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2018 NSC CHIEF MARKER'S REPORT

SUBJECT:		Physical Sciences
PAPER:		2
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SECTION 1: (General overview of Learner Performance in the question paper as a whole)

It is pleasing to note that candidates were able to score marks in every question in this question paper. One could hardly find a question where candidates received zero marks, even in the multiple-choice questions. This is a first for Physical Sciences paper 2. This indicates that easy questions were spread out evenly which was to the advantage of all candidates.

The average learner performance in this paper is 45% based on the 100 scripts analysis. This is an improvement compared to all previous CAPS exams since 2014.

QUESTION 1, **QUESTION 3** (Physical properties), **QUESTION 4** (Organic reactions), **QUESTION 5** (Reaction rates) were relatively well answered by candidates.

The scores in questions 1,3,4 and 5 were respectively **53%**,**51%**, **48%** and **46%.**

Questions that were answered poorly by the candidates were **QUESTION 2,6,8** and **10**.

Learner scores in these questions were **41%**, **41%**, **43%** and **37%** for **QUESTIONS 2**, **6**, **8** and **10** respectively.

Sub questions that were well answered by candidates include:

2.2 Esterification (**51%**), **8.2** Galvanic Cell (**50%**), **10.1** Industrial Processes. (**82%**)

Terms were defined satisfactorily for example the definition of:

3.1 Boiling point (**61%**),

5.2 Reaction rate (**61%**)

9.1 Electrolytic cell (**59%**)

But in some centres, it has been observed that definitions are treated too casually. For example:

- **3.1** Boiling point – "Vapour pressure and atmospheric pressure are at equilibrium"
- **4.1.6** Cracking – "large *molecules* are broken down to smaller *molecules*" instead of "long chain *hydrocarbons* are broken down to shorter/ more useful *alkanes and alkenes*"
- **5.2** Reaction rate – "How fast and slow a reaction is" instead of "A change in the concentration per unit time"
- **8.1.1** Oxidation – is the "*transfer* of electrons" instead of "the *loss* of electrons"

The following sub-questions were poorly answered by candidates:

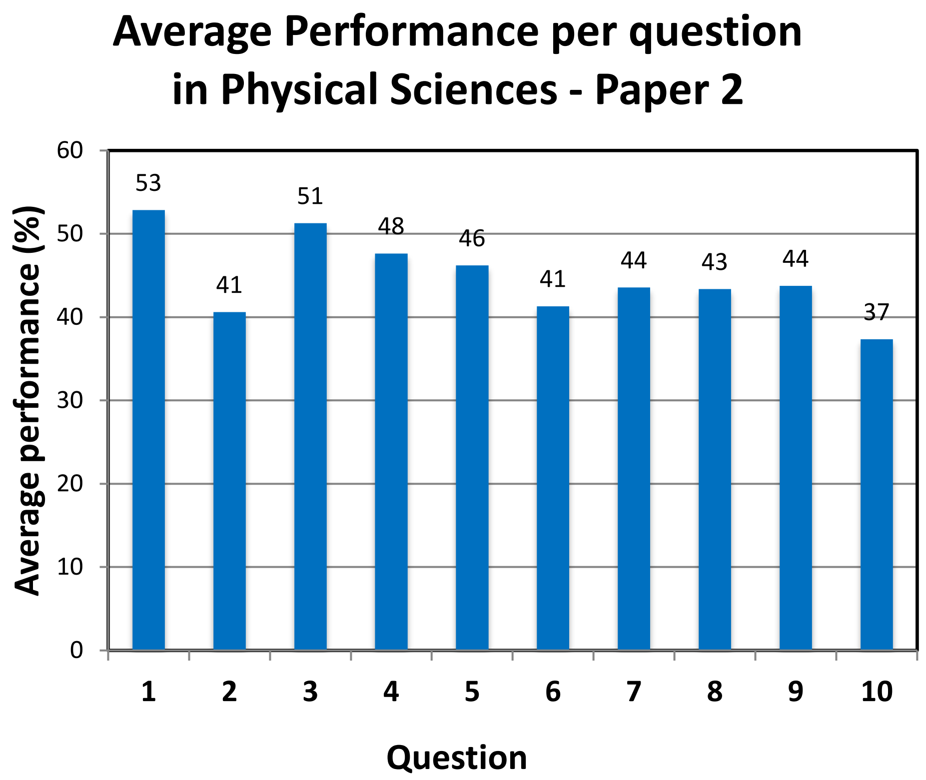
2.2 Determining molecular formula from empirical formula (**32%**). This work comes from grade 11, learners may not have revised it.

5.3 Effect of volume on reaction rate (**28%**). This points to poor or inadequate teaching of the section on rates as even the strong candidates could not answer it correctly.

