Province of the
EASTERN CAPE
EDUCATION

NATIONAL SENIOR CERTIFICATE

GRADE 11

NOVEMBER 2013

PHYSICAL SCIENCES P2 CHEMISTRY MEMORANDUM

MARKS: **150**

This memorandum consists of 11 pages.

GUIDELINES FOR MARKING

This section provides guidelines for the way in which marks will be allocated. The broad principles must be adhered to in the marking of Physical Sciences tests and examinations.

1.1 MARK ALLOCATION

1.1.1 **Definitions:** Two marks will be awarded for a correct definition. No marks will be awarded for an incorrect or partially correct definition.

1.1.2 **Calculations:**

- Marks will awarded for: correct formula, correct substitution, correct answer with unit.
- No marks will be awarded if an incorrect or inappropriate formula is used, even though there may be relevant symbols and applicable substitutions.

1.1.3 **Explanations and interpretations:** Allocation of marks to questions requiring interpretation or explanation will differ and may include the use of rubrics, checklists, memoranda, etc. In all such answers emphasis must be placed on scientific concepts relating to the question.

1.2 FORMULAE AND SUBSTITUTIONS

1.2.1 Mathematical manipulations and change of subjects of appropriate formulae carry no marks, but if a candidate starts with the correct formula and then changes the subject of the formula incorrectly, marks will be awarded for the formula and the correct substitutions. The mark for the incorrect numerical answer is forfeited.

1.2.2 When an error is made during **substitution into a correct formula**, a mark will be awarded for the correct formula and for the correct substitutions, but **no further marks** will be given.

1.2.3 Marks are only awarded for a formula if a calculation had been **attempted,** i.e. substitutions have been made or a numerical answer given.

1.2.4 Marks can only be allocated for substitutions when values are substituted into formulae and not when listed before a calculation starts.

1.2.5 All calculations, when not specified in the question, must be done to two decimal places.

1.3 **UNITS**

1.3.1 Candidates will only be penalised once for the repeated use of an incorrect unit **within a question or sub-question**.

1.3.2 Units are only required in the final answer to a calculation.

1.3.3 Marks are only awarded for an answer, and not for a unit per se. Candidates will therefore forfeit the mark allocated for the answer in each of the following situations:

- correct answer + wrong unit
- wrong answer + correct unit
- correct answer + no unit.

1.3.4 SI units must be used except in certain cases, e.g. $V \cdot m^{-1}$ instead of $N \cdot C^{-1}$, and $cm \cdot s^{-1}$ or $km \cdot h^{-1}$ instead of $m \cdot s^{-1}$ where the question warrants this. (This instruction only applies to Paper 1.)

1.4 **POSTIVE MARKING**

Positive marking regarding calculations will be followed in the following cases:

1.4.1 **Sub-question to sub-question**: When a certain variable is calculated in one sub-question (e.g. 3.1) and needs to be substituted in another (3.2 or 3.3), e.g. if the answer for 3.1 is incorrect and is substituted correctly in 3.2 or 3.3, **full marks** are to be awarded for the subsequent sub-questions.

1.4.2 **A multi-step question in a sub-question**: If the candidate has to calculate, for example, current in the first step and gets it wrong due to a substitution error, the mark for the substitution and the final answer will be forfeited.

1.4.3 If a final answer to a calculation is correct, full marks will not automatically be awarded. Markers will always ensure that the correct/ appropriate formula is used and that workings, including substitutions, are correct.

1.4.4 Questions where a series of calculations have to be made (e.g. a circuit diagram question) do not necessarily always have to follow the same order. FULL MARKS will be awarded provided it is a valid solution to the problem. However, any calculation that will not bring the candidate closer to the answer than the original data, will not count any marks.

1.4.5 If one answer or calculation is required, but two given by the candidate, only the first one will be marked, irrespective of which one is correct. If two answers are required, only the first two will be marked, etc.

1.4.6 Normally, if based on a conceptual mistake, an incorrect answer cannot be correctly motivated. If the candidate is therefore required to motivate in QUESTION 3.2 the answer given to QUESTION 3.1, and 3.1 is incorrect, no marks can be awarded for QUESTION 3.2. However, if the answer for e.g. 3.1 is based on a calculation, the motivation for the incorrect answer for 3.2 could be considered.

1.4.7 If instructions regarding method of answering are not followed, e.g. the candidate does a calculation when the instruction was to ***solve by construction and measurement*****,** a candidate may forfeit all the marks for the specific question.

1.4.8 For an **error of principle, no marks** are awarded (Rule 1) e.g.: If the potential difference is 200 V and resistance is 25 Ω, calculate the current.

