# Principal examiner reports for teachers

Principal examiner reports for teachers summarise what candidates did well and what candidates needed to improve for this examination series only.

This report is to be used in conjunction with the question paper and mark scheme.

For guidance on teaching and learning we provide resources for many of our syllabuses.

| Resource | Where to find it |
|---|---|
| Grade descriptions – Grade descriptions describe the level of performance typically demonstrated by candidates achieving the different grades awarded for a qualification. | School support hub<br>Select: Subject > Resource finder > Syllabus and specimen materials |
| Schemes of work – Schemes of work are designed to support you in your teaching and lesson planning. | School support hub<br>Select: Subject > Resource finder > Teaching and learning |
| Lesson planning – Guidance on how to plan a lesson. | Lesson planning |
| Resource plus – There may be additional resources such as teaching packs containing lesson plans, resources and worksheets and videos for aspects of your syllabus. | School support hub<br>Select: Subject > Resource finder > Teaching and learning |
| Teaching tools | Teaching Tools |
| Exemplar candidate responses | School support hub<br>Select: Subject > Resource finder > Teaching and learning |
| Learner guide – A guide for students to help them understand what the course involves. | School support hub<br>Select: Subject > Resource finder > Teaching and learning |
| Community forums – Do you have a question or something to share? Our online forums are great way to keep up to date with your subject and the global Cambridge community. | Community forum on the school support hub |
| Access to scripts for this series. | Access to scripts service |
| Results analysis is available for some syllabuses. | Results analysis |
| Test maker is available for some subjects. | Test maker |

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# PHYSICS

**Paper 0625/12**
**Multiple choice (Core)**

## Key messages

Candidates performed well on **Questions 1**, **4**, **6**, **7**, **8**, **9**, **10**, **11**, **12**, **15**, **16**, **19**, **22**, **23**, **26**, **28**, **30**, **32**, **36**, **39**, **40**.

Candidates performed less well on **Questions 2**, **3**, **5**, **13**, **14**, **17**, **18**, **20**, **21**, **24**, **25**, **27**, **29**, **31**, **33**, **34**, **35**, **37**, **38**.

Candidates should read all of the options before choosing their answer. While doing this, candidates should discard the options that they think are incorrect.

Candidates would also benefit from writing out equations in numerical questions in order to rearrange them if necessary.

## Comments on specific questions

### Question 2

- Options **A** and **D** were common incorrect answers.
- Most candidates did not correctly calculate the distance travelled using the area under the graph. Instead, many chose the maximum speed as their answer or calculated maximum speed × time.

### Question 3

- Option **A** was a common incorrect answer.
- Many candidates did not know the equation $g = W / m$.

### Question 5

- Option **D** was a common incorrect answer.
- Most candidates did not take the weight of the can into account when reading the graph.

### Question 13

- Options **A** and **B** were common incorrect answers, suggesting that candidates used an incorrect conversion or were challenged by the use of negative numbers in an equation
- Most candidates did not convert degrees Celcius into kelvin correctly.

### Question 14

- Option **B** was a common incorrect answer**.**
- Many candidates did not interpret the graph correctly and had a misconception that all of the solid substance had melted before the temperature started to increase again.

### Question 20

- Options **A** and **C** were common incorrect answers.
- Most candidates identified that the ray of light was refracted in the transparent medium.
- Few candidates were able to specify in which direction the ray of light was refracted.

**Question 25**

- Option **D** was a common incorrect answer.
- Most candidates recalled that the loudest sound would have the largest amplitude.
- Many candidates were unable to link pitch and frequency correctly.

**Question 27**

- Option **D** was a common incorrect answer.
- Most candidates did not make the link between the charges on the rods and whether they repelled or attracted. These candidates did not understand that if one rod had gained electrons and the other rod had lost electrons, the rods would be oppositely charged and therefore attract.

**Question 31**

- Option **B** was a common incorrect answer.
- Most candidates did not convert the time of one minute into seconds.

**Question 33**

- Options **C** and **D** were common incorrect answers.
- Most candidates did not recall the rules about current in parallel circuits to determine where the largest current would be in the circuit shown.

**Question 34**

- All options were popular.
- Few candidates knew that the earth wire needs to have a low resistance.
- Candidates' answers were distributed across all four options, suggesting that many candidates had guessed the answer.

**Question 35**

- Option **A** was a common incorrect answer.
- Most candidates recalled that the voltage was increased in order to increase the efficiency of the transformer.
- Many candidates had the misconception that current is transmitted by a transformer instead of power.

**Question 37**

- All options were popular.
- Few candidates knew the types of radioactive decay that change a nucleus of one element into another.
- Candidates' answers were distributed across the incorrect options, suggesting that many candidates had guessed the answer.

**Question 38**

- All options were popular.
- Few candidates recognised the shape of a graph showing the decay of a radioactive isotope, with many candidates choosing a straight line graph.
- Some candidates recognised that the graph should be a curve. This understanding was further demonstrated by those who used the half-life information of the isotope to determine whether option **A** or option **C** was correct.

# PHYSICS

**Paper 0625/22**
**Multiple choice (Extended)**

## Key messages

Candidates performed well on **Questions 1**, **3**, **4**, **5**, **6**, **9**, **10**, **12**, **14**, **17**, **18**, **20**, **21**, **23**, **24**, **25**, **26**, **27**, **28**, **29**, **34**, **35**, **36**, **38**, **40**.

Candidates performed less well on **Questions 2**, **7**, **8**, **11**, **13**, **15**, **16**, **19**, **22**, **30**, **31**, **32**, **33**, **37**, **39**.

Candidates should read all of the options before choosing their answer. While doing this, candidates should discard the options that they think are incorrect.

Candidates would also benefit from writing out equations in numerical questions in order to rearrange them if necessary.

## Comments on specific questions

### Question 2

- Options **B** and **C** were common incorrect answers.
- This suggests that most candidates did not apply their knowledge of resultant forces to this question. Instead, most candidates had the misconception that the reading on the balance was a result of the adding or subtracting the mass of the helium balloon.

### Question 7

- Option **B** was a common incorrect answer.
- Many candidates did not recall the definition of resultant force. Instead, many candidates had the misconception that a resultant force is required to keep an object moving at a constant speed.

### Question 11

- Option **B** was a common incorrect answer.
- This suggests that most candidates could not interpret this graphical representation of the relationship between pressure *p* and volume *V*. Although most candidates recalled that as the volume of a fixed mass of gas at constant temperature increases, the pressure of the gas decreases, many of these candidates had the misconception that there is a linear relationship between *p* and *V*.

### Question 13

- Option **A** was a common incorrect answer**.**
- Many candidates had a misconception that if there is an input of energy to a substance, the temperature of the substance must always increase.

### Question 15

- Option **B** was a common incorrect answer.
- This suggests that most candidates knew that having a lid on the container would reduce the transfer of thermal energy from the container. Many candidates thought that shiny white surfaces would emit radiation faster than matt black surfaces.

**Question 16**

- All options were popular.
- Many candidates recognised that all three methods of energy transfer were taking place in the example shown. Other candidates' answers were distributed across the three other options, suggesting that they had guessed the answer.

**Question 22**

- Option **B** was a common incorrect answer.
- This suggested that most candidates could identify the region of the electromagnetic spectrum that each device used. Many candidates mixed up the order of the regions and put them in in order of decreasing frequency.

**Question 30**

- All options were popular.
- Candidates should have realised that, as the conductor had to move in a perpendicular direction to both the flow of electrons and the direction of the magnetic field, only one of the four options was possible. Many candidates were aware of this.
- Other candidates' answers were distributed across all four options, suggesting that these candidates had guessed the answer.

**Question 31**

- Option **C** was a common incorrect answer.
- Few candidates recalled that the frequency of the output potential difference from an a.c. generator can only be increased if the speed of rotation is increased.
- Many candidates had the misconception that by increasing the number of coils on the a.c. generator, both the magnitude and the frequency of the output potential difference will increase.

**Question 32**

- All options were popular.
- Many candidates worked out the direction of the magnetic force. Other candidates' answers were distributed across all four options, suggesting that many candidates had guessed the answer.
- Candidates should have been able to narrow their answer down to either option **A** or option **B** as the direction of the force had to be perpendicular to both the direction of the current and the direction of the magnetic field.

