basic education

Department:
Basic Education
REPUBLIC OF SOUTH AFRICA

NATIONAL SENIOR CERTIFICATE/ *NASIONALE SENIOR SERTIFIKAAT*

GRADE/*GRAAD* 11

PHYSICAL SCIENCES: CHEMISTRY (P2)/
FISIESE WETENSKAPPE: CHEMIE (V2)

NOVEMBER 2016

MEMORANDUM

MARKS/*PUNTE*: 150

This memorandum consists of 11 pages.
Hierdie memorandum bestaan uit 11 bladsye.

QUESTION 1/*VRAAG 1*

1.1   B ✓✓   (2)

1.2   D ✓✓   (2)

1.3   D ✓✓   (2)

1.4   C / B ✓✓   (2)

1.5   A ✓✓   (2)

1.6   A ✓✓   (2)

1.7   B ✓✓   (2)

1.8   A ✓✓   (2)

1.9   D ✓✓   (2)

1.10   C ✓✓   (2)
[20]
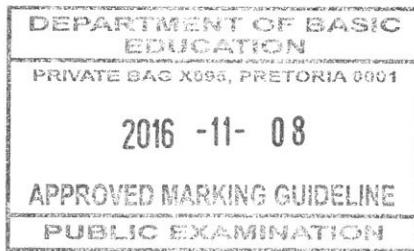
QUESTION 2/*VRAAG 2*

2.1   Electronegativity is a measure of the tendency of an atom in a molecule to attract bonding electrons. ✓✓
Elektronegatiwiteit is 'n maatstaf van die neiging van 'n atoom in 'n molekuul om bindingselektrone aan te trek✓✓   (2)

2.2

Marking Criteria/*Nasienkriteria*
• All atoms shown with 8 electrons around it.
Alle atome met 8 elektrone rondom elk geteken
• Two electron pairs on O atoms shared with two F atoms as shown.
Twee elektronpare op O-atome gedeel met twee F-atome, soos getoon

NOTE: Accept bent/angular Lewis structure
NOTA: *Aanvaar hoekige struktuur*   (2)

2.3 $\Delta EN\ (O - F) = 4 - 3{,}5 = 0{,}5$✓
$0 < \Delta EN < 1$, the bond is weakly <u>polar</u>/*die binding is swak <u>polêr</u>*✓   (2)

2.4   • The <u>bonds in both molecules are polar</u>✓ due to the difference in electronegativity between O and F and C and O.
• The shape of the OF_2 molecule is <u>angular/bent</u>✓ and because the charge distribution is <u>asymmetrical</u>✓ around the central atom the molecule is polar.
• The shape of the CO_2 molecule is <u>linear</u>✓ and because the charge distribution is <u>symmetrical</u> around the central atom the molecule is non-polar.
• *Die <u>bindings in albei molekules is polêr</u>✓ as gevolg van die verskil in elektronegatiwiteit tussen O en F en tussen C en O.*
• *Die vorm van die OF₂-molekule is <u>hoekig</u> ✓en omdat die ladings <u>asimmetries</u> ✓versprei is rondom die sentrale atoom is die molekuul polêr*
• *Die vorm van die CO₂-molekuul is <u>lineêr</u> ✓en omdat die ladings <u>simmetries</u> versprei is rondom die sentrale atoom is die molekuul nie-polêr*   (4)

Marking Criteria/*Nasienkriteria*
• Both Polar bonds✓ / *Beide het polêre bindings*✓
• Angular/ Bent ✓ / *Hoekig*✓
• Linear ✓ / *Lineêr*✓
• Symmetrical/asymmetrical ✓ / *Simmetries/Asimmetries*✓

2.5.1   X = bond energy ✓
Y = bond length ✓
X = *bindingsenergie*✓
Y = *bindingslengte*✓   (2)
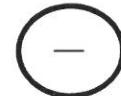
2.5.2   The energy needed to break one mole of its molecules into separate atoms.✓✓
Die energie benodig om een mol van sy molekules in aparte atome op te breek.✓✓   (2)

2.5.3   The higher the bond order (number of bonds between atoms),✓ the shorter the bond length✓, the stronger the bond and the bond energy increases✓.

