PRINCIPAL EXAMINER'S REPORT

BOTSWANA EXAMINATIONS COUNCIL

BSSE PHYSICS

2025

Advancing learning, certifying your future

PAPER 1: WRITTEN PAPER

General Comments

Generally, the performance of the candidates was fair with candidates not following the basics when answering questions. Candidates provided more than one working in the workspace and did not cross out work they do not want the Examiners to see. This resulted in candidates losing marks unnecessarily even in questions where they could have scored some marks through compensation. There was poor computation skills when determining numerical answers and candidates failed to express themselves comprehensively.

Candidates must be made advised on the correct rounding off of numerical responses and to express values correctly in scientific notation when they choose to do so, e.g. 3.6666 should be rounded to 3.7 or 3.67 and not 3.6 or 3.66. Candidates should avoid lots of rough work in the workspace as these appear in the scanned copies and impede earning of marks, at the very least candidates should cross out unwanted work. Candidates should also be advised to do the working for each part question in the spacing reserved for the question. Any work that is done in a different space may not be credited as it might not recognised by an Examiner who is marking the item.

Comments on Individual Items

1 **(a)** Most candidates classified energy as fundamental leading to them earning one mark. Centres urged to differentiate quantities as fundamental, derived, scalars, vectors and be broad in approach.

(b) Well done. Candidates showed familiarity with the concept of scientific notation using numbers greater than 1 but less than 10 to express 0.452 m in the required format. They also showed familiarity with the correct conversion of decimal places to correct index.

(c) Fairly done. Candidates failed to obtain the conversion factor. Candidates were familiar with the relationship between cm and m but failed to derive the conversion factor from per m^3 to per cm^3. Centres to adequately address the concept of conversions between different units even where the units are derived for quantities like volume, area, etc.

Answers **(b)** 4.52×10^{-1} **(c)** 0.0136

2 **(a)** Fairly done. Most candidates misplaced some physical quantities. They will get one scalar, and one vector correct but others wrongly placed. Some quantities appeared on both sides.

(b) **(i)** Fairly done. Most candidates showed poor interpretation of the vector diagram. Candidates recalled Trigonometric ratios (SOH CAH TOA, sine rule), but in the main failed to use them with the provided quantities and therefore did not earn any mark. Centres should emphasise that the ratios are a tool and only apply when physical quantities are used not in the basic mathematics form. Some candidates came up with a scale as if they had to draw. Some candidates were rounding answers wrongly, prematurely or rounding twice.

(ii) Fairly done. Most candidates showed poor interpretation of the vector diagram. Candidates made the same mistakes as in **(b)(i)** and added Pythagoras theorem, which would give the

correct answer, but it tended to point to an inadequacy when resolving components of a force. Centres are urged to ground candidates on required knowledge. Candidates were rounding answers wrongly, prematurely or rounding twice.

(iii) Fairly done. Most candidates recalled the equation $W = Fs$, but some candidates failed to recognise the force doing work. Centres to emphasise work done in situations depicted in the question.

Answers: **(b) (i)** 10565.46 **(ii)** 22657.69 **(iii)** 113288.47 J

3 (a) Faily done. Most candidates recalled Pascal's Law which states that pressure applied at any point to a fluid in a closed vessel is transmitted equally to every other point in the fluid, but some left out key words like enclosed system, in a fluid, equally transmitted. Some candidates displayed poor comprehension of the law as they stated Gas Laws (e.g. Boyles Law), basic equation of pressure $P = \frac{F}{A}$. Centres urged to always give laws as are.

(b) Poorly done. Most candidates recalled $P = \frac{F}{A}$ and $F = mg$ but failed derive the equation using the two formulae. They only focussed on the right side of the equation. Some candidates outrightly substituted the variables provided into $P = \rho g h$. Centres are advised to do more practice on derivation of equations and clearly showing all the steps involved.

(c) (i) Fairly done. Most candidates displayed poor comprehension of Pascal's Law and its application. The candidates were expected to use the relationship $\frac{F_1}{A_1} = \frac{F_2}{A_2}$. Some candidates showed poor computation skills, worked with direct proportionality between quantities that were not directly proportional.

(ii) Fairly done. Most candidates recalled the equation for mechanical advantage, $MA = \frac{F_1}{F_2}$ but gave mechanical advantage with a unit while some inverted the correct expression.