7.2 Equation for the hydrolysis of a salt (**23%**). This was a tough higher order question.

9.2 Writing chemical formulae (**15%**). The question was based on an electrolyte, so candidates were supposed to know the solubility rules that were covered in grade 10. Candidates did not revise the solubility rules as stated in the grade 12 examination guidelines.

The graph below shows average learner performance per question.



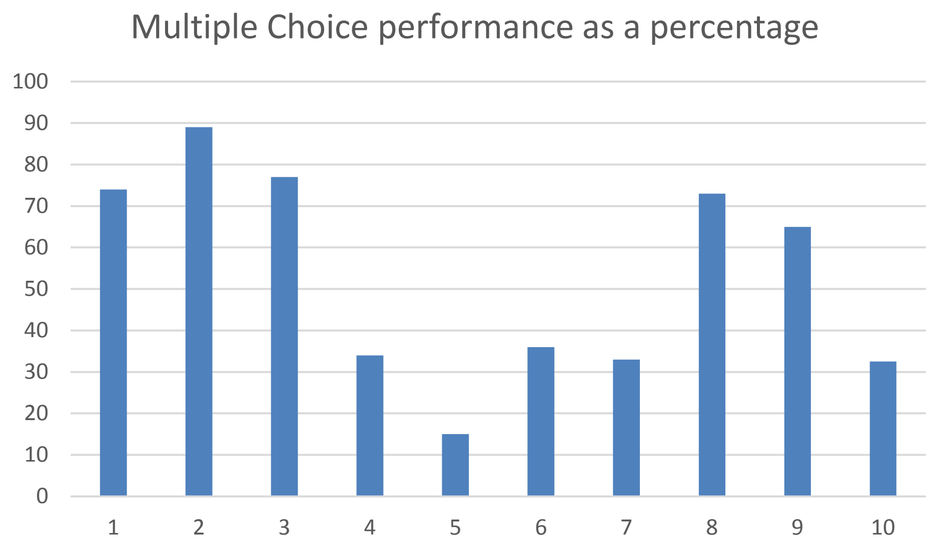
The graph reveals the following:

- There is an **IMPROVEMENT FROM THE PREVIOUS YEARS** (starting in 2014) in the following knowledge areas; **Organic molecules** and **Chemical change**.
- The BEST PERFORMED KNOWLEDGE AREA was Organic molecules followed by Chemical change. The improved performance may be explained by the fact that Organic molecules is explained in the first term and Chemical change in the second term and is therefore assessed in at least three examinations and more revision was done for these two topics.

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



The average score is **53%** which has improved from last year's score of **44,3%.** This an improvement of **8,7%**. Sub-question 1.4 (at 34%), 1.5 (at 15%), 1.6 (36%), 1.7 (at 33%) and 1.10(at 32,5%) were the worst performed. Sub-question 1.1 (at 74%), 1.2 (at 89%), 1.3 (at 77%), 1.8 (at 73%) and 1.9 (at 65%).

(b) Why the question was poorly answered? Also provide specific examples, indicate common errors committed by learners in this question, and any misconceptions.
1.4. Leaners found it difficult to correlate activation energy in relation to effective collisions – they are more familiar with the relationship between catalysts and activation energy.
1.5. Most learners answered **B** – learners do not know the importance of the word **RATE** in the definition of **DYNAMIC EQUILIBRIUM**.
1.6. Learners could not interpret graphical representation of equilibrium in terms of the different factors.
1.7. Learners could not identify H_2CO_3 as a weakest acid.
1.10. Learners did not learn processes or give enough attention to the different **CATALYSTS** in the different processes.

(c) Provide suggestions for improvement in relation to Teaching and Learning
1.4. RATES OF REACTIONS needs to be taught by mentioning the relationships between **ALL** concepts e.g. **ACTIVATION ENERGY & COLLISIONS, ACTIVATION ENERGY and E_K**
1.5. Need to demonstrate a simple reaction in a closed system to stress the concept of **RATE**
1.6. Need to focus more attention on **graphs**, **how to identify what factor is being changed** and what the change on the graph would look like.
1.7. Need to stress properties of acids – weak acids vs strong acids.

1.10. Need to teach learners using **FLOW DIAGRAMS** – showing **ALL REACTIONS** and catalysts.

The answering of multiple-choice questions is a skill that needs to be developed. Learners must be guided to eliminate the wrong answers through regular practice and assessment. Multiple choices must be assessed on a regular basis on all topics covered.

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

The answering of multiple-choice questions is a skill that needs to be developed. Learners must be guided to eliminate the wrong answers through regular practice and assessment. Multiple choices must be assessed on a regular basis on all topics covered.

