Province of the
EASTERN CAPE
EDUCATION

NATIONAL SENIOR CERTIFICATE/ *NASIONALE SENIOR SERTIFIKAAT*

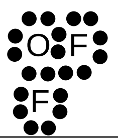
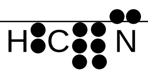
GRADE/*GRAAD* 11

NOVEMBER 2019

PHYSICAL SCIENCES P2
FISIESE WETENSKAPPE V2
(CHEMISTRY/*CHEMIE*)
MARKING GUIDELINE/*NASIENRIGLYN*

MARKS/*PUNTE*: 150

This marking guideline consists of 11 pages./
Hierdie nasienriglyn bestaan uit 11 bladsye.

QUESTION 1 / *VRAAG* 1		
1.1	C ✓✓	(2)
1.2	B ✓✓	(2)
1.3	B ✓✓	(2)
1.4	A ✓✓	(2)
1.5	C ✓✓	(2)
1.6	C ✓✓	(2)
1.7	D ✓✓	(2)
1.8	B ✓✓	(2)
1.9	C ✓✓	(2)
1.10	B ✓✓	(2)
		[20]
QUESTION 2 / *VRAAG* 2		
2.1	A group of two or more atoms covalently bonded and it functions as a unit. ✓✓ *'n Groep van twee of meer atome wat kovalent gebind en as 'n eenheid funksioneer.*	(2)
2.2.1	Tetrahedral ✓ *Tetraëdries*	(1)
2.2.2	Trigonal bipyramidal ✓ *Trigonaal bipiramidaal*	(1)
2.3.1	 ✓✓	(2)
2.3.2	 ✓✓	(2)
2.4	The nitrogen (N) atom in NH_3 contains a lone pair electrons. No lone pair in $CCℓ_4$. } ✓ Nitrogen (N) atom in NH_3 can donate its lone pair into the vacant orbital of H^+✓ *Die stikstof (N) atoom in NH_3 bevat 'n alleenpaar elektrone.* *Geen enkelpaar elektrone in $CCℓ_4$ nie* *Stikstof (N) atoom in NH_3 kan sy alleenpaar elektrone in die vakante wentelbaan van H^+ skenk*	(2)

2.5	Polar. ✓ • Sulphur atoms more electronegative than the hydrogen atom • Sulphur atom pulls the bonding electrons more towards itself. } ✓ • (The change in electronegative is 2,5 – 2,1 = 0,4) • The sulphur atom has a partial negative charge and hydrogen atom has a partial positive charge. ✓ • The H_2S molecule has an asymmetrical bent/angular shape. ✓ *Polêr.* • *Swawelatome is meer elektronegatief as die waterstofatoom* • *Swawelatoom trek die bindingselektrone meer na hom toe.* • *(Die verskil in elektronegatief is 2,5 – 2,1 = 0,4)* • *Die swawelatoom het 'n gedeeltelik negatiewe lading en waterstofatoom het 'n gedeeltelik positiewe lading.* • *Die H_2S-molekule het 'n asimmetriese buiging / hoekige vorm.*	(4)
		[14]
QUESTION 3/*VRAAG 3*		
3.1	The temperature at which the vapour pressure of a liquid is equal to the external (atmospheric) pressure. ✓✓ *Die temperatuur waarteen die dampdruk van 'n vloeistof gelyk is aan die eksterne (atmosferiese) druk.*	(2)
3.2	Boiling point. Accept answers in the range (180 to 190) ✓ (K) *Kookpunt. Aanvaar antwoorde tussen (180 tot 190) (K)*	(1)
3.3	• Group 4 hydrogen hydrides have London /dispersion/induced-dipole forces ✓ • Hydrogen halides have dipole-dipole forces ✓ • The dipole-dipole forces are stronger than the London/dispersion/induced-dipole forces ✓ • More energy will be required to overcome the dipole-dipole/ intermolecular forces in hydrogen halides ✓ • *Groep 4 waterstofhidriede het London-/ verspreiding / geïnduseerde-dipool kragte* • *Waterstofhaliede het dipool-dipool kragte* • *Die dipool-dipoolkragte is sterker as die London-/verspreidingskragte/ geïnduseerde-dipool kragte.* • *Meer energie sal benodig word om die dipool-dipool / intermolekulêre kragte in waterstofhaliede te oorkom*	(4)
3.4	HF has <u>hydrogen bonds</u> ✓✓ *HF het <u>waterstofbindings</u>*	(2)
3.5	GeH_4 ✓.It has a lower boiling point. ✓ *GeH_4. Dit het die laagste kookpunt*	(2)
		[11]

