EXAMINATIONS AND ASSESSMENT CHIEF DIRECTORATE
Home of Examinations and Assessment, Zone 6, Zwelitsha, 5600
REPUBLIC OF SOUTH AFRICA, Website: www.ecdoe.gov.za

2024 NSC CHIEF MARKER'S REPORT

SUBJECT	**PHYSICAL SCIENCES**		
QUESTION PAPER	1X	2	3
DURATION OF QUESTION PAPER	**3HRS**		
PROVINCE	**EASTERN CAPE**		
NAME OF THE INTERNAL MODERATOR	ESMERALDA LUCILE FILANDER		
NAME OF THE CHIEF MARKER	**CAROLINE ANSAH OWUSU**		
DATES OF MARKING	**29/11/2024 – 13/12/2024**		
HEAD OF EXAMINATION:	**MR. MABONA**		

SECTION 1: (General overview of Learner Performance in the question paper as a whole)

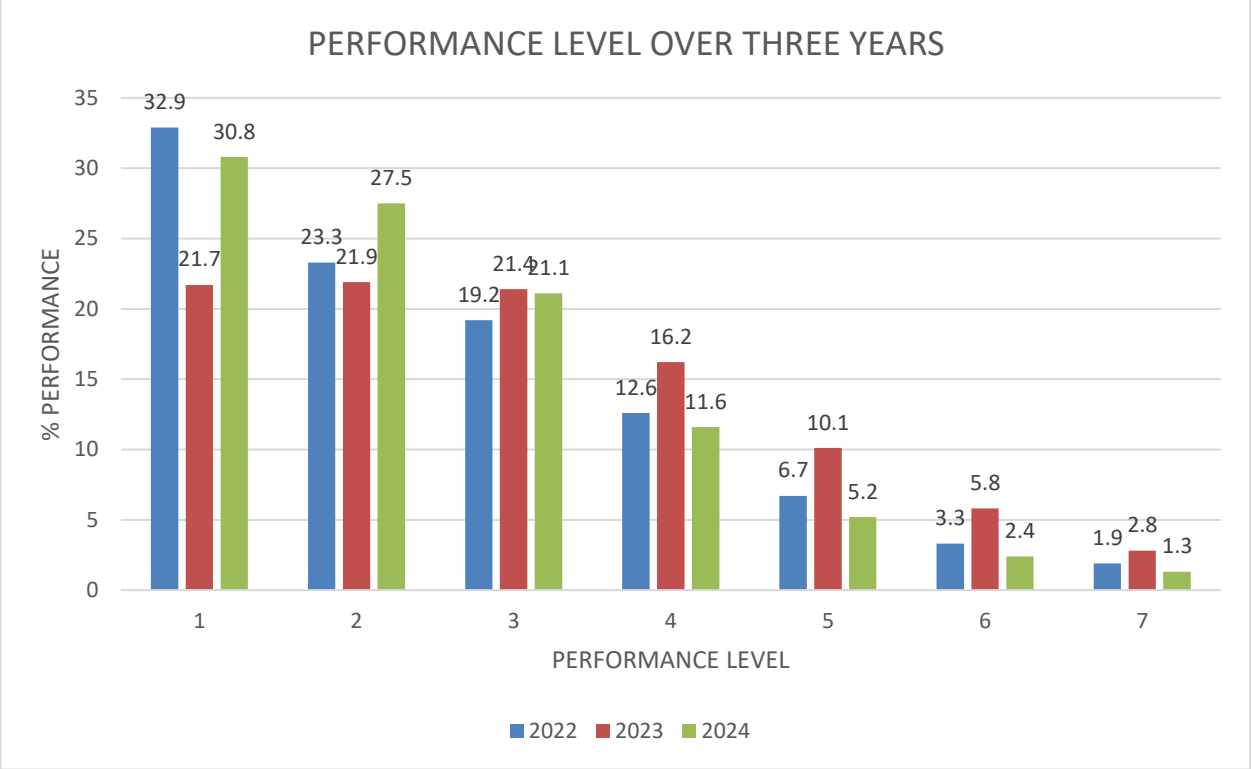
Generally, candidates' performance is fair but there is a decline from 78% in 2023 to 69,2% in 2024. Even though the pass rate is above average
Question 6 was the best answered question at 79%, followed by question 2 at 61% and question 5 at 60%. The worst performed questions are question 3 and 10 at 38%.

Question	Topic	Ave. performance %
1	Multiple-choice questions	54%
2	Newton's Laws of motion	61%
3	Vertical projectile motion	38%
4	Momentum and impulse & WEP	59%
5	Work, energy and power	60%
6	Doppler Effect	79%
7	Electrostatics	59%
8	Electric circuits	51%
9	Electrodynamics	55%
10	Optical Phenomenon	38%
Total		**55%**

The quality passes are very low. Only 20,5% in 2024 compared to 34,9%in 2023, therefore 20,5% obtained above 50% (level 4) which is a requirement for admission into the universities.

Level 1 increased from 21,7 in 2023 to 30,8 in 2024. Level 4,5,6 and 7 show a decline compared to both 2022 and 2023.

LEVELS	PERCENTAGE PERFOMANCE (%)		
	2022	2023	2024
1	32,9	21,7	30,8
2	23,3	21,9	27,5
3	19,2	21,4	21,1
4	12,6	16,2	11,6
5	6,7	10,1	5,2
6	3,3	5,8	2,4
7	1,9	2,8	1,3



SECTION 2: Comment on candidates' performance in individual questions

(It is expected that a comment will be provided for each question on a separate sheet).

QUESTION 1

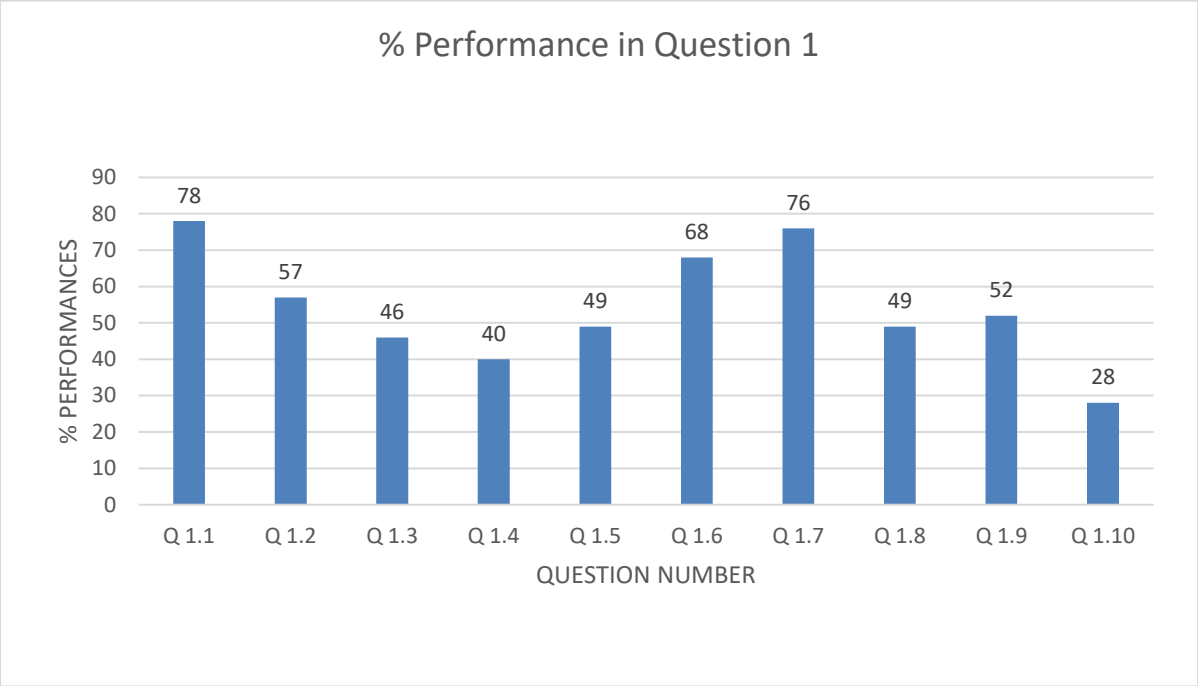
General comment on the performance of learners in the specific question. Was the question well answered or poorly answered?

Question 1 was fairly performed at 54%.

Question 1.1 and 1.7 are the best performed sub-questions with performances of 78% and 76% respectively.

Question 1.10 is the worst performed sub-question with a performance of 28%.

LEVELS	PERCENTAGE PERFOMANCE (%)
1.1	78%
1.2	57%
1.3	46%
1.4	40%
1.5	49%
1.6	68%
1.7	76%
1.8	49%
1.9	52%
1.10	28%
TOTAL	54%



Why was the question poorly answered? Also provide specific examples, indicate common errors committed by learners in this question, and any misconceptions.

Question 1.1(78%) Candidates had to interpret the word “equilibrium” from their grade 11 knowledge of vectors. Candidates were expected to know that $F_{net} = 0$, therefore $a = 0\ m.s^{-2}$ and the object is moving at a constant velocity.

Question 1.2(57%) Candidates had to interpret the area under the v-t graph which is equal to $a\Delta t$. Most learners were opting for option A (final velocity of the stone). The did not apply their grade 10 definition of acceleration that $a = \Delta v/\Delta t$. Candidates must be encouraged to read all options before selecting the answer. They must justify why the other options are wrong.

Question 1.3(46%) Momentum was related to Ek. Mathematical knowledge was required to express the Ek in terms of p. Most candidates chose option B, thinking $Ek \propto p$. They forgot that in the $Ek = ½ mv^2$ that the v is squared (v^2).

Question 1.4(40%) The filling in of the blanks makes the question unfamiliar to the candidates. Newton's laws of motion were integrated with work, energy, and power. Candidates should focus on understanding how different concepts relate to each other.