**Question 33**

- Option **A** was a common incorrect answer.
- Most candidates recalled the relationship between the number of turns on the coils and the voltage across the coils.
- Many candidates had the misconception that the current also increased if the number of coils increased.

**Question 37**

- Options **B** and **D** were common incorrect answers.
- Many candidates were confused about which type of field would deflect the beta particles in the path shown.
- Most candidates thought that the direction of the field must be towards the bottom of the page as the beta particles were deflected in this direction.

**Question 39**

- All options were popular.
- Many candidates were able to use the correct equation to calculate orbital speed.
- Some candidates made errors such as not including the radius of the Earth or using a time equivalent to one hour instead of 24 hours. A few candidates did not know the correct equation.

# PHYSICS

**Paper 0625/32**
**Theory (Core)**

## Key messages

### What candidates did well

- Most candidates were well prepared for this exam. They were able to apply their knowledge and physics understanding to the questions set and to produce correct responses. A high proportion of candidates displayed a good grasp of the English language, and almost all candidates had a sufficient understanding to be able to attempt the questions.
- Candidates demonstrated knowledge across many areas of the syllabus. In particular, candidates demonstrated good knowledge of forces and motion, the kinetic particle theory of matter, energy, work and power, light, electric circuits and the nuclear model of the atom.

### What candidates needed to improve

- Candidates need to improve their application of the kinetic particle theory of matter to processes such as Brownian motion.
- Candidates should ensure that working and answers to numerical questions are as clear as possible. In particular, there were some issues differentiating between the numbers 1 and 7, 4 and 7, 6 and 0, 9 and 0, and sometimes 4 and 9.
- Candidates sometimes needed to be clearer and more precise when answering questions requiring a description or explanation.
- Candidates need to know the electric circuit symbols used in drawing circuit diagrams.
- Candidates need to improve their skills of rearranging equations to correctly change the subject of an equation.
- Candidates could improve their performance, candidates should practise applying their knowledge to new situations by attempting questions in support materials or exam papers from previous sessions.
- In calculations, most candidates set out and explain their working clearly, which is commendable. Clear evidence of correct working was often seen even when the final numerical answer was incorrect. Where no working was shown, apparent arithmetic slips or calculator misreads could not be accounted for.

## Comments on specific questions

### Question 1

**(a) Comprehensive responses**

- Most candidates were able to select the correct information from the question and diagram and then to substitute these values into a correct equation to calculate the work done pulling the trolley as 360 J.

**Limited responses**

- Some candidates used an incorrect rearrangement of the equation for calculating work done. A common approach seen was dividing the pulling force by the distance the trolley moved.

**(b) Comprehensive responses**

- Most candidates were able to select the correct information from the question and diagram and then to substitute these values into a correct equation to calculate the moment of the force about the pivot as 10.8 Nm.

**Limited responses**

- Some candidates used an incorrect rearrangement of the equation for calculating work done. A common approach seen was dividing the lifting force by the perpendicular distance between the force and the pivot

**(c) (i) Comprehensive responses**

- Many candidates were able to analyse the shape of a speed–time graph to determine the regions of non-linear acceleration and constant speed.

**Limited responses**
- Some candidates confused the regions of the speed-time graph with those of a distance-time graph.
- Some candidates tried to give values for the regions rather than a verbal description.

**(ii Comprehensive responses**
- Most candidates displayed a good understanding of the area below the line of a speed- time graph being equivalent to the distance travelled and correctly determined the distance moved by the trolley as 6.0 m.

**Limited responses**
- Some candidates selected 5.0 s from the time axis of the graph. A commonly seen approach was using this value rather than calculating (5.0 − 2.0) = 3.0 s.
- Some candidates rearranged the equation for calculating distance travelled. A commonly seen approach was stating that distance = speed ÷ time.
- Some candidates confused distance travelled on a speed-time graph with calculating acceleration from a speed-time graph.

**Question 2**

**(a) Comprehensive responses**
- Many candidates gave clear descriptions of one oscillation of the simple pendulum. They also described in detail how to time 10 or more oscillations of the pendulum and how to determine the time period for one oscillation from their measurements.

**Limited responses**
- Some candidates did not include detail such as a description of an oscillation or when to start and stop the stopwatch.
- Some candidates did not explain why they should time at least 10 complete oscillations.

**(b) Comprehensive responses**
- Most candidates subtracted the 0.1 N force from the 0.5 N force to give an answer for the resultant force of 0.4 N and correctly stated that the direction of the resultant force was to the right.

**Limited responses**
- Some candidates added the two forces.
- Some candidates stated that the direction of the force was East/West. The diagram did not show which direction corresponded to East or West.

**(c) Comprehensive responses**
- Many candidates showed good understanding of the stopwatch display and gave the time correctly as 74.83 s.

**Limited responses**
- Some candidates did not include the one minute on the display and gave answers of 14.83 s
- Some candidates rounded their answers to give an answer of 75 s.

**(d) (i) Comprehensive responses**
- Candidates stated that the mass of an object is a measure of the amount of matter in the object.

**Limited responses**
- Candidates stated that the mass of an object is a measure of the weight of the object.

**(ii) Comprehensive responses**

- Candidates stated that weight is the force of gravity acting on an object.

**Limited responses**

- Candidates stated that weight is the force acting on an object.
- Candidates stated that weight is gravity acting on an object.

**Question 3**

**(a) Comprehensive responses**

- Most candidates were able to complete the energy transfer diagram to show that chemical energy is stored in the battery and that thermal energy is transferred to the surroundings.

**Limited responses**

- Some candidates thought that electrical energy is stored in a battery and others that light energy is transferred to the surroundings.

**(b) Comprehensive responses**

- Many candidates were able to select the correct information from the question and diagram and then to substitute these values into a correct equation to calculate the power output from the solar panel as 2.8 W.

**Limited responses**

- Some candidates rearranged the equation for calculating power output. A commonly seen approach was dividing the voltage output by the current output.

**(c) Comprehensive responses**

- Many candidates displayed a good understanding of the advantages and disadvantages of the solar panel in terms of renewability, availability and environmental impact.

**Limited responses**

- Some candidates gave advantages that did not specifically address the solar panel shown in the diagram and were consequently too vague such as ‘environmentally-friendly’ or eco-friendly.
- Some candidates gave disadvantages that did not specifically address the solar panel shown in the diagram such as the solar panel covers too much area.

**Question 4**

**(a) Comprehensive responses**

- Most candidates were able to give comprehensive descriptions about the kinetic particle theory of matter and its predictions about the arrangement, separation and motion of particles in a solid.

**Limited responses**

- Some candidates confused the motion of particles in a solid with the motion of particles in a liquid.

**(b) Comprehensive responses**

- Many candidates were able to describe the motion of the pollen grains as random or give a suitable synonym such as Brownian motion. Many candidates used the kinetic particle theory of matter and its predictions about bombardment of larger particles by microscopic water molecules to explain the Brownian motion of the pollen grains.

**Limited responses**

- Some candidates confused the random motion of the particles with the flow of particles in a convection current.

**(c) Comprehensive responses**

- Many candidates were able to give comprehensive descriptions about the kinetic particle theory of matter and its predictions about the motion of gas particles affects the pressure a gas when there is a change in temperature.

**Limited responses**

- Some candidates recognised that the speed of the gas molecules decreased when the temperature was decreased; this was not linked to a reduced rate of collisions with the wall of the balloon.
- Some candidates recognised that the speed of the gas molecules decreased when the temperature was decreased; this was not linked to a reduction in the force produced by each impact.

**Question 5**

**(a) (i) Comprehensive responses**

- Many candidates were able to identify the amplitude of wave and use the diagram to correctly determine its value of 10 cm.

**Limited responses**

- Some candidates confused the amplitude of the wave with the wavelength of the wave.
- Some candidates confused the amplitude of the wave with the peak to peak value of the wave.

**(ii) Comprehensive responses**

- Many candidates were able to identify the wavelength of wave and use the diagram to correctly determine its value of 40 cm.

**Limited responses**

- Some candidates confused the wavelength of the wave with the amplitude of the wave.
- Some candidates confused the wavelength of the wave with the length of the image in the diagram.

**(b) Comprehensive responses**

- Many candidates were able to select the correct information from the question and then to substitute these values into a correct equation to calculate the wavelength of the wave as $6.0 \times 10^{-13}$ m.

