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 2019

## MARKING GUIDELINES/*NASIENRIGLYNE*

**MARKS/*PUNTE*: 150**

**These marking guidelines consist of 14 pages./**
***Hierdie nasienriglyne bestaan uit 14 bladsye.***

## QUESTION 1/*VRAAG 1*

1.1 A ✓✓ (2)

1.2 B ✓✓ (2)

1.3 D ✓✓ (2)

1.4 D ✓✓ (2)

1.5 C ✓✓ (2)

1.6 D ✓✓ (2)

1.7 A ✓✓ (2)

1.8 D ✓✓ (2)

1.9 B ✓✓ (2)

1.10 A ✓✓ (2)

**[20]**

## QUESTION 2/*VRAAG 2*

2.1

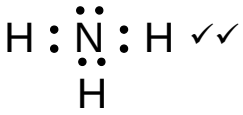
2.1.1

**Marking guidelines/*Nasienriglyne***
If any of the underlined key words/phrases are omitted: minus 1 mark
*Indien enige van die onderstreepte sleutelwoorde/frases uitgelaat is: minus 1 punt*

Two electrons shared between two atoms in a covalent bond. ✓✓
*Twee elektrone gedeel tussen twee atome in 'n kovalente binding.* (2)

2.1.2

(a)



✓✓

**Marking guidelines/*Nasienriglyne***
- Whole structure correct./*Hele struktuur korrek.* ✓✓
- H : N : H ✓ Max./*Maks.* ½
  H

(2)

(b)

✓✓

**Marking guidelines/*Nasienriglyne***
- Whole structure correct./*Hele struktuur korrek.* ✓✓
- H : C ℓ : O Max./*Maks.* ½

(2)

2.1.3

(a) 3 ✓ (1)

(b) 2 ✓ (1)

(c) Trigonal pyramidal ✓
*Trigonaal piramidaal* (1)

2.1.4 O-H ✓
O-H ΔEN = 3,5 - 2,1 = 1,4
N-H ΔEN = 3 - 2,1 = 0,9 ✓

**OR/*OF***
ΔEN between H and O is greater./ΔEN between N and H is smaller.
*ΔEN tussen H en O is groter./ΔEN tussen N en H is kleiner.* (2)

2.1.5 Hydrogen bonds ✓
*Waterstofbindings* (1)

2.1.6 Dative covalent bond ✓
*Datief kovalente binding* (1)

2.2

2.2.1

**Marking guidelines/*Nasienriglyne***
If any of the underlined key words/phrases are omitted: minus 1 mark
*Indien enige van die onderstreepte sleutelwoorde/frases uitgelaat is: minus 1 punt*

Energy needed to break one mole of a compound's molecules into separate atoms. ✓✓
*Die energie benodig om een mol molekule van 'n verbinding in aparte atome op te breek.* (2)

2.2.2 A ✓
When the bond order increases/double bond is formed, the bond length decreases ✓ and the bond energy increases. ✓
*Wanneer die bindingsorde verhoog/dubbelbinding gevorm word, verlaag die bindingslengte en verhoog die bindingsenergie.*

**OR/*OF***
When a second bond is formed, the bond length decreases ✓ and the potential energy of the molecule decreases. ✓
*Wanneer die tweede binding gevorm word,verlaag die bindingslengte en verlaag die potensiële energie.* (3)

2.2.3 148 pm ✓ (1)
**[19]**

## QUESTION 3/*VRAAG 3*

3.1

**Marking guidelines/*Nasienriglyne***
If any of the underlined key words/phrases are omitted: minus 1 mark
*Indien enige van die onderstreepte sleutelwoorde/frases uitgelaat is: minus 1 punt*

Temperature at which the solid and liquid phases of a substance are at equilibrium. ✓✓
*Die temperatuur waarby die vaste- en vloeistoffases van 'n stof in ewewig is*. (2)

3.2
- HF has hydrogen bonds between molecules. ✓
- HCℓ has dipole-dipole forces.✓
- Hydrogen bonds are stronger than dipole-dipole forces./*Intermolecular forces in HF stronger./ Intermolecular forces in HCℓ weaker.* ✓
- More energy is needed to overcome/break intermolecular forces. ✓

- *HF het waterstofbindings tussen molekule.*
- *HCℓ het dipool-dipoolkragte.*
- *Waterstofbindings is sterker as dipool-dipoolkragte./Intermolekulêre kragte in HF sterker./Intermolekulêre kragte in HCℓ swakker.*
- *Meer energie benodig om intermolekulêre kragte te oorkom/breek.* (4)