Question 1.5(49%) Vertical projectile motion was integrated with momentum. They had to understand the “energy principles” relating Ek to the height since $hB < hA$, there was loss of energy and velocity will decrease.

Question 1.6(68%) Candidates had related red shift to the movement of a star and frequency of the light observed on the earth.

Question 1.7(76%) Candidates had to apply Coulomb’s Law formula applying their knowledge of the change of subject of a formula in Mathematics to write an expression for r.

Question 1.8(49%) Candidates had to interpret that “kW” is the unit for power and “h” is time and Power x time = work done. $P = W/\Delta t = E/\Delta t$. Since the SI units for Power is Watt and time is s, candidates encountered challenges in relating to the given unit.

Question 1.9(52%) Candidates had to relate the commutator to split rings and apply Flemming’s left-hand rule to identify the direction of rotation of the coil. Most candidates are familiar with the split ring and not commutator and since split ring was not one of the options, they opted for option A. Candidates were confused with which hand (left or right) to apply to determine the direction of rotation of the coil.

Question 1.10(28%) All three descriptions are true for light in general. Candidates did not consider the context in which the question was asked (photoelectric effect).

Provide suggestions for improvement in relation to Teaching and Learning.

Multiple choice questions test understanding and application of scientific knowledge.

Learners must be encouraged to read all options before selecting the answer. They must justify why the other options are wrong.

Educators must teach definition of terminologies in relation to the formula to enhance the understanding of concepts as tested in this question paper.

Learners should practise the hand rules to make sure that they understand 'clockwise" and "anticlockwise" and educators must integrate ICT into teaching and learning i.e. You-tube videos and simulations.

Describe any other specific observations relating to responses of learners and comments that are useful to teachers, subject advisors, teacher development etc.

Educators must note that two distractors are completely out. Learners must be able to see them easily. Two distractors are close to the correct one. Teach learners to answer by elimination of distractors.

QUESTION 2

General comment on the performance of learners in the specific question. Was the question well answered or poorly answered?

The performance in this question was fair at 61%. The best answered amongst all the questions. Sub-question 2.1 was poorly answered at 42%.

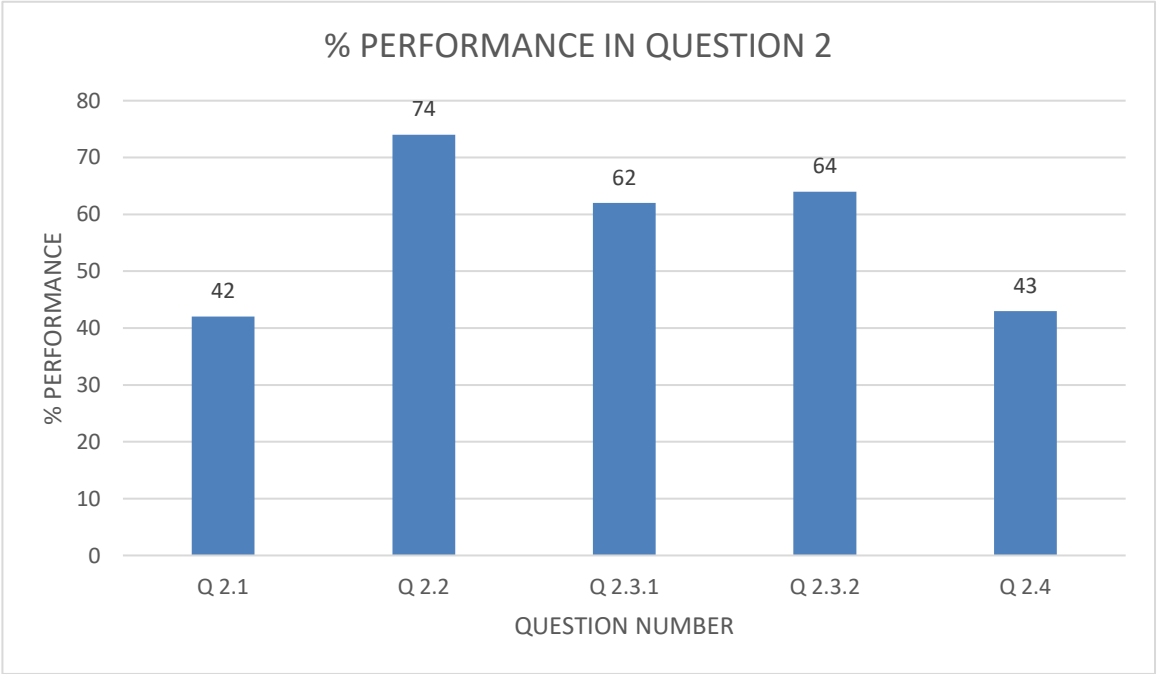
Sub-question 2.2 was the best answered sub-question at 88%.

Sub-question 2.3.1 was fairly answered at 61,5%.

Sub-question 2.3.2 was fairly answered at 64,4%.

Sub-question 2.4 was poorly answered at 43%

QUESTION NUMBER	% PERFORMANCE
2.1	42%
2.2	74%
2.3.1	62%
2.3.2	64%
2.4	43%
TOTAL	61%



Why was the question poorly answered? Also provide specific examples, indicate common errors committed by learners in this question, and any misconceptions.

In question 2.1, candidates omitted keywords in the definition such as:

- tendency
- motion
- stationary object
- relative/parallel to a surface

Some wrote "moving object" instead of "stationary object". Candidates were defining fk instead of fs or f. Some defined "inertia'.

Question 2.2: The free-body diagram was well answered and the best performing sub-question. Common errors in the free-body diagram: Testing on a particular direction was not tested since 2018. Few candidates could distinguish between horizontal and vertical They were drawing of vertical forces instead of horizontal forces. Some candidates draw ALL four forces.

The marking guideline was adjusted to favour such candidates for this examination only.

Arrows not touching the dot, f_k instead of f_s^{max} or f_s, Fapplied instead of T, no labels, no arrows and additional forces.

Question 2.3: Candidates could not interpret the unfamiliar graph.

It was a challenge for candidates to interpret static friction from the description given and to extract it from the graph. Lack of understanding of maximum static friction as the parallel force applied to an object just before it starts to move. They could not interpret the graph to distinguish between the mass that caused the object to move (f_k) = 7,4kg and the mass that correspond to the static friction f_s^{max} = 4,2kg.

Relating the applied force to the hanging mass. They misunderstood the hanging mass as part of the system.

The omission of subscripts: Max and s omitted in $f_s^{max} = \mu_s N$ and net omitted in $F_{net} = ma$.

Not applying the correct sign conventions.

Candidates used f_k or f instead of f_s and μ_k or μ instead of μ_s question 2.3.1 and forfeited marks.

Candidates used f_s or f instead of f_k and μ_s or μ instead of μ_k question 2.3.2 and forfeited marks.

In question 2.3.2, candidates used a = 0 and substituted the tension force T calculated in question 2.3.1, into the question 2.3.2.

In question 2.3.2: Vector notation of forces persist.

T - 33,32 = 8a ….....….eqn 1

T - 72,52 = 7,4a ……...eqn 2

Instead of T being in opposite direction in the two equations.

Some candidates still used the system approach with the two objects and scored a maximum of 1 mark for the final answer.

Question 2.4: Candidates could not identify the relationship between f_s^{max} and N or N and mg or N and m. A few wrote increase in "gravity" instead of "gravitational force or weight" of the crate.

Provide suggestions for improvement in relation to Teaching and Learning.

Educators need to thoroughly prepare topic by using the CAPS (page 62-66), Amended CAPS, Examination Guideline 2021(Page 7 and pay attention to the NOTES) and ATP effectively.

Educators should supply learners with copies of EG 2021, adhere to and emphasise the definitions in the EG 2021 and CAPS. Key words must be emphasised in these definitions. Explain the definitions and concepts to the learners and guide them in answering questions. Expose learners to various questions using $f_s^{max} = \mu_s N$ and $f_k^{max} = \mu_k N$.

Supply each learner with his/her datasheet and guide them how to use it effectively in problem solving.

Teachers should assist the learners see the relationship already used in the mathematical formula used in the calculation, to explain the changes made to the system.

For example:

$f_s^{max} = \mu_s N = \mu_s mg$ (μ_s and g are constant)

$f_s^{max} \propto N$ OR $f_s^{max} \propto m$

m increases $\rightarrow$ mg increases $\rightarrow$ N increases

The importance of drawing free-body diagrams for each object correctly in problem solving and their usefulness in problem solving must be emphasised. Encourage learners to use different problem-solving strategies to solve the same problem to ensure that they gain a greater understanding of the problem and their solution.

Teachers must ensure candidates can distinguish between vertical and horizontal forces by including problems for the drawing of vertical forces and/or horizontal forces.

Subject Advisors must mediate chief marker's reports per term with educators.

Teacher development with the assistance of curriculum subject advisors need to train educators in the first term on:

How to do planning and preparation using CAPS policies effectively.

Newton's 2nd law content, experiments and to draw up standardised tasks.

Describe any other specific observations relating to responses of learners and comments that are useful to teachers, subject advisors, teacher development etc.

Educators must allow learners to do experiments and learn through their own observations/findings.