Subject advisors can compile a workbook containing multiple choice questions from previous years, per topic, and distribute to schools for educators and candidates to use effectively.

QUESTION 2

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

The average score was **41%**. The candidates average score has **DECREASED** with **19.3%** from last year's score of **60,3%**.

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

QUESTION 2 based on **ESTERIFICATION** only, which was different from the format of previous years question papers. It is evident from the candidate's responses that the compulsory prescribed practical task on Esterification was not done at schools. Learners could not identify the aspect on what was asked from the experimental set-up, as provided in the question paper.

Common responses from candidates:

2.1 Most candidates responded that the "test tube will burst" when using a water bath or that the "reaction will occur faster".
The learners did not read the question properly.

2.2.1 "Elimination reaction", "Dehydration" and "Combustion reaction" were common errors instead of "**Esterification/ Condensation**"

2.2.2 Well answered, but some candidates used Platinum (Pt) as a catalyst.

2.3 Many candidates did not know how to determine the **MOLECULAR FORMULA**, using the molar mass of the **EMPIRICAL FORMULA**.

2.4 Because candidates struggled with **2.3**, they also struggled to identify the **IUPAC name**. This was a result of the candidates not understanding question **2.3**. Some were assisted by positive marking.
The naming of esters needs to be practiced in class.
Many could not draw the structural formula of the carboxylic acid from the molecular formula.

2.5 Most of the candidates attempted to do this question, but the majority wrote down incorrect structural formula. eg the structural formula of Alcohols, Aldehydes or even Alkenes.

(c) Provide suggestions for improvement in relation to Teaching and Learning
It is apparent that the **COMPULSORY/ FORMAL PRACTICAL ASSESSMENT TASK ON ESTERIFICATION** is not done in class. Concepts asked in the question paper should have been understood by the candidates if practical tasks were thoroughly done in class with complete explanations on the practical as a whole. Educators must also fully explain **safety measurements** that must be taken during **practical investigations**.
More exercises on **IUPAC naming** and writing **STRUCTURAL FORMULAE** when the empirical formula is given.
Grade 10 empirical formula and grade 11 molecular formula must be revised in grade 12, as candidates tend to forget basic concepts of Quantitative Aspects of Chemical Change.

(d) Describe any other specific observations relating to responses of learners and comments that are useful to teachers, subject advisors, teacher development etc.
Carelessness – 5 bonds per C-atom or bonds and/ or hydrogen atoms omitted. In some candidates' responses the functional groups are not known by learners Make sure candidates know the importance of a water bath in practical investigations. Structural vs Molecular vs Condensed formulae should be taught and applied so that learners know the difference and are able to apply them correctly.

QUESTION 3
(a) General comment on the performance of learners in the specific question. Was the question well answered or poorly answered?
Candidates did well in this question scoring an average mark of **51%**. This a **14.9% improvement** from 2017.

(b) Why the question was poorly answered? Also provide specific examples, indicate common errors committed by learners in this question, and any misconceptions.
3.1) Definition of boiling point: Incomplete/ Incorrect definition e.g. the "point" at which vapour pressure = atmospheric pressure. / When vapour pressure = atmospheric pressure. / Vapour pressure is in equilibrium with atmospheric pressure. They have a general idea of what the definition should be but cannot give complete definition. Many learners wrote "when liquid turns into gas"
3.2.1.) Learners could not NAME THE FUNCTIONAL GROUP of the carboxylic acid. Most learners wrote "carboxylic acid" instead of "carboxyl group"
3.2.2.) Propanoic acid = IUPAC name. Learners wrote 1-propanoic acid and forfeited the mark.

3.2.3.) Many learners drew the structural formula of B instead of the structural formula of the **FUNCTIONAL ISOMER** of **B.** Some learners gave molecular or condensed formulae.
3.3.) Relationships between boiling point and vapour pressure not understood by many learners. They wrote “highest vapour pressure = highest bp.”
3.4.1) Most learners wrote condition as “the same IMF’s or both have an –OH grp”. It was hard for learners to figure out that they had to compare molar mass, instead they focused on Hydrogen bonds.
3.4.2.) Primary Alcohol was identified. The rest of the question was poorly answered because most could not give a reason/definition of a primary alcohol. They wrote “alcohol gp” is attached to 1 carbon”. / OH group attached to first C-atom/ the end C/ C at the beginning. There were also many variations of the correct definition.
3.4.3.) Majority of candidates could not answer this question correctly. They failed to identify the Intermolecular Forces and could not make the comparison between: • number of sites of hydrogen bonds • strength of intermolecular forces • Energy used to break/ overcome intermolecular forces Some candidates used strange abbreviations e.g. “HB or HD. Some learners talked about “CHAIN LENGTH” instead of intermolecular forces. Could not identify the variable being tested. Many learners said “carboxylic acid has 2 hydrogen bonds and alcohol has 1 hydrogen bond”; i.e. not **2 SITES vs 1 SITE** for H-bonding. Some learners did not read the question correctly and compared **A** and **X**, instead of **B** and **X**.