Answers: **(c) (i)** 4000 **(ii)** 20

4 (a) (i) Well done. Candidates easily accessed all the marks as they were able to recall the formula for gravitational potential energy, GPE = $m\,g\,h$ and used it correctly. However, some candidates had a challenge as they gave wrong units such as N / m instead of Nm.

(ii) Fairly done. Candidates recalled the correct formula for efficiency, but some failed to appreciate that efficiency is between 0 and 1 and in terms of percentage it is between 0 and 100. Some candidates treated percentage as $\frac{1}{100}$ which made them lose marks. Some candidates did not round off their answers correctly. Centres should advice candidates to copy the answers as they appear on the calculator. Candidates should be advised to cancel their rough work.

(b) Fairly done. Most candidates were able to name an environmental effect of using coal as a source of energy especially air pollution which was worth a mark only. However, the candidates failed to describe the effect to show that when coal is burnt it produces harmful smoke most just stated harmful smoke not stating where the smoke comes from. Centres are urged to distinguish between environmental and socio-economic effect and also clarify what the effects are. Some candidates stated two effects and not explain them. e.g. air pollution leading to global warming rather than air pollution as burning of coal releases harmful gases and global warming as burning coal produces greenhouse gases.

Answers: **(a) (i)** 300 J **(ii)** 153.85 W

5 **(a)** **(i)** Well done. Most candidates were able to interpret the graph and gave correct temperature range where substance was a liquid. However, Centres are urged to encourage candidates to always write the units of quantities as given in the question especially when they read off a graph.

(ii) Fairly done. Candidates failed to interpret the heating curve at the specified time interval where the liquid was at the boiling point where intermolecular forces decreases and spaces between molecules increase. Most candidates mentioned increase in kinetic energy and failed to account for the time interval but rather referred to the start and end of the interval. Centres should also place emphasis on interpretation of graphs and also clear the misconception that molecules change state

(b) **(i)** Fairly done. The candidates recalled the equation $Q = mc\Delta T$, but they obtained a negative answer due to their temperature change being recorded as negative. Some candidate got the units wrong. Centres should stress that negative value for energy represents loss and a positive value should be given when loss is already stated in the answer space. There should be emphasis in the distinction between specific heat and latent heat

(ii) Poorly done. Most candidates noted that there was energy conservation giving the expression energy lost = energy gained. However, most candidates failed to recognise that for ice two stages were involved melting of ice and increase in temperature of the melted ice. Thus, the candidates on the main failed to include one of the stages. The candidates were to use the equation $mc\Delta T_w = m\, l_f + mc\Delta T$ where the first is for energy lost by water and other is for the latent heat of fusion required to melt the ice and the energy required to increase the temperature of the melted ice to 15 °C.

Answers: **(a) (i)** 20 °C to 60 °C **(b) (i)** 4200 J **(ii)** 0.0106 kg

6 **(a)** Well done. Most candidates displayed good knowledge of components of the electromagnetic spectrum. Centres are advised to address confusion between electromagnetic waves and nuclear radiation.

(b) **(i)** Well done. Most candidates displayed good knowledge of harmful effects of X-rays on people, which included causing cancer, radiation sickness, alteration of DNA, etc.

(ii) Well done. Most candidates displayed knowledge on application of X-rays, especially the one of detecting fractures in bones being the most popular answer.

(c) (i) Well done. Most candidates displayed good interpretation of the amplitude from the graph with only a few stating it as – 4 (cm). Centres should advise candidates that amplitude is a scalar and hence does not have direction.

(ii) Fairly done. Candidates displayed poor comprehension in interpreting the displacement-distance graph and the definition of wavelength and oscillation hence difficulty in deducing the wavelength from the graph. Centre are urged to put more emphasis on interpretations of displacement-time graphs and definitions for easy identification from the graphs.

(iii) Fairly done. Most candidates recalled the wave equation $v = f\lambda$ but gave the speed in m / s instead of cm / s. Some candidates used $S = \frac{D}{T}$ and never showed how T was obtained. Centres should advise candidates to work with provided quantities and save time in having to calculate other values. The candidates should also be made aware that the symbols *t* and *T* mean different things in equations.