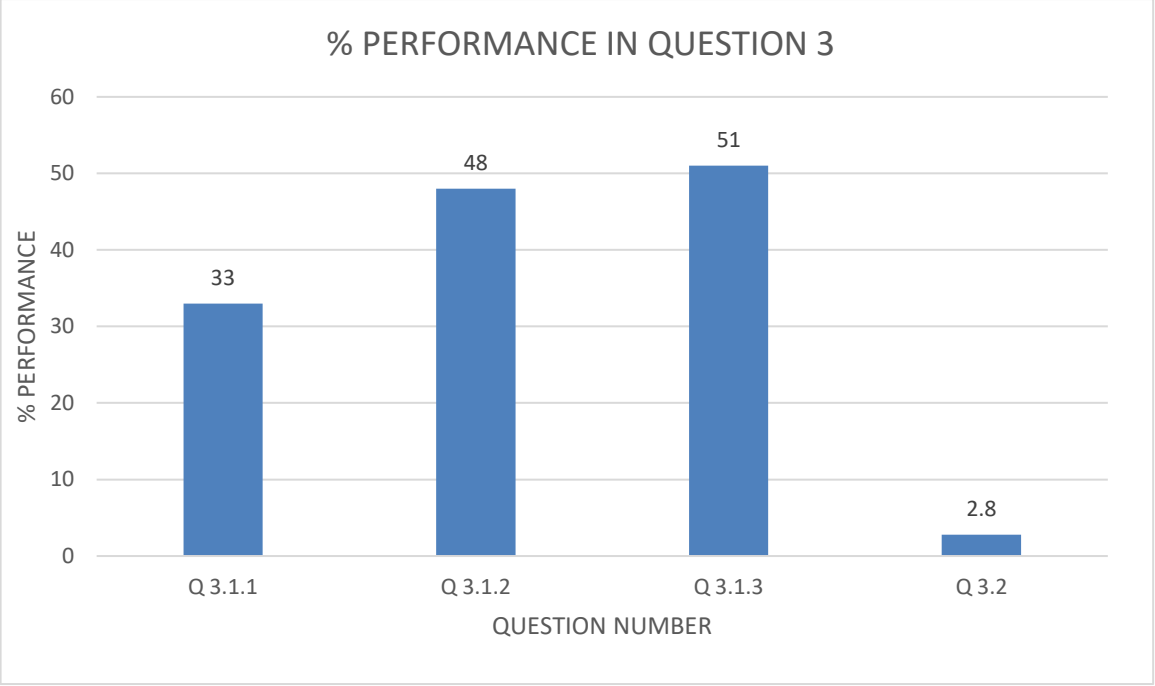
Educators should include the use of ICT in the teaching of the subject, i.e. YouTube videos, PhET simulations should be used to demonstrate virtual experiments and content.

QUESTION 3

General comment on the performance of learners in the specific question. Was the question well answered or poorly answered?

This question is the LOWEST performed question, and it dropped from 62% in 2023 to 38% in 2024. Sub-question 3.1.2 and 3.1.1 are very poorly answered at 23% and 33% respectively.

LEVELS	PERCENTAGE PERFOMANCE (%)
3.1.1	33%
3.1.2	48%
3.1.3	51%
3.2	23%
TOTAL	38%



Why was the question poorly answered? Also provide specific examples, indicate common errors committed by learners in this question, and any misconceptions.

Question 3.1.1 started with a L4 difficult question. Candidates were dependent on this answer to proceed with question 3.2.1, 3.1.3 and 3.2. The candidates were required to draw a graph in question 3.2 and it was not easy.

Most candidates could not identify the correct equation of motion.

The candidates had the misconception that both balls had the same speed/velocity when the ground and equate the incorrect formula: $v_f = vi + a\Delta t$ for both balls A and B to calculate the time t. OR they used $v_f^2 = v_i^2 + 2a\Delta y$.

When ball A reached its maximum height, ball B was not released yet. These candidates used vi for ball A as 0, while ball B has not yet been released, hence

$\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$

$\Delta y_A = 0\Delta t + \frac{1}{2}(-9,8)\ \Delta t^2$ $\Delta y = 2(-5,4)\ \Delta t_B + \frac{1}{2}(-9,8)\Delta t^2$

Others could only score the formula mark and not for the substitution.

Sign convention in ball A and B were opposite, i.e. where v_i for ball A was +12 $m.s^{-1}$ and $g = -9,8\ m.s^{-2}$ and for ball B +5,4 $m.s^{-1}$ and $g = +9,8\ m.s^{-2}$

Candidates could not interpret the time taken should be greater than 2s. A few candidates used t as a negative answer.

Question 3.1.2: Since candidates could not calculate the time t in question 3.1.1, they struggled to calculate the height Z. Some calculate time (t) in question 3.1.1 as less than 2s and struggled to answer question 3.1.2.

Candidates substituted the time (t) taken from question 3.1 1 for the time taken for the motion of ball B, OR they could not subtract the time taken since the calculated answer in question 3.1.1 was less than 2s.

Most candidates used the motion of ball B to calculate the height / value of Z.

Sign convention was used. Some candidates substituted vf = 0 for ball B into $v_f^2 = v_i^2 + 2a\Delta y$.

Candidates could not identify the displacement for ball A was Z. The time calculated in question 3.1.1 could be used to calculate the displacement of B. Hence, determine the value of Z.

A few candidates that used $\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$ question 3.1, did not repeat the formula and only did the substitution in question 3.1.2 and forfeited the mark.

Question 3.1.3: Most candidates scored marks for the formula. Sign convention was a challenge.

Candidates calculated the maximum height reached by ball A from its projected height above the ground, i.e. (Z-Y).

They did not add the answer to the answer in question 3.2.1. Due to sign conventions, some candidates correctly calculated the displacement of the ball A from Y to Z correctly. This gave them a negative answer and the added the negative answer to 7,35m.

Candidates cannot distinguish between distance and displacement and ended up subtracting instead of adding the answer.

Question 3.2: Candidates was expected to interpret a position vs t graph and do calculations from a position vs t graph position-time graph and to draw a velocity- time graph. Over testing of the same skill in the same question.

Many candidates could not interpret the motion of the balls from given sketch in question and therefore could not draw the correct graphs of velocity vs time.

Some candidates redraw the given position vs time graph in the question paper.

Since the balls are under gravitational acceleration, their gradients should be the same (both graphs must either have positive or negative gradients) hence both graphs should be parallel.

Some candidates used the incorrect values of the vi of graph A and/or B and the time. Graph B must start after the intercept of graph A with graph B to the right of graph A. Ball B was released after ball A reached its maximum height.

Graphs must end at the same time. Some candidates did not label the graphs and forfeited 1 mark. Some did not attempt to draw the graph.

Not applying the correct sign convention to each vector quantity was a challenge throughout question 3.

Some candidates failed to substitute the correct values for the different stages of the motion.

Candidates scored some marks in questions 3.1.2, 3.1.3 and 3.2 due to positive marking. Others did not attempt the question at all or left spaces open or retried questions but could not finish due to a lack of time. In many cases there was not even time to delete the first attempt, or all attempts were deleted, and new attempts were incomplete.

Provide suggestions for improvement in relation to Teaching and Learning.

Copies of Gr 12 Examination Guidelines 2021 should be supplied and effectively used during teaching and learning in collaboration with CAPS policies, Chief markers reports, Diagnostic reports and previous question papers. Questions should be planned according to level 1-4 and MCQs should be included in the daily activities not the end of the year only.

Encourage learners to read a question thoroughly and write the given data.

Data sheets need to be effectively used during teaching and learning whereby educators guide learners' step-by-step in how to identify the correct formulae, do correct substitutions and how to derive the correct answer using the calculator.

Encourage learners to always start with the formula even if it must be repeated in a different question.

Learners must first make sure that they understand the motion of the projectile and which values are relevant at each position. A rough drawing or diagram indicating the physical motion of the projectile together with all the information given (velocities, displacements, time etc) is necessary in all scenarios.

Advise learners to start every calculation on vertical projectile motion by indicating sign conventions at the beginning of the problem. They should NOT change their sign convention within a problem as it can lead to confusion. Teach learners that time cannot be negative. They simply change it to a positive and forfeit marks for substitution.

Teach learners the skills of graphs and sketching graphs especially for projectiles and expose them to various questions building from lower to higher order questions.

Expose learners to several questions involving different scenarios of vertical projectile motion., including two objects.

Question involving graphs should be included in teaching and assessment of all topics.

Describe any other specific observations relating to responses of learners and comments that are useful to teachers, subject advisors, teacher development etc.

Teacher development in collaboration with Curriculum subject advisors should train educators on vertical projectile motion and the effective use of the CAPS policies in planning and preparation. Subject advisors should mediate the Chief markers report and the diagnostic reports per term before the topics are taught. These reports should be used effectively and in collaboration with CAPS policies. Ensure that learners are provided with EG 2021, and that definition are only used from there.

Encourage educators to use datasheets effectively in teaching and learning and guide learners step-by-step in how to use it effectively.

