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 2018

MARKING GUIDELINES/*NASIENRIGLYNE*

MARKS/*PUNTE*: 150

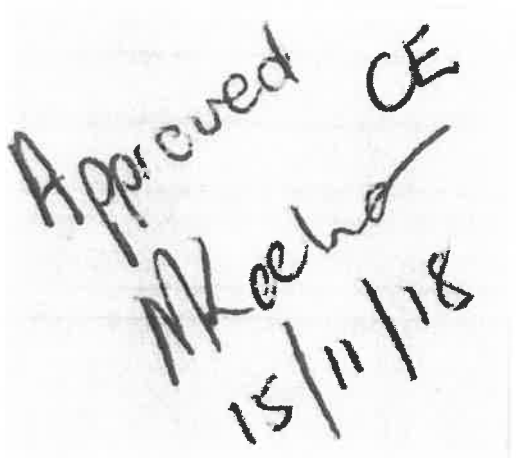
These marking guidelines consist of 16 pages.
Hierdie nasienriglyne bestaan uit 16 bladsye.

Please turn over/*Blaai om asseblief*

QUESTION 1/*VRAAG 1*

1.1	B ✓✓	(2)
1.2	C ✓✓	(2)
1.3	D ✓✓	(2)
1.4	B ✓✓	(2)
1.5	C ✓✓	(2)
1.6	A ✓✓	(2)
1.7	A ✓✓	(2)
1.8	B ✓✓	(2)
1.9	D ✓✓	(2)
1.10	D ✓✓	(2)

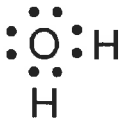
[20]



QUESTION 2/*VRAAG 2*

2.1 Chemical bond is mutual attraction between two atoms resulting from the simultaneous attraction between their nuclei and (outer) electrons. ✓✓
Chemiese binding is die wedersydse aantrekking tussen twee atome as gevolg van die gelyktydige aantrekking tussen hulle kerne en (buite)-elektrone. (2)

2.2.1  ✓✓ (2)

2.2.2  ✓✓ (2)

2.3 Linear ✓
Lineêr (1)

2.4 3 – 2,5 = 0,5 ✓ (1)

2.5 Polar ✓
Polêr (1)

2.6 CN has a higher order bond/triple bond with more orbitals overlapping ✓ than CH, which is a single bond. ✓ Thus CN bond needs more energy to break.
CN het 'n hoër orde/drievoudige binding met meer orbitale wat oorvleuel as die CN enkel binding. Dus benodig die CN-binding meer energie om te breek. (2)

2.7 CN has a longer bond length than CH ✓ because the H atom is smaller than the N atom. ✓
CN het 'n groter bindingslengte as CH omdat die H-atoom kleiner as die N-atoom is (2)

2.8 Yes/*Ja* ✓ (1)

2.9
- HCN has polar molecules with dipole-dipole forces. ✓
- H_2O has polar molecules with hydrogen bonds (dipole-dipole forces). ✓
- If the forces are of the same order/comparable the substances will dissolve. ✓

OR

- Both molecules are polar ✓
- HCN has dipole-dipole forces and H_2O has (dipole-dipole forces) hydrogen bonds ✓
- Like dissolve like. ✓

- *HCN het polêre molekules met dipool-dipoolkragte.*
- *H_2O het polêre molekules met waterstofbindings.*
- *Indien die intermolekulêre kragte van dieselfde orde is, sal stowwe oplos*

OF

- *Beide molekules is polêr* ✓
- *HCN het dipool-dipool kragte en H_2O het (dipool-dipool kragte) waterstofbindings* ✓
- *Soort los op in soort* ✓ (3)

[17]

QUESTION 3/*VRAAG 3*

3.1
- NH_3 has hydrogen bonds between the molecules ✓
- N_2 has London forces/induced dipole forces ✓
- NH_3 has stronger intermolecular forces than N_2 and therefore a higher boiling point than N_2 ✓
  (Accept: more energy requires to overcome stronger forces of NH_3)