3.3 $CS_2$ ✓ (1)

3.4
- $CS_2$ has a greater surface area/molecular mass/larger molecules (than $CO_2$). ✓
- London forces increase with molecular mass/molecular size. ✓
- More energy needed to break/overcome intermolecular forces. ✓

- *$CS_2$ has a groter oppervlak/molekulêre massa/groter molekule (as $CO_2$).*
- *Londonkragte neem toe met molekulêre massa/molekulêre grootte.*
- *Meer energie benodig om intermolekulêre kragte te oorkom/breek.* (3)

3.5 HCℓ ✓
Lowest boiling point. ✓
*Laagste kookpunt.* (2)
**[12]**

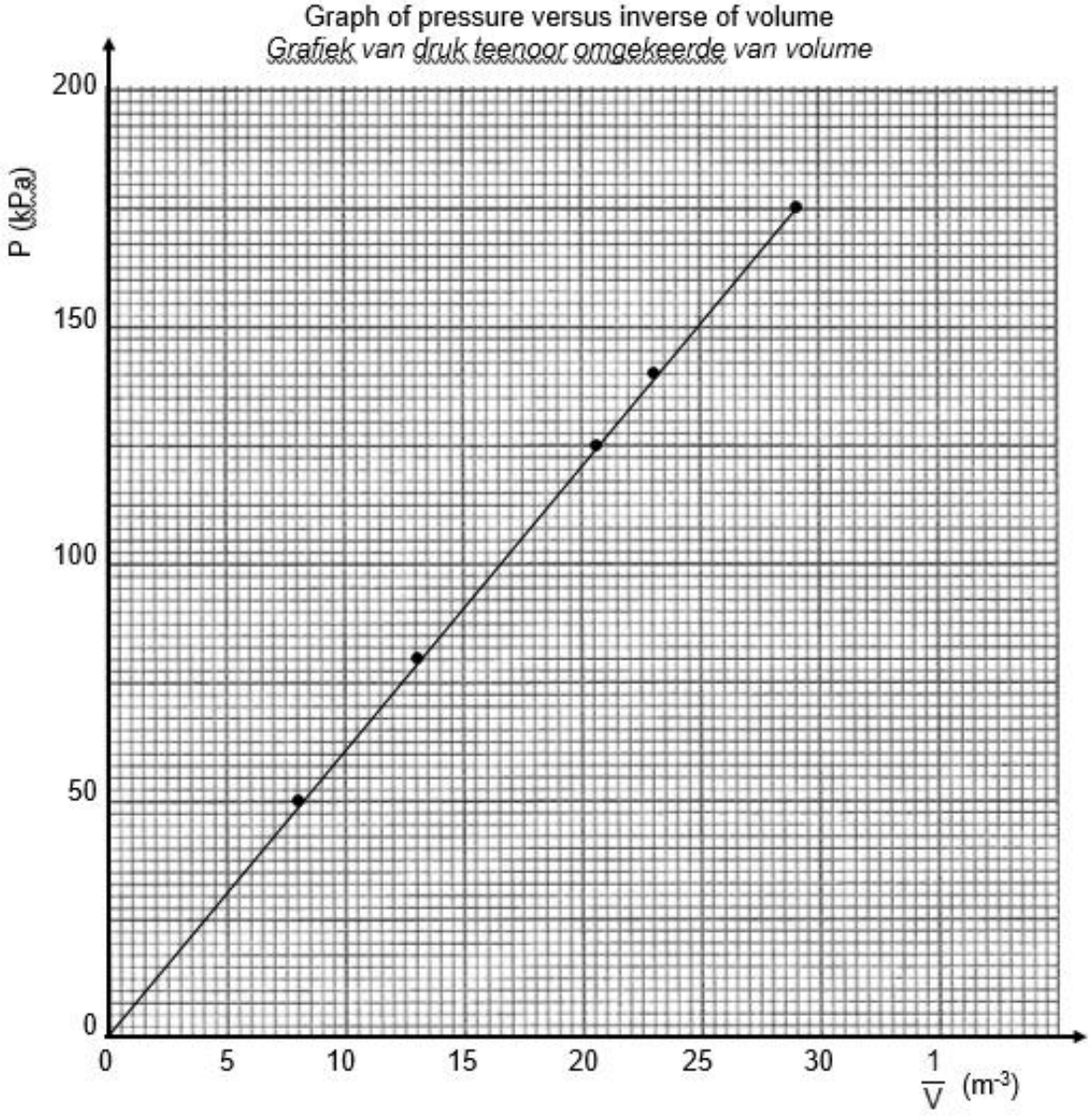
## QUESTION 4/*VRAAG 4*

4.1

**Marking guidelines/*Nasienriglyne***
If any of the underlined key words/phrases are omitted: minus 1 mark
*Indien enige van die onderstreepte sleutelwoorde/frases uitgelaat is: minus 1 punt*