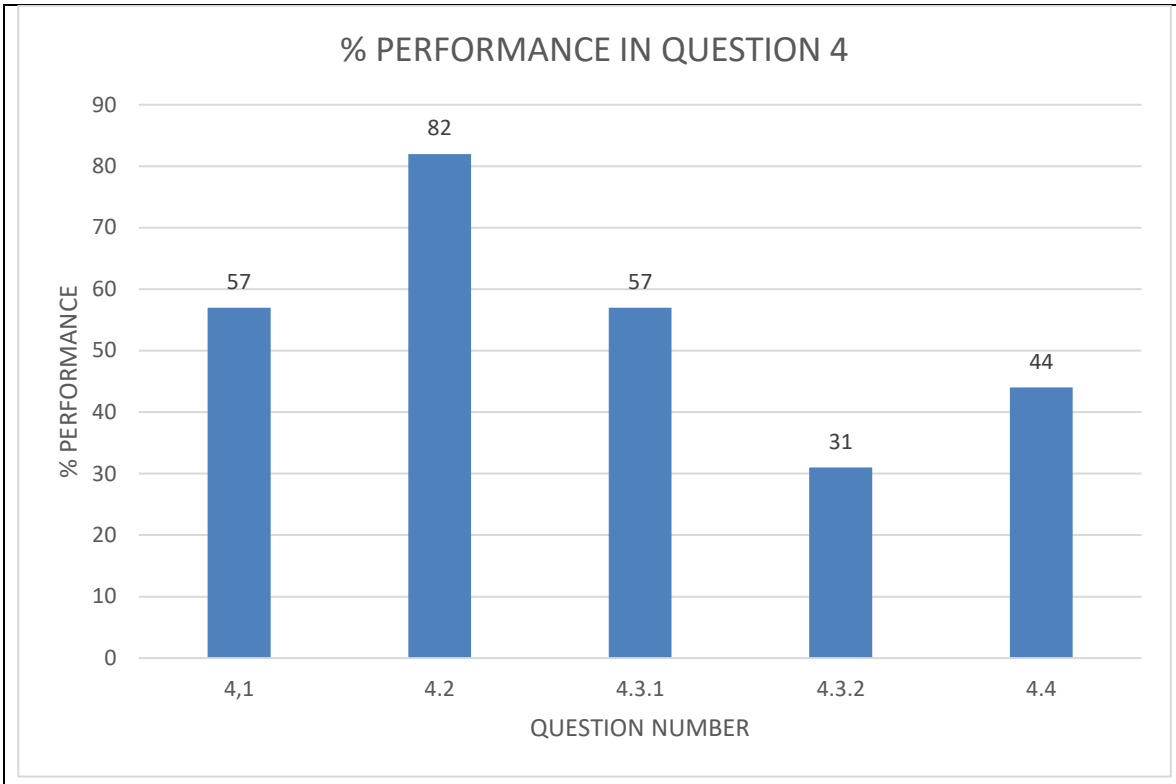
Learners cannot round off correctly to a minimum of 2 decimal places. They forfeited marks due to the incorrect use of calculators.

QUESTION 4

General comment on the performance of learners in the specific question. Was the question well answered or poorly answered?

This question was fairly answered at 59%, with a slight decline of 1% from 2023. The performance in question 4.3 stating the principle of conservation of mechanical energy was well answered by most learners at 86%. The worst sub-question is 4.3.2(31%) which was to write down the change in the momentum of trolley A, followed by Q 4.4 and Q 4.3.1 with performances of 44% and 57% respectively.

LEVELS	PERCENTAGE PERFOMANCE (%)
4.1	86%
4.2	62%
4.3.1	57%
4.3.2	31%
4.4	44%
TOTAL	59%



Why was the question poorly answered? Also provide specific examples, indicate common errors committed by learners in this question, and any misconceptions.

A new way of testing by integration of energy into impulse and momentum.

Question 4.1: The omission of key words e.g. "sum" in the sum of the gravitational energy and kinetic energy in an isolated system remains the same/is conserved. OR The word total was omitted in, total mechanical energy in a …

The omission of "isolated"

It is important to note that the correct term is "isolated system" and not "closed system".

It was ONLY accepted because of the "Eksamenriglyne 2021" using "geslote sisteem" and not "geisoleerde sisteem". Some candidates mention "total momentum in an isolated system remain conserved" and scored 0/2.

Question 4.2: The candidates could not identify the principle of conservation of mechanical energy.

Many candidates did write $E_{mech} = E_{mech}$ instead $E_{mech}(top) = E_{mech}(bottom)$, and only calculate

$E_p = mgh = 2(9,8)(1,5)$

$E_k = ½ mv^2 = 1/2v^2$ and $v = 5,42\ m.s^{-1}$ and scored 0/4.

Some use $E_{mech}(top) = E_{mech}(bottom)$

$2(9,8)(1,5) + 1/2v^2 = 0$ and score no marks for the substitution.

Some candidates used $W_{nc} = \Delta E_p + \Delta E_k$ and substituted

$0 = \underline{\frac{1}{2} mv_i^2 + 9,8(1,5)}$ instead of $0= \underline{-\frac{1}{2} mvi^2 + 9,8(1,5)}$ omitted the 0 in other candidates used $\Delta Ep = \Delta Ek$ instead of $\Delta E_p = -\Delta E_k$,

$W_{net} = \Delta E_k + \Delta E_p$, instead of $W_{net} = \Delta E_k$.

Some used the equations of motion and swopped vi and v_f, but it was accepted if the signs of 1,5 and 9,8 are the same. Some candidates left the answer for speed negative and forfeited the mark (speed is a scalar).

Candidate forfeited marks for incorrectly rounding off the answer to 2 decimal places.

Question 4.3.1: In applying $\Delta p = m(vf - vi)$, many candidates swopped the initial and the final velocities or used the incorrect sign convention for the velocities.

Some candidates used $p = mv$ and forfeited 3 marks.

Candidates forfeited marks for the incorrect unit for Δp and/or direction.

In question 4.3.2: Candidates could not identify or apply Newton's third law and used the answer of question 4.3.1, but in opposite direction.

Candidates forfeited marks for the incorrect unit for Δp and/or direction.

Question 4.4:

Some candidates used $p = mv$ and forfeited 3 marks.

Others wrote $p_i = p_f$ instead of $\Sigma p_i = \Sigma p_f$, omitting the sum(Σ) OR Σ before = Σ after OR

mv + mv = mv + mv without differentiating between masses and velocities.

Many candidates left speed as a negative answer.

Provide suggestions for improvement in relation to Teaching and Learning.

Training of educators on WEP by teacher development in collaboration with subject advisors.

A good foundation in Grades 10 and 11 content are very important for learners.

Use the statement (Ep + Ek) bottom = (Ep + Ek) top to demonstrate the principle of conservation of mechanical energy. Make sure that learners realise that $W_{nc} = 0$ because of the absence of non-conservative forces. Clearly explain to learners the difference between W_{net} (total work done by all forces acting on the object, i.e. both conservative and non-conservative) and W_{nc} (total work done by non-conservative forces acting on the object).

Work done by a force is always equal to the change in energy:

e.g. $W_{net} = \Delta E_k$; $W_{nc} = \Delta E_p + \Delta E_k$; $W_w = -\Delta E_p$

When using $W_{net} = \Delta E_k$, $W_{nc} = \Delta E_p + \Delta E_k$, the identification of forces acting on the object is very important and therefore the use of the free-body diagrams is advised.
Use the mark allocation in questions as a guide for the number of forces that is expected to be drawn in a free-body diagram.

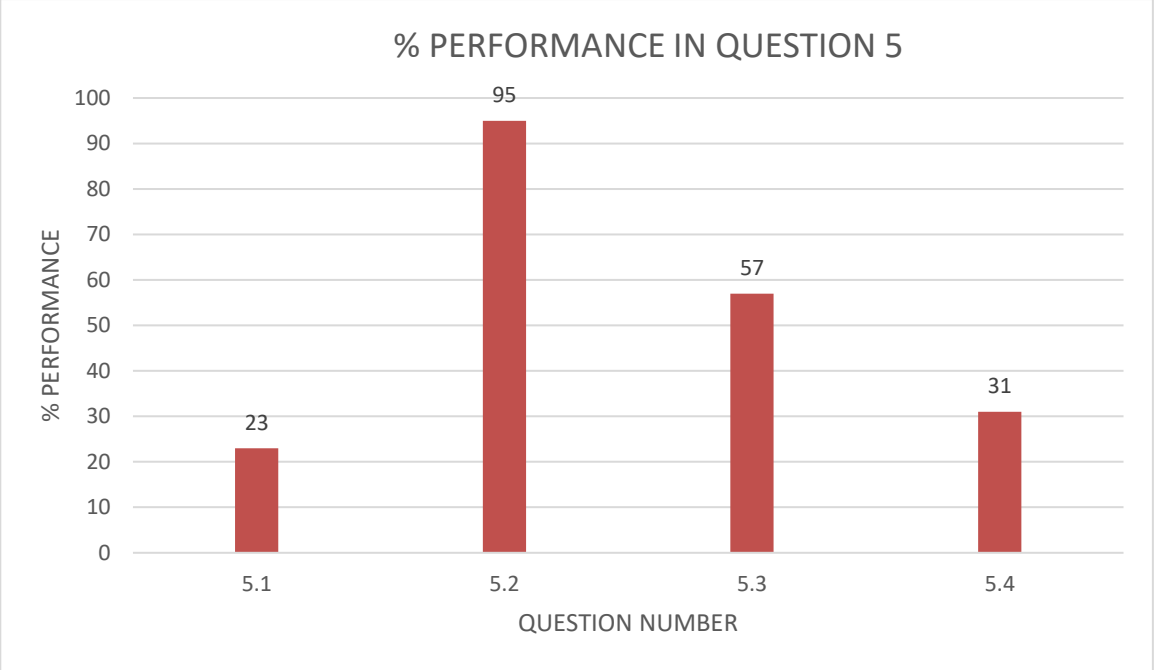
The vector nature of momentum and impulse should be emphasised during teaching.
Expose learners to many different scenarios or problems that involving the principle of conservation of principle of mechanical energy and momentum.
Learners should be encouraged to use the datasheets and assign the subscripts when using the formulae.
Teachers should emphasise that the symbol and Δ implies, final quantity – initial quantity and the symbol Σ imply the sum of quantities.
Educators should provide learners with the correct data sheets and effectively use it during teaching and learning whereby educators guide learners' step-by- step in how to identify the correct formulae, do correct substitutions and how to derive the correct answer using the calculator.

Encourage learners to refer to the supplied datasheets and use the formula as given on the data sheet and not create their own.
Teachers should make learners aware that topics are not in isolation. Educators must be encouraged to integrate topics and expose learners to such questions.

Describe any other specific observations relating to responses of learners and comments that are useful to teachers, subject advisors, teacher development etc.
Use PhET simulation for the identification of forces acting on objects. Use YouTube videos in teaching and learning.
QUESTION 5
General comment on the performance of learners in the specific question. Was the question well answered or poorly answered?

This questions performance was good at 60%, 2% increase from 2023. Sub-question 5.1 defining the term work done by a force was the worst performing at 23%, followed by sub- question 5.4 that tested the application of the work done **W = fΔx cos θ** at 31%.