OR

- N_2 has weaker intermolecular forces than NH_3 and therefore a lower boiling point than NH_3
  (Accept: less energy requires to overcome weaker forces of H_2)

- *NH_3 het waterstofbindings tussen die molekules*
- *N_2 het Londonkragte/geïnduseerde dipoolkragte*
- *NH_3 het sterker intermolekulêre kragte as N_2 en daarom 'n hoër kookpunt as N_2*

OF

- *N_2 het swakker intermolekulêre kragte as NH_3 en daarom 'n laer kookpunt as NH_3*
  (Aanvaar: NH_3 vereis meer energie om sterker kragte te oorkom) (3)

3.2 H_2 ✓ (1)

3.3

- H_2 and N_2 both have weak London forces/induced dipole forces ✓
- N_2 is a larger molecule/has a greater molecular mass/has a larger surface area than H_2 ✓
- and therefore N_2 has stronger intermolecular forces. ✓

OR

- H_2 is a smaller molecule/has a smaller molecular mass/has a smaller surface area than N_2 ✓
- and therefore H_2 has weaker intermolecular forces. ✓

- *H_2 en N_2 het beide swak Londonkragte/geïnduseerde dipoolkragte*
- *N_2 is 'n groter molekule/groter molekulêre massa/groter oppervlakarea as H_2*
- *en daarom het N_2 sterker intermolekulêre kragte.*

OF

- *H_2 is 'n kleiner molekule/het kleiner molekulêre massa/kleiner oppervlakarea as N_2*
- *en daarom swakker intermolekulêre kragte.*

(3)

3.4 H_2 ✓
It has the weakest intermolecular forces/London forces ✓
It has the lowest boiling point ✓
OR
It has the weakest intermolecular forces/London forces ✓
Boiling point is inversely proportional to vapour pressure ✓
Dit het die swakste intermolekulêre kragte
Dit het die laagste kookpunt
OF
Dit het die swakste intermolekulêre kragte/Londonkragte
Kookpunt is omgekeerd eweredig aan die dampdruk (3)
[10]

QUESTION 4/*VRAAG 4*

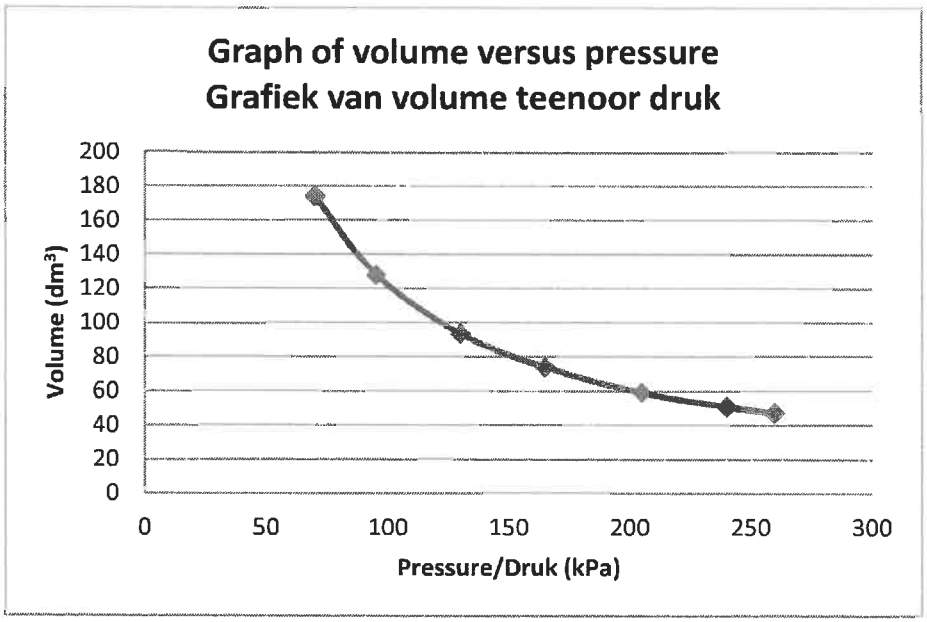
4.1 Boyle's law/*Boyle se wet* ✓ (1)