**Limited responses**

- Some candidates rearranged the equation for calculating power output. A commonly seen approach was dividing the frequency of the gamma ray by the speed of the gamma ray.
- Some candidates were unable to divide the powers of ten.

**(c) (i) Comprehensive responses**

- Most candidates gave a correct use of gamma rays.

**Limited responses**

- Some candidates stated that gamma rays were used in x-rays or were used to identify forged banknotes.

**(ii) Comprehensive responses**

- Candidates displayed a good understanding of the dangers of gamma rays and gave a correct harmful effect of overexposure to gamma rays.

**Limited responses**

- Candidates did not give enough detail and stated that overexposure to gamma rays caused skin issues

**Question 6**

**(a) (i) Comprehensive responses**

- Most candidates correctly answered *the normal.*

**Limited responses**

- Some candidates thought that the dashed line was a line of reflection.

**(ii) Comprehensive responses**

- Most candidates were able to select the correct information from the question and diagram and then to determine that the angle of reflection was 40°.

**Limited responses**

- Some candidates thought that the angle of incidence was the angle between the incident ray and the mirror.

**(b) (i) Comprehensive responses**

- Many candidates correctly determined the process as *refraction.*

**Limited responses**

- Some candidates confused the process shown with that of reflection.

**(ii) Comprehensive responses**

- Many candidates correctly determined the process as *dispersion.*

**Limited responses**

- Some candidates confused the process shown with that of refraction.

**(iii) Comprehensive responses**

- Many candidates correctly determined the process as *reflection or total internal reflection.*

**Limited responses**

- Some candidates confused the process shown with that of reflection.

**Question 7**

**(a) (i) Comprehensive responses**

- Most candidates correctly identified the N pole and the S pole on the diagram of a bar magnet.

**Limited responses**

- Some candidates thought that the N pole of the bar magnet was where the magnetic field lines entered the bar magnet.

**(ii) Comprehensive responses**

- Many candidates were able to state that the direction of a magnetic field line is the direction of the force on a N pole.

**Limited responses**

- Some candidates thought that the direction of a magnetic field line is the direction of the force on a magnet.

**(iii) Comprehensive responses**

- Many candidates correctly identified the device used to determine the direction of the magnetic field as a compass.

**Limited responses**

- Some candidates identified the device used to determine the direction of the magnetic field as iron filings. Iron filings can only give the shape of the magnetic field.

**(b) Comprehensive responses**

- Most candidates correctly identified a metal that is suitable for the core of an electromagnet, with the majority choosing *iron*.

**Limited responses**

- Some candidates confused the metal in the core with the metal used for the coil and gave an answer of *copper*.

**(c) Comprehensive responses**

- Few candidates correctly explained that when there was a current in the coil, the core became an induced magnet and that this caused the steel clips to also become induced magnets with the opposite pole nearest the core of the electromagnet.

**Limited responses**

- Some candidates simply repeated the question by stating that the steel clips were attracted to the electromagnet.
- Some candidates correctly explained that when there was a current in the coil, the core became an induced magnet. The attraction of the steel clips was not addressed.

**Question 8**

**(a) Comprehensive responses**

- Most candidates were able to correctly analyse the circuit diagram and then to add the correct circuit symbol for an ammeter in series with the lamps and the correct circuit symbol for a voltmeter in parallel with the lamps.

**Limited responses**

- Some candidates used an incorrect rearrangement of the equation for calculating work done. The most common transposed the positions of the ammeter and the voltmeter.
- A few candidates could not recall the correct circuit symbols for an ammeter or for a voltmeter.

**(b) Comprehensive responses**

- Most candidates were able to select the correct information from the question and diagram and then to substitute these values into a correct equation to calculate the effective resistance of the lamps in series as 18 Ω.

**Limited responses**

- A few candidates used an equation for calculating the effective resistance of resistors in series. A commonly seen approach was dividing the resistance of one lamp by the number of lamps.

**(c) Comprehensive responses**

- Many candidates displayed good knowledge of electric current to state that an electric current in a metal is a flow of *electrons*.

**Limited responses**

- Some candidates confused the current in a metal with the current in an ionic solution and stated the current in a metal is a flow of *ions*.

**(d) Comprehensive responses**

- Most candidates were able to select the correct information from the question and diagram and then to substitute these values into a correct equation to calculate the energy supplied to the lamp as 150 J.

**Limited responses**

- Some candidates rearranged the equation for calculating energy transferred. A commonly seen approach was dividing I × V by the time rather than multiplying I × V by the time in seconds.

**Question 9**

**(a) (i) Comprehensive responses**

- Most candidates were able to correctly analyse the circuit diagram and the information to deduce that the hazard from the damaged insulation was electrocution or possible a fire.

**Limited responses**

- Some candidates thought that the damaged insulation would stop the laptop from charging. This was identified as a possible fault rather than a hazard.
- Some candidates thought that the damaged insulation would cause a short circuit. This was identified as a possible fault rather than a hazard.

**(ii) Comprehensive responses**

- Few candidates were able to identify the live wire as the location of the switch and even fewer could explain that this positioning is to ensure that the laptop is isolated from the mains supply when the switch is in the off position.

**Limited responses**

- Some candidates simply repeated the information in the question by stating that the switch is in the mains supply or the mains cable.
- Some candidates thought that the switch should be in the Earth wire as this would reduce the possibility of electric shocks.

**(b) Comprehensive responses**

- Many candidates displayed good knowledge of the transformer equation and were able to transfer data from the question to the equation. The vast majority of these candidates were then able to rearrange the transformer equation to give the number of turns on the secondary coil as 60.

**Limited responses**

- Some candidates were unable to rearrange the transformer equation to give the number of turns on the secondary coil as 60. In most of these responses, the transformer equation was stated clearly, with correct substitution of values from the question, and the working was clearly set out.

**Question 10**

**(a) Comprehensive responses**

- Most candidates were able to correctly analyse the nuclide notation and use their knowledge to determine the numbers of protons and neutrons in the iodine isotope.

**Limited responses**

- Some candidates transposed the proton and neutron numbers.

**(b) Comprehensive responses**

- Some candidates displayed good knowledge of the concept of half-life and were able to use data from the question to determine that 180 days was equal to 3 half-lives for iodine-125. Few of these candidates were then able to use the idea of 3 half-lives to calculate the mass of iodine-125 remaining after 180 days as 5.0 mg.

**Limited responses**

- Some candidates recognised the concept of half-life and used data from the question to determine that 180 days was equal to three half-lives for iodine-125. This information was not taken further in the responses. A common approach seen was dividing 40 g by 3 to give an answer of 13.3 g.

**(c) Comprehensive responses**

- Many candidates displayed good understanding of the term *isotope* and gave clear descriptions in terms of the same numbers of protons but different numbers of neutrons.

**Limited responses**

- Some candidates transposed the numbers of protons and neutrons and so gave incorrect statement such as: An isotope has the same number of neutrons but different numbers of protons.

**Question 11**

**(a) Comprehensive responses**

- Many candidates were able to give clear and detailed descriptions of the motion of the planet Earth as it orbits the Sun.

**Limited responses**

- Some candidates gave responses that confused the terms rotation and orbit. This often led to contradictory statements about the time for the Earth to spin once on its axis and the time it takes the Earth to complete one orbit of the Sun

**(b)** **Comprehensive responses**

- Most candidates displayed good knowledge of the concept of the light-year and were able to give clear statements of the meaning of one light-year.

**Limited responses**

- Some candidates thought that the light-year was a unit of time.
- Some candidates thought that the light-year was a unit of speed.

**(c)** **Comprehensive responses**

- Many candidates recognised that the increase in the observed wavelength of light from distant receding galaxies was *redshift.*

**Limited responses**

- Some candidates simply paraphrased the question by stating that the increase in wavelength was a longer wavelength.
- Some candidates stated that when wavelength increases frequency decreases. This is correct but does not answer the question.

# PHYSICS

**Paper 0625/42**
**Theory (Extended)**

## Key messages

**What candidates did well**
- Comprehensive answers showed a good understanding of physics across the full range of the syllabus.
- Many candidates demonstrated good recall of physics equations.
- Comprehensive answers used precise, technical language with clarity to explain physics within the context of the question being asked.