LEVELS	PERCENTAGE PERFOMANCE (%)
5.1	23%
5.2	95%
5.3	59%
5.4	31%
TOTAL	60%



Why was the question poorly answered? Also provide specific examples, indicate common errors committed by learners in this question, and any misconceptions.

Question 5.1: Candidates omitted "the direction of the displacement/ force"

Some candidates used "distance" instead of "distance in a straight line"/displacement.

"The direction of the displacement" are the same as "θ the angle between the force and the displacement".

Other candidates stated the various physical quantities without stating FΔxcosθ. A few wrote the definition $W_{net} = \Delta E_k$

Question 5.2: Candidates forfeited unnecessary due to:

- writing incorrect labels like fr and Fapp.
- showing both weight and components of weight or only components (not accepted).
- draw the block (force diagram) instead of the dot (free-body diagram).
- Labelling" normal force" as "normal" and "gravity" as "gravitational force".

- Drawing arrows with no labels, and drawing forces as arrows, with labels but no arrow.
- the drawing of additional forces.
- Force(s) do not contact the dot.

Question 5.3: Candidates could not relate work done by net force to calculate W_{net} to calculate $W_{net} = ½m(v_f - vi)^2$ instead of $½ m (v_f^2 – vi^2)$. Some candidates omitted the subscripts and forfeited the formula mark.

Candidates could not calculate the work done by the forces but only the change in kinetic energy where they scored marks.

Question 5.4: Candidates could not apply the equation for work done $W = f\Delta x\cos\theta$. From the equation it is seen that work done by the force f is independent from the mass of the object.

Candidates could not identify that the mass will have no impact on the magnitude of the force, f.

Provide suggestions for improvement in relation to Teaching and Learning.

In question 5.1 the educators should explain definitions of work done by a constant for learners to understand and for learners to be able to recall in examinations. The second part of the definition referred to work done by the force being either positive (if the force /component of the force and the magnitude of the displacement in the same direction), or negative (if the force /component of the force and the magnitude of the displacement in the opposite direction).

Further testing on $W = f\Delta x\cos\theta$ was done in Q 5.4.

In question 5.2, educators should refrain from:

Using labelled force diagrams instead of free-body diagrams. It is very important to note that in free-body diagrams, the forces always move/flow out of the dot.

Drawing components of the force instead of the force when ask in a question. It should only be used when performing calculations. Use the mark allocation in questions as a guide for the number of forces that is expected to be drawn in a free-body diagram.

In question 5.3 and 5.4 a good foundation in Grades 10 and 11 content are very important for learners. Forces should be revised before teaching WEP.

Use the statement $(E_p+E_k)_{bottom} = (E_p+E_k)_{top}$ to demonstrate the principle of conservation of mechanical energy. Make sure that learners realise that $W_{nc} = 0$ because of the absence of non-conservative forces or isolated system. Clearly explain to learners the difference between W_{net} (total work done by all forces acting on the object, i.e. both conservative and non-conservative) and W_{nc} (total work done by non-conservative forces acting on the object).

Work done by a force is always equal to the change in energy. Energy principles refer to the relationship between work done and energy. The equations that relate energy principles are:

e.g. $W_{net} = \Delta E_k$, $W_{nc} = \Delta E_p + \Delta E_k$.

When using $W_{net} = \Delta E_k$, $W_{nc} = \Delta E_p + \Delta E_k$, the identification of forces acting on the object is very important and therefore the use of the free-body diagrams is advised.

Encourage learners to refer to the supplied datasheets and use the formula as given on the data sheet and not create their own.

Training of educators on WEP by teacher development in collaboration with subject advisors.

Describe any other specific observations relating to responses of learners and comments that are useful to teachers, subject advisors, teacher development etc.

The free-body diagram for Q 5.2 was well answered as it is a skill developed from grade 11 and constantly tested. Serious interventions are needed for WEP.

Training of educators on WEP by teacher development in collaboration with subject advisors

Use PhET simulation for the identification of forces acting on objects.

QUESTION 6

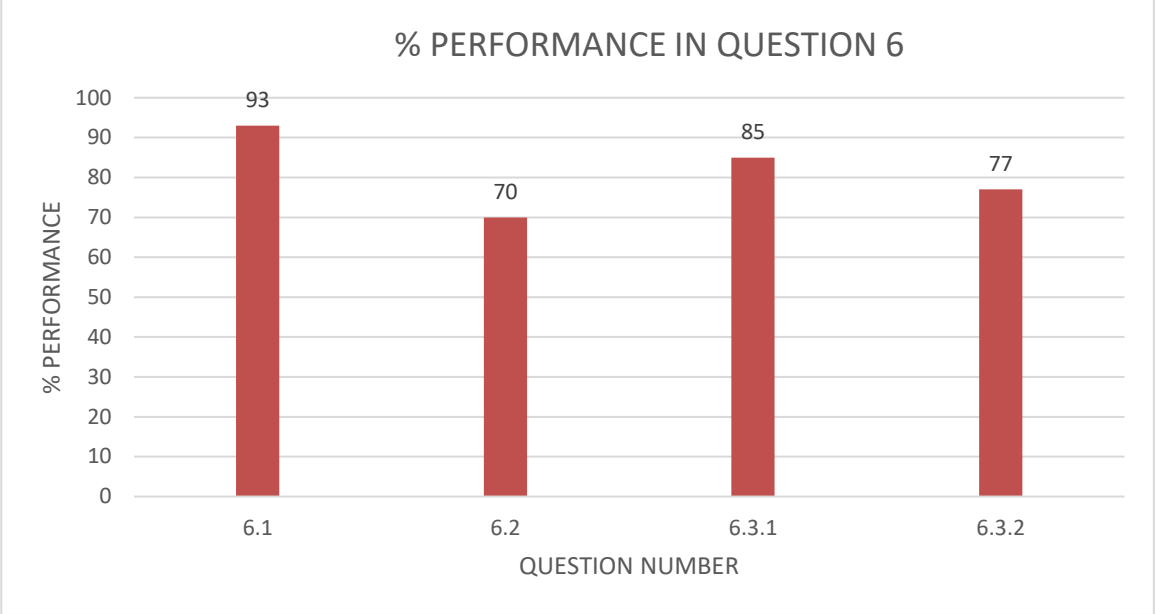
General comment on the performance of learners in the specific question. Was the question well answered or poorly answered?

This question was the BEST performing question at 79% and the performance improved from 66% in 2023 to 79%.

Sub-question 6.1 was the best answered sub-question at 93% where candidates had to name the phenomenon that explains why the λ in the graph differ.

In the sub-question 6.3.1(85%) candidate did a calculation of fs, followed by sub-question 6.3.2 where a calculation was done for the magnitude of velocity of the car.

LEVELS	PERCENTAGE PERFOMANCE (%)
6.1	93%
6.2	70%
6.3.1	85%
6.3.2	77,16%
TOTAL	79%



Why was the question poorly answered? Also provide specific examples, indicate common errors committed by learners in this question, and any misconceptions.

Many candidates struggled to interpret the graph of λ vs t. The relationships of $\lambda_L > \lambda_s$ implying the source is moving away from the listener. OR the relationship $f \propto 1/\lambda$ is not known to candidates.

Question 6.1 was very well answered.

Question 6.2: Candidates could not interpret the graph and conclude that the listener moved away. They also could not explain by comparing the λ of the source and the observer.

Question 6.3 was NOT an easy/ straight forward question. This calculation depends on the candidate's interpretation of the graphs and the mathematical skills.

Question 6.3.1 and 6.3.2: Some candidates used the equation c = fλ instead of v = fλ

Candidates swopped the λ into the equation i.e.,

$v = f_s\lambda$

$343 = f_s(0,40)$ instead of $343 = f_s(0,38)$

Others substituted v = 340 instead of given v = 343 $m.s^{-1,}$ i.e. $340 = f_s(0,38)$ and $340 = f_L(0,40)$

Some substituted v = $3x10^8$ instead of given v = 343 $m.s^{-1,}$ i.e. $3x10^8 = f_s(0,38)$ and $3x10^8 = f_L(0,40)$

Some candidates used the equation for electromagnetic radiation spectrum E = hf = hc /λ and used c = 3 $x10^8$.

Some substituted v = 340 into $f_L = \frac{v}{v-vs} f_s$ and $f_L = \frac{340}{340+vs} f_s$ instead of $f_L = \frac{343}{343+vs} f_s$

Some candidates substituted λ_L for f_L and λ_s for f_s, i.e. $0,4 = \frac{343}{343+vs} 0,38$

OR swopping λ_L and λ_s i.e. $0,38 = \frac{343}{343+vs} 0,40$

Some selected the following equations: $f_L = \frac{v}{v-v_S} f_s$ OR $f_L = \frac{v}{v-v_S} f_s$ and forfeited 2 marks.

Mathematical manipulation is a challenge.

Positive marking assisted candidates in scoring marks.

Provide suggestions for improvement in relation to Teaching and Learning.

Teachers need to source and expose learners to a variety of questions relating to Doppler effect equation as the scope is very broad, given the number of variables in the equation. Identification of variables in relation to the equation describing the graphs should be stressed.

Educators must teach learners to write the Doppler effect equation as it appears on the datasheet. Only once substitution starts, should they change the signs.

Problem solving exercises that involve the interpretation and drawing of sketch graphs should be done in a variety of topics. Teachers should note that learners can be asked to draw or interpret graphs in any of the physics topics.

When teaching Doppler effect, educators must know that speed of sound in this equation v = f λ is constant, therefore the Doppler effect can either be related to f or λ.

Educators must use the equation v = f λ for the constant speed of the wave to show the relationship between f and λ.

Encourage learners to refer to the supplied datasheets and use the formula as given on the data sheet and not create their own.