Answers: **(c) (i)** 4 **(ii)** 5 **(iii)** 25 cm / s

7 (a) Fairly done. Common response that denied candidates mark was stating the use of a resistor as: resistor prevents/stops/opposes the flow of current rather than to reduce or divide current.

(b) (i) Well done, the mark was accessible since all the answers were within a wide range. Centres should ensure that when candidates choose to present their answers in scientific notation they should do it correctly. The candidates should also be advised to place emphasis on the 4th colour band representing number of zeros in the resistor value.

(ii) Well done, marks were accessible. Candidates were able to correctly use the tolerance to determine the maximum value of the resistor.

(c) (i) Fairly done, candidates showed problem of not crossing off their rough work. Others did not separate working.

(ii) Well done. The candidates were able to recall the equation $V = IR$ and used it correctly to obtain the answer. Some candidates scored through error carried forward.

(iii) Poorly done. Most candidates failed to realise that the current obtained in **(c)(ii)** will split into equal at the junction with 0.5 A in each branch. Candidates were either challenged by using the correct value of resistance across the parallel resistors or the correct value of current through each resistor.

(iv) Fairly done. Most candidates chose the wrong equation $P = VI$, which required them to calculate *V*, since it was not provided instead of $P = I^2 R$. Centres should advise candidates to know the different equations and where they are applicable when dealing with electricity and also they need to work with information provided in the question.

Answers: **(b) (i)** 25000 **(ii)** 27500 **(c) (i)** 12 **(ii)** 1 **(iii)** 2 **(iv)** 6

8 **(a)** Fairly done. Candidates failed to express the correct physics of operation of the transformer. The candidates should be made aware of the correct sequence with current in primary coil causing changing magnetic field which cuts the secondary coil. Centres are urged to differentiate between how a transformer works: its use, structure and types. They should also provide the correct details and emphasise the key technical words.

(b) **(i)** Well done. Candidates showed familiarity with the transformer equation, $N_pV_s = V_pN_s$ and applied it correctly.

(ii) Fairly done. The candidates were to note that input power is equal to output power for an ideal transformer ($V_sI_s = V_pI_p$). Some candidates used the equation with the number of turns and approached the equation as if voltage and current were directly proportional like number of turns and voltage. Centres are advised to clear the confusion.

(c) **(i)** Poorly done. Candidates showed lack of familiarity with the functioning of the transistor. Most candidates were able to state that the resistance of the thermistor decreases with a rise in temperature, but they failed to link that with voltage drop and current through R_1. The transistor would be switched if the current is enough to trigger it. Centres urged to address topics at the end of the module.

(ii) Poorly done. Most candidates who knew about the LDR had no clue where to place the LDR in the circuit instead explained how it worked, not the modified circuit. Thus, candidates failed to notice that the LDR, whose resistance increases as it gets dark, has to be swapped with R_1 for the lamp to switch on when it is dark.

Answers: **(b) (i)** 20 **(ii)** 0.125

9 **(a)** Fairly done. Candidates missed out on key points: unstable and spontaneous or anything that carried the same meaning which led to them losing marks. The process is uncontrolled hence it is important that they mention the spontaneous emission of particles.

(b) Well done. Most candidates recalled the equation $E = mc^2$ and used it correctly to determine the energy released.

(c) Well done. Since it had many possible answers some of which were covered under electromagnetic spectrum the marks were accessible. Most candidates scored all the two marks.

Answer: (b) 2.826×10^{-12} J

PAPER 2: 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. Centres are advised to inform candidates to round off indefinite answers appropriately. Candidates generally have challenges when it comes to worded questions, like precautions, or any follow up question and stating relationship between two variables. For example, most candidates wrote observations instead of conclusions. In most instances candidates did not follow their result instead used the concept / theory of physics to give conclusions. Generally, candidates have good tabulation and graphing skills, which are basically observed in question 4.

Comments on Individual Items

1 **(a)** Fairly done. The candidates were expected to describe how the length is accurately measured which is measuring of the length more than once and finding the average for the first marking point. The second mark was for the description of parallax error and stating that it is to minimise parallax error. Most candidates were describing the use of Vernier callipers in measuring length. Centres must advise candidates that you cannot prevent or avoid error, but you can only minimise it.

(b) Well done. Most of the candidates were able to measure and record masses with correct unit and accuracy of the instrument.

