Province of the
EASTERN CAPE
EDUCATION

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NATIONAL SENIOR CERTIFICATE/ *NASIONALE SENIOR SERTIFIKAAT*

GRADE/*GRAAD 11*

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

MARKS/*PUNTE*: **150**

This marking guideline consists of 16 pages./
Hierdie nasienriglyn bestaan uit 16 bladsye.

QUESTION 1/*VRAAG 1*

1.1 D ✓✓ (2)

1.2 C ✓✓ (2)

1.3 C ✓✓ (2)

1.4 D ✓✓ (2)

1.5 C ✓✓ (2)

1.6 C ✓✓ (2)

1.7 B ✓✓ (2)

1.8 C ✓✓ (2)

1.9 A ✓✓ (2)

1.10 A ✓✓ (2)

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QUESTION 2/*VRAAG 2*

2.1

Marking criteria/Nasienriglyne
If any of the underlined key words/phrases in the **correct context** are omitted: - 1 mark per word/phrase.
Indien enige van die sleutelwoorde/frases in die korrekte konteks weggelaat word: - 1 punt per word/frase.

A chemical bond is a mutual attraction between two atoms resulting from the simultaneous attraction between their nuclei and the outer electrons.✓✓
'n Chemiese binding is 'n wedersydse aantrekkingskrag tussen twee atome wat voortspruit uit die gelyktydige aantrekkingskrag tussen hul kerne en die buitenste elektrone. (2)

2.2 2.2.1


✓✓ (2)

2.2.2


✓✓ (2)

2.3 2.3.1 Bent/ Angular ✓
Gebuig/ Hoekig (1)

2.3.2 Trigonal – pyramidal ✓
Trigonaal – piramidaal (1)

2.4 Polar ✓

- F is more electronegative than N / F attracts the bond electrons more towards itself / ΔEN = 4,0 – 3,0 = 1✓
- N-F bond is polar ✓
- NF_3 molecular geometry is assymetrical. ✓

Polêr

- *F is meer elektronegatief as N / F trek die bindingselektrone meer na homself toe / ΔEN = 4,0 – 3,0 = 1*
- *N-F-binding is polêr*
- *NF_3 molekulêre geometrie is assimmetries* (4)

2.5 2.5.1 **B** ✓ (1)

2.5.2 **D** ✓ (1)

2.5.3
- As the two H atoms approaches each other, the electrons of the one H atom is attracted to the nucleus (protons) of the other H atom. ✓ The protons repel and electrons repel from the two H atoms.
- Attractive forces are greater than the repulsive forces, therefore the potential energy of the system decreases until it reaches the minimum value (most stable state) ✓

- *Soos die twee H-atome nader aan mekaar kom, word die elektrone van die een H-atoom na die kern (protone) van die ander H-atoom aangetrek. Die protone stoot mekaar af en die elektrone stoot die twee H-atome af.*
- *Aantrekkingskragte is groter as die afstotingskragte, daarom neem die potensiële energie van die stelsel af totdat dit die minimum waarde bereik (mees stabiele staat)* (2)

[16]

QUESTION 3/*VRAAG 3*

3.1 3.1.1 Hydrogen bond / *Waterstofbinding* ✓ (1)

3.1.2
- A hydrogen atom covalently bonded to a highly electronegative atom. ✓
- A lone pair of electrons on a nearby highly electronegative atom. ✓

- *'n Waterstofatoom wat kovalent verbind aan 'n hoë elektronegatiewe atoom.*
- *'n Alleen elektronpaar op 'n nabygeleë hoë elektronegatiewe atoom.* (2)

3.1.3 (Polar) covalent bond/(*Polêre) kovalente binding* ✓ (1)

3.1.4 a ✓ (1)

3.2.1

Marking criteria/Nasienriglyne
If any of the underlined key words/phrases in the **correct context** are omitted: - 1 mark per word/phrase.
Indien enige van die sleutelwoorde/frases in die korrekte konteks weggelaat word: - 1 punt per word/frase.