Describe any other specific observations relating to responses of learners and comments that are useful to teachers, subject advisors, teacher development etc.

Expose learners to PhET simulations, YouTube videos and the Ten-Fold App to demonstrate Doppler Effect.

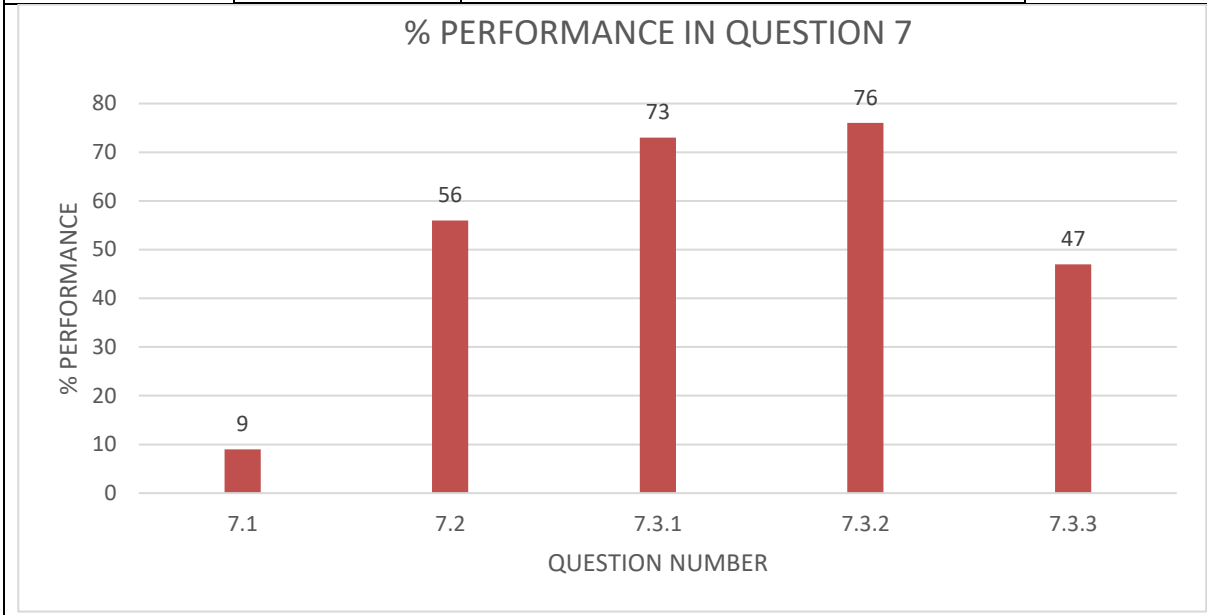
QUESTION 7

General comment on the performance of learners in the specific question. Was the question well answered or poorly answered?

The performance of this question improved from 45% to 59%, but it is still fairly answered. Sub-question 7.3.1 stating Coulomb's Law and 7.3.2 identifying the polarity of Q_T, are the best answered sub-questions with a performance of 73% and 76% respectively, followed by sub-question 7.1(69%) calculating the magnitude of the electric field at point X. Sub-question 7.2 the drawing of the electric field pattern and 7.3.3 the calculation of the magnitude of Q_T were the poorest answered sub-questions at a performance of 56% and 46% respectively.

LEVELS	PERCENTAGE PERFOMANCE (%)
7.1	69%

7.2	56%
7.3.1	73%
7.3.2	76%
7.3.3	47%
TOTAL	59%



8.Why was the question poorly answered? Also provide specific examples, indicate common errors committed by learners in this question, and any misconceptions.

Question 7.1: Most candidates could identify and use the correct equation, but had challenges in the conversions for 2nC to 2 x 10^{-9} C and 6 cm to 6x10^{-2} m.

Some substituted negative values for charge(scalar), i.e. Q = - 2 x 10^{-9} C into E = $\frac{kQ}{r2}$.

A few candidates wrote E = $\frac{kQ}{r}$ instead of E = $\frac{kQ}{r2}$, which indicated that candidates did not use the datasheets and wrote the incorrect formula from the memory.

Some omitted the square of the distance between charges, i.e. E = $\frac{kQ}{r2}$ = $\frac{9x109(2x10-9)}{(0,06)}$

Incorrect units used, i.e. N or N.C instead of N.C^{-1}

Question 7.2: Candidates forfeited unnecessary marks for:

Incorrect direction of the electric field lines.

Incorrect shape of the electric field pattern between the charges and the outside of the spheres.

Field lines crossing each other/not touching the charge/going inside the charge.

Some candidates draw patterns of two like charges or one single charge and scored a max 0/3.

Candidates substituted negative sign, forfeited the substitution mark.

Question 7.3.1: Candidates forfeited marks for the omission of:

"force" and scored 0/2.

"One point charge on another point charge".

"product"

"square" of the distance between them/there centres.

Some candidates referred to masses and scored 0/2.

Question 7.3.2 was well answered.

Question 7.3.3: Candidates wrote $F_{net} = \frac{kQ1Q2}{r2}$ instead of $F = \frac{kQ1Q2}{r2}$ and forfeited the mark for formula.

Candidates experienced challenges in the conversions from 2nC to 2 x 10^{-9} C and 6 cm to 6x10^{-2} m.

A few candidates omitted the square for the distance between the $F= \frac{kQQ}{r}$ instead of $F = \frac{kQQ}{r2}$.

ONLY absolute values should be for Q into substituted $F= \frac{kQQ}{r2}$ and $E = \frac{kQ}{r2}$.

(If a negative value is substituted learners use the negative answer mistakenly as an indication of the direction.)

Some candidates substituted the Q = -2x10^{-9} into the above formulae (Q is a scalar) and this result in a wrong negative sign for the vector of E and F.

Some candidates did not realise that there are two forces acting in a straight line on Q_T and they responded as follow: $F^2_{res} = F_s^2 + F_{PY}^2$

OR $F_{net} = \frac{kQ1Q2}{r2}$ OR $E_{net} = \frac{kQ}{r2}$

$2{,}5x10^{-4} = \frac{9x109(2x109)QT}{r2}$ OR $2{,}5x10^{-4} = \frac{9x109(2x109)}{r2}$

The vector sum where the two forces F_{PT} and F_{ST} are acting are in opposite direction.

F_{net} at point Q_T is in the same direction of $F_{ST,}$ therefore $F_{net} = F_{ST} – F_{PT}$ and $– F_{net} = F_{PT} -- F_{ST}$

Mathematical manipulation was a challenge for some candidates.

Provide suggestions for improvement in relation to Teaching and Learning.

Learners should be shown when it is a force of attraction or repulsion; when it will be a force experienced by a field; all possible field patterns. Only field pattern of the equal charge will be asked.

Educators should use the field/charge lines to determine the direction of the electrostatic force.

The absolute value of Q must be substituted into $F= \frac{kQQ}{r2}$ and $E = \frac{kQ}{r2}$.

(If a negative value is substituted learners use the negative answer mistakenly as an indication of the direction.)

Teachers can use vector diagrams very effectively to assist learners in sign conventions when working with forces/fields and to calculate the net force/field. In-depth training is required in electrostatics.

Encourage learners to refer to the supplied datasheets and use the formula as given on the data sheet and not create their own.

Describe any other specific observations relating to responses of learners and comments that are useful to teachers, subject advisors, teacher development etc.

Electrostatics must be included in Term 1 control test 1 since the concept is taught in grade 11 and most learners turn to give little attention to it in terms of revision.

In-depth training is required in electrostatics.

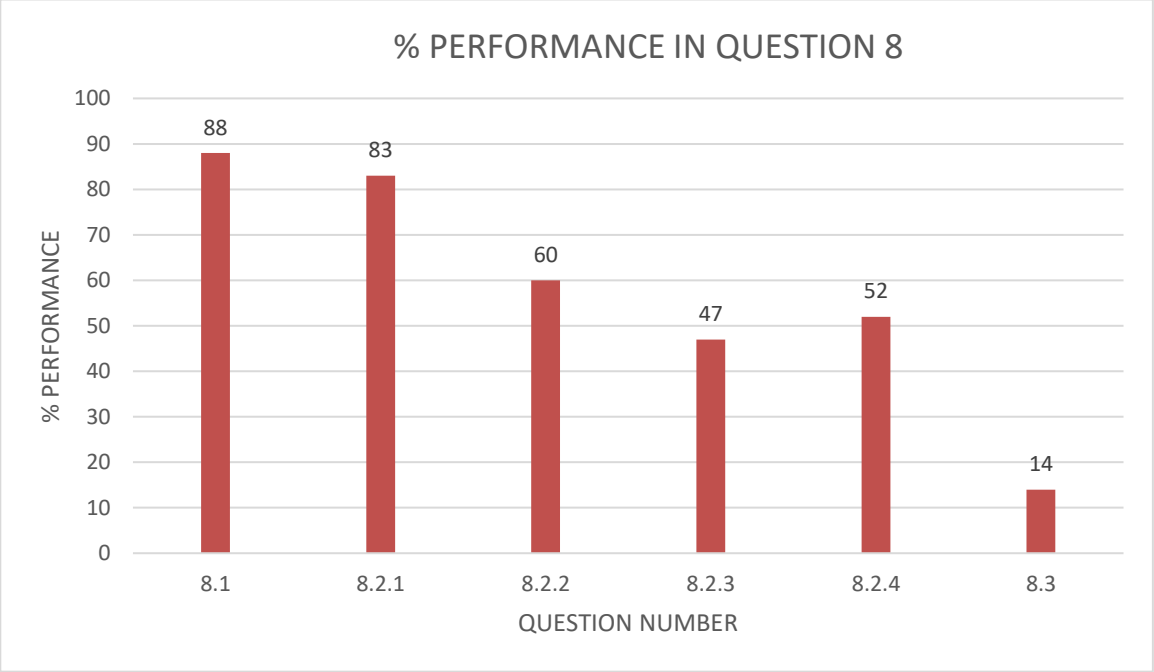
Vectors nature of forces and electric field at a point should be tested in straight line and perpendicular.

