

BOTSWANA EXAMINATIONS COUNCIL

BGCSE PHYSICS 2024

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PAPER 1: MULTIPLE CHOICE

General Comments

The performance of the candidates was better than that of the 2023 cohort with a mean of 29.28 which is very good for the paper. The candidates did extremely well in 24 items where at least 70% of them got the item correct. There was only one item where less than 50% of the candidates got the item correct.

Centres are encouraged to give candidates more opportunities for them to interact with questions where application of skills rather than recalling is required. The item reports are given as tables that include key information as indicated:

the number of candidates who selected each of the opti	ons
	the number of candidates who selected each of the opti

Key the option that was taken as the answer

Comments on Individual Items

Item 1: Length and Time

Option	Ν	Key	Comment
Α	19	в	
В	1884		Well done. Almost all the candidates were able to recall the SI unit of
С	1		acceleration even when it was presented to them in words
D	6		

Item 2: Mass, Weight and Centre of Mass

Option	Ν	Key	Comment
Α	36	С	
В	20		the mass of a body. There were yory few candidates across all the three
С	1843		distractors
D	11		

Item 3: Length and Time

	0		
Option	Ν	Key	Comment
Α	1		
В	42	D	Well done. The candidates were able to describe the oscillation of a
С	138		pendulum using the diagram that was provided.
D	1729		

Item 4: Forces: Effect on Shape and Size

Option	Ν	Key	Comment
Α	1124	A	Fairly done. Candidates were expected to use diagram (a) to determine the
В	214		spring constant which they were to use to determine the length <i>l</i> as shown
С	413		in diagram (b). For parallel springs the total spring constant is the sum of the
D	159		spring constants.



Item 5: Pressure

Option	N	Key	Comment
Α	132	B	Wall done. Almost all the condidates remembered that the manameter
В	1735		is used to measure as pressure. Very few candidates selected entions
С	40		A and C
D	3		A and C.

Item 6: Forces: Turning Effect of Forces

Option	Ν	Key	Comment
Α	40	С	Fairly done. The candidates were able to select moment as the quantity
В	699		which was not a force. However, there were a good number of them who
С	1102		selected couple as the answer. Candidates should be made aware that a
D	69		couple is a pair of equal and parallel forces acting in opposite direction.

Item 7: Pressure

Option	N	Key	Comment
А	108	0	Fairly done. The candidates were aware that when one the distances
В	658		increases the other increases, but they failed to note which one was
С	1110		decreasing. Pressure decreases as you move higher hence the column
D	34		height should also decrease.

Item 8: Pressure

Option	N	Key	Comment
Α	395	С	Fairly dans. Condidates were able to remember that the direction is
В	199		rainy done. Candidates were able to remember that the direction is
С	1055		pressure was high or low
D	261		

Item 9: Pressure

Option	N	Key	Comment
Α	498	В	Fairly down Mast of the condidates were cally between entires D and A
В	1102		Thus, the candidates who selected option A calculated pressure due to the
С	225		hight of the water above the fish but did not add the atmospheric pressure
D	85		

Item 10: Simple Kinetic Molecular Model of Matter

Option	Ν	Key	Comment
А	15	С	Excellent. Candidates were able to apply the correct gas law to determine
В	20		the pressure when the gas volume is doubled. However, the proportion of
С	1532		candidates who doubled the pressure without using the correct formula is
D	343		worrisome.



Item 11: Melting and Boiling

	•	0	
Option	Ν	Key	Comment
Α	27	D	Evention Almost all the condidates were able to use the information
В	68		Excellent. Almost all the candidates were able to use the information provided on the graph and the equation $Q = mc \Delta t$ to determine the thermal
С	24		energy lost
D	1791		

Option	N	Key	Comment
Α	367	D	Well done. Many candidates were able to recall that sea breezes are a
В	136		consequence of convection in the atmosphere. The strongest distractor was
С	56		A, cold nights in deserts, in which heat escapes without forming a convection
D	1351		current.