The temperature at which the vapour pressure of a substance equals the atmospheric pressure ✓✓

Die temperatuur waarby die dampdruk van 'n stof gelyk is aan die atmosferiese druk (2)

3.2.2 Gas ✓ (1)

3.2.3

MARKING CRITERIA/*NASIENKRITERIA*
- State the increase in molecular size from H_2S – H_2Te
- State the relationship between molecular size and London forces correctly.
- Refer to the energy involved.

- *Noem die toename in molekulêre grootte van H_2S – H_2Te*
- *Stel die verwantskap tussen molekulêre grootte en London kragte korrek.*
- *Verwys na die energie betrokke.*

- From H_2S to H_2Te the molecular size increases. ✓
- As the molecular size increases so does the London forces. ✓
- More energy is needed to overcome the intermolecular forces from H_2S to H_2Te ✓

- *Van H_2S na H_2Te neem die molekulêre grootte toe*
- *Soos die molekulêre grootte toeneem, neem die London-kragte ook toe.*
- *Meer energie is nodig om die intermolekulêre kragte van H_2S na H_2Te te oorkom* (3)

3.2.4 H_2Te ✓

It has the highest boiling point. / *Dit het die hoogste kookpunt*. ✓ (2)

3.2.5 HIGHER THAN/*HOËR AS* ✓ (1)

3.2.6

Marking criteria/*Nasienkriteria*
- State the dipole-dipole forces in H_2S ✓
- State the hydrogen bonds in HF ✓
- Compare strength of intermolecular forces between these two molecules ✓
- Refer to the energy involved ✓

- *Noem die dipool-dipoolkragte in H_2S*
- *Noem die waterstofbindings in HF*
- *Vergelyk die sterkte van intermolekulêre kragte tussen hierdie twee molekules*
- *Verwys na die energie wat betrokke is*

- HF has Hydrogen bonds ✓
- H_2S has dipole-dipole forces ✓
- Hydrogen bonds are stronger than dipole dipole forces ✓
- More energy is needed to overcome the intermolecular forces in HF ✓

- *HF het waterstofbindings*
- *H_2S het dipool-dipoolkragte*
- *Waterstofbindings is sterker as dipool-dipoolkragte*
- *Meer energie word benodig om die intermolekulêre kragte in HF te oorkom*

OR/*OF*

- HF has hydrogen bonds ✓
- H_2S has dipole-dipole forces ✓
- Dipole dipole forces are weaker than hydrogen bonds ✓
- Less energy is needed to overcome the intermolecular forces in H_2S ✓

- *HF het waterstofbindings*
- *H2S het dipool-dipoolkragte*
- *Dipool-dipoolkragte is swakker as waterstofbindings*
- *Minder energie word benodig om die intermolekulêre kragte in H_2S te oorkom*

(4)
[18]

QUESTION 4/*VRAAG 4*

4.1 Boyle's law/*Boyle se wet* ✓ (1)

4.2 4.2.1

Criteria for investigative question/*Nasienkriteria vir ondersoekendevraag*

The independent and dependent variables are stated ✓
Die onafhanklike en afhanklike veranderlike korrek gestel
Ask a question about the relationship between the independent and dependent variables ✓
Vra 'n vraag rondom die verwantskap tussen onafhanklike en afhanklike veranderlike

How does the pressure of a gas affects the volume? ✓✓
Hoe beïnvloed die druk van 'n gas die volume?

OR/*OF*

What is the relationship between pressure and volume of the gas? ✓✓
Wat is die verwantskap tussen druk en volume van die gas? (2)

4.2.2 Temperature ✓and amount of gas ✓
Temperatuur en hoeveelheid gas (2)

4.3 **When volume is decreased**

- The same number of gas particles are now occupy a smaller volume. ✓
- Particles collide with each other and walls of the container more frequently. ✓
- More frequent collisions mean greater pressure**.** ✓

Wanneer die volume afneem

- *Dieselfde aantal gasdeeltjies beset nou 'n kleiner volume.*
- *Deeltjies bots meer gereeld met mekaar en teen die wande van die houer.*
- *Meer gereelde botsings beteken groter druk.*

OR/*OF*

When the volume is increased

- The same number of gas particles are occupy a larger volume. ✓
- Particles collide with each other and walls of the container less frequently. ✓
- Less frequent collisions mean a decrease in pressure.✓

