain credit here. Many successful candidates seem to have been taught a pattern and gave the answer of “plot a graph of the dependent variable against the independent variable, see if changing the independent variable affects the dependent variable”.

Marking point 7: There were various ways of gaining credit here. The most common was to use at least five different lengths of wire, or to state a second control variable. Some candidates made the mistake of stating “repeat the experiment and take the average” when they needed to say that it was necessary to repeat the readings for each length and take the average.

PHYSICS

Paper 0625/62
Alternative to Practical

Key messages

Candidates should be given practice in a wide range of practical work in the classroom and should be familiar with the apparatus involved. They should be given opportunities to write plans for experiments detailing steps logically, allowing them to follow their plans so they can reflect upon the quality of their explanations.

General comments

Candidates generally found each of the four questions of equal difficulty. They showed a good knowledge of the experiments included on the paper including the methods and the apparatus. They were able to make measurements, analyse data, form conclusions and critically evaluate their work. In **Question 1**, the graph was often plotted using dots or blobs. Candidates should use crosses instead. Lines of best fit should not just join the first and last points. In **Question 3**, there was evidence that many candidates had experience of performing this experiment with ray boxes in a dark room rather than with optical pins. They should be familiar with both methods.

Comments on specific questions

Question 1

(a) Many candidates gained partial credit here. There was some confusion about the word 'technique' and some candidates suggested measuring the spring with a metre rule or tape or measuring the length before and after adding the load. Some answers were very vague, e.g. "use a set square", without describing how it should be used. The most frequent correct response was looking perpendicular to the rule. Many candidates were awarded partial credit for their diagrams, rather than from a written answer.

(b) Most graphs had suitable scales but there were some scales of 3 or 7 seen. There were very few instances of candidates using the data points for the scales. Points were generally well plotted. There were some points just over half a square out, and quite a few candidates used blobs. Candidates should be encouraged to avoid plotting with dots and should instead use crosses for points. Few candidates gained credit for the line of best fit, with many just joining the first and last points, leaving two points below the line and none above the line. Candidates should be encouraged to ensure there are a balance of points above and below their line of best fit.

(c) Most candidates read their intercept correctly.

(d) (i) Very few candidates gave the answer to the nearest 0.1 cm with the unit, with 10 cm being the most common answer. Candidates should be encouraged to quote measurements to the level of details of the measuring device.

(ii) Some candidates just drew a small mark on the line. This was difficult to see and could be missed. Candidates should ensure that lines are clearly drawn, horizontally across from the y axis and then vertically down to the x axis. The value given was usually within the correct range.

(e) Many candidates thought that 132.6 g was the more accurate answer because it had more significant figures, so therefore must be more precise. Of those who chose 130 g, many gave reasons such as "it is easier to do calculations", "it is easier to plot on a graph". Some candidates

gained credit by referring to the number of significant figures in the table or that one square on the graph represented 10 g, so it was impossible to give an answer to the nearest 0.1 g.

Question 2

(a) (i) This question was usually answered correctly. The answer of 20.1 was the most common incorrect response.

(ii) The word 'technique' proved to be confusing for some candidates. Avoiding draughts, taking an average temperature from different parts of the room, starting the thermometer at 0 °C and leaving the thermometer in the beaker were all suggested, but these did not gain credit. The technique required here was to read the scale perpendicularly.

(b) Correct responses suggested having a beeper sound every 30 s, having the timer and thermometer next to each other, and working with a partner, one watching the clock and the other reading the temperature.

(c) Many candidates stated that insulation did affect the rate of cooling but not how it affected it. Some candidates stated that the temperature decrease for B was greater than for A, but they did not gain credit because they did not quote any values. Others did not compare temperatures over the whole duration of the experiment, while some just compared the final temperatures, ignoring the difference in starting temperature.

(d) (i) This question was generally answered well, with just a few candidates incorrectly rounding to 0.066 or 0.045.

(ii) Most candidates stated the correct answer of °C / s with just a few candidates using 'sec' instead of 's' or changing the order of the degrees symbol with respect to the C or the slash.

(e) Some candidates thought that the starting temperature was not relevant as they were looking at the overall change in temperature. Stronger candidates stated that the cooling rate was higher at higher temperatures. For credit, candidates were required to state that the starting temperature had to be the same so that it was only the insulation that was influencing the cooling rate.

(f) (i) Many candidates referred to adding a lid. Few mentioned this was required for both beakers.

(ii) Significantly more candidates referred to both beakers in this question. Many correctly stated that the cooling rate decreases in both beakers.

Question 3

(a) (i) The normal was drawn well with just a few candidates drawing it perpendicular to the ray rather than to the glass block.

(ii) The most common incorrect answer was 50 °. Candidates needed to make sure they line up the ray with the zero line on the protractor, not the 90 ° line.

(b) (i) An imprecise answer was not penalised here as precision was tested in **1(d)(i)**.

(ii) Some candidates were able to answer this question part well.

(c) Most candidates gave a set of lines in the correct position and had **EJ** as a straight line. Some candidates produced lines which were not straight. Candidates should be encouraged to use a 30 cm ruler rather than a shorter ruler which needs to be used multiple times.

(d) (i) This question was answered well. Some candidates measured the angle between the ray and the normal to **CD**.

(ii) Most candidates were able to say that their values were close enough or within experimental accuracy. Stronger answers showed a calculation of the percentage difference to reinforce their statement.

(e) The most common correct answers were with thin lines and thin pins. There were a number of answers stating the experiment needed to be done in a dark room or referring to a ray box.

Candidates need to ensure that they are referring to the correct experimental context in their answers.

(f) Very few candidates were able to state that it was difficult to place the pins in the correct place. Most incorrect answers referred to poor experimental practice, e.g., thick lines, not observing the base of the pins. Stronger candidates noted the part of the question which said that the experiment was done carefully.

Question 4

Marking point 1: The voltmeter was usually drawn in an acceptable place with only a few candidates drawing it in series or with a continuous straight line through the symbol.

Marking point 2: Candidates often repeated the list of available apparatus and omitted to say that a ruler was also needed.

Marking point 3: Good details on the method were given by most candidates. However, many candidates did not state that the length of the wire was measured.

Marking point 4: There was a choice of factors to keep constant and most candidates were able to state at least one of them, with material of wire and diameter of wire being the most common.

Marking point 5: Candidates needed to note that this was a results table. This meant that any measurements they made should have been recorded in this table. Some candidates drew a table showing just length and resistance, with no mention of current and voltage. Other candidates just wrote “ammeter reading” or “voltmeter reading”. These are not quantities, and candidates needed to write ‘current’ and ‘voltage’ here. Units were generally correct in the table with a few candidates giving the current unit as I rather than A.

Marking point 6: The most common way to gain credit here was to draw a graph with the axes stated, rather than stating “draw a graph of the results”. Another way was to suggest looking at the results to see if the resistance changes as the length increases. Some candidates gave a prediction instead of a conclusion, e.g. “as the length increases the resistance will increase” and so did gain credit here. Many successful candidates seem to have been taught a pattern and gave the answer of “plot a graph of the dependent variable against the independent variable, see if changing the independent variable affects the dependent variable”.

Marking point 7: There were various ways of gaining credit here. The most common was to use at least five different lengths of wire, or to state a second control variable. Some candidates made the mistake of stating “repeat the experiment and take the average” when they needed to say that it was necessary to repeat the readings for each length and take the average.