(c) Well done. Most of the candidates were able to measure and record the lengths with correct unit and accuracy of the instrument.

(d) Fairly done. A fair number of candidates used the equation wrongly: they added instead of multiplying. Candidates are advised to always use appropriate units and avoid unit conversions where it is not necessary.

(e) Fairly done. A good number of candidates lost the mark due to wrong calculations and/or poor rounding off. Candidates are encouraged to always write correct units.

(f) Fairly done. Most of the candidates were able to interpret their results stating that they agree but failed to correctly justify; the densities are different. Candidates instead talked about mass or volume being different.

(g) Poorly done. Most of the candidates wrongly stated that increase in volume increase density. The density of a material is a constant and does not change when the size of the material changes. Centres are advised to cover the concepts of derived quantities ensuring candidates understand all the derived quantities in detail.

(h) Fairly done. Expected answer: Hydrometer. Most of the candidates wrote hygrometer. Candidates are advised to desist from overwriting (d on top of g) but instead cancel and re-write correct answer.

2 This question was well done by most candidates.

(a) Most candidates were able to record the lengths, l_1, l_2, l_3 and l_4 with correct units. Candidates were also able to record the lengths to an accuracy of 1 mm or 0.1 cm. Calculation of extension and spring constant were well done by most candidates using the given formulae.

(b) Drawing conclusion was fairly done. Candidates were able to correctly interpret their results to generate a conclusion which was *k* being smaller for springs in parallel or the conclusion should be consistent with the observed patterns of the results. Unfortunately, some candidates lost the mark when they came up with conclusions that were not supported by their results. Some candidates simply stated Hooke's law which was not acceptable.

(c) Most candidates were able to notice the trend in their results and used it to predict what will happen when a third spring is connected in series. Some were able to state that they agreed with the statement but could not justify using their results.

(d) Most candidates could not get the mark for stating the source of inaccuracy in the experiment. Candidates were expected to state that they could not align eyes perpendicular to the scale at a point where the reading is taken or using springs that exceeded elastic limit. Candidates lost the mark when they just mentioned parallax error without explaining it.

(e) Most candidates did well in stating the variable to be controlled in the experiment. The variables expected included mass / load / original length of spring / type of spring / spring constant.

(f) Suggesting an improvement to the experiment to make results reliable was fairly done. Candidates were expected to mention that they repeated with different lengths / masses / diameters / materials.

3 **(a)** Fairly done. The candidates were able to make correct readings from the voltmeter to the correct accuracy. However, there were some candidates who had difficulties with reading of an ammeter as candidates recorded readings of more than 1 A and to the accuracy of 0.1 A and 0.01 A.

(b) Well done. Generally, candidates were able to make sound conclusions which were consistent with candidates' results. The candidates noted that the thicker the wire the more the current in the wire with justification that the ammeter reading (current) for the thicker wire is more.

(c) Poorly done. The candidates were expected to apply their knowledge on voltage across parallel components, which is the same across the parallel branches. Most candidates included resistance in their justification and ended up with some contradictions and wrong physics concepts.

(d) Well done since it was simple substitutions. The candidates substituted the voltage and current they have found correctly in the equation given.

(e) Fairly done. The candidates were expected to provide an experimental reason for switching of the circuit which is the concept of Ohm's Law which states that current is directly proportional to voltage *provided temperature remains constant*. When the circuit is on for a long time the temperature increases hence the need to switch off the circuit. Candidates made statements such as "avoid / minimise / reduce heating" instead of "avoid / minimise / reduce overheating". Some just wrote "stop current from flowing / reset meters to zero". Candidates should be advised that current has

a heating effect and when left for long it leads to overheating which affects the relationship between current and voltage.

NB. Candidates generally used the terms “directly proportional” and “inversely / indirectly proportional” anyhow not knowing their proper interpretations.

4 **(a)** Well done. Candidates recorded h with units and calculated $\frac{1}{h}$. with ease.

(b) Fairly done. Most candidates had difficulties in writing correct units for $\frac{1}{h}$, otherwise recording length to the correct accuracy was not a problem. Only few candidates could not round off correctly after calculating $\frac{1}{h}$.