Wanneer die volume toeneem

- *Dieselfde aantal gasdeeltjies beset 'n groter volume.*
- *Deeltjies bots minder gereeld met mekaar en teen die wande van die houer.*
- *Minder gereelde botsings beteken 'n afname in druk.* (3)

4.4 $V = 1 / 0,66 \times 10^{-1}$ ✓ $= 15,15\ cm^3$ ✓ (2)

4.5 **Positive marking from QUESTION 4.4/*Positiewe nasien vanaf VRAAG 4.4***

$p_1V_1 = p_2V_2$ ✓

$(96)(15,15)$ ✓ $= (252)V_2$ ✓

$V_2 = 5,77\ cm^3$ ✓

NOTE:
For any other pressure values used from the table:
1) Then no positive marking from QUESTION 4.4.
2) Learners must use the reciprocal value of volume in their substitution.

LET WEL:
Vir enige ander drukwaardes wat uit die tabel gebruik word:
1) Dan geen positiewe nasien vanaf VRAAG 4.4 nie
2) Leerders moet die omgekeerde waarde van volume in hul vervanging gebruik. (4)

4.6 At very high pressure, the volume of the gas particles increases. ✓
At very high pressure the volume of the gas becomes significant and the space inside the container becomes significantly less. ✓
The volume measured is higher than predicted by the ideal gas law ✓

Teen baie hoë druk neem die volume van die gas deeltjies toe.
Teen baie hoë druk word die volume van die gas beduidend en die ruimte binne die houer word aansienlik minder.
Die gemete volume is hoër as wat deur die ideale gaswet voorspel word. (3)
[17]

QUESTION 5/*VRAAG 5*

5.1 Heat of reaction is the energy absorbed or released per mole in a chemical reaction. ✓✓
Reaksiewarmte is die energie wat per mol in 'n chemiese reaksie geabsorbeer of vrygestel word. (2)

5.2 EXOTHERMIC REACTION/*EKSOTERMIESE REAKSIE* ✓
More energy is released than the energy absorbed. ✓
Meer energie word vrygestel as die energie wat geabsorbeer word.

OR/*OF*

Heat/Enthalpy of the products is less than heat/enthalpy of the reactants. ✓
Die warmte/entalpie van die produkte is minder as die warmte/entalpie van die reaktante

OR/*OF*

$\Delta H < 0$ ✓ (2)

5.3 ΔH reaction/*reaksie* = $\sum$ H products/*produkte* - $\sum$ H reactant/*reaktanse*

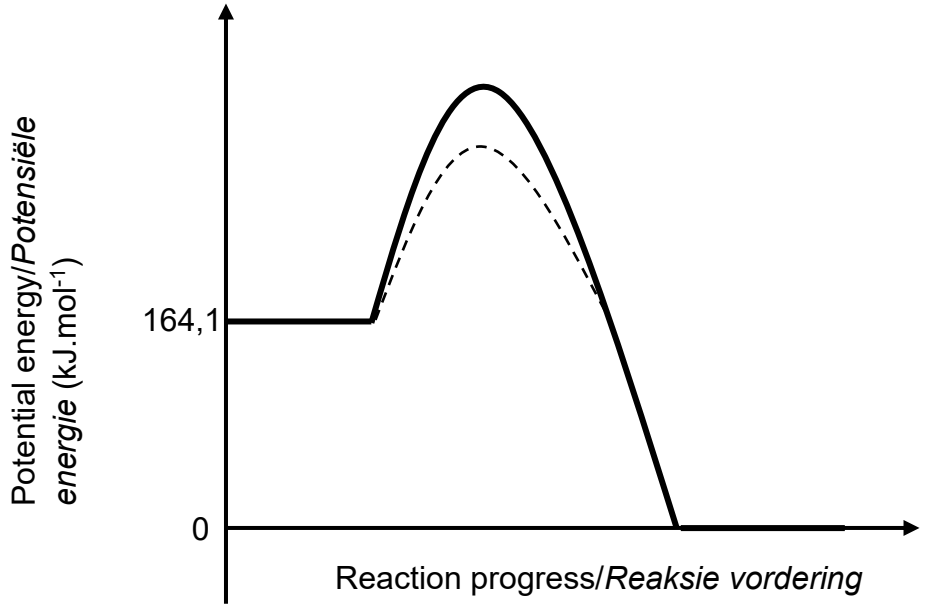
ΔH reaction/*reaksie* = $0 - (164,1)$ ✓

ΔH reaction/*reasksie* = $-164,1\ kJ \cdot mol^{-1}$ ✓ (2)