4.2

Criteria for hypothesis/*Riglyne vir hipotese*	
The dependent and independent variables are stated correctly. *Die afhanklike en onafhanklike veranderlikes korrek genoem.*	✓
State the relationship between the dependent and independent variables. *Stel die verwantskap tussen die afhanklike en onafhanklike veranderlike.*	✓
Dependent variable/*afhanklike veranderlike*: volume Independent variable/*onafhanklike veranderlike*: pressure/*druk*	

Example:/*Voorbeeld*:
If the pressure of and enclosed gas increases the volume will decreases at constant temperature.
The pressure of an enclosed gas is inversely proportional to the volume it occupies if the temperature is kept constant.
Die druk van 'n ingeslote gas is omgekeerd eweredig aan die volume wat dit beslaan indien die temperatuur konstant gehou word.
Indien die druk van 'n ingeslote gas toeneem, sal die volume afneem. (2)

4.3



Refer to the last page of the memo for the graph drawn to scale
Verwys na die laaste bladsy van die memo vir die skaalgrafiek

Criteria for marking the graph/*Nasienkriteria vir grafiek*	
Use of correct scale on both axis (If learners used table values as scale values maximum 1/3 for line drawn) *Korrekte skaal op die asse* *(Indien leerders tabelwaardes as skaalwaardes gebruik maksimum 1/3 vir lyn getrek)*	✓
At least five (5) points plotted correctly *Ten minste vyf (5) punte korrek gestip*	✓
Curve is drawn *Kurwe getrek*	✓

(3)

4.4 Any set of values can be used from the table :
Enige stel waardes vanaf die tabel kan gebruik word:
$p_1V_1 = p_2V_2$ ✓
$\underline{70(174) = (300)V_2}$ ✓
$V_2 = 40{,}6\ dm^3$ ✓
(Accept/*Aanvaar* 40,32 – 40,8 dm^3) (3)

4.5 At high pressure a gas starts to deviate from ideal gas behaviour ✓
because the volume of the molecules of a gas and the intermolecular forces start to influence the measured value, causing it to be greater than the theoretical value calculated/Forces of repulsion between the gas particles prevents them from moving closer ✓
By hoë druk sal 'n gas begin afwyk van ideale gasgedrag
want die volume van die gasdeeltjies en intermolekulêre kragte begin die waarde van die volume beïnvloed, wat veroorsaak dat die gemete waarde groter is as die berekende waarde/Afstotingskragte veroorsaak dat gasdeeltjies nie nader aan mekaar kan beweeg nie (2)

4.6 Low/*Laag*✓ (1)

4.7 Temperature is an indication of the average kinetic energy of the molecules of a gas. If the temperature of a gas decreases, the molecules <u>move slower and closer together</u> ✓up to a point where the gas will start to <u>condense</u> ✓ and not behave like an ideal gas.
OR
The intermolecular forces of attraction becomes significant ✓ then the gas condenses. ✓
Temperatuur is die aanduiding van die gemiddelde kinetiese energie van die molekules van 'n gas. Indien die temperatuur afneem sal die molekules <u>stadiger en nader aan mekaar</u> beweeg tot by die punt waar die gas sal begin <u>kondenseer</u> sodat dit nie meer soos 'n ideale gas optree nie.
OF
Die intermolekulêre kragte word beduidend en dit veroorsaak dat die gas kondenseer. (2)

4.8 $pV = nRT$ ✓
$(70\ 000)(174 \times 10^{-3})$ ✓ $= n(8{,}31)(293)$ ✓
$n = 5$ moles ✓ (4)
[18]