QUESTION 8

General comment on the performance of learners in the specific question. Was the question well answered or poorly answered?

Electric circuits are generally a challenging question. The overall performance of this question was fair at 51%. Sub-question 8.1 defining the term power and 8.2.1 calculating the reading of current on ammeter A2 was very well answered at 88% and 83% respectively. Sub-question 8.2.2 followed with a performance of 60%. Sub-question 8.3.2 was L3 difficult question for the calculation of the resistance of resistor R_1 and was poorly answered at 47%. Sub-question 8.2.4 was average calculating the EMF of the battery and was a L3 difficult question. Sub-question 8.3 was a level 4 question and very poorly answered at 14%.

LEVELS	PERCENTAGE PERFOMANCE (%)
8.1	88%
8.2.1	83%
8.2.2	60%
8.2.3	47%
8.2.4	52%
8.3	14%
TOTAL	51%



Why was the question poorly answered? Also provide specific examples, indicate common errors committed by learners in this question, and any misconceptions.

Question 8.1: Candidates responses are:

Work done.

Energy transferred.

The rate at which work is "down".

The rate of change in work done.

The rate at work or power is done.

Work done per unit charge. (potential difference).

The rate at which work is done per unit time.

The rate of energy "expanded" instead of "expended"

The rate at which charge flows. (Current)

Question 8.2.1: Candidates use the V across L_2 and the resistance of R_2 to calculate the current/reading on A_2.

$I = V/R = 32/4 = 8A$

Question 8.2.2: Candidates struggle to differentiate between "parallel" and "series" and to identify which resistor or lamp were connected in which part of the circuit.

Question 8.2.2: Candidates responded: $V = IR \rightarrow 32 = I4 \rightarrow I = 8A$

Candidates did not interpret the circuit correctly and therefore could not do the proper calculations. Candidates did not know how to use the power formula and opted for V=IR and use the potential difference for L_2 and the resistance of R_2.

Question 8.2.3: Most candidates calculated the resistance of the lightbulb L_1 for R_1.

$P=V^2/R$	$R_2 = V/I$	$R = V/I$
$36 = 20/R$	$= 20/1,8$	$= 32/1,8$
$R = 11,11\ \Omega$	$= 11,11\ \Omega$	$= 11,11\ \Omega$

Question 8.2.4: Most candidates could not identify the parallel branch before adding the resistor R_2. Hence, omitting the resistance at lightbulb L_2.

Using the reading on A_2 as the total current in question 8.2.4.

$EMF = I(R + r) = 3,3(11,11 + 4 + 0,6) = 51,843\ V$

Question 8.3: Candidates did not know that the current/power/voltage rating of the lightbulb is exceeded that the lightbulb will blow.

Hence, candidates did not know what to calculate. Ratings of the lightbulb against the changes in the circuit.

Question 8.2.1 to 8.3: Candidate used the equations Electrodynamics for Electric circuits.

i.e. $P_{ave} = V_{rms}I_{rms}$ instead of $P = VI$

$P_{ave} = V^2_{rms} / R$ instead of $P = V/R$

Question 8.2.1 to 8.2.3: Some candidates used the internal resistance of 0,6 to answer various questions. This the candidates have no understanding of what internal resistance is or its relevance in the circuit calculations.
Question 8 overall errors:
Some candidates used “A” instead of “I” as the symbol for current.
Some candidates used “Amps” instead of “A” for Ampere
Candidates forfeited marks with mathematical manipulation and incorrect rounding off to two decimal places.
Some left the final answer in fractions.
Candidates did not use the numbering system in the question paper. They also wrote their responses next to each other. It complicated marking and markers had to interpret the responses.

Provide suggestions for improvement in relation to Teaching and Learning.

Teachers should provide each learner with a copy of the Examination Guideline and use the definitions out of this document. Educators need to explain definitions for learners to understand and not only memorise.
Educators can use the equation P= W/Δt to assist with the recall of the definitions.
Educators should use a variety of circuit set-ups and using ALL electrical quantities
(P, V, I, Q and W) when working with electrical circuits.
PhET simulations should be used effectively in practical demonstrations when teaching electric circuits.
Focus should be on the properties of potential difference and current in series and parallel branch.
Educators should use various forms of EMF = I(R+r) ; EMF = V_{ext} + V_{int} ; EMF = IR + Ir.
So that learners are expose to the different ways to calculate EMF instead of always expecting
to use R_{ext} and r to calculate EMF.
The properties of potential difference and current in a series and parallel branch should be thoroughly tested in grade 10 and 11. These skills and knowledge should only be reinforced in grade 12.
Educators should be encouraged to emphasise that the power rating on a device is the maximum it can sustain without burning out.
Encourage learners to refer to the supplied datasheets and use the formula as given on the data sheet and not create their own.
Learners must be taught not to leave the answers in fraction but to write them with at least two decimal places and to ensure that the unit is correct.
Others did not attempt the question at all or left spaces open or retried questions but could not finish due to a lack of time. In many cases there was not even time to delete the first attempt, or all attempts were deleted, and new attempts were incomplete.
Development or/and Subject Advisors must train educators in the usage of ICT in their classrooms

Describe any other specific observations relating to responses of learners and comments that are useful to teachers, subject advisors, teacher development etc.

Educators should use a variety of circuit set-ups and using ALL electrical quantities (P, V, I, Q and W) when working with electrical circuits.

PhET simulations should be used effectively in practical demonstrations when teaching electric circuits.

Educators should be encouraged to emphasise that the power rating on a device is the maximum it can sustain without burning out.

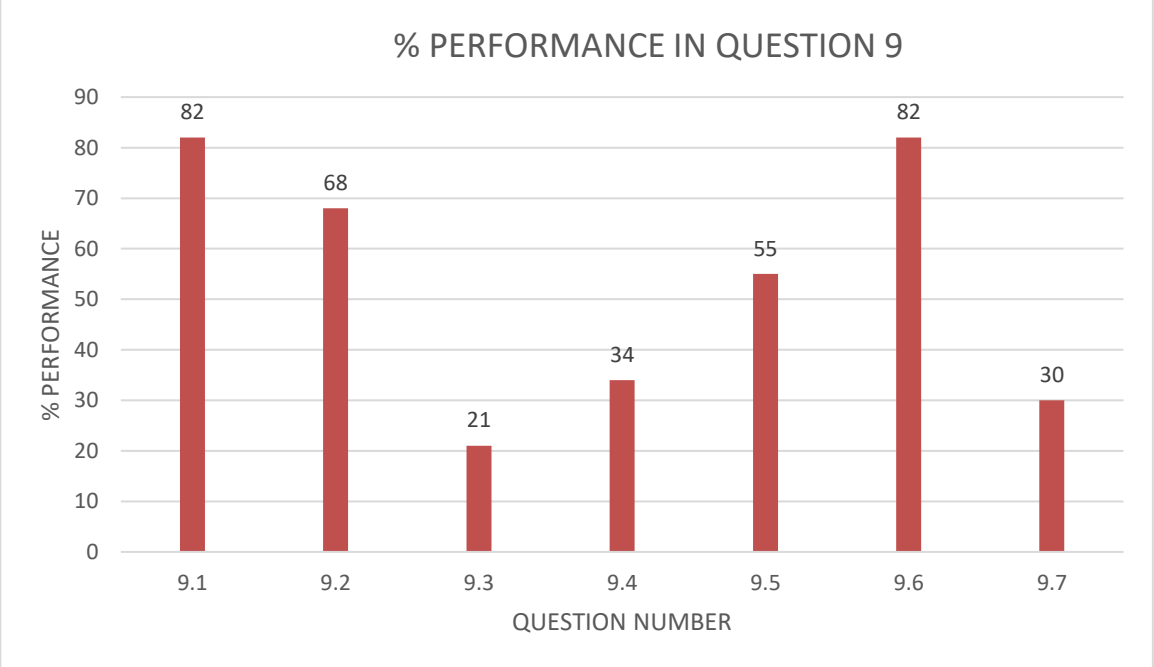
Development or/and Subject Advisors must train educators in the usage of ICT in their classrooms.

QUESTION 9

General comment on the performance of learners in the specific question. Was the question well answered or poorly answered?

The overall performance in this question was fair and there was a decline from 59% in 2023 to 54% in 2024. The best performed questions were Q9.1 where candidate had to identify and name the generator as AC or DC and Q 9.6 was a calculation of the I_{rms} delivered by the generator at 82%. Sub-questions 9.3(21%), 9.4(34%) and 9.7(30%) contributed to the fair performance in this question.

LEVELS	PERCENTAGE PERFOMANCE (%)
9.1	82%
9.2	68%
9.3	21%
9.4	34%
9.5	55%
9.6	82%
9.7	30%
TOTAL	55%



Why was the question poorly answered? Also provide specific examples, indicate common errors committed by learners in this question, and any misconceptions.

Question 9: Underteaching in Electrodynamics could be the reason for the performance at 55%.

Question 9.1: Candidates cannot interpret the graph to identify the DC generator.

Question 9.2: Candidates responses were: “electrical to chemical”/ “mechanical to chemical” / “chemical to mechanical”.

Question 9.3: SEE “CAPS Page 131” and “EG 2021 page 14.

“Explain/state the advantages of alternative current over direct current”

Not emphasize during teaching and learning OR not covered at all.

A few candidates answered current/ voltage cannot be step-up or down.

Question 9.4: Most candidates could not interpret the graph of induced current vs time for a DC generator.

They interpreted the period incorrectly as 0,01s i.e. f =1/T= 1/0,01=100Hz.

Candidates could not identify the number of waves/cycles in the graph.