Pressure of an enclosed gas is inversely proportional to the volume it occupies at constant temperature. ✓✓
*Die druk van 'n ingeslote gas is omgekeerd eweredig aan die volume wat dit beslaan by konstante temperatuur.* (2)

4.2




| **Marking criteria for graph/*Nasienriglyne vir grafiek*** | |
|---|---|
| Three (3) points plotted correctly./*Drie (3) punte korrek gestip.* | ✓ |
| All 5 points correctly plotted./Al 5 punte korrek gestip. | ✓✓ |
| Line of best fit drawn./Beste paslyn getrek. | ✓ |

Refer to the last page of marking guideline for graph drawn on supplied graph sheet./*Verwys na die laaste bladsy van nasienriglyn vir grafiek getrek op verskafde grafiekpapier.* (3)

4.3 Temperature/*Temperatuur* ✓
**OR/OF**
Number of moles of gas/*Aantal mol gas*

Gradient/*gradiënt* = pV = nRT ✓ (2)

4.4 Particles/molecules of real gases occupy volume. ✓
At high pressure, volume of gas molecules/particles become significant ✓ and the measured volume is greater than expected. ✓

*Deeltjies/molekule van werklike gasse beslaan volume.*
*By hoë druk word volume van molekule/deeltjies beduidend en die gemete volume is groter as verwag.* (3)

4.5 pV = nRT ✓
(125 000)(0,049) ✓ = n(8,31)(298) ✓
n = 2,47 mol ✓ (4)
**[14]**

**QUESTION 5/*VRAAG 5***

5.1 $\frac{p_1}{T_1} = \frac{p_2}{T_2}$

$\frac{240}{303}$ ✓ = $\frac{x}{263}$ ✓

x = 208,32 (kPa) ✓ (3)

5.2 Greater than/*Groter as* ✓ (1)

5.3

| **Marking guidelines/*Nasienriglyne*** | |
|---|---|
| • Compare gradients./*Vergelyk gradiënte*. ✓<br>• Gradient = $\frac{p}{T} = \frac{nR}{V}$. ✓<br>• Compare $\frac{1}{V}$ ✓ | |
| **OPTION 1/*OPSIE 1*** | **OPTION 2/*OPSIE 2*** |
| Gradient of graph for N smaller than gradient of graph for M./*Gradiënt van grafiek vir N kleiner as gradiënt van grafiek vir M.* ✓<br>Gradient = $\frac{nR}{V}$ ✓<br>Therefore/*Dus* $(\frac{1}{V})_N < (\frac{1}{V})_M$ ✓<br>Thus volume of N larger than volume of M. *Dus is die volume van N groter as die volume van M.* | Gradient (N) < g*radient (M)* ✓<br>$(\frac{p}{T})_N < (\frac{p}{T})_M$<br>$(\frac{nR}{V})_N < (\frac{nR}{V})_M$ ✓<br>$(\frac{1}{V})_N < (\frac{1}{V})_M$ ✓<br>$V_N > V_M$ |

(3)
**[7]**

## QUESTION 6/*VRAAG 6*

6.1

6.1.1

**Marking guidelines/*Nasienriglyne***
If any of the underlined key words/phrases are omitted: minus 1 mark
*Indien enige van die onderstreepte sleutelwoorde/frases uitgelaat is: minus 1 punt*

The mass of one mole of a substance measured in $g \cdot mol^{-1}$. ✓✓
*Die massa van een mol van 'n stof gemeet in $g \cdot mol^{-1}$.* (2)

6.1.2

$n(C) = \frac{39,13}{12}$ ✓ = 3,26

$n(H) = \frac{8,7}{1}$ ✓ = 8,7

$n(O) = \frac{52,17}{16}$ ✓ = 3,26

Ratio/*Verhouding* C : H : O:

$\frac{3,26}{3,26} = 1$
$\frac{8,7}{3,26} = 2,67$ ✓
$\frac{3,26}{3,26} = 1$

C : H : O = 1 : 2,67 : 1 = 3 : 8 : 3 ✓
Empirical formula/*Empiriese formule*:
$C_3H_8O_3$ ✓ (6)

**Marking guidelines/*Nasienriglyne***
- Divide %C by 12 $g \cdot mol^{-1}$./*Deel %C deur 12 $g \cdot mol^{-1}$.*
- Divide %H by 1 $g \cdot mol^{-1}$./*Deel %H deur 1 $g \cdot mol^{-1}$.*
- Divide %O by 16 $g \cdot mol^{-1}$./*Deel %O deur 16 $g \cdot mol^{-1}$.*
- Divide by smallest answer/*Deel deur kleinste antwoord.*
- Ratio/*Verhouding:* 3 : 8 : 3
- *Final answer/Finale antwoord:* $C_3H_8O_3$ ✓

6.1.3 5 ✓ (1)

6.1.4

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

$n = \frac{18}{137}$ ✓

n = 0,131 mol

$KMnO_4 : Mn_2O_3 = 2 : 1$
$n(Mn_2O_3) = 0,0656$ mol ✓

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

$0,0656 = \frac{m}{158}$ ✓

$\therefore m = 10,38$ g ✓ (4)

**Marking guidelines/*Nasienriglyne***
- Substitute 137 $g \cdot mol^{-1}$ in ratio/$n = \frac{m}{M}$. ✓
  *Vervang 137 $g \cdot mol^{-1}$ in verhouding/$n = \frac{m}{M}$.*
- Use ratio/*Gebruik verhouding*: $n(Mn_2O_3) = ½n(KMnO_4)$ ✓
- Substitute 158 $g \cdot mol^{-1}$ in ratio/$n = \frac{m}{M}$. ✓
  *Vervang 158 $g \cdot mol^{-1}$ in verhouding/$n = \frac{m}{M}$.*
- Final answer/*Finale antwoord:* 10,38 g ✓

6.2

6.2.1

**Marking guidelines/*Nasienriglyne***
If any of the underlined key words/phrases are omitted: minus 1 mark
*Indien enige van die onderstreepte sleutelwoorde/frases uitgelaat is: minus 1 punt*

The amount of solute/dissolved substance per litre/$dm^3$ of solution. ✓✓
*The hoeveelheid opgeloste stof per liter/$dm^3$ van die oplossing.* (2)

6.2.2

$c = \frac{n}{V}$ ✓

$0,1 = \frac{n}{0,1}$ ✓

n = 0,01 mol ✓ (3)

6.2.3

$n(HC\ell) = \frac{V}{V_m}$ ✓

$= \frac{0,460}{24,45}$ ✓

= 0,01881 mol

Ratio HCℓ : NaCℓ = 1 : 1

n(NaCℓ) = 0,01881 mol ✓

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

$0,0188 = \frac{m}{58,5}$ ✓

m(NaCℓ) = 1,1 g

$\%purity = \frac{1,1}{1,5} \times 100$ ✓

= 73,37% ✓

**Marking guidelines/*Nasienriglyne***

- Formula/*Formule*: $n = \frac{m}{M} / n = \frac{V}{V_m}$ ✓
- Substitute 25,45 $dm^3 \cdot mol^{-1}$ in ratio/$n = \frac{V}{V_m}$. ✓
  *Vervang* 25,45 $dm^3 \cdot mol^{-1}$ *in verhouding/* $n = \frac{V}{V_m}$.
- Use ratio/*Gebruik verhouding*:
  n(NaCℓ) = n(HCℓ) ✓
- Substitute 58,5 $g \cdot mol^{-1}$ in ratio/$n = \frac{m}{M}$. ✓
  *Vervang 58,5 $g \cdot mol^{-1}$ in verhouding/* $n = \frac{m}{M}$.
- $\frac{m(\text{calculated / } bereken)}{m(\text{impure / } onsuiwer)} \times 100$ ✓
- Final answer/*Finale antwoord:* 73 g ✓

(6)
**[24]**

## QUESTION 7/VRAAG 7

7.1

**Marking guidelines/*Nasienriglyne***
If any of the underlined key words/phrases are omitted: minus 1 mark
*Indien enige van die sleutelwoorde/frases uitgelaat is: minus 1 punt*

The energy absorbed or released per mole in a chemical reaction. ✓✓
*Die energie geabsorbeer of vrygestel per mol in a chemiese reaksie.* (2)