(c) Provide suggestions for improvement in relation to Teaching and Learning
Suggestions for improvement in respect to teaching and learning: • Revision. • Repetition, repetition, repetition. • Past question papers (Guide candidates on how to answer questions, work previous question papers into lesson planning and homework exercises, and guide learners step-by-step on how to answer specific questions).

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

Teachers should refrain from using unauthorized abbreviations; e.g.

- HB/HD – Hydrogen Bonds
- Rxn – reaction

Examination Guidelines should be used for definitions.

Examination Guidelines and the Chief Markers Report should be used **WITH** the **CAPS** documents when teaching (so that educators can see the depth/extent of a specific topic).

Structural vs Molecular vs Condensed formulae should be taught and applied so that learners know the difference and be able to apply them correctly.

Relationships between physical properties and chain length/homogenous series should be re-enforced. Learners must be given exercises and questions on how to identify the variable being investigated.

QUESTION 4

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

There was on average a poor performance in this question. The average score was **48%** down from last year's score of **53.1%**.

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

4.1.1 Many learners gave the definition on an *isomer* instead of a *homologous series*.

Key words in the definition was missing. Learners view *molecular formula* and *general formula* as the same thing. Learners try to write definitions from recall of how the teacher explained it.

4.1.2 General confusion of learners to distinguish between *substitution* and *addition* reactions.

4.1.3 Some learners did not know what the *inorganic* compound was.

4.1.4 Many learners were putting the Br on the second C-atom.

Most learners did not understand the question and just drew the structural formula of 2-bromobutane.

Many learners drew 1,2-dibromobutane.

4.1.5 Most learners got 1 or 2 out 3 for this question.

Learners recognized the reactants or products or both.

Many learners did not know the products.

4.1.6 Key words in the definition was missing, e.g. "long hydrocarbons",

Learners do not understand that only long chain alkanes undergo cracking, they think all large molecules can undergo cracking.

4.1.7 Very few learners got this wrong

4.2.1 Many learners were unable to write the correct IUPAC name

4.2.2 Many learners drew the structural formula of but-1-ene.

(c) Provide suggestions for improvement in relation to Teaching and Learning
Teachers must use wording cautiously when explaining definition and concepts. EMPHASIS MUST BE PLACED ON MEMORISING DEFINITIONS. Learners should understand the difference between general formula, structural formula and molecular formula. Teachers need to teach these concepts properly. Structural vs Molecular vs Condensed formulae should be taught and applied so that learners know the difference and be able to apply them correctly.

(d) Describe any other specific observations relating to responses of learners and comments that are useful to teachers, subject advisors, teacher development etc.
4.1.1 Many learners gave the definition on an *isomer* instead of *homologous series*. Many learners wrote “same molecular formula”
4.1.2 Many learners answered “addition” or “addition (halogenation)”
4.1.3 Some learners wrote “HB”, a few gave the structural formula of HBr. Some learners wrote H_2O. A few learners wrote “BrH”
4.1.4 Learners drew the structural formula of 2- bromobutane.
4.1.5 Many Learners wrote $C_5H_{12} + O_2 \rightarrow C_2H_{12}O_2$ A few learners wrote $C_5H_{12} + O \rightarrow C_2H_{12}O_2$ and others wrote $C_5H_{12} + H_2O \rightarrow C_2H_{12}O_2$
4.2.1 Many learners wrote butan-1-ol, but-1-ol or buta-1-ol.
4.2.2 Many learners drew the structural formula of but-1-ene. Many learners got the functional group correct.

QUESTION 5
(a) General comment on the performance of learners in the specific question. Was the question well answered or poorly answered?
Even though the average for this question was **46%**, the percentage increased with **15.5%** from last year’s average of **30.5%.**

(b) Why the question was poorly answered? Also provide specific examples, indicate common errors committed by learners in this question, and any misconceptions.
5.1 Candidates did not know how to identify the correct factor that influences the reaction rate.
5.2 Per unit was used out of context Too many candidates mention “the speed of the reaction”. “change” was a key word that was missing most of the time. Key word was left out. Candidates also wrote “Rate of change in concentration of reactants or products per unit time”.
5.3 Candidates do not know that volume does not affect rate of change. Many candidates assume because volume x 2, the rate will double, hence many wrote x = 28 min
5.4.1 & **5.4.2** Learners struggl to understand the Maxwell-Boltzmann distribution curves. If a factor is changed, then a learner cannot apply the collision theory to explain the changes that occurred in the Maxwell-Boltzmann distribution curve.
5.6 Candidates use mol ratio for zinc and hydrochloric acid, whereas zinc was used up because of

the excess of hydrochloric acid. Candidates found it difficult to identify the limiting reagent as some attempted to calculate it using the hydrochloric acid.