CORRECT	ANSWER (1)	POSSIBLE	ANSWER (2)	POSSIBLE
$I = \frac{V}{R}$ ✓ $= \frac{200}{25}$ ✓ $= 8A$ ✓	$R = \frac{V}{I}$ ✓ $= \frac{200}{25}$ ***x*** $= 8A$ ***x***	$R = \frac{V}{I}$ ***x*** $= \frac{200}{25}$ $= 8A$	$R = \frac{V}{I}$ ✓ $I = \frac{R}{V}$ ***x*** $= \frac{25}{200}$ $= 0{,}125\ A$ ***x***	$I = \frac{V}{R}$ ✓ $= 8A$ ✓

1.5 GENERAL PRINCIPLES OF MARKING IN CHEMISTRY

The following are a number of guidelines that specifically apply to Paper 2.

1.5.1 When a chemical **FORMULA** is asked, and the **NAME** is given as answer, only one of the two marks will be awarded. The same rule applies when the **NAME** is asked and the **FORMULA** is given.

1.5.2 When redox half-reactions are to be written, the correct arrow should be used. If the equation

$$H_2S \rightarrow S + 2H^+ + 2e^- \ (^2/_2)$$

is the correct answer, the following marks will be given:

$H_2S \leftrightharpoons S + 2H^+ + 2e^- \ (^1/_2)$

$H_2S \leftarrow S + 2H^+ + 2e^- \ (^0/_2)$

$S + 2H^+ + 2e^- \leftarrow H_2S \ (^2/_2)$

$S + 2H^+ + 2e^- \leftrightharpoons H_2S \ (^0/_2)$

1.5.3 When candidates are required to give an explanation involving the relative strength of oxidising and reducing agents, the following is unacceptable:

- Stating the position of a substance on Table 4 only (e.g. Cu is above Mg).
- Using relative reactivity only (e.g. Mg is more reactive than Cu).
- The correct answer would for instance be: Mg is a stronger reducing agent than Cu, and therefore Mg will be able to reduce Cu^{2+} ions to Cu. The answer can also be given in terms of the relative strength as electron acceptors and donors.

1.5.4 One mark will be forfeited when the charge of an ion is omitted per equation.

1.5.5 The error carrying principle does not apply to chemical equations or half-reactions. For example, if a learner writes the wrong oxidation/reduction half-reaction in the sub-question and carries the answer to another sub-question (balancing of equations or calculations of E^{θ}_{cell}) then the learner is not credited for this substitution.

1.5.6 *When a calculation of the cell potential of a galvanic cell is expected, marks will only be awarded for the formula if one of the formulae indicated on the data sheet (Table 2) is used. The use of any other formula using abbreviations etc. will carry no marks.

1.5.7 In the structural formula of an organic molecule all hydrogen atoms must be shown. Marks will be deducted if hydrogen atoms are omitted.

1.5.8 When a structural formula is asked, marks will be deducted if the candidate writes the condensed formula.

1.5.9 *When an IUPAC name is asked, and the candidate omits the hyphen (e.g. instead of 1-pentene the candidate writes 1 pentene), marks will be forfeited.

SECTION A

QUESTION 1

1.1 Ionic bond ✓ (1)

1.2 Trigonal bipyramidal ✓ (1)

1.3 Limiting reagent ✓ (1)

1.4 Brønsted base ✓ (1)

1.5 Cyanidation ✓ (1)
[5]

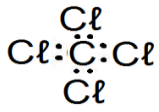
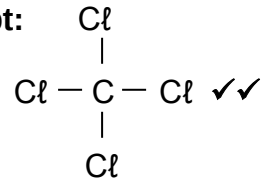
QUESTION 2

2.1 C ✓✓ (2)
2.2 A ✓✓ (2)
2.3 C ✓✓ (2)
2.4 B ✓✓ (2)
2.5 B ✓✓ (2)
2.6 C ✓✓ (2)
2.7 A ✓✓ (2)
2.8 C ✓✓ (2)
2.9 C ✓✓ (2)
2.10 B ✓✓ (2)
[20]

TOTAL SECTION A: 25

SECTION B

QUESTION 3

3.1  ✓✓ **Accept:**  ✓✓ (2)

3.2 **$CC\ell_4$:** tetrahedral ✓ **CO_2:** linear ✓ (2)

3.3 Van der Waals/London forces✓ (1)

3.4 CH_4 ✓ and CO_2 ✓ (2)

3.5 Both the C – H and C – O bonds are covalent due to the electronegativity difference ✓ but the charge distribution on both of the molecules as a whole is symmetrical ✓ and therefore these molecules are non-polar. (2)

3.6 C ✓ (1)

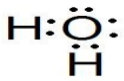
3.7 NH_3 ✓ (1)

[11]

QUESTION 4

4.1 Hydrogen bonds ✓ (1)

4.2 The amount of heat required for evaporation to take place. ✓ (1)

4.3  ✓✓ **OR**  ✓ (2)