Item 12: Transfer of Thermal Energy

Item 13: Transfer of Thermal Energy

Option	Ν	Key	Comment
Α	12		Almost all the candidates noted that the coat keeps a person warm by
В	4		reducing loss of thermal energy from the body. The body produces heat
С	14		which is prevented from escaping by the coat thereby increasing the
D	1880		temperature around the body

Item 14: Measurement of Temperature

Option	Ν	Key	Comment
А	30		Well done. Almost all the candidates were able to recall the value of the upper fixed point of a temperature scale
В	24	С	
С	1801		
D	55		

Item 15: Measurement of Temperature

Option	N	Key	Comment
Α	46		Fairly done. Candidates should note that linearity is from 0 °C to 100 °C. The distances used should be 20 cm and $d - 2$ cm.
В	397	D	
С	437		
D	1030		

Item 16: Sound

Option	N	Key	Comment
Α	271		Fairly done. This is a recall question which candidates did fairly in with most of those who failed to get it correct split between options A and B. Reverberations are a results of multiple reflections
В	275	С	
С	1214		
D	150		



Item 17: Sound

Option	N	Key	Comment
А	79		Fairly done. The candidates were mainly split between options C and D. Candidates should note that ultra-sonic sound has frequencies greater than
В	55	D	
С	476		
D	1300		

Item 18: Light

Option	N	Key	Comment
Α	791		Fairly done. The candidates were mainly split between options A and C thus
В	18		showing that they were aware that the images are same size as the object
С	1080	C	but were not sure whether it is real or virtual. Candidates should be made
D	21		aware that real images are formed on a screen.

Item 19: Light

Option	N	Key	Comment
A	757	В	Poorly done. A thin converging lens forms images that are same size as the
В	727		object when the object is placed at 2F or a distance that is twice the focal
С	303		length. Most of the candidates selected F or 10 cm as their answer which
D	123		results in no image being formed.

Item 20: Electromagnetic Waves

Option	Ν	Key	Comment
А	383		Fairly done. The candidates should be aware that all radio waves have the
В	243	С	same speed hence they can determine the wavelength of each of the waves
С	1192		using the frequencies provided using the wave equation $v = f\lambda$. Strongest
D	92		distractors were A and B.

Item 21: General Wave Properties

		•	
Option	N	Key	Comment
Α	36	С	Well done. The candidates used the information to determine the frequency and the speed of the waves with ease.
В	260		
С	1556		
D	58		

Item 22: Sound

Option	Ν	Key	Comment
Α	1482	A	Well done. The item required candidates to use the sound equation, $v = \frac{2 d}{t}$ to determine the distance between the wall and the student, which they used
В	312		
С	62		
D	54		correctly



Item 23: Magnetism

	0		
Option	Ν	Key	Comment
А	166		Well done. Most candidates noted that repulsion is conclusive to show that the unknown metal is a magnet. Attraction alone can mean a magnetic material or an opposite pole of a magnet
В	60	С	
С	1555		
D	129		

Item 24: Magnetism

Option	N	Key	Comment
Α	59	D	Well done. The candidates were mainly split between C and D. Direct current is used for making magnets (alignment of dipoles) while alternating current is used to demagnetise.
В	48		
С	334		
D	1469		

Item 25: Electromagnetic Effects

Option	Ν	Key	Comment
Α	510	С	Fairly done. The candidates were mainly split between A and C. Thus, the
В	293		candidates were aware that the force is either up or down but were not sure
С	1003		of whether to use Flemmings Left Hand Rule (motor) or Flemmings Right
D	104		Hand Rule (generator).

Item 26: Electricity

Option	N	Key	Comment
Α	70	С	Well done. Almost all the candidates were able to calculate the potential
В	102		difference using the information provided. The question required the
С	1720		candidates to determine the current using $Q = It$ and then use $V = IR$ to
D	18		determine the potential difference.

Item 27: Introductory Electronics

Option	Ν	Key	Comment
А	495	В	Well done. The candidates were mainly split between options B and A. The capacitor is used mainly for storing charge in an electric field between its plates while batteries have chemical energy that is converted to electrical
В	1381		
С	16		
D	18		

Item 28: Introductory Electronics

Option	N	Key	Comment
A	155	D	Well done. The candidates were mainly split between options D, C and A. The brightness of the lamp is determined by the current in the lamp. The total resistance of the circuit determines the amount of current in the circuit with larger or increased resistance reducing the current in the circuit including the
В	14		
С	210		
D	1531		lamp.