The lower the bond order✓, the longer the bond length✓, the weaker the bond and the bond energy decreases. ✓

Hoe hoër die bindingsorde, ✓ hoe korter is die bindingslengte, ✓ hoe sterker die binding en die bindingsenergie neem toe.✓

Hoe laer die bindingsorde, ✓ hoe langer is die bindingslengte, ✓ hoe swakker die binding en die bindingsenergie neem af.✓   (3)
[17]

QUESTION 3/*VRAAG 3*

3.1   The temperature at which the vapour pressure of a substance equals to the atmospheric pressure.✓✓
Die temperatuur waarteen die dampdruk van 'n stof aan die atmosferiese druk gelyk is.✓✓   (2)

3.2   What is the relationship between intermolecular forces and boiling point?✓✓
Wat is die verband tussen intermolekulêre kragte en kookpunt? ✓✓

How does the strength of the intermolecular force affect the boiling point? ✓✓   (2)
Hoe sal die sterkte van die intermolekulêre kragte die kookpunt beïnvloed? ✓✓

NOTE : Identifying independent and dependent variables – 1 mark/ *Aandui van korrekte veranderlikes – 1 punt*
Formulating a question regarding the relationship between variables – 1 mark
Formuleer van 'n vraag met betrekking tot die veranderlikes – 1 punt

3.3   Glycerine✓It has the highest boiling point.✓
Glisirien ✓ Dit het die hoogste kookpunt.✓   (2)

3.4   No,✓
boiling point is only affected by the atmospheric pressure✓.
Accept
boiling point is not affected by volume of the liquid. ✓
boiling point is affected by the intermolecular forces which in this case did not change. ✓
Nee✓
kookpunt word slegs deur die atmosferiese druk beïnvloed. ✓

Aanvaar:
Kookpunt word nie deur volume beïnvloed nie✓
Kookpunt word deur intermolekulêre kragte beïnvloed wat in die geval nie verander het nie. ✓   (2)

3.5   Avoid direct heating with open flame✓
Work in a well-ventilated room/use a fume cupboard   ✓
Accept
Protective clothing, heating in a water bath./
Vermy dit om naby 'n oop vlam te werk✓   (2)
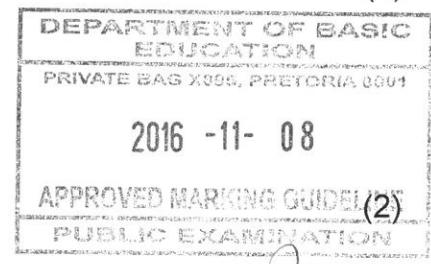
Werk in 'n goed geventileerde vertrek/gebruik 'n dampkas✓

Aanvaar:
Dra beskermende klere, verhit in 'n waterbad

3.6   Nail polish remover✓, lowest boiling point/ weakest intermolecular forces✓

   Naellakverwyderaar✓, *laagste kookpunt / swakste intermolekulêre kragte*✓   (2)

3.7   Sunflower oil has a large molecular mass✓✓
   Sonneblomolie het 'n groot molekulêre massa✓✓   (2)
   [14]

QUESTION 4/*VRAAG 4*

4.1.1
- When the temperature of a gas increases, the average speed/kinetic energy of the particles also increase✓.
- At constant pressure the volume will increase✓.

- *Wanneer die temperatuur van 'n gas toeneem, sal die gemiddelde spoed/ kinetiese energie van die deeltjies ook toeneem.* ✓
- *By 'n konstante druk sal die volume toeneem*✓

   OR/*OF*

- When the temperature of a gas decreases, the average speed / kinetic energy of the particles also decrease✓.
- At constant pressure the volume will decrease✓

- *Wanneer die temperatuur van 'n gas afneem, sal die gemiddelde spoed/ kinetiese energie van die deeltjies ook afneem.* ✓
- *By konstante druk sal die volume afneem*✓   (2)