QUESTION 5/*VRAAG 5*

5.1 $n = \frac{m}{M}$
$n = \frac{160}{40}$ ✓
$n = 4$ mole
$pV = nRT$ ✓
$(120\ 000)V = (4)(8{,}31)(288)$ ✓
$V = 0{,}08\ m^3$ ✓ (4)

5.2 **POSITIVE MARKING FROM QUESTION 5.1**
POSITIEWE NASIEN VANAF VRAAG 5.1

OPTION 1/*OPSIE 1*

$\frac{p_1V_1}{T_1} = \frac{p_2V_2}{T_2}$ ✓

✓

$\frac{120(0,08)}{288} = \frac{240V_2}{308}$ ✓

$V_2 = 0,043\ m^3$ ✓ (427,78 dm^3)

OPTION 2/*OPSIE 2*

pV = nRT ✓

(240 000)V ✓ = (4)(8,31)(308) ✓

V = 0,043 m^3 ✓ (426,58 dm^3) (4)

[8]

QUESTION 6/*VRAAG 6*

6.1.1 One mole is the amount of a substance having the same number of particles as there are atoms in 12 g carbon-12. ✓✓
Een mol is die stofhoeveelheid wat dieselfde getal deeltjies het as wat daar atome in 12 g koolstof-12 is.
[2 or 0] (2)

6.1.2 $Na_2CO_3 + 2HC\ell$ ✓ → $2NaC\ell + H_2O + CO_2$ ✓ (2)

6.1.3 **Mark allocation/Nasienriglyne:**

- Formula for/ *Formule vir* volume ✓
- Substitution of 0,306 and 24,45 ✓/*Vervanging van 0,306 en 24,45*
- Using ratio/*Gebruik verhouding* ✓
- Formula for/*Formule vir* mass ✓
- Substitutions of moles ✓and 106 ✓ /*Vervanging van mole en 106*
- Answer with units/*Antwoord met eenheid* ✓

$n = \frac{V}{V_m}$ ✓

$n = \frac{0,306}{24,45}$ ✓

n = 0,0125 mol of CO_2

$Na_2CO_3 : CO_2$

1 : 1 ✓ (use of the ratio/*gebruik die verhouding*)

n = 0,0125 mol of Na_2CO_3

$n = \frac{m}{M}$ ✓

✓

$0,0125 = \frac{m}{106}$ ✓

m = 1,33 g ✓ (1,325 – 1,33 g) (7)

6.1.4 **POSITIVE MARKING FROM QUESTION 6.3**
POSITIEWE NASIEN VANAF VRAAG 6.3
OPTION 1/*OPSIE 1*

$$\% \ CaCO_3 \text{ unreacted} = \frac{1,5 - 1,33}{1,5} \times 100 \quad \checkmark$$

$$= 11,33\% \ \checkmark \ (11,33\% - 11,67\%)$$

OPTION 2/*OPSIE 2*

$$\% \ CaCO_3 \text{ reacted} = \frac{1,33}{1,5} \checkmark \times 100 = 88,67\%$$

$$\% \text{ unreacted} = 100 - 88,67 = 11,33\% \ \checkmark$$

OPTION 3/*OPSIE 3*

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

$$n = \frac{1,5}{106}$$

$$n = 0,0142 \text{ mol}$$

initial mol – reacted mol = 0,0142 – 0,0125 = 0,0017 mol unreacted

$$\% \ CaCO_3 \text{ unreacted} = \frac{0,0017}{0,0142} \checkmark \times 100 = 11,97\% \ \checkmark$$ (2)

6.2.1 Sulphuric acid ✓ (1)
Swawelsuur

6.2.2

Mark allocation/Punte toekenning:

- Any one of the formulae/Enige een van formules ✓
- Substitution of/*Vervanging van* 3 g (5 g – 2 g) ✓
- Ratio/*Verhouding 1:1* ✓
- Substitution of moles and volume in dm^3 /*Vervanging van mol en volume in* dm^3 ✓
- Answer with units/*Antwoord met eenheid* ✓