Item 29: Electricity

Option	N	Key	Comment
А	273	В	Well done. The popular options were B and A. The candidates were aware
В	1553		that it is the electrons that were gained but some could not decide whether
С	72		it was inducing positive or negative charges on the surface of the paper for
D	12		attraction to take place.

Item 30: Electricity

Option	Ν	Key	Comment
Α	75	В	Well done. The candidates were to determine the combined resistance of the circuit which they used to determine the current in the circuit with ease.
В	1702		
С	29		
D	104		

Item 31: Introductory Electronics

Option	Ν	Key	Comment
Α	1679	A	Well done. The cathode ray oscilloscope measures voltage determining peak to peak amplitude while current is determined from voltage drops across resistors. The stronger distractors were C and D
В	5		
С	117		
D	109		

Item 32: Electricity

Option	N	Key	Comment
Α	30	С	Well done. The candidates were aware that the total resistance for resistors in series is greater than the value of each of the resistors while for those in parallel it is less than the value of the lowest resistor
В	92		
С	1658		
D	130		

Item 33: Electricity

	,		
Option	N	Key	Comment
Α	6	В	Well done. Almost all the candidates remembered the symbol of a fuse from the symbols that were given.
В	1825		
С	17		
D	62		

Item 34: Practical Electric Circuitry

Option	Ν	Key	Comment
А	171	В	Fairly done. The strongest distractor was C. Candidates should be made aware that current should complete a loop hence the neutral wire also has current.
В	987		
С	693		
D	59		



Item 35: Introductory Electronics

Option	N	Key	Comment
Α	171	С	Fairly done. Candidates were mainly split between options B and C. The Y-
В	556		plates are for vertical deflections with the time base being for the horizontal
С	1069		movement hence the display should represent both the vertical deflection
D	114		and horizontal movement

Item 36: Radioactivity

Option	Ν	Key	Comment
Α	93	В	Well done. Almost all the candidates remembered the characteristics of gamma rays.
В	1733		
С	61		
D	23		

Item 37: Practical Electric Circuitry

Option	Ν	Key	Comment
А	159	С	Fairly done. Candidates were split between B and C. Ideally a fuse rating should be slightly higher than the current in the appliance to allow for short- lived minimum overloads without the fuse being broken frequently and breaking the circuit. If the fuse rating equals current in the heater, frequent
В	746		
С	947		
D	58		breaks are likely

Item 38: Radioactivity

Option	Ν	Key	Comment
Α	1794	A	Well done. Almost all the candidates were able to determine the proton number and neutron numbers from the information provided. Protons should be equal to the neutrons
В	69		
С	36		
D	11		

Item 39: Radioactivity

Option	Ν	Key	Comment
А	289	D	Well done. The strong distractor was option A. The candidates failed to note that by 0600 hours there should be more radioactive atoms than at 0630 hours hence A was not plausible
В	91		
С	175		
D	1352		

Item 40: Radioactivity

Option	Ν	Key	Comment
Α	1115	A	Fairly done. The candidates were split evenly across all the distractors showing that they did not have better understanding of the nature of a beta particle (high energy electrons $\binom{0}{-1}\beta$).
В	191		
С	232		
D	346		





PAPER 3: WRITTEN THEORY

General Comments

Candidates are still presenting poor quality diagrams and generally have poor memory of theories, laws and equations. Centres are urged to avail time to address inadequacies that are prevalent in candidates' responses. More attention should be paid to comprehension.

Comments on Individual Questions

- (a) Well done. However, some candidates showed poor comprehension as they gave examples of length e.g. distance, despite being excluded by the question statement.
 - (b) (i) Fairly done. Most candidates tended to use speed to describe the sections of the graph instead of the stated acceleration. Centres are urged to advice their candidates to read questions thoroughly in order to respond accordingly.
 - (ii) Well done. Candidates showed familiarity with area under a speed time graph for calculation of distance travelled.

Answer. (b) (ii) 40 m

- 2 (a) (i) Well done. Most candidates were able to deduce that an empty can has air inside.
 - (ii) Poorly done. Candidates failed to recognise that pressure inside the can decreased instead only referred to difference in pressure inside the can and outside without justifying the difference
 - (b) (i) Well done. Most candidates identified the formula for use in calculating the pressure, $P = \rho gh$ and used it correctly to determine the pressure at the top surface of the cylinder.
 - (ii) Well done. The candidates noted that a similar approach used in (b)(i) was also applicable to determining the pressure at the bottom surface.
 - (iii) Poorly done. Candidates failed to realise that the pressure at the bottom is pushing upwards while pressure at the top is pushing downwards thereby creating a pressure difference. Most candidates summed up the values. The resultant force could be determined using F = PA where A is the surface area of the cylinder and P is the pressure difference between top and the bottom.