(c) Provide suggestions for improvement in relation to Teaching and Learning
Teachers must use wording cautiously when explaining definition and concepts. Emphasis must be placed on memorising definitions. Educators can give small quizzes in class or small tests so that the candidate can familiarise themselves with the correct wording of the definitions as stated in the Examination Guidelines ONLY.
5.2 Teachers should stay away from "nonspecific "terms" like "speed" and "faster".
5.4.1 & **5.4.2** Teachers must emphasise how a change in one of the factors will influence the Maxwell-Boltzmann distribution curve in terms of the collision theory.
5.5.2 Teachers need to revise factors affecting rates using different practical examples in their explanation.
5.6 LIMITING REAGENT must be thoroughly covered in grade 11, so that a candidate can understand when and where limiting reagent should be used, and how to use a limiting reagent in stoichiometric calculations. Old examination papers should be used so that candidates can get enough exposure to stoichiometric calculations, even if limiting reagent was previously used in acids and basis, a candidate needs to understand how to apply their knowledge of quantitative aspects of chemical change to any other topic in the grade 12 CAPS syllabus.
Examination Guidelines and the Chief Markers Report should be used daily in lesson planning. Encourage candidates to use Examination Guidelines to study their definitions. You-tube videos and Phet simulations can also be used to make teaching and learning more interactive and interesting.

(d) Describe any other specific observations relating to responses of learners and comments that are useful to teachers, subject advisors, teacher development etc.
5.1 Many learners wrote "time" or "concentration" instead of "temperature" as the independent variable.
5.2. Many learners wrote "How fast or slow the reaction takes place" of "time is takes for reaction to take place"
5.3 Many learners assume because volume x 2, the rate will double, hence many wrote x = 28 min. A few learners did a calculation. A few wrote x = 14 x 2 = 28

5.4.1 & 5.4.2 Learners struggle to interpret the Maxwell-Boltzmann energy distribution curves.
5.6 Several candidates were unable to substitute correct values into the formula for determining reaction rate. Candidates calculated concentration instead of calculating the rate.

QUESTION 6
(a) General comment on the performance of learners in the specific question. Was the question well answered or poorly answered?
A poor performance of **41%** for question 6, but an increase of **8.4%** was recorded for 2018.

(b) Why the question was poorly answered? Also provide specific examples, indicate common errors committed by learners in this question, and any misconceptions.
6.2. Some learners could not interpret the dipping of the syringe in **COLD WATER** as decreasing the temperature that was needed to answer this question.
6.3. Learners could not apply **Le Chatelier's** principle to identify how the number of moles, K_C, and rate of forward reaction and reverse reactions would be affected. Learners did not know that temperature is the only factor that affects reaction rate.
6.4. Learners did not start with **x** as the initial number of moles of N_2O_4. Those that did went on to score $\frac{8}{8}$. The allocation of marks is quite commendable. It enables learners to score at least half the marks in this question. Learners still have difficulty understanding the concept of mole change. Many of them knew they had to divide by 2 to get the concentration but the mathematical application of this question was a challenge to many of them.

(c) Provide suggestions for improvement in relation to Teaching and Learning
6.1. Each learner should be provided with an Examination Guideline that must be used in the classroom and studying.
6.2. Demonstration of what **COOLING AND HEATING** implies in the context of DYNAMIC EQUILIBRIUM. Learners will be able to see a chemical reaction and conceptualize the increase/decrease in temperature.
6.3. More focus on the different factors and how they impact on a reaction in equilibrium. More examples from past year papers.

(d) Describe any other specific observations relating to responses of learners and comments that are useful to teachers, subject advisors, teacher development etc.	
6.4.	$\boldsymbol{Kc} = \frac{[\boldsymbol{products}]}{[\boldsymbol{reactants}]}$ $\boldsymbol{Kc} = \frac{[\boldsymbol{N_2O_4}]}{[\boldsymbol{NO}]^2}$

QUESTION 7
(a) General comment on the performance of learners in the specific question. Was the question well answered or poorly answered?
The candidates' performance in this question was poor. The average score was **44%** up from last year's score of **50.2%**.