**What candidates needed to improve**
- Candidates need to be able to rearrange physics equations to make any term the subject of the equation.
- Candidates need to be able to work with numbers in standard form and to round numerical values correctly.
- Data in questions is usually given to two significant figures and, unless otherwise stated in a question, answers expressed to two significant figures are expected.
- Candidates need to know the difference between the number of decimal places and the number of significant figures in numerical values <1.
- Candidates need to be able to give precise, clear definitions of physics terms from the syllabus.
- Candidates need to read questions carefully and ensure that they are answering exactly the question that is being asked.

## Comments on specific questions

### Question 1

**(a)** **Comprehensive responses**
- Most candidates correctly identified the maximum distance value on the distance-time graph.
- Most candidates recorded the value to two significant figures.

**Limited responses**
- A few candidates misread the scale on the distance axis.
- A few candidates confused the maximum distance value on the graph scale with the maximum value of distance shown by the plotted points on the graph.

**(b)** **Comprehensive responses**
- Most candidates identified acceleration at B and deceleration at either C or D.

**Limited responses**
- A common misconception was to confuse acceleration with deceleration.
- A few candidates mistook the graph for a speed-time graph, giving a pair of points for each answer.

**(c)** **Comprehensive responses**
- Candidates recognised that the maximum speed is shown by the steepest gradient on the distance-time graph.
- Candidates used a pair of coordinates on the line BC to calculate the gradient of the line.
- Candidates often chose the coordinates at B and at C, which were easy to read accurately, being on grid lines.

- Candidates converted time coordinates from min to h before calculating the gradient or converted the gradient in km / min into km / h.

**Limited responses**
- Most candidates converted time in minutes correctly into time in hours.
- Many candidates applied the equation $v = s / t$ to one point on the graph.
- Some candidates confused maximum speed with average speed for the whole journey.
- A few candidates used the graph to calculate maximum speed and gave the answer in km / min.

**Question 2**

**(a) Comprehensive responses**
- Most candidates recalled and rearranged the correct equation, substituting data from the question to calculate the volume of the cube.

**Limited responses**
- A few candidates did not correctly rearrange the density equation to make volume the subject.
- Some candidates gave their answer to only one significant figure. In this calculation the answer expressed to two significant figures required three decimal places.
- A few candidates rounded 0. 0139 to 0.013 instead of 0.014.
- A few candidates described density instead of stating the equation asked for in the question.

**(iii) Comprehensive responses**
- Most candidates compared the density of steel with the density of sea water to state why the cube sinks.

**Limited responses**
- A few candidates were confused about whether the more dense or less dense object sinks.
- A few candidates attempted an explanation in terms of quantities other than density, for example, steel is heavier.

**(iv) Comprehensive responses**
- Responses stated clearly that the density of the ship was less than the density of sea water.
- Candidates often explained this either by noting that the hull was hollow or that the ship contained a lot of air.

**Limited responses**
- Many candidates linked air with a vague lowering of density. Answers needed to compare the overall density of the ship with the density of sea water.
- Some candidates attempted to explain floating in terms of pressure, for example, the large base spread the weight over a larger surface area, so the ship floats.

**(b)(i) Comprehensive responses**
- Most candidates substituted the data provided into the equation $F = ma$ to calculate the force which causes the acceleration of the ship.

**Limited responses**
- A few candidates were unable to recall the equation relating Force and acceleration. These responses usually went on to divide mass by acceleration.
- A few candidates were not always successful when working with numbers in standard form and calculated the force value to an incorrect power of ten.

**(ii) Comprehensive responses**
- Some responses identified a suitable resistive force and described this as opposing the ship's motion.
- Some candidates identified the force in **(b)(i)** as the resultant force and explained that the engine force must be larger than that because there are also resistive forces.

**Limited responses**

- A few candidates were confused about the meaning of the term resultant force. Resultant force was sometimes used to describe driving force and at other times it was used to describe resistive forces.
- Some candidates stated that a larger force was needed to get the ship to move or to accelerate the ship, without making any reference to resistive forces.
- A few candidates referred to energy losses in their answer rather than giving an answer in terms of forces.

**Question 3**

**(a) (i) Comprehensive responses**

- Most candidates used the mass of the bear from Table 3.1 and the equation $W = mg$ to calculate the weight of the bear.

**Limited responses**

- A few candidates made arithmetic errors in their calculation or rounding errors in the stated value of their final answer, for example, rounding 5782 to 5700 instead of 5800.
- Candidates are expected to use $g = 9.8$ N / kg in calculations. If candidates multiplied the mass of the bear by 10, they needed to state explicitly that they were using the value $g = 10$ N / kg in their calculation.

**(ii) Comprehensive responses**

- Most candidates applied the equation $P = F / A$ correctly, using data from Table 3.1 and the weight calculated in **2(a)(i)**.
- Most answers were recorded to at least two significant figures.

**Limited responses**

- A few candidates correctly recalled the equation $P = F / A$ and then substituted a value for the mass of the bear instead of the weight of (force exerted by) the bear.
- A few candidates stated that $P = m / A$.
- A few candidates misread the data in Table 3.1 and thought the data provided was for just one of the bear's feet.

**(iii) Comprehensive responses**

- Most candidates worked out the mass, contact area and pressure ratios and used their answers to select values from the list and complete each equation.

**Limited responses**

- A common misconception in the last equation was to calculate the ratio of the pressure exerted by bear to the pressure exerted by person, choosing the value 0.125 from the list.

**(b) Comprehensive responses**

- Most candidates correctly recalled the equation for pressure change with depth of liquid and used the data in the question to calculate the required pressure change.

**Limited responses**

- A common misconception was to state that pressure change equals density times depth.
- A few candidates confused $\Delta p$ and $\rho$ (density) in the equation $\Delta p = \rho g h$.
- Some candidates did not correctly apply the equation for pressure change in this situation. They used the equation to attempt a calculation of pressure at the surface of the liquid, using a height of 0 m, but obtained a value for pressure greater than zero.
- A few candidates attempted to subtract a value for air pressure from their calculation of pressure change with depth of liquid.

**Question 4**

**(a)** **Comprehensive responses**

- Some candidates knew that thermal energy transfers from the outdoor heater via radiation.

**Limited responses**

- A common misconception was to state that thermal energy transfers by convection.
- A few candidates suggested the transfer was by conduction.

**(b) (i)** **Comprehensive responses**

- A few candidates were able to complete all the sentences with accurate statements about energy transfer.
- Some candidates recognised that energy was transferred into the internal (thermal) store of the table.
- Some candidates provided words to show that the rate of energy absorbed by the table was greater than the rate of energy emitted by the table.

**Limited responses**

- Some candidates were confused about the correct name for the energy store of the table.
- Some candidates provided ambiguous words such as increased, decreased and transferred instead of words that clearly describe absorption and emission.
- A few candidates thought that the rate of energy emitted by the table was greater than the rate of energy absorbed by the table.

**(ii)** **Comprehensive responses**

- Responses clearly identified that white was a good reflector or poor absorber of radiation or thermal energy.
- A few responses explained clearly that this caused less energy to be absorbed by the table or that less energy reached the table.
- Other responses explained that, with the white cloth, the rate of emission of thermal energy by the table was greater than the rate of absorption.

**Limited responses**

- Some candidates did not include the quantity (radiation or thermal energy) that white was reflecting well or absorbing poorly.
- Other candidates made statements that white reflected radiation or did not absorb radiation without reference to how effectively white reflected or absorbed.
- A few candidates described white as a poor conductor or a good emitter of radiation.

**(c)** **Comprehensive responses**

- Most candidates knew how to calculate the electrical energy transferred by the heater.
- Many candidates used the data in the question to calculate the energy in kWh.

**Limited responses**

- A few candidates attempted conversion of the data to give an answer in joules.
- A few candidates were confused about the terms energy and power in their equation and performed the calculation power divided by time to give energy.

**Question 5**

**(a)** **Comprehensive responses**

- Most candidates applied their knowledge about the relationship between pressure and volume for a fixed mass of gas at constant temperature to find the volume of air in the car tyre.

**Limited responses**

- A few candidates related pressure and volume as $p_1V_1 = p_2V_2$ and were then unable to rearrange their equation to make $V_2$ the subject.
- A few candidates gave their answer to only one significant figure or rounded the answer to 0.40.
- A few candidates subtracted atmospheric pressure from either the pressure inside the tyre or from their calculated volume.