Answers: (b) (i) 14 000 Pa (b) (ii) 32 000 Pa (b) (iii) 8100 N

- 3 (a) (i) Fairly done. The candidates recalled the formula to use when calculating the energy, E = Pt. However, most candidates failed to change the time, which was given in minutes, to seconds yet still gave their answers in joules.
 - (ii) Fairly done. The candidates recalled the equation to for use, Q = ml. Most candidates were challenged by the unit as they used 31 g in their calculations but gave their answer with a unit of J/kg. The unit would have been correct if they had converted 31 g to kg.



- (b) Well done. Generally, candidates were able to note that in answering (a)(ii) it is assumed that there is no energy loss with all energy being transferred to the ice.
- (c) Poorly done. The candidates failed to realise that some of the thermal energy is now used to raise the temperature of ice from -20 °C to 0 °C. The ice will start to melt once the temperature has increased to the melting point.

Answers: (a) (i) 10200 J (a) (ii) 329.03 J/g

- 4 (a) Well done. Candidates were able to differentiate between gas and a liquid, even though some compared unrelated properties hence making their comparisons incomplete. Centres are advised to inform candidates that when comparing they should always cover both sides i.e. if they say particles in gas have very high kinetic energy then the difference is completed by stating how the energy is for particles in liquids.
 - (b) Fairly done. While on the main candidates noted that pressure increases, they failed to correctly explain the statement. Most candidates stated Boyle's law thereby not addressing the question. Centres urged to advice candidates that laws are not assumptions and also that pressure is due to particles colliding with walls of a container, increase in pressure is due to increased frequency of collisions with walls.
- 5 (a) Poorly done. Candidates failed to state the necessary conditions for total internal reflection to occur. They easily accessed the mark about critical angle being less than angle of incidence but failed to recognise that total internal reflection occurs inside a more optically dense medium.
 - (b) Well done. Candidates readily identified the angle as critical angle.
 - (c) Fairly done. Candidates showed familiarity with the equation for refractive index, $n = \frac{\sin i}{\sin r}$ but their failure to identify the medium in which total internal reflection will occur meant they could not adapt the equation to the situation. Those that used the equation with the critical angle had no problem in accessing marks.
 - (d) Poorly done. Even though candidates showed some bit of understanding of the concept, they failed to present neat diagrams. It was evident that some candidates did not bring appropriate tools to the examination. There was evidence of free hand drawing and not paying attention to detail.

Answer. (c) 1.52

- 6 (a) Well done. The candidates easily recalled the examples for transverse and longitudinal waves.
 - (b) Fairly done. The diagram showed reducing frequency and reducing amplitude. Most candidates were able to note that loudness decreases but failed to identify how frequency affected the pitch. When frequency decreases the pitch increases.
 - (c) Poorly done. Even though candidates had an idea of using echo sounding they failed to describe how the depth is measured. The candidates should always identify the variables that they need to measure and the variables that are known. The candidates were required to determine the depth,



d of a river. The candidates should use the speed *v* of sound in water and measure the time *t* it takes for ultra-sonic waves to move from the source to the bottom of the river and back. Either candidates failed to note that the speed of ultra-sonic sound is the same as the speed of sound hence vt = 2s can be used to determine the depth or they did not have an idea about the experimental set-up.