QUESTION 4/*VRAAG 4*		
4.1.1	Boyle's (law /*wet*)	(1)
4.1.2	What effect will a (change in) pressure have on the volume of a fixed amount gas at constant temperature? ✓✓ *Watter effek sal 'n (verandering in) druk op die volume van 'n vasgestelde gas by konstante temperatuur hê?*	(2)
4.1.3	Temperature. ✓ *Accept* mass / number of moles of gas *Temperatuur. Aanvaar massa / aantal mol gas*	(1)
4.1.4	• According to the Kinetic Molecular Theory, <u>the pressure exerted by a gas depends on the number of collisions per unit time per unit area.</u> ✓ • <u>The same number of particles in a smaller volume (area) leads to an increase in the number of collisions per unit volume (area)</u> ✓ • The <u>more collisions per unit volume (area) results in an increase in pressure</u>. ✓ • *Volgens die Kinetiese Molekulêre Teorie hang <u>die druk wat 'n gas uitoefen af van die aantal botsings per tydseenheid per eenheidsarea.</u>* • *<u>Dieselfde aantal deeltjies in 'n kleiner volume (oppervlakte) lei tot 'n toename in die aantal botsings per eenheid volume (oppervlakte)</u>* • *<u>Meer botsings per eenheid volume (oppervlakte) lei tot 'n toename in druk.</u>*	(3)
4.2.1	**Experiment 2**. ✓ • The product of pressure and volume (pV) is higher for the same amount of gas. ✓ • pV ∝ T ✓ ***Eksperiment 2**.* • *Die produk van druk en volume (pV) is hoër vir dieselfde hoeveelheid gas.* • pV ∝ T	(3)
4.2.2	• The intermolecular forces thus increase and the gas liquifies. ✓ • The volume becomes constant at extreme pressure. ✓ • *Die intermolekulêre kragte neem dus toe en die gas word 'n vloeistof.* • *Die volume word konstant by uiterste druk.*	(2)
4.3.1	Guy-Lussac (law/ *wet*) ✓	(1)

4.3.2	$\frac{p_1V_1}{T_1} = \frac{p_2V_2}{T_2}$ ✓ $\frac{(101)}{(25+273)} = \frac{p_2}{(60+273)}$ ✓ ($V_1 = V_2$) p_2 = 112,86 kPa ✓	(4)
4.3.3	100 °C✓ or/*of* 373 K	(1)
		[18]
QUESTION 5/*VRAAG 5*		
5.1	Ideal ✓ (gas) *Ideale (gas)*	(1)
5.2	pV = nRT ✓ $(100 \times 10^3)(31,98)$ ✓ = n (8,31)(23 + 273) ✓ n = 1300,12 mol M = m/n✓ M = (2600)/(1300,12) ✓ M = 2 $g{\cdot}mol^{-1}$ ✓ H_2 ✓	(7)
		[8]

QUESTION 6/*VRAAG 6*		
6.1	Minimum energy required to start a chemical reaction ✓✓ *Minimum energie benodig om ʼn chemiese reaksie te begin.*	(2)
6.2	Exothermic ✓ The total potential energy of the products is less than the total potential energy of the reactants. ✓ **OR** More energy is released than the energy taken in. **OR** The heat of the reaction is less than zero/negative. *Eksotermies* *Die totale potensiële energie van die produkte is minder as die totale potensiële energie van die reaktante* ***OF*** *Meer energie word vrygestel as die energie wat ingeneem word* ***OF*** *Die reaksiewarmte is minder as nul / negatief.*	(2)
6.3	679,1 $kJ \cdot mol^{-1}$ ✓ The energy needed to break all the bonds✓✓ / Activation energy *Die energie wat benodig word om al die bindings te breek / Aktiveringsenergie*	(3)
6.4	Bond formation/*Bindingsvorming* = 184,7 + 679,1✓ Bond formation/*Bindingsvorming* = 863,8 $kJ \cdot mol^{-1}$ 863,8 $kJ \cdot mol^{-1}$ is the energy released for two HCℓ molecules/*is die energie wat vrygestel word vir twee HCℓ- molekules* Bond energy for each/ *Bindingsenergie vir elke* HCℓ = 863,8 / 2 ✓ Bond energy for each/ *Bindingsenergie vir elke* HCℓ = 431,9 $kJ \cdot mol^{-1}$✓	(3)
6.5	No effect. ✓ Catalyst only has an effect on the activation energy and no effect on the heat of the reaction ✓ *Geen effek.* *Katalisator het slegs ʼn invloed op die aktiveringsenergie en het geen invloed op die hitte van die reaksie nie.*	(2)
		[12]