4.1.2,
4.1.3
and/*en*
4.1.6

Graph of volume against temperature
Grafiek van volume teenoor temperatuur
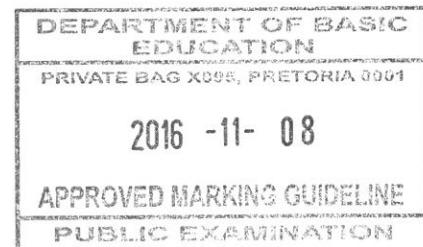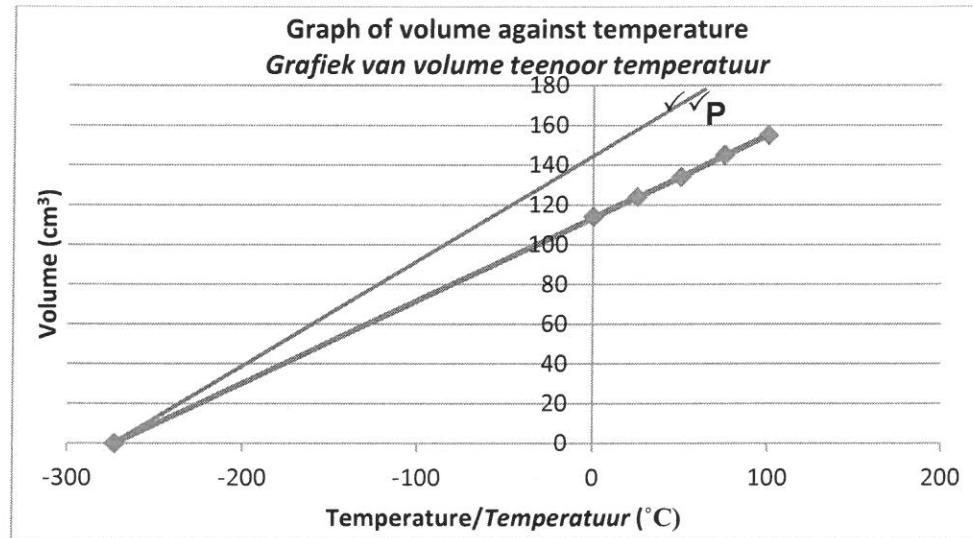
Marking Criteria for Question 4.1.2 /*Nasienkriteria*

- Labelling both axes with the unit correctly✓
  Benoem beide asse met eenheid korrek✓
- Plotting minimum three points correctly ✓✓
  Stip minimum drie punte korrek✓ ✓
- Shape of the graph✓
  Vorm van die grafiek✓   (4)

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x-intercept = -273 ºC   ✓ (range -270 ºC to -273 ºC)
x-afsnit = -273 ºC ✓   (1)

4.1.4   It is the absolute zero 0 K (-273ºC)✓, which is the coldest possible
temperature at which the <u>particles will have no kinetic energy/no movement</u>.✓
*Dit is die absolute nulpunt 0 K (-273 ºC) ✓ wat die koudste moontlike
temperatuur is waarby die <u>deeltjies geen kinetiese energie/ beweging sal hê
nie</u>. ✓*   (2)

4.1.5 $\dfrac{V_1}{T_1} = \dfrac{V_2}{T_2}$ ✓

$\dfrac{155}{373} = \dfrac{V_2}{393}$ ✓

$V_2 = 163{,}31 \ cm^3$ ✓
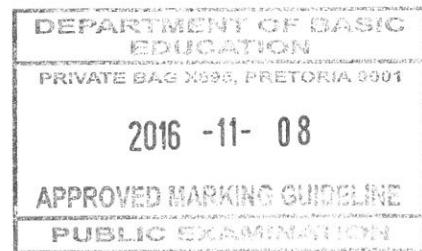
Accept any other set of values from the table.
Using the graph without calculation, correct answer – 1/3 marks
/ *Aanvaar enige stel waardes vanuit die tabel. Indien die grafiek gebruik word
sonder 'n berekening met 'n korrekte antwoord- 1/3 punte*   (3)

4.1.6   Straight line above graph (steeper gradient) drawn in QUESTION 4.1.2✓
x-intercept = -273 ºC (OR the same x-intercept as drawn in
QUESTION 4.1.3)✓
*Reguitlyn bo grafiek (groter helling) in VRAAG 4.1.2 geteken ✓
x-afsnit = -273 ºC (OF dieselfde x-afsnit soos geteken in VRAAG 4.1.3)✓*   (2)