- 7 (a) Well done. Most candidates were able to recall the unit of charge as coulomb. There were a few candidates who answered by giving a symbol. Centres should encourage candidates to pay attention to command words used and respond to the questions accordingly.
 - (b) Well done. Most candidates were aware that the negative charges should move from cloth to plastic for the rod to become negatively charged.
 - (c) Poorly done. Candidates showed understanding of induction but failed to demonstrate charging by induction and transfer of charge when the sphere touches the metal plate. Most candidates described separation of charges thereby not scoring. Centres are urged to advice candidates to differentiate between electrostatic induction and transfer of charge.
 - (d) Fairly done. Most candidates showed understanding that negative charges are transferred into the sphere but failed to show that the sphere becomes neutral, instead, a sizeable candidature stated that the sphere becomes negatively charged whereas it is neutralised by negative charges from the earth.
- 8 (a) Very well done. Candidates determined the combined resistance of the parallel resistors mainly using the equation $R = \frac{R_1 R_2}{R_1 + R_2}$. The candidates presented their answer with correct units.
 - (b) Well done. The candidates used Ohm's Law accordingly to determine the current. Most candidates who got a wrong value of resistance in (a) were still able to determine current correctly and scored all the marks.
 - (c) Poorly done. The candidates were aware of the formula they were to use, V = IR to determine the potential difference but mixed up the currents. The candidates were supposed to determine the current in the branch of the 4Ω resistor which is 2 A to score the first mark. Most candidates used the wrong current, 6 A determined in (b), to calculate the potential difference hence failed to score a mark for the question.

Answers: (a) 2Ω (b) 6A (c) 8V

9 (a) Well done. A few candidates were not able to recall the formula $R = \frac{V^2}{P}$ for calculation of the resistance of the heater. Some candidates wrote the equation well but failed to square the potential difference, *V* when doing the actual calculation.



- (b) Fairly done. Candidates recalled the equation, $R = \frac{\rho l}{A}$ and substituted well in the equation. It seems the candidates failed to use their calculators correctly to find the right answer. Centres are urged to give candidates practice on the use of calculators.
- (c) Poorly done. Most candidates stated that current in the second material would be more than in the first material but did not quantify it as expected. When the length is reduced by half, and diameter maintained the resistance reduces by half thereby making the current to double. Centres are advised to encourage candidates to use all the equations that can assist them to make quantitative analysis of the different quantities in a formula.

Answers: (a) 2.4Ω (b) 1.2 m

- 10 (a) Well done. Most candidates were aware that there is current in the circuit when switch S is closed. The current results in soft-iron core being magnetised. However, the candidates stated that the soft-iron armature is attracted to soft-iron core and failed to indicate that the soft-iron armature moves towards the core. Centres should encourage candidates to indicate clearly when attraction (or repulsion) is accompanied by movement, the resulting movement of the material since either one of them alone does not necessarily imply that there is motion.
 - (b) (i) Well done. Most candidates correctly indicated that the resistance of the LDR would decrease with an increase in light intensity.
 - (ii) Poorly done. Most candidates fitted the lamp in the gap seen on the circuit diagram instead of drawing it across the LDR. Most candidates seemed distracted by the gap.
- **11 (a)** Well done. Most candidates used alternative words to unpredictable. Centres encouraged to be clear on descriptive terms / words in radioactivity. Teachers should explain in detail and give meaning to terms.
 - (b) Well done. Almost all the candidates were able to determine that Q is 54. There were some candidates who failed to determine R the number of neutrons produced in the reaction which is 2 for the equation to be balanced.
 - (c) Fairly done. The property which was key is the penetrating power of radiation. Most candidates included properties that did not address the question. Candidates should be encouraged to focus on properties that address the question. Ionisation has no effect in the use of alpha particles in monitoring uptake of fertilisers.



PAPER 4: PRACTICAL TEST

General Comments

The candidates generally performed well in this paper. Mostly they were able to record their findings to the accuracy of the instrument they used. They also substituted their values well in the equations given and were able to obtain correct answers. The candidates mostly paid attention to the significant figures on their final answers. They were able to round-off their answers to 2 or 3 significant figures or to 2 or 3 decimal places which ever was most appropriate to give a meaningful answer i.e. an answer like 234.91027 is better rounded to decimal places, and 0.025718 to significant figures. Centres are advised to advice their candidates to round off indefinite answers appropriately. Candidates generally have challenges when it comes to worded questions, like precautions, or any follow up question. Generally, candidates have good tabulation and graphing skills, which are basically observed in question 4.