OPTION 1/*OPSIE 1*

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

$= \frac{3}{65}$ ✓ ← (5 – 2)

= 0,0462 mol of Zn

✓ any one of the two formula/Enige een van formules

Ratio Zn : H_2SO_4

1 : 1 ✓

$n(H_2SO_4)$ = 0,0462 mol

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

$= \frac{0,0462}{0,05}$ ✓

= 0,92 $mol \cdot dm^{-3}$ ✓

OPTION 2/*OPSIE 2*

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

$= \frac{3}{65}$ ✓

= 0,0462 mol of Zn

✓ any one of the two formula/Enige een van formules

Ratio Zn : H_2SO_4

1 : 1 ✓

$n(H_2SO_4)$ = 0,0462 mol

$m = nM$

= (0,0462)(98)

= 4,5276 g of H_2SO_4

$c = \frac{m}{MV}$

$= \frac{4,5276}{(98)(0,05)}$ ✓

= 0,92 $mol \cdot dm^{-3}$ ✓

OPTION 3/*OPSIE 3*

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

$= \frac{5}{65}$

= 0,0769 mol of Zn initial

✓ any one of the two formula/Enige een van formules

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

$= \frac{2}{65}$

= 0,0308 mol of Zn final

n_{used} = 0,0769 ✓ − 0,0308 = 0,0461 mol

Ratio Zn : H_2SO_4

1 : 1 ✓

$n(H_2SO_4)$ = 0,0461 mol

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

$= \frac{0,0461}{0,05}$ ✓

= 0,92 $mol \cdot dm^{-3}$ ✓

(5)

[19]

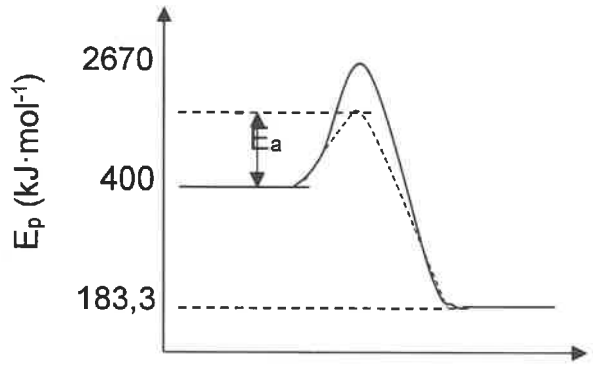
QUESTION 7/VRAAG 7

7.1 The minimum energy needed for a reaction to take place. ✓✓
Die minimum energie benodig vir die reaksie om plaas te vind.
[2 or 0] (2)

7.2 More energy is released than absorbed **OR** energy of products is less than energy of reactants **OR** $\Delta H < 0$ **OR** ΔH is negative ✓
*Meer energie word afgegee as opgeneem **OF** energie van die produkte is minder as die energie van reaktante **OF** $\Delta H < 0$ **OF** ΔH is negatief* (1)

7.3 $\Delta H = H_{products} - H_{reactants}$
$= 183,3$ ✓ $- 400$ ✓
$= -216,7\ kJ \cdot mol^{-1}$ ✓ (3)

7.4



Course of reaction/Reaksieverloop

Criteria for marking/*Nasienkriteria*	
Lower curved line/*Laer kurwelyn*	✓
Lower activation energy indicated *Laer aktiveringsenergie aangedui*	✓

(2)

7.5 One mole of any gas occupies the same volume at the same temperature and pressure. ✓✓
Een mol van enige gas beslaan dieselfde volume by dieselfde temperatuur en druk.
[2 or 0] (2)

7.6 **OPTION 1/*OPSIE 1***

	$4NH_3$	$5O_2$	4NO	$6H_2O$	
Initial vol	6	9 ✓	0	0	
Change in vol	6	7,5	6	9	Ratio ✓
Final vol	0	1,5	6	9	