(c) Graph was fairly done. The candidates were tested on the various graphing skills which included labelling of axes, suitable scales, plotting of points and drawing line of best fit. The axes were correctly labelled with correct units from the candidates’ table. The candidates on the main chase scales that were suitable though there were instances where scales were not readable and not suitable i.e. each small division not giving numbers like 0.33333… and the scale chosen ensuring that the points plotted will cover more than half of the graph space provided. The candidates were able to plot the points to within half of the small square. The line of best fit well drawn with the line covering most of the points that were plotted. The quality mark was difficult to access for some candidates mainly because of wrong scale and some points been too far from the line.

(d) Gradient was poorly done. Candidates’ failure to read points correctly from the graph(line) was the main reason. In some instances, the triangle drawn was too small or some points picked were outside the line while some opted to use points from the table which were not part of the line.

(e) Well done. Most candidates used the equation correctly but a the few values of f fell outside the expected range.

(f) Fairly done most candidates managed to get the reading from the y-axis either by interpolation or otherwise but failed to calculate h from the obtained value.

(g) Well done except for (g)(i) simply because they used the value of h calculated in (f) instead of getting if from (a) and (b).

(h) Fairly done. The words accuracy and averaging were thrown around and sometimes not making sense at all. Establishing trend and or drawing a graph was missed from candidates’ responses. There was less mention of reliability in reasons advanced.

PAPER 3: ALTERNATIVE TO PRACTICAL TEST

General Comments

The candidates generally performed fairly in this paper. They were able to record their answers to the accuracy of the measuring instrument drawn and/or used. They were able to make correct substitutions in the equations and obtaining correct calculations or answers.

Candidates generally had challenges when it comes to worded questions, like giving conclusions, statements, justifications and stating relationship between two variables. For example, most candidates wrote observations instead of conclusions. In most instances candidates did not make use of the result provided but instead used the concept / theory of physics to give conclusions.

Comments on Individual Items

1 **(a)** The question was well done by most candidates. Candidates were able to correctly record the mass with correct units from the given figures. The candidates had to get both answers correct for them to be awarded the mark.

(b) Fairly done. Most candidates were able to describe how length can be measured accurately, stating the use of instruments like the micrometer screw gauge and the Vernier calliper, as well as taking measurements from different sides, repeating the experiment and taking the average.

(c) Well done. Generally, the candidates were able to make the correct readings from the Vernier scale reading diagram and gave their answers to the correct accuracy of the Vernier calliper.

(d) Well done. Almost all the candidates made correct substitutions and obtained correct calculation for the volume.

(e) Well done. Most candidates correctly calculated densities and stated the correct units.

(f) Fairly done. Most of the candidates agreed with the statement but failed to correctly justify; the densities are different. Candidates repeated the stem of the question just stating that they are made from different materials instead of stating that the densities are different.

(g) Poorly done. Candidates failed to note that the density of the same material is a constant. They tried to explain their answers in terms of increase in length and increase in volume which will increase or decrease the density with realising that volume is directly proportional to mass.

(h) Fairly done. The most common correct answer was repeating experiment and take average and were failing to give other options like using a more precise instrument e.g. Micrometre screw gauge.

(i) Most candidates wrote hygrometer and measuring cylinder instead of hydrometer as an instrument used to directly measure the density of a liquid. Centres are advised to differentiate between the hygrometer which measures pressure and hydrometer which measures density.

Answers: **(a)** 8.83 g and 7.86 g, **(c)** 1.01 cm, **(d)** 1.03 cm, **(e)** $8.57\,g/cm^3$ and $7.63\,g/cm^3$

2 **(a)** This question was well done by most candidates. The candidates correctly measured and recorded length with correct accuracy of the ruler.

(b) Well done. Most candidates correctly calculated the extensions using the information provided.

(c) Well done. The candidates substituted the values they found to calculate the force constants.

(d) Well done. Candidates were able to relate the values of the spring constants to the arrangement of the springs with *k* being smaller for springs in series.

(e) Fairly done. Most candidates failed to relate the question with the results of the two experiments. They were to note that as the springs are added in series the spring constant *k* decreases.

(f) Fairly done. Most candidates stated the type of error e.g. parallax instead of the source of inaccuracy which required them to state the inability to align the eyes with the point where the reading is taken.

(g) Well done. Most candidates noted that the mass must be kept constant. Only a few candidates noted that material of the spring and lengths of the springs were also control variables.