Comments on Individual Questions

- 1 Generally the question was fairly done. Most candidates were able to record the final and the initial temperature values with correct units and to the correct accuracy of a thermometer which is 1°. The results mostly showed that the liquid with less volume cools faster. Centres are advised to advice their candidates that conclusions are drawn according to the aim of the experiment, in this case to investigate the effect of volume on the cooling rate of water. For part (c) where they had to suggest an improvement, the expected improvements were performing the experiment one at a time to obtain the temperature at the exact set time or to eliminate time lapse between taking readings, using a quick responding thermometer or a thermocouple to obtain the temperature at the exact set time or to eliminate time lapse between taking readings, repeat the experiment several times and use average value to minimise errors and use a digital or a more accurate thermometer to minimise errors, for instant temperature measurements etc.
- 2 This question was fairly done by most candidates. Most candidates were able to draw a correct diagram with evidence of where they inserted their pins. Most candidates were able to use a protractor to measure and draw angles correctly, they even recorded their measured angles to the correct precision of the protractor which is 1°. Most candidates were able to calculate the refractive index accurately and rounded off infinite answers correctly. Mostly their answers were between 1.4 and 1.6 showing that they did the experiment accurately. For part (d) most candidates gave the answer which related to parallax error positioning the eyes directly above the point where the reading is taken on the ruler. Other expected answers for the precaution are observing the base of the pins, ensuring the pins are vertical and drawing thin lines. Some candidates said to avoid parallax error. Centres are advised to inform their candidates that experimental errors are reduced but cannot be completely eliminated.
- 3 This question was fairly done by most candidates. Records for voltage, V and current, I were with correct units. Most candidates recorded V to the correct accuracy of the voltmeter, which is 0.1 V, but for current a lot of candidates failed to record current to the correct accuracy of the ammeter which is 0.02 A. Part (b) was poorly done by most candidates since most of them failed to pick the trend from part (a). The expected answer is the voltage across wires W, Y and Z is less than V₂ the reason is from (a) V₂ < V₁ or there is lower voltage drop for resistors in parallel, or there is low resistance for resistors



in parallel. Most candidates said the voltages would be the same because voltage across resistors in parallel is the same.

4 This question was generally well done. There were three main sections being records, graph and deductions.

Records

Most candidates were able to give their records of mass and time with correct units. Most candidates were able to the draw a proper table for recording their results with headings, *m*, *t*, *T* and T^2 with correct units and at the top of the table only. Some candidates failed to give units for T^2 hence lost a mark for tabulation. Most candidates were able to calculate the period *T* and square of the period T^2 correctly and to the same rounding offs (consistent).

Graph

Mostly the graph was well done. Most candidates were able to draw and label the axes correctly with correct units and correct orientation. Most candidates were able to make readable scales (the smallest division on their scale was easy to obtain) for the horizontal but were a bit challenged by the vertical scale. Mostly of the scales were suitable, i.e. the points to be plotted would cover more than half the graph sheet. Most points were plotted accurately to within half a small square of the exact position where they should be. They also used the correct notation (small cross (x) or encircled dots (O)). Most candidates were able to draw the line of best fit (passing through most points, straight and thin). Some candidates ignored the trend of their points and drew a forced line to pass through the origin. A few candidates drew free hand lines and with such lines the gradient cannot be determined.

Deductions

This part of the question was fairly done by most candidates. For part (c), most candidates were able to draw a big triangle or used points which were on their line when calculating the gradient of the line. Some candidates ignored their line and used points from their table which were not even on the line. Nevertheless, they were mostly able to calculate the gradient correctly. A few candidates swapped the axes when calculating the gradient. Candidates are advised to write the units for their gradient as this helps them determine the correct units for the next steps.

Part (d) most candidates failed to obtain the correct calculation for the spring constant *k*. Majority lost the mark due to wrong units and being out of range.

Part (e), this one was well done. The most common source of inaccuracy was human reaction, stopwatch accuracy, and difficulty to time a complete oscillation.

Part (f), the expected effects are oscillations not harmonic, force not proportional to the load or the spring being damaged the reason being elastic limit might be exceeded or limit of proportionality exceeded.



PAPER 5: ALTERNATIVE TO PRACTICAL TEST

General Comments

The candidates generally performed well in this paper. Mostly they were able to record their findings to the accuracy of the instrument given in the paper. They also substituted their value well in the equations given and were able to obtain correct answers. Candidates were able to round their answers to 2 or 3 significant figures or to 2 or 3 decimal places which ever was most appropriate to give a meaningful answer i.e. an answer like 234.91027 is better rounded to decimal places, and 0.025718 to significant figures. Centres are advised to advice their candidates to round off indefinite answers appropriately. Candidates generally have challenges when it comes to worded questions, like precautions, or any follow up question.