**(b) (i) Comprehensive responses**

- Some candidates were able to give a clear description of the separation, arrangement and motion of particles in a gas.
- Responses focused on providing a succinct description of each named property.

**Limited responses**

- A few candidates confused the terms separation and arrangement of particles.
- Some candidates gave vague answers such as particles are not touching or particles are easily separated.
- In the arrangement section, a few candidates confused gas particles with the particles in a liquid, saying that the particles take the shape of the container.
- A common ambiguous description of particle motion was to state that particles move freely.

**(ii) Comprehensive responses**

- A few candidates stated clearly that the average kinetic energy of particles changes with temperature.

**Limited responses**

- Some candidates referred to kinetic energy without clarifying that this meant kinetic energy of the particles.
- Candidates needed a clearer understanding that the internal energy of a gas is linked to the average kinetic energy of the particles in the gas.

**Question 6**

**(a) (i) Comprehensive responses**

- Most candidates identified the principal axis in Figure 6.1.

**Limited responses**

- Common misconceptions were identifying Z as the principal focus, the normal or 2F.
- A few candidates gave ambiguous answers, for example is axis.

**(ii) Comprehensive responses**

- Some candidates used Figure 6.1 to construct a ray from the tip of the object to the tip of the image so that it passed through one of the principal focuses of the lens.
- These candidates then measured the distance along the principal axis from the centre of the lens to the principal focus and recorded this measurement to two significant figures.
- A few candidates noted that since the object and image were the same size, they must both be 2F from the lens. They then halved their measurement of 2F to find the focal length.

**Limited responses**

- Candidates needed to identify a ray that links the tip of the image to the tip of the object and passes through the focal point.
- Some candidates included the ray which passes through the centre of the lens, even though this ray is not necessary to find the focal length.
- A few candidates showed a correct ray on Figure 6.1 and then recorded the focal length as the length of the ray between the centre of the lens and the tip of the image.
- A few candidates were unable to construct a correct ray and simply took a measurement from the figure, for example, the length of the principal axis or the height of the lens to record as the focal length.

**(iii) Comprehensive responses**

- Some candidates identified both characteristics of the image.

**Limited responses**

- Some candidates repeated the characteristic given in the question stem.
- A few candidates added a contradictory response to a correct answer, for example real and virtual.

**(b) (i) Comprehensive responses**

- Some candidates positioned X clearly to show how the lens could magnify an object placed at that position.

**Limited responses**

- Some candidates placed X at or directly above F.
- Some candidates placed X further away from the lens than F.
- A few candidates attempted to construct the ray diagram for a magnified image without showing the position of X.

**(ii) Comprehensive responses**

- Some candidates identified both correct statements.

**Limited responses**

- A common mistake was to suggest that the image is on the opposite side of the lens.
- Another common mistake was to suggest that the image is closer to the lens than the object.
- A few candidates ticked only one statement.

**Question 7**

**(a) Comprehensive responses**

- Most candidates noticed that the voltmeter reading was across two cells and therefore the e.m.f. of one cell was half the value of the voltmeter reading.

**Limited responses**

- Some candidates stated that the e.m.f. was equal to the voltmeter reading.
- Common incorrect units for e.m.f. were mA or J.
- A few candidates did not show a clear understanding of what is meant by the term e.m.f., as they attempted to calculate the value by multiplying the voltmeter and ammeter readings together.

**(b) Comprehensive responses**

- Most candidates correctly completed the definition of electric current.

**Limited responses**

- Some candidates confused amount of charge with either current or electrons.
- A few candidates confused electric current with an amount of energy per unit charge.

**(c) Comprehensive responses**

- The most common approach seen here was a calculation of total resistance from which the resistance of the fixed resistor was subtracted.
- A few candidates calculated the p.d. across the fixed resistor and used this to find the p.d. across the thermistor. They then used $R = V / I$ to calculate the resistance of the thermistor.

**Limited responses**

- Most candidates recognised that the equation $R = V / I$ was needed in this question.
- Some candidates attempted to calculate the total resistance without converting the current from mA to A.
- A few candidates attempted to calculate the resistance of the thermistor using the formula for resistors in parallel.

**(d) Comprehensive responses**

- A few candidates were able to apply correct knowledge of how resistance of a thermistor changes with temperature to state how the ammeter and voltmeter readings would be affected.

**Limited responses**

- Most candidates suggested that both readings would change.
- Candidates needed a clearer understanding of how changes in the resistance of a component would affect readings in a circuit where the potential difference across the component is unchanged.

**Question 8**

**(a) (i) Comprehensive responses**

- Most candidates were able to calculate the input voltage to the transformer.

**Limited responses**

- Some candidates did not correctly rearrange the equation to make input voltage the subject.
- A few candidates were unable to recall the equation relating turns ratio to voltage ratio.

**(ii) Comprehensive responses**

- A few candidates correctly recalled the equation $I_pV_p = I_sV_s$, rearranged it to make primary current the subject, substituted the power (in Watts) for $I_sV_s$, and recorded their answer to a minimum of two significant figures.

**Limited responses**

- Some candidates correctly converted the power output from 2.2 kW to 2200 W.
- Some candidates were confused about how to use the data provided in the question.
- Some candidates attempted to use $P = IV$ with the secondary voltage to calculate the primary current.

**(b) Comprehensive responses**

- A few candidates had a comprehensive understanding of how step-up transformers reduce power losses. They correctly recalled the equation for power loss. They then related the increase in voltage to a reduced current for the same power transmission. Finally, they recognised that a reduced current would reduce the heating effect in the wires.

**Limited responses**

- A common misconception was to link high voltage to a change in resistance of the wire.
- Some candidates were confused about the difference between power transmission and power loss during transmission.
- A few candidates included information unrelated to the question, such as the use of thinner wires for transmission.

**Question 9**

**(a) Comprehensive responses**

- Many candidates showed that gamma rays pass undeflected through the electric field.
- Some candidates showed the path of alpha particles curving towards the negative plate as it entered the electric field.

**Limited responses**

- Most candidates knew that alpha particles are deflected towards the negative plate.
- A common misconception was to continue the path of alpha particles undeflected until they were a long way through the electric field.
- A few candidates were confused about the direction of deflection of the alpha particles.
- A few candidates indicated the deflection of alpha particles in a straight line from the horizontal path.
- A few candidates continued the path of gamma rays with a line that was not clearly horizontal.

**(b) Comprehensive responses**

- Some candidates stated that the path of alpha particles is stopped by the paper, and the path of gamma radiation is unaffected by the paper.

**Limited responses**

- Some candidates clearly described how the path of alpha particles was affected by the paper and then were unable to state clearly that the paper had no effect on the gamma radiation.
- A few candidates suggested that alpha particles were reflected by the paper or that a few alpha particles travelled through the paper.
- Some candidates stated that gamma radiation penetrated the paper without stating clearly that the path of the gamma radiation inside the electric field was unaffected.

**(c) Comprehensive responses**

- Responses clearly identified that the path of the beta particle was deflected in the electric field.
- Most responses explained that this was due to a beta particle's negative charge which caused a force of attraction between opposite charges.

**Limited responses**

- Some candidates described attraction (for an instance, a force) between the path of beta particles and the positive plate without stating clearly that the path deviated or the particles moved towards the plate.
- Some candidates identified that opposite charges experience an electrostatic force without clearly stating that the beta particles were negatively charged.

**Question 10**

**(a) Comprehensive responses**

- Some candidates correctly recalled that a red giant forms a planetary nebula when it runs out of hydrogen to fuel nuclear reactions and that a white dwarf is at the centre of a planetary nebula.

**Limited responses**

- A common misconception was to state that a red super giant forms a planetary nebula.
- Common incorrect responses for what is at the centre of a planetary nebula were either a black hole or dust and gas.

**(b) (i) Comprehensive responses**

- Most candidates knew the order of colours of light in the electromagnetic spectrum and correctly identified blue light as having a shorter wavelength.

**Limited responses**

- Some candidates attempted explanations in terms of red shift or blue shift.
- A few candidates contradicted correct explanations with incorrect information about the frequency of blue light, the speed of blue light or the amount of diffraction with blue light.
- A few candidates attempted explanations in terms of frequency instead of wavelength.