7.2 Endothermic ✓
More energy is absorbed than released ✓ **OR** $\Delta H > 0$
*Endotermies*
*Meer energie is geabsorbeer as vrygestel **OF** $\Delta H > 0$* (2)

7.3

7.3.1 544 (kJ/kJ·mol$^{-1}$) ✓✓ (2)

7.3.2 131 (kJ/kJ·mol$^{-1}$) ✓✓ (2)
**[8]**

## QUESTION 8/*VRAAG 8*

8.1

8.1.1 An acid is a proton donor. ✓✓
*'n Suur is 'n protonskenker.* (2)

8.1.2 $HNO_3$ and/*en* $NO_3^-$ ✓✓
**OR/*OF***
$H_2O$ and/*en* $H_3O^+$ (2)

8.1.3 Acidic/Suur ✓
Hydronium ions/$H_3O^+$ formed in water. ✓
*Hidroniumione/$H_3O^+$ vorm in water.* (2)

8.1.4

**Marking guidelines/*Nasienriglyne***
If any of the underlined key words/phrases are omitted: minus 1 mark
*Indien enige van die onderstreepte sleutelwoorde/frases uitgelaat is: minus 1 punt*

An ampholyte is a substance that can act as either acid or base. ✓✓
*'n Amfoliet is 'n stof wat as suur of basis kan optree.* (2)

8.1.5 $H_2O$ ✓

8.1.6 Reaction 1: It/$H_2O$ reacts as base/accepts a proton or $H^+$. ✓
Reaction 2: It/$H_2O$ reacts as acid/donates a proton or $H^+$. ✓ (2)

8.1.7

**Marking guidelines/*Nasienriglyne***
- Substitute 0,1 $dm^3$ & 0,2 $mol \cdot dm^{-3}$ in formula/ratio. ✓
  *Vervang 0,1 $dm^3$ & 0,2 $mol \cdot dm^{-3}$ in formule/verhouding.*
- Use ratio/*Gebruik verhouding*:
  n(dilute/*verdun*) = n(concentrated/*gekonsentreerd*) ✓
- Substitute 0,02 mol & 0,16 $mol \cdot dm^{-3}$ in formula/ratio.
  *Vervang 0,0,2 mol & 0,16 $mol \cdot dm^{-3}$ in formule/verhouding.*
- Final answer/*Finale antwoord:* 0,025 $dm^3$ / 25 $cm^3$ ✓

**OPTION 1/*OPSIE 1***

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

$0,2 = \frac{n}{0,1}$ ✓

$\therefore$ n(conc/*gekons*) = 0,02 mol
= n(dilute/verdun) ✓

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

$0,16 = \frac{0,02}{V}$ ✓

$V = 0,125\ dm^3$

Amount added/*Hoeveelheid bygevoeg:*
$0,125 - 0,1 = 0,025\ dm^3$ ✓

**OPTION 2/*OPSIE 2***

$c_1V_1 = c_2V_2$
(0,2)(100) ✓ = (0,16)$V_2$ ✓✓
$V_2 = 125\ cm^3$

Amount added/*Hoeveelheid bygevoeg:*
$125 - 100 = 25\ cm^3$ ✓

(4)

8.2

8.2.1

$c = \frac{n}{V}$ ✓

$0,16 = \frac{n}{0,08}$ ✓

n = 0,0128 mol

n(ZnO) = ½n($HNO_3$)
= ½ (0,0128) ✓
= 0,0064

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

$0,0064 = \frac{m}{81}$ ✓

m = 0,52 g ✓

**Marking guidelines/*Nasienriglyne***
- Formula/*Formule*: $n = \frac{m}{M} / c = \frac{n}{V}$ ✓
- Substitute/*Vervang* 0,16 $dm^3 \cdot mol^{-1}$ & 0,08 $dm^3$ in $c = \frac{n}{V}$ /ratio/*verhouding* ✓
- Use ratio/*Gebruik verhouding*:
  n(ZnO) = ½n($HNO_3$) ✓
- Substitute/*Vervang* 81 $g \cdot mol^{-1}$ in $n = \frac{m}{M}$ /ratio/*verhouding.* ✓
- Final answer/*Finale antwoord:*
  0,52 g ✓

(5)

8.2.2 Zinc nitrate/*Sinknitraat* ✓
$Zn(NO_3)_2$ ✓

(2)
**[21]**

## QUESTION 9/*VRAAG 9*

9.1 A reaction in which electrons are transferred. ✓✓
*'n Reaksie waar elektrone oorgedra word.* (2)

9.2
9.2.1 +7 ✓ (1)