(b) Why the question was poorly answered? Also provide specific examples, indicate common errors committed by learners in this question, and any misconceptions.
7.1.1.) LOWRY-BRONSTED THEORY: Acid = Proton donor. Learners wrote $[H^+]$, $[H_3O^+]$ in solutions = Arrhenius theory. Candidates could not differentiate between the two theories. Some candidates gave the definition for a strong acid "ionizes completely in H_2O".
7.1.2.) Swapping answers with Question 7.1.3
7.1.3.) Most candidates got this question wrong and wrote H_2O as the ampholyte. They are taught H_2O is an example of an ampholyte, hence they wrote only H_2O without working it out.
7.2.1.) Incorrect definition. Often the word "reaction" is left out of the definition or answered by referring to "ionization / addition of H_2O to salt", "dissolving in salt in H_2O", "dissolution of salt in H_2O", "mixture of salt and H_2O".
7.2.2.) This was very poorly answered as the word "neutralize" was related to "hydrolysis". Most learners wrote an acid-base (neutralization) reaction instead of a hydrolysis reaction.
7.3.1.) Almost all attempted this question. Most scored $\frac{2}{3}$ for: • The Formula and • The substitution No marks for final answer as they could not find the antilog or left out the unit. Some used the pH + pOH = 14; and could not proceed any further. Common error: dividing log on both sides of equation (i.e. Mathematics Problem).
7.3.2.) Most learners did not find $\Delta n = n_{initial} - n_{final}$ They used the ratio and correct molar mass correctly but became confused after that. They mixed up when to calculate for an acid and when for CaO. Most scored 3 or 4 marks out of 7. Not using formula sheet, hence incorrect formulae written; e.g. $m = \frac{n}{Mr}$ $m = \frac{n}{V}$ $n = \frac{c}{V}$ Using molar volume equation. $n = \frac{v}{Vm}$ Leaving out units.

(c) Provide suggestions for improvement in relation to Teaching and Learning
Start the teaching of basic stoichiometry in Grade 10 as prescribed by **CAPS.** Continue in Grade 11 = revision and consolidation plus additional stoichiometry, **THEN** proper teaching and revision (consolidation) in Grade 12. Use Examination Guidelines and CAPS documents for definitions and thorough teaching. Each learner from grade 10 to 12 should have a copy of the Examination Guidelines which include content coverage, definitions and data sheets needed.

Candidates should know how to use the formula sheet. This should be introduced from Grade 10 and not just be given in the examination. Each learner must have his/her own copy of the formula sheet in their books so that they can get used to it.

- Candidates must be made aware on how marks are awarded for a calculation in Physical Sciences

  Formula (Correctly written or copied from the information sheet)

  Substitution

  Answer and SI-unit

Educators must emphasize in class: **"NO UNIT, NO MARK!"**.

Teach lessons that molar volume equation is only used for **GASES** at **STP**.

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

- Incorrect/incomplete definitions
- Incorrect formulae (not using the formula sheet)
- Incorrect substitution/ partial substitution
- Errors in stoichiometry calculations.

COMMENTS:

- Start stoichiometry in Grade 10; continue in Grade 11 and revise in Grade 12.
- Exercise must be given regularly.
- Revision done continuously.
- Past question papers **MUST** be consulted to guide the candidates, DO NOT just hand out question paper and memo.
- The questions in the textbooks only test basic applications, but not in-depth calculations.
- Use Examination Guidelines and CAPS document when teaching.

Familiarize yourself and your learners with the formula sheet. Learners lose too many marks for using/writing incorrect formulae.

QUESTION 8

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

There was poor learner performance in this question. The average score was **43%** down from last years' score of **50.2%**.

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

8.1.1. Many educators do not consult exam guidelines. Many wrote Oxidation is transfer of electrons or Oxidation is a decrease of electrons or Oxidation is a substance….

Candidates do not refer to oxidation as a process.

8.1.2. Table of Standard Red Potentials must be practiced.

Candidates wrote the wrong equation from table $Fe \rightarrow Fe^{2+} + 2e^-$

8.1.4. Many candidates referred to the oxidizing ability of Cu^{2+}, as a stronger oxidizing agent than Fe/Fe^{2+}, instead of Fe is a stronger reducing agent than Cu.