**(ii) Comprehensive responses**

- Most candidates correctly calculated the frequency of the blue light.

**Limited responses**

- Many candidates were able to recall the wave equation.
- Some candidates did not correctly rearrange the equation to make frequency the subject.
- A few candidates calculated the frequency to an incorrect power of ten when working with numbers in standard form.

**Question 11**

**(a) Comprehensive responses**

- Some candidates gave clear, precise definitions for both the radius of the orbit and the orbital period.

**Limited responses**

- Many candidates gave incomplete definitions, for example, radius and period.
- Some candidates described $r$ as the distance from the Sun, instead of defining $r$ as the orbital radius.
- A few candidates gave ambiguous definitions for $T$, for example, the time for one revolution.

**(b) (i) Comprehensive responses**

- A few candidates linked the average orbital speed to variation in $r$. They usually explained this variation in terms of the orbit being elliptical.

**Limited responses**

- Most candidates explained that the orbit of Saturn is not a perfect circle or that it is elliptical.
- The effect of varying *r* on orbital speed was not always clearly understood.
- Some candidates suggested that it was impossible to measure *r* or *T* accurately and so estimates were used.
- A few candidates offered explanations in terms of the expansion of the Universe causing orbital speed to increase with time.

**(ii) Comprehensive responses**

- Some candidates set out a proof clearly and logically, outlining the steps which show that a Saturn year is 29 years (to two significant figures) and that therefore the statement in the question was true.

**Limited responses**

- Some candidates used $v = s / t$ instead of rearranging the equation for orbital speed to make *T* the subject.
- A few candidates attempted a calculation of the number of seconds in an Earth year using 360 days (for an instance, 12 months of 30 days each).
- Candidates needed to know that *T* for the Earth is approximately 365 days.
- A few candidates rounded intermediate calculations during their proof. This led to an incorrect value of *T* (to two significant figures) at the end of their proof.
- A few candidates attempted to use the Hubble equation or the value for a light year in their proof.

# PHYSICS

**Paper 0625/52**
**Practical Test**

## Key messages

**Demonstrate knowledge of how to select and safely use techniques, apparatus and materials (including following a sequence of instructions where appropriate)**

**What candidates did well**
- Candidates followed the instructions in the question paper and recorded results for all required measurements.
- Described techniques to obtain accurate measurements from a balance, a measuring cylinder and a rule(r).

**What candidates needed to improve**
- Ensure they are specific with their choice of language in their answer, so that 'reading a scale with the eye perpendicular' does not become 'keep eyes perpendicular to the measuring cylinder'.

**Plan experiments and investigations**

**What candidates did well**
- Many candidates followed the rubric in the question and included all the information requested in the order suggested.

**What candidates needed to improve**
- Some methods and tables did not correspond. Candidates should ensure they give a plan for the experiment described in the question and not for a similar experiment they may have practised previously.

**Make and record observations, measurements and estimates**

**What candidates did well**
- Many candidates recorded measurements to match the precision of the measuring device.
- Many candidates carefully considered the selection of consistent and regular scales for the graph axes.

**What candidates needed to improve**
- Candidates should practice drawing smooth, accurate lines of best fit.

**Interpret and evaluate experimental observations and data**

**What candidates did well**
- Candidates performed correct calculations and plotted graphs using their data.

**What candidates needed to improve**
- When two quantities are directly proportional, a line of best fit on a graph of these quantities is a straight line through the origin.
- Candidates should always round numbers correctly, rather than truncating their answers.

**Evaluate methods and suggest possible improvements**

**What candidates did well**
- Many candidates evaluated methods and suggested improvements to the procedures.

**What candidates needed to improve**

- Candidate should not confuse an improvement (use a measuring cylinder with smaller scale divisions) with a good measurement technique (read with eye level with bottom of the meniscus).

## Comments on specific questions

### Question 1

**(a) (i) Comprehensive responses**

- Most candidates recorded an appropriate value for $m_1$ to the nearest gram.

**Limited responses**

- Some candidates did not round their answer to the nearest gram.

**(ii) Comprehensive responses**

- Reference was made to ensuring the reading was zero before the measurement was taken or that the measuring cylinder must be placed in the centre of the balance.

**Limited responses**

- Some candidates referred to subtracting the mass of the empty measuring cylinder from the measurement. The question required the mass of the measuring cylinder and the water, and responses of this nature did not address the question asked.

**(iii) Comprehensive responses**

- Most candidates gave an appropriate value for $V_1$ recorded to the nearest ml.

**Limited responses**

- Some candidates gave answers to the nearest tenth of a ml. Measuring cylinders do not have a resolution of a tenth of the ml making answers of this nature incorrect.

**(iv) Comprehensive responses**

- Candidates referred to making the measurement with their eye level with the surface of the water or from the bottom of the meniscus.

**Limited responses**

- Some candidates referred to a measurement made from below the meniscus. This answer is incorrect because there are many places to take a measurement below the meniscus, none of which are correct.
- Some candidates referred to eye level perpendicular with the water surface. This implies they are looking down on the surface from above.
- Some candidates referred to the measuring cylinder needing to be at eye level. This answer does not provide a clear indication where the eye level should be in relation to the water level.

**(b) (i) Comprehensive responses**

- Most candidates recorded a measurement greater than their answer for **Question 1(a)(i)**.

**(ii) Comprehensive responses**

- Most candidates correctly subtracted their answers for $m_2$ and $m_1$ and divided by 5.

**Limited responses**

- Some candidates omitted the division by 5.

**(iii) Comprehensive responses**

- Most candidates recorded a measurement greater than their answer for **Question 1(a)(iii)**.

**(iv) Comprehensive responses**

- Most candidates correctly subtracted their answers for $V_2$ and $V_1$ and divided by 5.

**Limited responses**

- Some candidates omitted the division by 5.

**(v) Comprehensive responses**

- Most candidates divided their answers for **Questions 1(b)(ii)** and **1(b)(iv)**.

**(c) Comprehensive responses**

- Many candidates gave improvements to the method which would give a more accurate value of the volume such as using a measuring cylinder with smaller scale divisions, repeating and calculating a mean, using more glass balls or measuring the diameter and calculating the volume.

**Limited responses**

- Some candidates referred to measuring just one ball at a time.
- Some candidates referred to procedures used to carry out the experiment successfully, such as those described in **Question 1(a)(ii)** and **1(a)(iv)** rather than improvements.
- Some candidates referred to repeating the measurement. Calculation of the mean was not included.

**Question 2**

**(a) (i) Comprehensive responses**

- Most candidates recorded an appropriate value for the initial length of the spring to the nearest mm.

**Limited responses**

- Some candidates gave an answer in cm rather than mm.

**(ii) Comprehensive responses**

- Most candidates drew a sketch of the spring with the length clearly marked.

**Limited responses**

- Some candidates copied the whole of Figure 2.1.
- Some candidates did not clearly show where the length of the spring was measured.

**(iii) Comprehensive responses**

- Most candidates gave at least one technique such as having the ruler close to the spring, the ruler parallel to the spring, the eye perpendicular to the reading or the use of a marker.
- Many candidates drew a diagram which was sufficient on its own or helped to clarify their description.

**Limited responses**

- Referred to the ruler being perpendicular to the spring.
- Referred to the ruler being perpendicular, with the reference to the bench not specified.
- Referred to the use of a set square, without stating that it was used to align the spring with the ruler. Some responses indicated that the set square was being used as a short ruler.

**(b) Comprehensive responses**

- Most candidates recorded appropriate measurements of l and performed correct calculations of x.

**Limited responses**

- Some candidates gave an answer to the neatest tenth a mm which is not possible from a rule(r).
- Some candidates did not subtract the correct initial length to calculate the x value from their l values. This was sometimes correlated with candidates manipulating their data to produce a perfect straight line on the graph.

**(c) (i) Comprehensive responses**

- Most candidates plotted the correct graph containing all observations in the table and to the required accuracy.
- Many candidates used sensible and regular scales where all the data occupied more than half the graph grid.
- Points were plotted using neat crosses within half a small square.

- A suitable line of best fit was plotted which followed the trend in the data and had a balance of points above and below the line.