4.2.1 $pV = nRT$✓

$\underline{(96 \times 10^3)(0,32 \times 10^{-3})}$✓ $= \underline{n(8,31)(300)}$✓

n = 0,0123225mol (0,012mol)

$n = \dfrac{m}{M}$

$0,0123225 = \dfrac{0,77}{M}$ ✓

M = 62,49 g·mol^{-1} ✓ (64,17 g.mol^{-1})   (5)

Accept/*Aanvaar* 62,49 g.mol^{-1}, 64,17 g.mol^{-1} and/*en* 77 g.mol^{-1}

4.2.2 SO_2 ✓✓ **NOTE** – Do not mark this question because it is not possible to determine the gas with the above molar masses. Total for question 4 is **19 marks**/ *NOTA- Die vraag word nie gemerk nie omrede dit nie moontlik om die gas te identifiseer vir die bostaande molêre massas nie.Die totaal vir vraag 4 is dus **19 punte**.*

[19]

QUESTION 5/*VRAAG 5*

5.1   Amount of solute per litre of solution/ per unit volume.✓✓
Hoeveelheid oplosmiddel per liter oplossing/ per eenheidsvolume oplossing✓✓   (2)

5.2 $c = \dfrac{m}{MV}$ ✓

$c = \dfrac{8}{(158)(0,5)}$ ✓

c = 1,01x10^{-1} mol.dm^{-3} ✓ (0,10 mol.dm^{-3})

OR/*OF*

$n = \dfrac{m}{M}$

$= \dfrac{8}{158}$✓

= 0,0506mol

$c = \dfrac{n}{V}$

$= \dfrac{0,0506}{0,5}$

= 1,01x10^{-1} mol.dm^{-3} ✓ (0,10 mol.dm^{-3})   (3)

NOTE : Award 1 mark for both formulae✓
***NOTA**: Ken 1 punt toe vir beide formules*✓
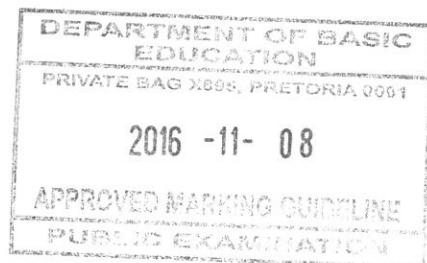
5.3.1   Empirical formula is the simplest whole number ratio between the elements in a compound.✓✓
Empiriese formule is die eenvoudigste heelgetalverhouding tussen die elemente in 'n verbinding✓✓   (2)

5.3.2

Element	$\dfrac{g}{10g}$	$n = \dfrac{m}{M}$	Simplest ratio/ *Eenvoudigste verhouding*		
K	2,66	2,66/39 = 0,068✓	1	x2	=2
Cr	3,54	3,54/52 = 0,068✓	1	x2	=2
O	3,81	3,81/16 = 0,238✓	3,5	x2	=7
			✓	✓	✓

Empirical formula/*Empiriese formule*= $K_2Cr_2O_7$✓   (7)

[14]

QUESTION 6/*VRAAG 6*

6.1   Limiting reagent in a reaction is the <u>reactant that is consumed completely</u>.
It determines the maximum amount of product that is made.✓✓
Beperkte reagens in 'n reaksie is die <u>reagens wat volledig opgebruik word</u>.
Dit bepaal die maksimum hoeveelheid produk wat gemaak word. ✓✓   (2)

6.2

$$c = \frac{n}{V} \checkmark$$

$$0,2 = \frac{n}{0,1}$$

$$n(CH_3COOH) = (0,2)(0,1)$$
$$= 0,02 \text{ mol} \checkmark$$

$$n(NaHCO_3) = \frac{m}{M}$$

$$n = \frac{10}{84} \checkmark$$
= 0, 12 mol✓
Mole ratio/*Molverhouding* 1 : 1
0,02 mol CH_3COOH reacts with/*reageer met* 0,02 mol $NaHCO_3$✓
CH_3COOH is the limiting reagent./*is die beperkte reagens* ✓   (6)