✓

Total volume = 1,5 + 6 + 9 = 16,5 dm^3 ✓

OPTION 2/*OPSIE 2*
Mol ratio 4 : 5 : 4 : 6 from balanced equation
Mol verhouding 4 : 5 : 4 : 6 vanuit gebalanseerde vergelyking

Volume ratio reacting 6 : 7,5 : 6 : 9 ✓
Volume verhouding wat reageer 6 : 7,5 : 6 : 9

O_2 in excess/*in oormaat*
Only/*Slegs* 7,5 dm^3 of/*van* 9 dm^3 reacts/*reageer*
9 – 7,5 = 1,5 dm^3 ✓

✓
Total volume at the end of reaction = 6 + 9 + 1,5 = 16,5 dm^3 ✓
Totale volume aan die einde van die reaksie = 6 + 9 + 1,5 = 16,5 dm^3 (4)

7.7 $n = \frac{m}{M}$

$n(H) = \frac{1,59}{1}$ ✓
= 1,59 mol

$n(N) = \frac{22,2}{14}$ ✓
= 1,5857 mol

$n(O) = \frac{76,2}{16}$ ✓
= 4,625 mol

H	:	N	:	O
$\frac{1,59}{1,5857}$	:	$\frac{1,5857}{1,5857}$	:	$\frac{4,625}{1,5857}$
1	:	1	:	3

✓ divide by smallest number/
deel deur kleinste getal

Empirical formula/*Empiriese formule* is HNO_3 ✓

(5)
[19]

QUESTION 8/*VRAAG 8*

8.1 A hydroxide ion can act as proton acceptor. ✓✓
'n Hidroksiedioon kan optree as protonontvanger. (2)

8.2 Dative covalent bond ✓
Datiefkovalente binding (1)

8.3 $HC\ell(aq) + H_2O(\ell)$ ✓ $\rightarrow H_3O^+(aq) + C\ell^-(aq)$ ✓
OR/*OF*
$HC\ell(aq) + NH_3(g)$ ✓ $\rightarrow NH_4^+(aq) + C\ell^-(aq)$ ✓ (2)

8.4 Concentration is the amount of solute per litre of solution. ✓✓
Konsentrasie is die hoeveelheid opgeloste stof per liter van 'n oplossing.
OR/*OF*
Concentration is the number of moles of a substance per dm^3 of solution.
Konsentrasie is die aantal mol van 'n stof per dm^3 –oplossing. (2)

8.5

OPTION 1/*OPSIE 1*	**OPTION 2/*OPSIE 2***
$c = \frac{n}{V}$ ✓ $0,75 = \frac{n}{5}$ ✓ $n = 3,75$ mol $c = \frac{n}{V}$ $= \frac{3,75}{1000}$ ✓ $= 3,75 \times 10^{-3}$ mol·dm^{-3} ✓	$c_1V_1 = c_2V_2$ ✓ $(0,75)(5)$ ✓ $= c_2(1000)$ ✓ $c_2 = 3,75 \times 10^{-3}$ mol·dm^{-3} ✓ **OPTION 3/*OPSIE 3*** ✓ $\frac{5}{1000}$ ✓ $= \frac{c}{0,75}$ ✓ $c = 3,75 \times 10^{-3}$ mol·dm^{-3} ✓

(4)

8.6 **Mark allocation/Punte toekenning**

- Usage of formula(e) of c = n/V and/or n = m/M
- Usage or calculation of number of moles (3,75 mol) of HNO_3
- Ratio/*Verhouding* 2:1
- Usage of 74 g.mol^{-1} in formula n = m/M
- Answer/*Antwoord*
- Correct conclusion/*Korrekte gevolgtrekking*