4.4 Angular/bent ✓ (1)

4.5 Polar. ✓
- The O atom is more electronegative than the H atom. ✓
- Both dipole moments work in the same direction to give a net dipole moment in the direction of the O atom. ✓
- The oxygen side of the molecule becomes slightly more negative than the hydrogen side ✓ and a polar molecule forms. (4)

4.6 KCℓ ✓
- The KCℓ is an ionic substance with Coulomb forces ✓which are comparable in size with the hydrogen bonding found in water. ✓ (3)

4.7 Capillarity ✓ Adhesion forces between the water molecules and the glass causes water to rise up the edges of the glass. ✓✓ (3)

[15]

QUESTION 5

5.1 $A\ell_2(SO_4)_3$ ✓ (1)

5.2 $M\ [A\ell_2(SO_4)_3]$ = (27 x 2) + (32 x 3) + (16 x 12)
= 54 + 96 + 192
= 342 g·mol^{-1} ✓

$\%A\ell = \frac{54}{342} \times 100 = 15,79\%$ ✓
$\%S = \frac{96}{342} \times 100 = 28,07\%$ ✓
$\%O = \frac{192}{342} \times 100 = 56,14\%$ ✓ (4)

5.3 $n(A\ell) = \frac{15,79}{27} = 0,585$ ✓ $\therefore \frac{0,585}{0,585} = 1$
$n(S) = \frac{28,07}{32} = 0,877$ ✓ $\therefore \frac{0,877}{0,585} = 1,5$
$n(O) = \frac{56,14}{16} = 3,509$ ✓ $\therefore \frac{3,509}{0,585} = 6$

mole ratio = 1 : 1,5 : 6 (x2)
= 2 : 3 : 12 ✓

$\therefore$ Empirical formula: $A\ell_2S_3O_{12}$ ✓ (5)
[10]

QUESTION 6

6.1 6.1.1 What is the relation between pressure and volume? ✓✓ (2)

6.1.2 Volume is directly/inversely proportional ✓ to pressure. ✓ (2)

1 mark for both variables correct/1 mark for relationship

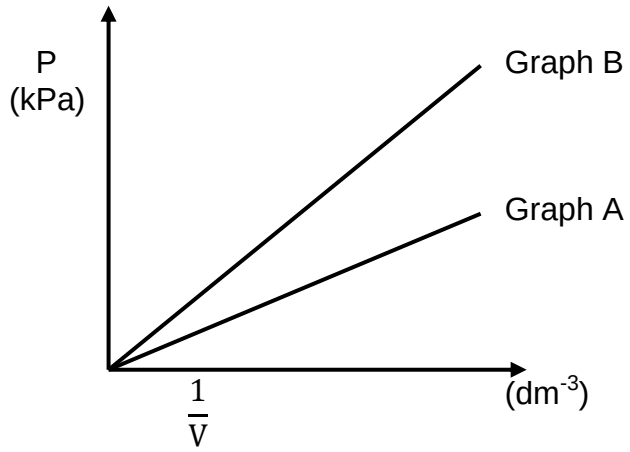
6.1.3 Temperature ✓ and amount of gas ✓ (2)

6.1.4 P_1 = 100 kPa ; $\frac{1}{V_1} = x$ dm^{-3}
P_2 = 120 kPa ; $\frac{1}{V_2} =$ 3,5 dm^{-3} $\therefore V_2 = \frac{1}{3,5} = 0,29\ dm^3$
$P_1V_1 = P_2V_2$ ✓
100 ✓ x V_1 = 120 ✓ x 0,29 ✓
$\therefore V_1$ = 0,35 dm^3 ✓
$x = \frac{1}{V_1} = \frac{1}{0,35} =$ 2,86 dm^{-3} ✓ (6)

6.1.5 Boyle's law ✓
The volume of a fixed amount of gas is inversely proportional to the pressure on the gas if the temperature remains constant. ✓ (2)

6.1.6 $P \propto \frac{1}{V}$ ✓ (1)

6.1.7



Guidelines for marking graph	
Both axes labelled correctly	✓
Steeper gradient for graph B	✓

(2)

6.2 The gas particles inside the tyre have kinetic energy and collide with the inside of the tyre. These collisions are responsible for the pressure inside the tyre. ✓ When the car is moving, the friction between the tyre and the road increases the temperature of the tyre. ✓ The heat from the tyre is transferred to the gas particles with every collision of the particles against the tyre. ✓ Since temperature (of a gas) is directly proportional to the kinetic energy of the gas particles, ✓ This results in the gas particles gaining more energy and colliding with the sides of the tyre more often and with greater force. ✓ The pressure inside the tyre will increase. ✓ The result is that the tyre could blow/burst. ✓ (7)

[24]