QUESTION 7/*VRAAG 7*		
7.1	**OPTION 1/ *OPSIE 1***	
	$n=\frac{m}{M}$ ✓ $n=\frac{11,79}{12}$ ✓ $n=0,9825\ mol$ $n=\frac{m}{M}$ $n=\frac{69,57}{35,5}$ ✓ $n=1,9597\ mol$ $n=\frac{m}{M}$ $n=\frac{18,64}{19}$ ✓ $n=0,9811\ mol$	
	$\frac{0,9825}{0,9811}=\frac{1,9597}{0,9811}=\frac{0,9811}{0,9811}$ ✓ Ratio/*Verhouding* = 1:2:1 Empirical formula/ *Empiriese formule*: $CC\ell_2F$ Relative formula mass/ *Relatiewe formulemassa* = 12 +2(35,5) + 19 = 102 Ratio/*Verhouding* = 204/102 = 2✓ Molecular formula/ *Molekulêre formule*: $C_2C\ell_4F_2$✓(Order of elements not important/ *Volgorde van elemente nie belangrik nie*)	
	OPTION 2/*OPSIE 2*	
	m(C) = $204\times\frac{11,79}{100}$ ✓= 24,05 g m(Cℓ)= $204\times\frac{69,57}{100}$ = 141,92 g m(F) = $204\times\frac{18,64}{100}$ ✓= 38,03 g n(C) = $\frac{24,05}{12}$ = 2 mol✓ n(Cℓ) = $\frac{141,92}{35,5}$ = 4 mol✓ n(F) = $\frac{38,03}{19}$ = 2 mol✓ Molecular formula/ *Molekulêre formule*: $C_2C\ell_4F_2$✓ (Order of elements not important/*Volgorde van elemente nie belangrik nie*)	(7)
7.2.1	Limiting reagent is the substance that is completely used up during a chemical reaction ✓✓ *Die beperkende reagens is die stof wat tydens 'n chemiese reaksie volledig opgebruik word.*	(2)

<table>
<tr><td rowspan="3">7.2.2</td><td colspan="2">$n(Li) = \frac{m}{M}$ ✓ $\quad n(N_2) = \frac{m}{M}$
$n(Li) = \frac{12,3}{7}$ ✓ $\quad n(N_2) = \frac{33,6}{28}$
$n(Li) = 1,76 \ mol \quad n(N_2) = 1,20 \ mol$</td><td rowspan="3">(6)</td></tr>
<tr><td rowspan="2">Stoichiometri ratio = $\frac{6 \ mol \ Li}{1 \ mol \ N_2}$ ✓

Available ratio = $\frac{1,76}{1,2} = \frac{1,47}{1}$ ✓
Therefore Li is limiting reagent✓
Daarom is Li die beperkende reagens</td><td>n(N_2) required if ALL 1,76 mol of Li react.
n (N_2) benodig as AL 1,76 mol Li reageer
n(N_2) = $1,76 \times \frac{1}{6} = 0,29 \ mol$✓
required/benodig
1,2 mol is available ✓
1,2 mol is beskikbaar
Therefore Li is the limiting reagent ✓
Daarom is Li die beperkende reagens</td></tr>
<tr><td>n(Li) required if ALL 1,20 mol of N_2 react.
n(N_2) = $1,20 \times \frac{6}{1} = 7,2 \ mol$ ✓
required/benodig
Only 1,76 mol is available ✓
Therefore Li is the limiting reagent ✓
Slegs 1,76 mol is beskikbaar
Daarom is Li die beperkende reagens</td></tr>
<tr><td></td><td colspan="2"></td><td></td></tr>
<tr><td></td><td colspan="2">Positive marking from 7.2.2/ Positiewe nasien vanaf 7.2.2</td><td></td></tr>
<tr><td>7.2.3</td><td colspan="2">Theoretical yield/Teoretiese opbrengs
n(Li) : n (Li_3N)
6 : 2 ✓

n(Li_3N) = $1,76 \times \frac{2}{6}$✓
n(Li_3N) = 0,59 mol
$n = \frac{m}{M}$
$0,59 = \frac{m}{35}$ ✓
m = 20,65 g

%yield/opbrengs = $\frac{5,89}{20,65} \times 100 \ \%$ ✓
%yield/ opbrengs = 28,52 % ✓</td><td>(5)</td></tr>
<tr><td></td><td colspan="2"></td><td>[20]</td></tr>
</table>