**Limited responses**
- Candidates sometimes omitted the axis labels or reversed the axes.
- Irregular or awkward scales often led to incorrect plotting. Candidates should avoid trying to fit data exactly to the graph grid, as this usually results in inappropriate scale choices.
- Points should not be larger than half a square in diameter so candidates should use a sharpened pencil to produce clear crosses rather than blobs.
- Lines of best fit were drawn through the origin, required adjustment, or showed an uneven distribution of points above and below the line.

**(ii) Comprehensive responses**
- A limited number of responses recognised that for variables to be directly proportional, the line of best fit must be a straight line through the origin.

**Limited responses**
- Many candidates referred to the points being close to the line or the line being straight. Reference to the line passing through the origin was not included.

**Question 3**

**(a) (i) Comprehensive responses**
- Most candidates recorded an appropriate measurement for voltage and current.

**(ii) Comprehensive responses**
- Most candidates recorded correct units in the table headings.

**Limited responses**
- Some candidates omitted units.

**(iii) Comprehensive responses**
- Most candidates performed two correct calculations for resistance and gave answers to 2 significant figures.

**Limited responses**
- Some candidates truncated, rather than rounded their answers.
- Some candidates did not give their answers to 2 significant figures.

**(iv) Comprehensive responses**
- Most candidates gave a statement matching their results.
- Most candidates referred to their results being the same within the limits of experiment accuracy.

**Limited responses**
- Some candidates stated that the results were not the same, despite the values being within 10 per cent of each other. This reflected instances where variation in experimental measurements was not taken into account.

**(v) Comprehensive responses**
- Many candidates gave a value the same as or between their values calculated in **Question 3(a)(iii)**.
- Some candidates gave a value that followed a pattern, for example is 7.9.
- Some candidates gave the value X.

**Limited responses**
- Some candidates gave values quite different from the values calculated in **Question 3(a)(iii)**.

**(b) (i) Comprehensive responses**
- Most candidates added three resistors in series.

**Limited responses**

- Some candidates omitted the question.
- Some candidates drew a fuse symbol rather than a resistor.

**(ii) Comprehensive responses**

- Most candidates gave measurements for voltage to at least 1 decimal place and measurements for current to at least 2 decimal places.

**Limited responses**

- Some candidates gave measurements to a variety of different numbers of decimal places.

**(c) Comprehensive responses**

- Some candidates referred to the prevention of the circuit or the components becoming warm if the circuit was left with a current.

**Limited responses**

- Some candidates referred to heating, without clearly stating what was being heated.
- Some candidates referred to saving energy or wasting energy with was insufficiently detailed.
- Some candidates referred to prevention of electric shocks: these are unlikely with a 4 V power supply.
- Some candidates referred to safety without expanding upon this any further.

**Question 4**

**Comprehensive responses**

- MP1 Most candidates stated that a stop-watch and a thermometer were needed. Often this was in a dedicated statement and was the first statement a candidate wrote.
- MP2 Candidates could either refer to measuring the starting temperature and the temperature after a given time, or the starting temperature and the time taken to drop to a particular temperature.
- MP3 Most candidates referred to repeating for different starting temperatures. A common feature seen was reference to repeating at five different starting temperatures, securing MP3 and MP7 in a single sentence.
- MP4 Most candidates referred to volume of water as the control variable.
- MP5 Many candidates gave a suitable table for their measurements with correct units.
- MP6 Candidates referred to plotting a suitable graph with axes specified in many scripts. Another way is to say ‘look at the results and see if the change in initial temperature affects the cooling rate’. Many candidates seem to have been taught a pattern: ‘plot a graph of the dependent variable against the independent variable’ or ‘see if changing the independent variable affects the dependent variable’.
- MP7 Many candidates gave more than one of the additional points given on the mark scheme.

**Limited responses**

- MP1 Candidates who did not give a dedicated statement often missed out one or both pieces of equipment from their method description.
- MP2 Some candidates referred to measuring the temperature every 30 seconds. A final temperature at which the experiment would end was not specified. Some candidates referred to measuring the time taken for the beaker to cool down.
- Some candidates referred to measuring the temperature every 30 seconds. A final temperature at which the experiment would end was not specified. Some candidates referred to measuring the time taken for the beaker to cool down.
- MP2 Some candidates had practised a past paper or example question involving a comparison of beakers with and without lids and so they described this experiment instead.
- MP4 Some candidates referred to a control variable, for example a volume of 100 ml. The requirement for this to remain constant was not specified.
- MP4 Amount was allowed for volume in this paper. Reference to volume rather than amount was expected.
- MP5 The table did not always match the experiment described or contain enough columns, for example is a column heading of ‘temperature’ was given by some candidates rather than ‘initial temperature’.
- MP5 Units were sometimes missing for one or more columns or the unit was given incorrectly: C° was a common replacement for °C.
- MP5 Some candidates gave only an initial temperature column and a column for temperature change. Candidates must ensure that their table allows the recording of measured values.

- MP6 Many candidates gave brief responses for this point. Some did not address the intended focus. Some candidates gave a prediction instead of describing how to draw a conclusion, for example ‘water with a higher initial temperature will cool faster’.
- MP7 Some candidates referred to repeating and finding an average. Clear explanation that the experiment was repeated for each value of the independent variable and that an average of the dependent variable measurements was taken for each value was not always included.

# PHYSICS

**Paper 0625/62**
**Alternative to Practical**

## Key messages

**Demonstrate knowledge of how to select and safely use techniques, apparatus and materials (including following a sequence of instructions where appropriate)**

**What candidates did well**
- Candidates followed the instructions in the question paper and recorded results for all required measurements.
- Described techniques to obtain accurate measurements from a balance, a measuring cylinder and a rule(r).

**What candidates needed to improve**
- Ensure they are specific with their choice of language in their answer, so that 'reading a scale with the eye perpendicular' does not become 'keep eyes perpendicular to the measuring cylinder'.

**Plan experiments and investigations**

**What candidates did well**
- Many candidates followed the rubric in the question and included all the information requested in the order suggested.

**What candidates needed to improve**
- Some methods and tables did not correspond. Candidates should ensure they give a plan for the experiment described in the question and not for a similar experiment they may have practised previously.

**Make and record observations, measurements and estimates**

**What candidates did well**
- Many candidates recorded measurements to match the precision of the measuring device.
- Many candidates carefully considered the selection of consistent and regular scales for the graph axes.

**What candidates needed to improve**
- Candidates should practice drawing smooth, accurate lines of best fit.

**Interpret and evaluate experimental observations and data**

**What candidates did well**
- Candidates performed correct calculations and plotted graphs using their data.

**What candidates needed to improve**
- Recognise that when two quantities are directly proportional a line of best fit on a graph of these quantities is a straight line through the origin.
- Candidates should always round numbers correctly, rather than truncating their answers.

**Evaluate methods and suggest possible improvements**

**What candidates did well**
- Many candidates evaluated methods and suggested improvements to the procedures.

**What candidates needed to improve**

- Candidate should not confuse an improvement (use a measuring cylinder with smaller scale divisions) with a good measurement technique (read with eye level with bottom of the meniscus).

## Comments on specific questions

### Question 1

**(a) (i) Comprehensive responses**

- Reference was made to ensuring the reading was zero before the measurement was taken or that the measuring cylinder must be placed in the centre of the balance.

**Limited responses**

- Some candidates referred to subtracting the mass of the empty measuring cylinder from the measurement. The question required the mass of the measuring cylinder and the water and so responses of this nature did not address the question asked.
- Some candidates did not appreciate that the question was about using the balance and gave answers relating to reading the measuring cylinder

**(ii) Comprehensive responses**

- Most candidates gave the correct answer of 91.

**Limited responses**

- The most common error was giving an answer to too high a resolution: ’91.0’.
- Just a few candidates gave an answer of 90.1, misinterpreting what one division was worth on the scale.

**(iii) Comprehensive responses**

- Candidates referred to making the measurement with their eye level with the surface of the water or from the bottom of the meniscus.

**Limited responses**

- Some candidates referred to a measurement made from below the meniscus. This answer is incorrect because there are many places to take a measurement below the meniscus, none of which are correct.
- Some candidates referred to eye level perpendicular with the water surface. This implies they are looking down on the surface from above.
- Some candidates referred to the measuring cylinder needing to be at eye level. This answer does not provide a clear indication where the eye level should be in relation to the water level.