QUESTION 7

7.1 $pV = nRT$ ✓

$(101,5 \times 10^3)$ ✓ $\times (70 \times 10^{-3})$ ✓ $= n \times 8,31$ ✓ $\times (273 + 23)$ ✓

$\therefore n = 2,89$ mol ✓

$n = \frac{m}{M} \Rightarrow 2,89 = \frac{m}{28}$ ✓

$\therefore m = 80,92$ g ✓ (8)

7.2 Less (energy) ✓

- ΔH is less than zero ✓ (2)

7.3 A side-impact collision/A head-on collision with another vehicle which is also travelling at a high speed/A situation where the car overturns/rolls over. ✓✓ (2)

[12]

QUESTION 8

8.1 $2H_2 + O_2$ (✓reactants) $\rightarrow 2H_2O$ (✓products) (✓bal.) (3)

8.2 Hydrogen.✓ Oxygen is in excess.✓ (2)

8.3 $n(H_2)=\frac{m}{M}$ ✓ $=\frac{25}{2}$ ✓ = 12,5 mol H_2 ✓

from balanced equation: 2 mol H_2 produces 2 mol H_2O
∴ 12,5 mol H_2 will produce 12,5 mol H_2O ✓

Theoretical yield: $n=\frac{m}{M} \Longrightarrow 12,5=\frac{m}{18}$ ✓ ∴ m = 225 g ✓

$$\% \text{ yield} = \frac{\text{actual yield}}{\text{theoretical yield}} \times 100\%$$
$$= \frac{140}{225} \times 100\% \checkmark$$
$$= 62,22\% \checkmark$$

(8)
[13]

QUESTION 9

9.1 Endothermic (reaction) ✓
- ΔH is greater than zero/energy is absorbed/ heat is taken in ✓ (2)

9.2 Photosynthesis ✓
- During endothermic reactions, more energy is absorbed than released. ✓
- The graph shows that the energy of the products is more than that of the reactants which indicates that more energy was absorbed than released. ✓ (3)

9.3 A – E_A/activation energy ✓ B – ΔH/heat of reaction/enthalpy change ✓ (2)

9.4 Enzymes increase the reaction rate ✓ by lowering the activation energy. ✓ (2)
[9]

QUESTION 10

10.1 An ampholyte is a substance that can act as either an acid or a base. ✓✓
H_2O ✓ (3)

10.2 $HC\ell$ (aq) + H_2O (ℓ) → $C\ell^-$ (aq) + H_3O^+ (aq)
$acid_1$ $base_2$ $base_1$ $acid_2$ ✓✓
OR
$HC\ell$ is an acid and $C\ell^-$ is its conjugate base ✓
H_2O is a base and H_3O^+ is its conjugate acid ✓ (2)

10.3 10.3.1 Indicator ✓ (1)

10.3.2 (i) ✓
$HC\ell$ is an acid ✓ and forms H_3O^+ which lowers the pH ✓ (3)

10.4 ammonium chloride ✓ $NH_4C\ell$ ✓ (2)
[11]

QUESTION 11

11.1 Oxidation number in SO_2 = 4 OR +4 ✓and in SO_3 = 6 OR +6 ✓ (2)

11.2 Oxidation ✓ (1)

11.3 Reducing agent ✓
Its oxidation number is increased which indicates it is oxidised.✓ (2)
[5]

QUESTION 12

12.1 12.1.1 Calcination and smelting ✓ (1)

12.1.2 Zinc/Zn ✓ (1)

12.1.3 Activated carbon ✓
It is much more cost effective/cheaper/It is less expensive ✓ (2)

12.1.4 Cyanide is poisonous ✓ and when it enters water can cause death of aquatic life. ✓ (2)

12.1.5 (Any ONE – Accept any other valid answer)
- Gold earns large sums of foreign currency for the country ✓✓
- Gold contributes to economic growth ✓✓
- The profits from the sale of gold can be used to develop the country's infrastructure ✓✓
- The mining of gold creates jobs ✓✓ (2)

12.2 12.2.1 Fossil fuel reserves are limited/will be used up eventually ✓✓ (2)

12.2.2 Coal ✓ (1)

12.2.3 (Any TWO – Accept any other valid answer)
- It is relatively inexpensive to mine. ✓
- The mining of coal is well established. ✓
- The technology to produce energy from coal is well established in SA. ✓
- It is readily available/there are abundant reserves available in SA. ✓
- It is currently the cheapest way of producing energy in SA. ✓ (2)

12.2.4 (Any ONE – Accept any other valid answer)
- Fossil fuel reserves are limited/will be used up eventually ✓✓
- Burning of fossil fuels pollutes the air/contributes to climate change/global warming ✓✓ (2)
[15]

TOTAL SECTION B: 125
GRAND TOTAL: 150