8.1.5. In terms of oxidizing agent. Learners did not read the question or understand what was asked.
8.2.1. Majority of learners could not answer question properly and those that got it right could not balance it. Many learners wrote the cell notation ($Fe/Fe^{3+}//Cu^{2+}/Cu$) instead of the overall (net) cell reaction ($3Cu^{2+} + 2Fe \rightarrow 3Cu + 2Fe^{2+}$).
8.2.2. Equation written incorrectly from data sheet. Learners looked at wrong equation on Table of Reduction Potentials and ended up with a negative E_{cell} potential. Candidates also used unconventional abbreviations e.g. $E_{cell} = E_{red} – E_{ox}$/ $E_{cell} = E_{cat} - E_{an}$

(c) Provide suggestions for improvement in relation to Teaching and Learning
Definitions should be studied from the Examination Guidelines. Each learner must be provided with a copy of the Examination Guidelines. The table of Standard Reduction Potentials must be explained and taught to learners so that they can understand, interpret and apply it. Definitions e.g. Reducing agent, oxidizing agent, oxidation and reduction need to be taught to learners thoroughly in grade 11 and revised in grade 12. The meaning of E_{cell} values: Many candidates got negative E_{cell} values or wrong E_{cell} values which means that educators do not explain the table properly. There is a misconception about the explanation of standard reduction potentials when referring to the table. The candidates' response to the answers based on the table is "When you go down the table of standard reduction potentials" or "when you descend the table of standard reduction potentials". They don't know how to express themselves or give an explanation regarding the table in **8.1.4** Many learners gave the cell notation instead of the overall (net) cell reaction.

(d) Describe any other specific observations relating to responses of learners and comments that are useful to teachers, subject advisors, teacher development etc.
Most of our candidates are not English First Language speakers. Question **8.1.4** and **8.1.5** was very unclear. Majority of the candidates responded in terms of oxidizing agent. Because of the language challenge they should be guided as to how to respond to the questions.

QUESTION 9
(a) General comment on the performance of learners in the specific question. Was the question well answered or poorly answered?
Question 9 showed the HIGHEST PERFORMANCE INCREASE from 2017, an increase of **20.6%** was recorded and the average for this question increased from **23.4%** in 2017 to **44%** in 2018.

(b) Why the question was poorly answered? Also provide specific examples, indicate common errors committed by learners in this question, and any misconceptions.
9.1. This question was poorly answered. Teachers use textbooks during their lesson preparation instead of the approved policy documents and examination guidelines. Most learners wrote electrical energy is converted to **Mechanical Energy**; they confuse energy conversion in generators and motors with that in electrolytic cells. Instead of electrical energy to chemical energy most learners have written: - Electrical to Chemical - Electricity to Chemical process - Electrical energy to Mechanical Energy. - Defined electrolysis and electrolyte. Many learners did not know the proper definition of an electrolytic cell and instead provided one for an electrolyte. The common error regularly made by learners was electric energy to mechanical energy.
9.2. Poorly answered question, most learners did not attempt it. They struggled to write chemical name/formula of a soluble salt used, instead they wrote solids. Most learners wrote: - $Cu_{(s)}$, Cu^{2+}, $CuCO_3$, $Zn_{(s)}$ Learners gave Cu^{2+} as an electrolyte instead of $Cu(NO_3)_2$, $CuSO_4$ or $CuCl_2$ which are soluble copper salt. Some gave wrong chemical formulae for Copper salts. e.g. CuCl, $CuNO_3$ Some wrote reduction and oxidation reactions $Cu^{2+} + 2e^-$ Leaners found this question difficult to answer due to knowing very little about solution solubility rules learnt in grade 10. Many learners wrote Cu^{2+} ions instead of the salt. Common error: There were charges on the final compound and incorrect valency.

9.3. Poorly answered questions, most learners guessed the answer; they could not distinguish between anode and cathode. Most of them wrote: - $Cu^{2+} + e^- \rightarrow Cu$ - $Cu^{2+} + 2e^-\ Cu$ - $Cu \rightarrow Cu^{2+} + 2e^-$ - $Cu^{2+} + 2e^- = Cu$ They omitted charges in their equations. Most leaners knew that pure copper is formed at the cathode, but some leaners did not know the difference between oxidation half-reaction and the reduction half-reaction. Learners did not understand the question and wrote the equation with both arrows.

9.4. Well answered although some learners guessed by writing all the metals that were given on the question paper.

Most learners wrote only one metal instead of two.

Learners are unable to use standard reduction potential.

This question seemed a bit unfair. The concept of redox strength was already tested in questions **8.1.4** and **8.1.5**, so learners were penalised three times if they did not know the concept. Most learners gave only one metal showing that they did not understand the question.

(c) Provide suggestions for improvement in relation to Teaching and Learning

During lesson preparation, planning and demonstrations, teachers **<u>must</u>** use the policy documents, CAPS, Examination guidelines and Chief Marker's reports.

More informal assessments should be done with regular feedback to learners to avoid these misconceptions and to expose them in different questioning styles.

In **Question 9** basic stoichiometry and making learners familiar with the periodic table of elements (grade 7-10) would help to write correct chemical formulae and correct chemical equations.