(h) One of the challenges for candidates was repeating the experiment and taking average without mentioning varying the apparatus.

Answers: **(a)** 1.9 ± 0.1 cm **(b)** 4.9 cm and 9.9 cm **(c)** 0.41 N / cm and 0.20 N / cm.

3 **(a)** Fairly done. Most candidates were able to record the voltmeter reading correctly thought they failed to notice that the precision was supposed to be 0.25 V. Both answers of voltage with a precision of 0.1 V and 0.25 V were accepted.

(b) **(i)** Poorly done. Most candidates failed to state the actual relationship between diameter and current, increase in diameter results in increase in current, but instead were talking mostly about relationship between diameter and resistance.

(ii) Well done. Candidates were able to deduce that the two voltages were the same but were challenged by the justification as they had to show that voltage across parallel branches is equal.

(c) Well done. Candidates correctly calculated resistance, stating the correct units.

(d) Fairly done. The candidates were expected to apply their knowledge on the heating effect of current which results in the wire being hot and resistance changing. Most candidates used the words, avoid and prevent overheating of cables which are not possible but should be about minimising or reducing overheating of wires. Some candidates stated to stop the flow of current. Centres are advised to explain the concepts of heating effect of current together with the correct descriptive words. Most candidates used the words, power supply, number of cells, and battery as an alternative for EMF (voltage).

(e) Fairly done. The candidates were able to identify at least one variable that must be kept constant with diameter and length of the wire being the most popular responses.

Answers: **(a)** 3.0(0) V and 0.16 A **(c)** 18.75 Ω

4 **(a)** **(i)** The candidates performed well with almost all of them measuring the height h correctly and providing the answer to the correct precision of the ruler.

(ii) Poorly done. Most candidates provided the correct unit for *h* (cm) but struggled to derive the unit for $\frac{1}{h}$ (cm^{-1}). Centres are advised to cover the concept of derived quantities and their units in detail.

(iii) Well done. Most candidates calculated $\frac{1}{h}$ correctly and were consistent for the number of decimal places in all of their answers.

(b) Well done. The candidates were tested on the various graphing skills which included labelling of axes, suitable scales, plotting of points and drawing line of best fit. The axes were correctly labelled with correct units from the candidates' table. The candidates on the main chase scales that were suitable though there were instances where scales were not readable and not suitable i.e. each small division not giving numbers like 0.6666… and the scale chosen ensuring that the points plotted will cover more than half of the graph space provided. The candidates were able to plot the points to within half of the small square. Most had a challenge in drawing line of best fit, using solid lines which were not visible and leaving the points rather directing the line towards the origin.

(c) It was fairly done. Candidates chose points or triangle not covering more than half the line. The second marking point was easily accessible i.e. the correct calculation of *G*.

(d) Most candidates did well on this item. They correctly calculated the focal length *f* using the value of the gradient.

(e) It was fairly done. Though most candidates failed to determine *h* from $\frac{1}{h}$, they were able to get the mark for interpolation i.e. determining the value of $\frac{1}{h}$ from the graph. Centres are advised to help candidates on interpretation of data and transforming data from one form to another.

(f) Candidates performed well on this item. The challenge was using the height *h* from (e) instead of the height *h* from (a). Candidates substituted correctly and gave correct values for *M* and *v.*

(g) Candidates performed fairly on this item. They were able to access 1 mark, either from statement, determine a trend or justification, increases reliability.

(h) Candidates performed poorly. They mostly gave characteristics of plane mirrors rather than characteristics of images formed by convex mirrors being erect, virtual and smaller than the object.

(i) Candidates performed fairly on this item. Most were able to state the use of convex mirrors mainly on security and eyeglasses. Most stated the use of concave mirrors instead of convex mirrors.

Answers: **(f) (i)** 0.375 **(ii)** 15 (.0 cm) **(iii)** 10.9 (cm)

PAPER 5: ALTERNATIVE TO PROVIDER BASED ASSESSMENT

General Comments

Candidates were assessed through a research-oriented task as well as through laboratory report-based questions. Overall, candidates fairly displayed knowledge of Physics content and were able to recall theoretical information. This was particularly evident in Question 2, which mainly assessed recall and direct knowledge. Performance in this question was generally good, indicating that candidates were familiar with the subject content.