Candidates used s^{-1} instead of Hz for the unit of frequency or omitted the unit.

Question 9.5 The definition of the root mean square current was still a major problem. There seem to be a lack of understanding of the content that candidates had learnt.

Candidates’ responses:

DC that dissipates the same amount of energy as an equivalent AC current and scored ½ marks.

Omission of “equivalent” leading to candidates forfeiting ½ mark.

Candidates omitted or replaced the word” energy/ heat” with current. Candidates forfeited 2 marks since it is out of context.

Candidates wrote “DC potential difference” instead of “direct current (DC)”.

Question 9.6: Candidates forfeited 1 mark for:

Some candidates used $V_{rms} = \frac{Vmax}{\sqrt{2}}$ and $I_{rms} = \frac{Imax.}{\sqrt{2}}$ instead of $I_{rms} = \frac{Imax}{\sqrt{2}}$

Some candidates still omitted subscripts” rms” and “max” in equation $I_{rms} = \frac{Imax}{\sqrt{2}}$

Some candidates incorrectly rounded off to two decimal places and wrote no unit or incorrect unit.

Question 9.7: Interpretation of graphs was a challenge. Candidates describe the graph instead of the changes that was made. Responses by candidates were:

“Number of turns in the coil was decreased” and “Time taken has increased”.

Candidates could not relate that the frequency/ period and induced current has changed and then relate this change as a combination to what was responsible for this change which was the speed of the rotation of the coil.

Provide suggestions for improvement in relation to Teaching and Learning.

Educators do thorough planning, and preparation and it must be guided by CAPS, Examination guidelines and ATPs. The underperformance in question 9.3 is due to non-adherence to CAPS policies or that not enough emphasis was placed on the advantage of alternative current over long distance. SEE "CAPS Page 131" and "EG 2021 page 14.

"Explain/state the advantages of alternative current over direct current"

Educators must use PhET or YouTube simulations or videos for the working on the AC/DC generators and showing the graphs. Educators should relate frequency of an appliance in their homes to show the real-life applications of AC generators. The frequency of the appliance should be incorporated do that learners can see the application of this topic on the real-life i.e.

f = 50 Hz, V_{rms} = 200V with low current in South Africa.

Educators should supply each learner with a copy of Examination guideline and only use the definition in there. Explain the definitions for understanding and recalling. Include the definitions and graphs in all activities. Give learners a topic test at the end of sub-topic/topic and include graphs and definitions. Educators can compile questions on graphs and expose learners to a variety of questions.

Educators should use PhET /YouTube simulations to demonstrate the effect of:

Number of the coils; Speed of the rotation; Size of the inducting waves in the coil.

The strength of the magnetic field on the EMF or current produced in electromagnetic induction.

This should be done graphically to ensure the skills of interpreting graphs will improve.

Encourage learners to refer to the supplied datasheets and use the formula as given on the data sheet and not create their own.

Describe any other specific observations relating to responses of learners and comments that are useful to teachers, subject advisors, teacher development etc

Non-adherence to CAPS policies observed.

The underperformance in question 9.3 is due to non-adherence to CAPS policies or that not enough emphasis was placed on the advantage of alternative current over long distance. SEE "CAPS Page 131" and "EG 2021 page 14.

"Explain/state the advantages of alternative current over direct current"

QUESTION 10

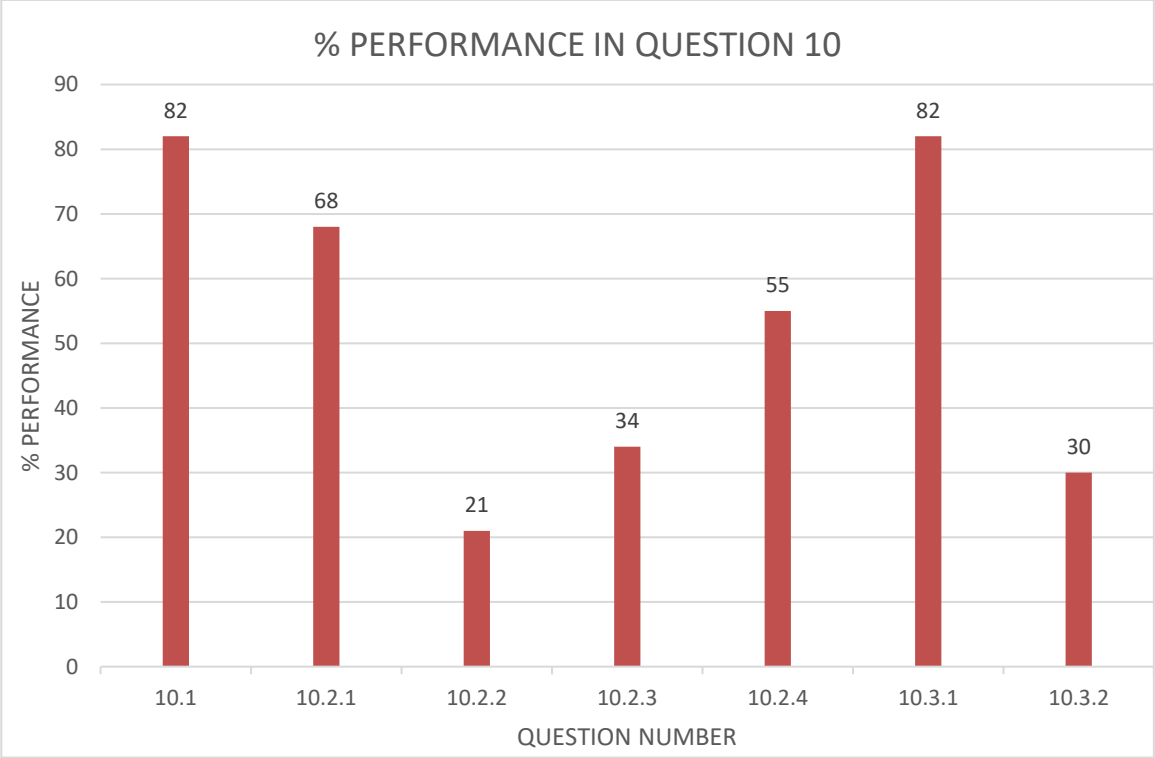
General comment on the performance of learners in the specific question. Was the question well answered or poorly answered?

This question was fairly answered at 55%. Q 10.1 defining photoelectric effect

and 10.3.1 naming the spectrum describe are the best performed question at 82%.

The worst performed sub-question is 10.2.2(21%) explaining which colour light will be responsible for ejecting electrons that have a Ek_{max} equal to $2{,}65x10^{-20}$ and question 10.3.2(30%) explaining the presence if the coloured lines in the spectrum.

LEVELS	PERCENTAGE PERFOMANCE (%)
10.1	82%
10.2.1	68%
10.2.2	21%
10.2.3	34%
10.2.4	55%
10.3.1	82%
10.3.2	30%
TOTAL	55%



Why was the question poorly answered? Also provide specific examples, indicate common errors committed by learners in this question, and any misconceptions.

Question 10.1: The omission of key words or phrases, i.e. “surface”, incident/shining/shone.

Some candidates defined “work function” and “threshold frequency” and scored 0/2 marks.

Question 10.2.1 and 10.2.2: Candidates could not relate the colour of the electromagnetic radiation/ light to the frequency/ energy /wavelength, therefore could not use the equation

$E = W_o + Ek_{(max)}$ OR $hf = hf_o + Ek_{(max)}$ OR Gradient = $\Delta Ek/\Delta f$

to relate the colour/frequency/ energy to $Ek_{(max)}$ for constant W_o /f_o (as the same metal/ potassium that the light was radiated/ incident on). Scientific skills of using $E = W_o + Ek_{(max)}$ where, W_o/ f_o/ h are the controlled variables, E/f/λ is the independent variable with $Ek_{(max)}$ being the dependent variable.
Candidates could not identify the colour that will not eject/emit electrons.

Question 10.2.3: Some did not write the formula or omitted subscripts: Ek instead of $Ek_{(max)}$ or v instead of v_{max} or W instead of W_o and f instead of f_o.
Question 10.3: Underteaching in the formation of the line emission spectrum.

Provide suggestions for improvement in relation to Teaching and Learning.

This topic is done last according to ATP, and it was not tested in any examination except in the Trail Examination. Not sufficient assessment done. Push the content coverage to ensure quality revision time.
Prepare question in order of cognitive and difficult levels and include graph.
Make a summary of content and graphs, i.e. E vs f; Ek vs f; Ek vs 1/λ Ek vs λ and include the spectra as outlaid in the EG 2021 page 14.
Apply y = mx + c, for a straight-line graphs.
Educators must use EG 2021 and datasheets effectively in teaching and learning and encourage learners to do the same to ensure that learner can score marks.
Candidates are still writing equations incorrectly and omitted subscripts.
Educators must use the electromagnetic spectrum to show the frequencies/ energy and the wavelength of the various electromagnetic radiation.
Use PhET or YouTube simulations to design virtual experiments to strengthen abstract content in this topic.
Subject advisors must assist to use standard experiments/demonstrations and videos/simulations across EC to improve teaching and learning.
Scientific skills of using $E = W_o + Ek_{(max)}$ where, W_o is the controlled variable, E/f/λ is the independent variable with $Ek_{(max)}$ being the dependent variable need to be strengthened.
Simulations and YouTube videos should be used in teaching the continuous spectrum, line spectrum and line absorption spectrum.

Describe any other specific observations relating to responses of learners and comments that are useful to teachers, subject advisors, teacher development etc.

Subject advisors must mediate the Chief Markers and diagnostic report per term.
Subject advisors must assist to use standard experiments/demonstrations and videos/simulations across EC to improve teaching and learning. Compile notes and questions including graphs and the spectra. Training on the

use of PhET simulations. The content coverage of educators needs to be monitored, since underteaching is observed and insufficient revision and assessment.