Comments on Individual Questions

1 The question was well done by most candidates

- (a) Most candidates were able to read and record the temperatures with correct units and accuracy.
- (b) The question was well done by most candidates. Most candidates were able to calculate temperature drops (ΔT_A and ΔT_B correctly)
- (c) Most candidates were able to draw the correct conclusion of the experiment which the expected answer was volume is inversely proportional to cooling rates.
- (d) This question was fairly done. The expected improvements were performing the experiment one at a time to obtain the temperature at the exact set time or to eliminate time lapse between taking readings, using a quick responding thermometer or a thermocouple to obtain the temperature at the exact set time or to eliminate time lapse between taking readings, repeating the experiment several times and use average value to minimise errors, using a digital or a more accurate thermometer to minimise errors, for instant temperature measurements etc.

Answers: (a) $T_A = 63 \degree C$ and $T_B = 72 \degree C$ (b) $\Delta T_A = 17 \degree C$ and $\Delta T_B = 8 \degree C$

- 2 (a) This question was mostly well done by most candidates. They were able to draw the correct diagram with LM, AE, EL and LG at the right places.
 - (b) Most candidates were able to read and record the lengths q, r, and s correctly and to the correct accuracy of a rule which is to 1 mm.
 - (c) The question was fairly done by most candidates. The candidates were able to calculate the refractive index, *n* correctly and gave their answers correctly without units.
 - (d) Most candidates gave the answer which related to parallax error positioning the eyes directly above the point where the reading is taken on the ruler. Other expected answers for the precaution are observing the base of the pins, ensuring the pins are vertical and drawing thin lines. Some candidates said to avoid parallax error. Centres are advised to advice their candidates that experimental errors are reduced but cannot be completely eliminated.

Answers: (b) q = 5.7 cm r = 7.6 cm s = 8.6 cm (c) 1.47



- 3 The question was fairly done by most candidates.
 - (a) Most candidates were able to record current and voltage well with correct unit and to the correct accuracy of the meters. Current to 0.02 A and voltage to 0.1 V.
 - (b) This question was poorly done by most candidates as they failed to pick the trend from part (a). The expected answer is the voltage across wires W, Y and Z is less than V₂ the reason is from (a) V < 1.4 V or there is lower voltage drop for resistors in parallel, or there is low resistance for resistors in parallel. Most candidates said the voltages would be the same because voltage across resistors in parallel is the same.</p>
 - (c) This question was well done by most candidates. The expected answers were type of wire / resistivity, cross sectional area / diameter / thickness, temperature.

Answers: (a) I = 0.48 A V = 0.9 V

- 4 (a) This question was well done. Most candidates were able to give time from the stopwatch.
 - (b) Most candidates were able to write the correct units for T and for T^2 . They were able to calculate T and for T^2 and correctly rounded off their answers to 2 or 3 significant figures or to 1 or 2 decimal places.

<i>m</i> /g	t/s	T/s	<i>T</i> ² /s ²
100	6.93	0.35	0.12
200	9.80	0.49	0.24
300	12.00	0.60	0.36
400	13.71	0.69	0.47
500	15.49	0.77	0.59

- (c) Most candidates were able to draw and label the axes correctly with correct units and correct orientation. Most candidates used readable (the smallest division on their scale was easy to obtain) and suitable scales (the points to be plotted would cover more than half the graph sheet). Most points were plotted accurately to within half a small square of the exact position where they should be. They also used the correct notation (small cross (x) or encircled dots (O)). Most candidates were able to draw the line of best fit (passing through most points, straight and thin). A few candidates drew free hand lines, with such lines the gradient cannot be determined.
- (d) Most candidates were able to draw a big triangle or used points which were on their line when calculating the gradient of the line. Some candidates ignored their line and used points from their table which are not even on the line. Nevertheless, they were able to calculate the gradient correctly.
- (e) Most candidates failed to obtain the correct calculation for the spring constant *k*. Majority of the candidates lost the mark due to wrong units.



(f) This question was fairly done. The expected effects are oscillations not harmonic, force not proportional to the load or the spring being damaged the reason being elastic limit might be exceeded or limit of proportionality exceeded.

Answer: (a) 6.93 s