6.3   Mass of $NaHCO_3$ in excess:/*Massa $NaHCO_3$ in oormaat*:

$$n = \frac{m}{M} \checkmark$$

$$(0,12 - 0,02) = \frac{m}{84} \checkmark$$

$$m = 8,4 \text{ g} \checkmark$$ (3)

6.4   **OPTION 1**

$0,02$ mol $CH_3COOH \rightarrow 0,02$ mol CO_2✓
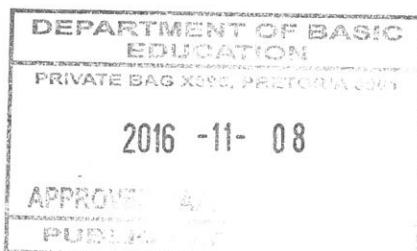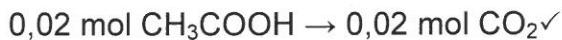
$$n = \frac{V}{Vm} \quad ✓$$

$$0,02 = \frac{V}{22,4} \quad ✓$$

$V = (0,02)(22,4)$✓
$\quad = 0,45$ dm^3✓

OPTION 2

$60g$ CH_3COOH $\rightarrow$ $44g$ CO_2
$1,2$ g CH_3COOH $\rightarrow$ x
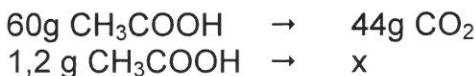
$\qquad\qquad$ x $=$ $0,88g$

$$n = \frac{0,88}{44} = 0,02 mol$$

$V (CO_2) = 0,02 \times 22,4 = 0,45 dm^3$

OPTION 3

Mass of $NaHCO_3$ reacted $= 0,02 \times 84$
$\qquad\qquad\qquad\qquad = 1,68g$

$84g \rightarrow 22.4 dm^3$
$1.68g \rightarrow x$

$V = 0.45 dm^3$

(4)

QUESTION 7/*VRAAG 7*

7.1   Exothermic✓, energy is given out.✓
Eksotermies✓, *energie word afgegee.* ✓   (2)

7.2   Energy is needed to break the bond between atoms/ions in molecules.✓✓
Energie is nodig om die bindings tussen atome/ione te breek✓✓   (2)
       Accept – minimum energy needed to start the reaction.
       Aanvaar- *minimum energie nodig om die reaksie te begin.*

7.3   Produces a greenhouse gas✓ and which can contribute to global warming.✓/
       any reference to acid rain - mark correct.
       Vervaardig 'n kweekhuisgas✓ *wat tot aardverwarming kan bydra*✓/ *enige*
       verwysing na suurreën word as korrek aanvaar.   (2)
                                                                                          [6]
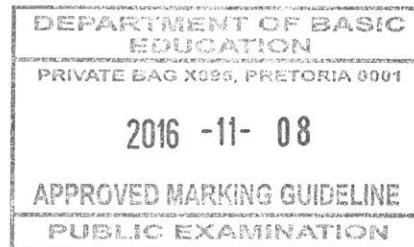
QUESTION 8/*VRAAG 8*

8.1   Acid is a proton donor   ✓✓
       Suur is 'n protonskenker✓✓   (2)

8.2.1   conjugate pairs/*gekonjugeerde pare*

$$H_2PO_4^- \quad + \quad NH_3 \quad \rightarrow \quad HPO_4^{2-} \quad + \quad NH_4^+$$
$$\quad a_1 ✓ \qquad\quad b_1 ✓ \qquad\qquad\quad b_1 ✓ \qquad\qquad a_2 ✓$$
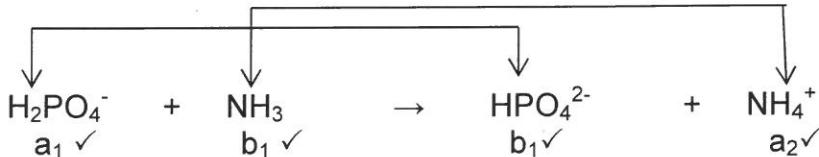
Acid-Base pair/ *Suur-basis pare*
$H_2PO_4^-$/ HPO_4^{2-} and/*en* NH_4^+/ NH_3 (4)