9.2.2 +2 ✓ (1)

9.3. Reduction/*Reduksie* ✓
The oxidation number decreased. ✓
*Die oksidasie getal verminder.*
**OR**
Electrons are gained./*Elektrone is opgeneem.* (2)

9.4 (Reaction/*reaksie*) 1 ✓

Oxidation number (of S) decreases ✓ from +4 (in $SO_2$) to 0 (in S).
*Oksidaseigetal (van S) neem af van +4 (in $SO_2$) na 0 (in S).*

**OR/*OF***
$SO_2$ gains electrons./*$SO_2$ neem elektrone op*.
**OR/*OF***
In reaction 2, the oxidation number (of S) increases from +4 (in $SO_2$) to +6 (in $SO_4^{2-}$)./*In reaksie 2, neem die oksidasiegetal (van S) toe van +4 (in $SO_2$) na + 6 in $SO_4^{2-}$).* (2)

9.5 $H_2S \rightarrow S + 2H^+ + 2e^-$ ✓✓

**Marking guidelines/*Nasienriglyne***
- $H_2S \rightleftharpoons S + 2H^+ + 2e^-$ $\frac{1}{2}$ $S + 2H^+ + 2e^- \leftarrow H_2S$ $\frac{1}{2}$
  $S + 2H^+ + 2e^- \rightleftharpoons H_2S$ $\frac{0}{2}$ $S + 2H^+ + 2e^- \rightarrow H_2S$ $\frac{0}{2}$
- Ignore if charge on electron is omitted./*Ignoreer indien lading op elektron uitgelaat is.*
- If charge on ion omitted e.g. $S + 2H + 2e^- \rightarrow H_2S$
  *Indien lading op ion uitgelaat is bv. $S + 2H + 2e^- \rightarrow H_2S$* Max/*Maks.* $\frac{1}{2}$

(2)

9.6 $H_2S \rightarrow S + 2H^+ + 2e^-$ (x2)
$SO_2 + 4H^+ + 4e^- \rightarrow S + 2H_2O$ ✓
$2H_2S + SO_2$ ✓$\rightarrow 3S + 2H_2O$ ✓ Bal. ✓

**IF/*INDIEN***
No half-reactions shown/*Geen halfreaksies getoon nie:*
Max/*Maks.* $\frac{1}{2}$

(4)
**[14]**

## QUESTION 10/*VRAAG 10*

10.1 Cyanide/$CN^-$/It is toxic. ✓
*Sianied/$CN^-$/Dit is giftig.* (1)

10.2 Basic/*Basies* ✓
Hydroxide is a base./*Hidroksied is 'n basis.*✓ (2)

10.3 +1 ✓ (1)

10.4 Au ✓ (1)

10.5 Oxidation/*Oksidasie* ✓ (1)

10.6 $Zn \rightarrow Zn^{2+} + 2e^-$ ✓✓

**Marking guidelines/*Nasienriglyne***

- $Zn \rightleftharpoons Zn^{2+} + 2e^-$ $\frac{1}{2}$ $Zn^{2+} + 2e^- \leftarrow Zn$ $\frac{1}{2}$
  $Zn^{2+} + 2e^- \rightleftharpoons Zn$ $\frac{0}{2}$ $Zn^{2+} + 2e^- \rightarrow Zn$ $\frac{0}{2}$
- Ignore if charge on electron is omitted./*Ignoreer indien lading op elektron uitgelaat is.*
- If charge on ion omitted e.g. $Zn \rightarrow Zn + 2e^-$
  *Indien lading op ion uitgelaat is bv.* $Zn \rightarrow Zn + 2e^-$ Max/*Maks.* $\frac{1}{2}$

(2)

10.7 $\%Au = \frac{197}{272} \times 100$ ✓
= 72,42% ✓ (2)

**[10]**

**TOTAL/*TOTAAL*: 150**

## GRAPH SHEET/*GRAFIEKPAPIER*

**SUBMIT THIS GRAPH SHEET WITH THE ANSWER BOOK.**
***LEWER HIERDIE GRAGIEKPAPIER SAAM MET DIE ANTWOORDEBOEK IN.***

**NAME/*NAAM*** _____ **CLASS/*KLAS*** _____

**QUESTION/*VRAAG* 4.2**

**Graph of pressure versus inverse of volume**
***Grafiek van druk teenoor omgekeerde van volume***