However, the performance declined significantly in questions that required application, analysis, and scientific methods / skills. Many candidates struggled to integrate their Physics knowledge with the demands of the project and experimental tasks. Although they understood the content, they failed to effectively blend theory with practice, particularly in tasks that required designing, investigating, or explaining procedures scientifically.

Candidates showed limited research skills and scientific processes, which are key attributes of a 21st-century learner. There was also a noticeable lack of competence in handling project-based and report writing requirements, such as identifying precautions, suggesting improvements, or evaluating experimental procedures. As a result, Questions 1 and 3 posed major challenges, largely due to insufficient experimental and project-based skills.

Despite these challenges, one question stood out in demonstrating some qualities of a 21st-century learner. In a question that required candidates to discuss the negative effects of pressure, some candidates performed fairly and showed evidence of extended research beyond classroom teaching. This suggests that, when candidates engage with real-life or relatable contexts, they are capable of independent research and critical thinking.

Centres are therefore encouraged to place greater emphasis on covering all assessment objectives, particularly those related to practical work, experimentation, and research skills, in order to better prepare candidates for outcome-based assessments and the expectations of 21st-century learning.

Comments on Individual Items

1 This was poorly done. Candidates demonstrated that they were not familiar with the content and structure of the question. Candidates largely displayed theoretical knowledge of physics but failed to translate this knowledge into answers that addressed project related tasks, this indicates lack of understanding of what was required, as a result responses were often irrelevant to the objectives of the question.

(a) Fairly done. Candidates were able to identify the topic and showed understanding of what the question demanded. However, some candidates failed to differentiate between a model of an electromagnet and a model that uses an electromagnet which were the key terms of the questions. Some students also included inappropriate action words such as designing which resulted in loss of marks while others provided topics which were not relevant to what was required.

(b) (i) Poorly done. Most candidates showed little understanding of what an objective of a study is, how it should be written, and the appropriate wording used when formulating an objective. As a result, many responses were vague or incorrectly structured.

Candidates also failed to correctly identify the variables involved in the investigation. In addition, they did not relate current or magnetic strength and the magnetic material of different weights picked. Most responses only focused on the relationship between current and the strength of the electromagnet.

(ii) Well done. Candidates were able to clearly state the purpose of the study and demonstrated an understanding that they were required to design a working model that uses an electromagnet to lift magnetic materials of different weights. However, a few candidates wrote the purpose that does not show magnetic materials of different weights picked.

(iii) Poorly done. Most candidates were able to state the relevant principle, law, or theory related to electromagnets and were generally able to score one out of the three marks available. However, the second and third marking points were largely inaccessible to candidates.

Candidates failed to relate the stated theory to the research objectives of the investigation. Although they displayed knowledge of electromagnets, they did not apply this knowledge in the context required by the question, resulting in responses that did not fully address the demands of the task.

(iv) Poorly done. Most candidates failed to correctly state the variables involved in the investigation. Candidates were unable to appropriately link the research questions to the research objectives. Candidates also showed a lack of understanding of how research questions are formulated. Many responses were framed as yes-or-no questions, rather than investigative questions that require analysis, measurement, and further investigation.

(c) (i) Poorly done. Most candidates failed to correctly differentiate between independent and dependent variables and identify what should be kept constant. Candidates frequently confused variables with apparatus, listing instruments / apparatus instead of the variables themselves. For example, some candidates stated voltage supplier instead of voltage as a variable.

(ii) Fairly done. Some candidates were able to correctly identify additional materials required to make a complete working model that uses an electromagnet. However, other candidates listed materials used to make an electromagnet itself, which led to a loss of marks, as they did not fully understand the demands of the question.

(iii) Poorly done. Most candidates described the electrical connections rather than outlining a clear experimental procedure. Many responses focused on how to make an electromagnet instead of explaining the procedure for a working model that uses an electromagnet.

Within the procedures provided, candidates failed to indicate which variables were to be varied, how these variables would be controlled and method to keep one variable constant, and how the dependent variable would be measured. Despite these challenges, many

candidates were able to draw a correct circuit diagram, indicating that they had a basic understanding of how an electromagnet is constructed. Their diagrams were however short of indicating how a circuit that uses the electromagnet is used.