Teacher must make it a point to use examination guidelines when teaching definitions and make copies available for learners. Teachers must revise solubility rules, valency and writing chemical formulae from grade 10. Teachers must also use different teaching methods to get concepts across, especially with videos and simulations. Teachers must use/teach the reduction potential tables properly. Teachers should try and complete the chapter on fertilizers earlier. Leaners must study all the processes and the preparation of ammonium nitrate and ammonium sulfate. Leaners must be given opportunities to answer different examples of the fertilizer calculations. Educators must always ensure to have revision before exams.

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

From learners' responses and misconceptions reflected on question 9 and 10.

Subject advisors should ensure that all teachers for the subject have exam guidelines and policy documents and use it effectively.

Informal assessments must include all cognitive levels and should be done on a regular basis (SMT to monitor that)

Syllabus must be tracked to make sure that all topics are taught within the stipulated time and intense revision is done.

Common memo discussions for each formal assessment should be done by teachers at district level together with the district subject advisors.

Teachers must be supported by the subject advisors.

Team and peer teaching and preparation are recommended in order to share knowledge. Teachers must diversify their teaching material, not relying on one prescribed textbook. They should also try to get or download videos to explain difficult concepts.

QUESTION 10
(a) General comment on the performance of learners in the specific question. Was the question well answered or poorly answered?
This question recorded the LOWEST LEARNER PERFORMANCE. The average score was **37%** down **5.4%** compared to **42.4%** in 2017.

(b) Why the question was poorly answered? Also provide specific examples, indicate common errors committed by learners in this question, and any misconceptions.
10.1.1 & 10.1.2. Fairly well answered question, but some learners gave wrong spelling of the processes, others just guessed between Haber, Ostwald and Contact process. e.g: Hamba process; Heyber process; Hamper process; Oswayd process; Oshwald process.
10.2.1. Most learners wrote NH_3, they do not understand the flow diagrams. Some learners write the incorrect formula of ammonium nitrate e.g. NH_3HNO_3, $(NH_4)NO_3$
10.2.2. Learners did not write the correct formula for an iron oxide, the problem lies with basic Chemistry of ions, 'valency' from lower grades Common errors: Fe_3O_2, FeO_2, Fe_2O_4
10.3. Most poorly answered question: Learners could not write equations at all, they did not know that this question was about the preparation of ammonium sulphate. 80% of them wrote the reaction for the preparation of Ammonium nitrate. If the equation was correctly identified, then only reactants were correct, but products were wrong. e.g. $NH_3 + H_2SO_4 \rightarrow NH_4SO_4$ or NH_4SO_3 Learners seemed not to remember what they were taught in earlier grades.

10.4. Most learners could not integrate Grade 10 work on mass, molar mass and Percentage Composition. Prior knowledge was lacking. It seems this topic (fertilisers) is not covered by most schools. Educators leave this chapter to last, and therefore they rush through it. Candidates do not get enough exposure to the type of questions asked and struggle with writing balanced chemical equations. Learners lack basic knowledge on ratio and proportion. They also do not understand the meaning of percentage. 20% is interpreted and used as 20, instead of $\frac{20}{100}$ or 0,2. Most learners did not attempt **Question 10.4** at all.

(c) Provide suggestions for improvement in relation to Teaching and Learning
Regular use of standard reduction potential table should be highlighted, and each candidate must have a copy of it to familiarize themselves with it. Educators should have a memorandum for the past question papers in order to know exactly what is expected because most candidates' misconceptions come from educators teaching methods and short-hand writing. Educators should manage the time in teaching these topics (fertilizers and electrochemistry) so as to have more time to revise and practice correct spelling of names and writing chemical formulae. Candidates and educators must be encouraged to take definitions from the Examination Guidelines. Educators must revise solubility rules, valency and writing chemical formulae from grade 10. Educators must teach the reduction potential tables properly. Teachers should try and complete the chapter on fertilizers earlier. Leaners must study all the processes and the preparation of ammonium nitrate and ammonium sulfate. Leaners must be given opportunities to answer different examples of the fertilizer calculations. Educators must always ensure to have revision before exams.

(d) Describe any other specific observations relating to responses of learners and comments that are useful to teachers, subject advisors, teacher development etc.
More revision should be done with candidates with different question styles and to boost their level of confidence to finish the question paper as some have not completed question **10.4**. Teachers should stick to the marking guidelines and stop giving learners marks they do not deserve e.g. if a unit is omitted, learners are awarded marks. In each type of assessment definitions must be included formula sheet must be given to learners should be encouraged to use/take formulae as they are from formula sheet. Teachers must diversify their teaching material, not relying on one prescribed textbook. They should also try to get or download videos to explain difficult concepts.