QUESTION 8/*VRAAG 8*		
8.1.1	Acid is a substance that donates protons (H^+) *'n Suur is 'n stof wat protone (H^+) skenk*	(2)
8.1.2	Base. ✓ It <u>accepts protons</u> (H^+) in both reactions ✓ *Basis.* *Dit <u>aanvaar protone</u> (H^+) in albei reaksies*	(2)
8.1.3	HSO_4^- ✓✓	(2)
8.1.4	H_2SO_4 + 2 $NaHCO_3$ ✓ → Na_2SO_4 + 2 H_2O + 2 CO_2 ✓ (✓ Balanced/ *Gebalanseerd*) *Accept/Aanvaar* H_2SO_4 + $NaHCO_3$ → $NaHSO_4$ + H_2O + CO_2	(3)
8.2.1	A standard solution is a solution of which the <u>concentration is</u> exactly <u>known</u>. ✓✓ *'n Standaardoplossing is 'n oplossing waarvan die <u>konsentrasie presies bekend is</u>.*	(2)
8.2.2	Reaction 2/ *Reaksie 2* n(NaOH) = cv ✓ n(NaOH) = (0,968)(0,025) ✓ n(NaOH) = 0,0242 mol Mole Ratio/*Verhouding* CH_3COOH : NaOH 1 : 1 n(CH_3COOH) = 0,0242 mol ✓ Original/*Oorspronlik* (CH_3COOH) n(CH_3COOH) = cv n(CH_3COOH) = (0,5)(0,25) ✓ n(CH_3COOH) =0,125 mol n(reacted) = 0,125-0,0242 ✓ n(reacted) = 0,1008 mol Reaction 1/*Reaksie* Mole Ratio CH_3COOH : $CaCO_3$ 2 : 1 ✓ n($CaCO_3$) = 0,1008/2✓ n($CaCO_3$) = 0,0504 mol m($CaCO_3$) = nM m($CaCO_3$) = (0,0504)(100) ✓ m($CaCO_3$) = 5,04 g % purity / *suiwerhede*= $\frac{5,04}{56} \times 100\%$ ✓	(10)

	%purity/ *suiwerhede* = 9%✓	
		[21]

QUESTION 9/*VRAAG 9*		
9.1	Oxidation is the <u>loss in electrons</u> ✓✓ *Oksidasie is die <u>verlies in elektrone</u>*	(2)
9.2	$C\ell^-$ ✓✓	(2)
9.3	Mg ✓ Mg oxidation number increases from 0 ✓ to +2 ✓ *Mg oksidasiegetal neem toe vanaf 0 na +2*	(3)
9.4	$2\ H^+_{(aq)} + 2\ e^- \rightarrow H_{2\ (g)}$ ✓✓	(2)
9.5	6✓ ($Fe^{2+} \rightarrow Fe^{3+} + e^-$) ✓ $14H^+$✓ + $Cr_2O_7^{2-}$ + $6e^-$ ✓ → $2\ Cr^{3+}$✓ + $7\ H_2O$ ✓ <u>$6\ Fe^{2+} + 14\ H^+ + Cr_2O_7^{2-} \rightarrow 6\ Fe^{3+} + 2\ Cr^{3+} + 7\ H_2O$</u> ✓	
	<u>Marking guideline/*Nasienriglyne*</u> • Correct oxidation half reaction/ *Korrekte oksidasie-halfreaksie* • $7\ H_2O$ in the reduction half reaction/*reduksie-halfreaksie* • $14\ H^+$ in the reduction half reaction/*reduksie-halfreaksie* • $2\ Cr^{3+}$ balancing the Cr^{3+} ions/*Balansering van die Cr^{3+} ione* • $6e^-$ in reduction half reaction/ *reduksie-halfreaksie* • ×6 the oxidation half reaction/ *oksidasie-halfreaksie* • Correct final balanced equation/*Korrekte finale gebalanseerde vergelyking*	(7)
		[16]

QUESTION 10/*VRAAG 10*		
10.1	Witwatersrand ✓	(1)
10.2	Redox reaction ✓ Oxidation number of gold changes from 0 to +1 ✓ **OR** Oxidation number of oxygen decreases from 0 to -2. *Redoksreaksie* *Oksidasiegetal van goud verander vanaf 0 na +1* ***OF*** *Oksidasiegetal van suurstof verminder vanaf 0 to -2.*	(2)
10.3	Zinc ✓✓ *Sink*	(2)
10.4	Activated carbon ✓✓ *Geaktiveerde koolstof*	(2)
10.5	Process Z is the smelting process of gold. ✓ Gold has a very high boiling point. ✓ Large amount of energy is needed for gold to change state. ✓ *Proses Z is die smeltproses van goud.* *Goud het 'n baie hoë kookpunt.* *'n Groot hoeveelheid energie is nodig om die fase van goud te verander.*	(3)
		[10]
	TOTAL/*TOTAAL:*	**150**