**(b) (i) Comprehensive responses**

- Most candidates correctly calculated this answer**.**

**Limited responses**

- The most common error was just dividing $m_2$ by 4.

**(ii) Comprehensive responses**

- Most candidates correctly calculated this answer**.**

**Limited responses**

- The most common error was just dividing $V_2$ by 4.

**(iii) Comprehensive responses**

- Many candidates were able to correctly calculate, without rounding error, a value of density and give a correct and consistent unit. Some who had incorrect values of mass and volume from **(b)(i)** and **(b)(ii)** showed correct processing of the data.

**Limited responses**

- Just a few candidates gave incorrectly rounded answers.

**(c) Comprehensive responses**

- Many candidates gave improvements to the method which would give a more accurate value of the volume such as using a measuring cylinder with smaller scale divisions, repeating and calculating a mean, using more glass balls or measuring the diameter and calculating the volume.

**Limited responses**

- Some candidates referred to measuring just one ball at a time.
- Some candidates referred to procedures used to do the experiment well such as those described in **Question 1(a)(i)** and **1(a)(iii)** rather than improvements.
- Some candidates referred to repeating the measurement. Calculation of the mean was not included.

**Question 2**

**(a) (i) Comprehensive responses**

- Most candidates gave at least one technique such as having the ruler close to the spring, the ruler parallel to the spring, the eye perpendicular to the reading or the use of a marker.
- Many candidates drew a diagram which was sufficient on its own or helped to clarify their description.

**Limited responses**

- Referred to the ruler being perpendicular to the spring.
- Referred to the ruler being perpendicular, without reference to the bench.
- Referred to the use of a set square, without stating that it was align the spring with the ruler. Some responses indicated that the set square was being used as a short ruler.

**(ii) Comprehensive responses**

- Many candidates drew clear, well-defined horizontal lines.

**Limited responses**

- A significant number of candidates gave their value in cm. Some omitted the required horizontal lines

**(b) Comprehensive responses**

- The majority calculated x correctly, many with ECF applied.

**Limited responses**

- Just a few rounded their answer too severely, for example is 124.6 mm to 120 mm.

**(c) (i) Comprehensive responses**

- Most candidates plotted the correct graph containing all observations in the table and to the required accuracy.
- Many candidates used sensible and regular scales where all the data occupied more than half the graph grid.
- Points were plotted using neat crosses within half a small square.
- A suitable line of best fit was plotted which followed the trend in the data and had a balance of points above and below the line.

**Limited responses**

- Candidates sometimes omitted the axis labels or reversed the axes.
- Irregular or awkward scales often led to incorrect plotting. Candidates should avoid trying to fit data exactly to the graph grid, as this usually results in inappropriate scale choices.
- Points should not be larger than half a square in diameter so candidates should use a sharpened pencil to produce clear crosses rather than blobs.
- Lines of best fit were forced through the origin, required rotation or did not have ‘balanced’ points.

**(ii) Comprehensive responses**

- Recognition that variables are directly proportional when the line of best fit is a straight line through the origin was less frequently seen.

**Limited responses**

- Many candidates referred to the points being close to the line or the line being straight. Reference to the line passing through the origin was not included.

**Question 3**

**(a) (i) Comprehensive responses**

- Most candidates gave the correct reading here.

**Limited responses**

- For V the main error was giving the answer to too great a resolution: 2.40 and 2.30.

**(ii) Comprehensive responses**

- Most candidates gave the correct reading here.

**Limited responses**

- For I, the main error was a misread (0.26 and 0.25) or POT (3.2 and 3.0).

**(iii) Comprehensive responses**

- Most candidates performed two correct calculations for resistance and gave answers to 2 significant figures.

**Limited responses**

- Some candidates truncated, rather than rounded the resistance for circuit 2. This gave an answer of 7.6 rather than 7.7.
- Some candidates did not give their answers to 2 significant figures.

**(iv) Comprehensive responses**

- Most candidates gave a statement matching their results.
- Most candidates referred to their results being the same within the limits of experiment accuracy.

**Limited responses**

- Some candidates stated the results were not the same despite them being within the 10 per cent limit of experimental accuracy. It is important that candidates have an appreciation of experimental errors and understand that measurements do not have to be identical to be considered the same.

**(v) Comprehensive responses**

- Many candidates gave a value the same as or between their values calculated in **Question 3(a)(iii)**.
- Some candidates gave a value which followed a pattern.
- Some candidates gave the value X.

**Limited responses**

- Some candidates gave values quite different from the values calculated in **Question 3(a)(iii)** for example is 63 W.

**(b) (i) Comprehensive responses**

- Many candidates stated ‘more accurate’ or ‘easier to read’. Avoidance of parallax error was also mentioned.

**Limited responses**

- A number of candidates missed out the word ‘more’ when referring to accuracy. Both digital and analogue metres can be considered accurate.
- Reference was made to human error by some candidates.

**(ii) Comprehensive responses**

- Many candidates stated the correct answer**.**

**Limited responses**

- One common error was misreading the case of the unit prefix, confusing mA with MA, so they gave an answer of 290 000 000 A

**(c) Comprehensive responses**

- Some candidates referred to the prevention of the circuit or the components becoming warm if the circuit was left with a current.

**Limited responses**

- Some candidates referred to heating and did not clearly state what was being heated.
- Some candidates referred to saving energy or wasting energy with was insufficiently detailed.
- Some candidates referred to prevention of electric shocks: these are unlikely with a 4 V power supply.
- Some candidates referred to safety without expanding upon this any further.

**Question 4**

**Comprehensive responses**

- MP1 Most candidates stated that a stopwatch and a thermometer were needed. Often this was in a dedicated statement and was the first statement a candidate wrote.
- MP2 Candidates could either refer to measuring the starting temperature and the temperature after a given time, or the starting temperature and the time taken to drop to a particular temperature.
- MP3 Most candidates referred to repeating for different starting temperatures. A common feature seen was reference to repeating at five different starting temperatures, addressing MP3 and MP7 in a single sentence.
- MP4 Most candidates referred to volume of water as the control variable.
- MP5 Many candidates gave a suitable table for their measurements with correct units.
- MP6 Candidates referred to plotting a suitable graph with axes specified in many scripts. Another way is to say ‘look at the results and see if the change in initial temperature affects the cooling rate’. Many candidates seem to have been taught a pattern: ‘plot a graph of the dependent variable against the independent variable’ or ‘see if changing the independent variable affects the dependent variable’.
- MP7 Many candidates gave more than one of the additional points given on the mark scheme.

**Limited responses**

- MP1 Candidates who did not give a dedicated statement often missed out one or both pieces of equipment from their method description.
- MP2 Some candidates referred to measuring the temperature every 30 seconds and did not give a final temperature at which they would end the experiment. Some candidates referred to measuring the time taken for the beaker to cool down.
- MP2 Some candidates had practised a past paper or example question involving a comparison of beakers with and without lids and so they described this experiment instead.
- MP4 Some candidates did not clearly state their control variable. They referred to a volume of, for example, 100 ml and did not say that this should remain constant.
- MP4 Amount was allowed for volume in this paper, the candidates should refer to volume rather than amount.
- MP4 Some candidates offered parts of the apparatus as control variables (for example: thermometer, beaker)
- MP5 The table did not always match the experiment described or contain enough columns, for example is a column heading of ‘temperature’ was given by some candidates rather than ‘initial temperature’ or ‘rate of cooling’ was given without a ‘final temperature’ column.
- MP5 Units were sometimes missing for one or more columns or the unit was given incorrectly: C° was a common replacement for °C.
- MP5 Some candidates gave only an initial temperature column and a column for temperature change. Candidates must ensure that their table allows the recording of measured values.
- MP6 Many candidates gave brief responses for this point. Some responses did not address the intended focus. Some candidates gave a prediction instead of describing how to draw a conclusion, for example ‘water with a higher initial temperature will cool faster’.
- MP6 Some candidates suggested a graph of temperature against time and did not mention that this particular graph needs multiple lines, for different starting temperatures.

- MP7 Some candidates referred to repeating and finding an average and did not explain clearly that they were repeating the experiment for each value of their independent variable and then taking an average of their measurements of their dependent variable for each value of their independent variable.