(iv) Fairly done. Most candidates wrote precautions in a negative form, focusing on what not to do rather than instructing what should be done, often using terms such as do not and avoid. There was also evidence of confusion among Candidates regarding electrical instructions, particularly the difference between switch open and switch closed.

2 Candidates performed well in this question though there were some aspects that Centres need to pay attention to. Centres are advised to encourage candidates to give definitions as they are stated to avoid attempt to give meaning to the definition.

(a) Well done. The definition of pressure was well presented by the majority of the candidates. Some still failed as they described pressure e.g. force applied on surface divided by area or force applied on an area.

(b) Fairly done. Most candidates accessed one mark out of two. Candidates failed to appreciate the continuous random movement of particles. They only stated the collisions with the wall of the container only which resulted in them getting one mark. There was also evidence of failure to mention collision with the wall, with candidates writing collisions with each other only hence not addressing the question fully.

(c) Fairly done. Candidates were able to recognise that the kinetic energy of the molecules decreased. However, there was a misconception between molecules contracting and air contracting, some failed to recognise that there was pressure imbalance.

(d) Well done. Most candidates were able to show that the speed was increasing with increase in kinetic energy. Candidates were able to show that pressure increased with increase in rate of collisions with the walls. However, a few candidates lost the second mark due to showing increases in rate of collisions with walls.

(e) Poorly done. Candidates failed to be specific on the negative effects of pressure, they only gave general statements. For example, sickness, material explosions. Their explanation was fairly done as candidates demonstrated diverse knowledge on negative effects of pressure. They failed to express themselves in their answers though the knowledge was there.

3 The question was poorly done. Most candidates were unable to record correct units of quantities such as moment. Some candidates could recall the units but divided the N by m They were able to substitute quantities correctly using formulas provided and rounded off their answers to 1 or 2 decimal places. Candidates generally have challenges when it comes with worded questions such as accuracy, improvements and limitations of the experiment.

(a) Poorly done. Most candidates had a challenge in stating the source of inaccuracy. The expected answer had to deal with reducing the experimental errors. Most candidates wrote parallax error instead of giving a proper description of the source of error. Other sources of inaccuracy included

uneven ruler (that does not balance at the 50 cm mark), which was not captured by the candidates. Centres are advised to assist candidates to differentiate between source of error and source of inaccuracy.

(b) Well done. Most candidates were able to state that to ensure that the results are more accurate as possible or one to repeat measurements and average the results. However, a few candidates had the knowledge of repetition but did not appreciate averaging.

(c) Faily done. Some candidates were able to describe how to obtain the distances d_1 and d_2 correctly. Some of the candidates described what distance d_1 and d_2 are rather than describing how the distances are be obtained. Candidates did not use appropriate words such as measure and subtract to show how the lengths are obtained. Some candidates would use values such as 42 cm as if it is constant throughout the experiment.

(d) **(i)** Fairly done. Candidates were able to recall units of moment which are N m, N cm, and units of mass which are grams, kg. A few used N / cm for units of moments which made them lose the mark. Calculation of moment was fairly done. Some candidates were able to complete the table by correctly calculating moment using various units such as N m, N cm, N mm. However, some were challenged in converting 60 g to weight in N. Calculation of mass was well done, candidates were able to substitute correctly in the equation given and correctly calculated mass, giving the answer to consistency of decimal places or significant figures. Only a few candidates were challenged with rounding off and decimal places.

(ii) Poorly done. Most candidates failed to understand what the question required them to do. Most answers given were, line graphs, straight graphs instead of stating the variables to be plotted. Answers to this question were graph of d_1 against d_2; determine the gradient and the product of gradient and 60 g mass is M or graph of d_2 against d_1; determine the gradient and 60 g divided by the gradient is M or graph of moment against d_2 determine the gradient and divide it by 10 to get M.

(e) Poorly done. Most candidates were unable to make suggestions for improvement of the experiment. Their answers were centred on repeating without stating at different positions. Centres are advised to guide candidates on how to write the modifications of the experiments that can assist in getting better reliable results.

(f) Poorly done. Most Candidates failed to identify limitations of the experiment , their answers were centred around environmental factors such as wind or air currents from the switched-on fans. Some of the limitations are difficulty in determining the centre of mass or difficulty in balancing the rule at a point.