OPTION 1/*OPSIE 1*

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

$0,75 = \frac{n}{5}$

n = 3,75 mol ✓

✓ any one of the two formula/Enige een van formules

Ratio $HNO_3 : Ca(OH)_2$
2 : 1 ✓

$n(Ca(OH)_2)$ = 1,875 mol

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

$1,875 = \frac{m}{74}$ ✓

m = 138,75 g ✓

No, it is insufficient. ✓
Nee, dit is nie genoeg nie

POSITIVE MARKING FROM 8.5
POSITIEWE NASIEN VANAF 8.5
OPTION 2/*OPSIE 2*

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

$3,75 \times 10^{-3} = \frac{n}{1000}$

n = 3,75 mol ✓

✓ any one of the two formula/Enige een van formules

Ratio $HNO_3 : Ca(OH)_2$
2 : 1 ✓

$n(Ca(OH)_2)$ = 1,875 mol

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

$1,875 = \frac{m}{74}$ ✓

m = 138,75 g ✓

No, it is insufficient. ✓
Nee, dit is nie genoeg nie

POSITIVE MARKING FROM 8.5
POSITIEWE NASIEN VANAF 8.5
OPTION 3/OPSIE 3

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

$n = \frac{120}{74}$ ✓

n = 1,62 mol

✓ any one of the two formula/Enige een van formules

n = cV
= 3,75 x 10^{-3}(1000)
= 3,75 mol ✓

$HNO_3 : Ca(OH)_2$
2 : 1 ✓

$n(Ca(OH)_2) = ½(3,75)$
= 1,875 mol ✓

1,875 > 1,62 mol

No it is insufficient ✓
Nee dis nie genoeg nie

(6)
[17]

QUESTION 9/*VRAAG 9*

9.1 Reduction is a decrease in oxidation number ✓✓
Reduksie is die afname in oksidasiegetalle (2)

9.2 Mn is +7 / Mn^{7+} ✓ (1)

9.3 H_2S / S^{2-} ✓ (1)

9.4 The oxidation number of S increases ✓ from -2 to 0 ✓
Die oksidasiegetal van S neem toe van -2 na 0 (2)

9.5 MnO_4^- / Mn^{+7} ✓ (1)

9.6 $H_2S(g) \rightarrow S + 2H^+ + 2e^-$ ✓✓ (2)

9.7 $H_2S \rightarrow S + 2H^+ + 2e^-$
$MnO_4^- + 8H^+ + 5e^- \rightarrow 2Mn^{2+} + 4H_2O$ ✓
$2MnO_4^- + 5H_2S + 6H^+ \rightarrow 2Mn^{2+} + 5S + 8H_2O$ ✓ balancing ✓ equation (3)
[12]

QUESTION 10/*VRAAG10*

10.1
- Dangerous for workers because they can be trapped underground. ✓
- Sinkholes ✓

(Any relevant answer)
- *Gevaarlik vir werkers want hulle kan ondergronds vasgekeer word*
- *Sinkgate*

(Enige relevante antwoord) (2)

10.2 O_2 ✓ (1)

10.3 Oxidation number of O decreases from 0 (in O_2) to -2 (in NaOH) ✓
Die oksidasiegetal van O neem af van 0 (in O_2) na -2 (in NaOH) (1)

10.4 $Fe^{3+} + 3e^- \rightarrow Fe$ ✓✓ (2)

10.5 $\%Fe = \frac{2(56)}{160} \times 100\%$ ✓
$= 70\%$ ✓ (2)

10.6 $m(Fe) = (0{,}65)(2\,500)$ ✓ or/of $\frac{65}{100}(2\,500)$
$= 1\,625$ kg Fe extracted/*ontgin* ✓ (Accept/Aanvaar $1{,}625 \times 10^6$ g) (2)
[10]

TOTAL/*TOTAAL*: 150

SUBMIT THIS SHEET WITH THE ANSWER BOOK/
LEWER SAAM MET DIE ANTWOORDEBOEK IN

NAME/*NAAM* _____ **CLASS/*KLAS*** _____
QUESTION/*VRAAG* 4.3

Graph of volume versus pressure/*Grafiek van volume teenoor druk*