8.2.2   A substance which can act as an acid or a base.✓
         'n Stof wat as 'n suur of 'n basis kan optree✓   (1)

8.2.3 $H_2PO_4^-$ OR/OF HPO_4^{2-} ✓✓   (2)

8.3.1 $Na_2CO_3 + 2HC\ell \rightarrow 2NaC\ell + H_2O + CO_2$ balancing/*balansering* ✓   (1)

8.3.2
$$c = \frac{n}{V} ✓$$
$$0{,}2 = \frac{n}{0{,}1}$$
$$n = (0{,}2)(0{,}1) ✓$$
$$= 0{,}02\text{mol} ✓$$
(3)

8.3.3   n $Mg(OH)_2$ = (0,02)(0,1) ✓
         = 0,002mol
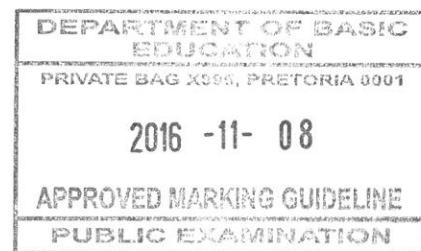
n $HC\ell$(excess/*oormaat*) = 2✓(0,002) = 0,004mol

n $HC\ell$ react with/*reageer met* Na_2CO_3 = 0,02 $\overset{✓}{-}$ 0,004 = 0,016mol

n Na_2CO_3 = 0,008mol (dividing answer by 2/*deel antwoord deur 2*) ✓

m Na_2CO_3 = nM = (0,008)(106) ✓
       = 0,848 g✓

$$\%purity / suiwerheid = \frac{0{,}848}{10} \times 100 ✓ = 8{,}48\% ✓$$
(8)

[21]

QUESTION 9/*VRAAG 9*

9.1   Oxidation is the increase in oxidation numbers ✓✓
        Oksidasie is die toename in oksidasiegetalle ✓✓   (2)

9.2.1 $Cu(s)$ ✓✓   (2)

9.2.2   Silver ion/*Silwerioon* OR $AgNO_3$✓✓   (2)

9.2.3 $Cu \rightarrow Cu^{2+} + 2e^-$ ✓✓   (2)

> **Marking Criteria/*Nasienkriteria***
> $Cu \rightleftharpoons Cu^{2+} + 2e^-$ 1/2 marks/*punte*

9.2.4 $Cu \rightarrow Cu^{2+} + 2e^-$
        $\underline{Ag^+ + e^- \rightarrow Ag}$ ✓
        $Cu + 2Ag^+$✓ $\rightarrow Cu^{2+} + 2Ag$✓   balancing/*balansering* ✓   (4)

9.3 $Cu + 2AgNO_3 \rightarrow Cu(NO_3)_2 + 2Ag$
              +1   0
        Ag oxidation number changes/decreases from +1 to 0, gaining electrons,
        reduction. ✓✓
        Ag se oksidasiegetal verander van +1 na 0, ontvang elektrone, reduksie✓✓

                                                                  (2)
                                                                  [14]

QUESTION 10/*VRAAG 10*

10.1   Open cast mining/*Oopgroefmyn*   ✓
        Underground (Deep pit) mining/*Ondergrondse myn* ✓   (2)

10.2   Create job opportunities✓/Local communities benefit from infrastructure ✓/
        Provides opportunities for other industries
        Skep werksgeleenthede✓/*Plaaslike gemeenskappe verkry voordeel ten
        opsigte van infrastrukture*✓/*Verskaf geleenthede aan ander nywerhede*   (2)

10.3   Changing landscape
        Air pollution
        Resource consumption   ✓✓ any two
        Water poisoning
        Veranderende landskap
        Lugbesoedeling
        Hulpbronverbruik   ✓✓ *enige twee*
        Watervergiftiging   (2)

10.4.1 It is too soft ✓
        Dit is te sag ✓   (1)

10.4.2 Used in computer circuits ✓/Used as a heat protector in space suits/any other
        relevant answer
        *Gebruik in rekenaarstroombane/Gebruik as 'n hittebeskermer in ruimtepakke/
        enige ander relevante antwoord*✓   (1)
                                                                  [8]

                                          TOTAL/*TOTAAL*:   150