5.4 $E_a = 405,30 - 164,1$ ✓✓

$E_a = 241,20\ kJ \cdot mol^{-1}$ ✓ (3)

5.5



Marking criteria/*Nasienkriteria*

- Peak of the catalyst is lower. ✓
  Die piek van die katalisator is laer.
- Graphs start at the E_a and ends horizontally to H_r ✓
  Grafieke begin by die Ea en eindig horisontaal by H_r

(2)
[11]

QUESTION 6 / *VRAAG 6*

6.1 The mass of one mole of a substance. ✓✓ **(2 or 0)**
Die massa van een mol van 'n stof. ***(2 of 0)*** (2)

6.2

Marking criteria:
a. Calculation of moles of carbon ✓
b. Calculation of moles of hydrogen ✓
c. Calculation of moles of oxygen ✓
d. Dividing by smallest number of moles ✓
e. Empirical formula ✓
f. Dividing M(molecular mass) by M(empirical mass) ✓
g. Correct molecular formula ($C_4H_8O_2$) ✓

Nasienkriteria
a. Berekening van mol koolstof
b. Berekening van mol waterstof
c. Berekening van mol suurstof
d. Deel deur die kleinste aantal mol
e. Empiriese formule
f. Deel M(Molekulêre massa) deur M(empiriese massa)
g. Korrekte molekulêre formule ($C_4H_8O_2$)

$\frac{n\,(C)}{12}$ $\frac{54,54}{}$ (a) ✓ : $\frac{n\,(H)}{1}$ $\frac{9,1}{}$ (b) ✓ $\frac{n\,(O)}{16}$ $\frac{36,36}{}$ (c) ✓

Simplest ratio/ *Vereenvoudigste verhouding*

$\frac{5,545}{2,2725}$: $\frac{9,100}{2,2725}$: $\frac{2,2725}{2,2725}$ (d) ✓

2 : 4 : 1

Empirical formula / *Empiriese formule*: C_2H_4O (e) ✓

M_r (C_2H_4O) = 2(12) + 4(1) +16 = 44

$n = \frac{M(molecular\ mass)}{M(formula\ mass)} = \frac{88}{44} = 2$ (f) ✓

Molecular formula / *Molekulêre formule*: $C_4H_8O_2$ (g) ✓ (7)

6.3 6.3.1 The amount of solute per litre of solution. ✓✓
Die hoeveelheid opgeloste stof per liter oplossing. (2)

6.3.2

OPTION 1/*OPSIE 1*	**OPTION 2/*OPSIE 2***
n = cV n = (0,326)(0,1) ✓ n = 0,0326 mol M = m / n ✓ M = (1,826) / 0,0326 ✓ M = 56 g·mol^{-1} **M** + 16 + 1 = 56 ✓ M = K^+ MOH = Potassium hydroxide/*Kalium hidroksied* ✓	c = m / MV ✓ 0,326 = 1,826 / M (0,1) ✓✓ M = = 56 g·mol^{-1} **M** + 16 + 1 = 56 ✓ M = K^+ MOH = Potassium hydroxide/*Kalium hidroksied* ✓

(5)
[16]

QUESTION 7/*VRAAG 7*

7.1 The substance that is completely used up during a chemical reaction. ✓✓
Die stof wat volledig tydens 'n chemiese reaksie opgebruik word. (2)

7.2

Marking Criteria
a) Substitution into n = V/V_m
b) Use of mol ratio $CaCO_3 : CO_2$
c) Formula n = m/M
d) Substitution into n = m/M
e) Final answer

Nasienkriteria

a) Vervanging in n = V / V_m
b) Gebruik van mol verhouding $CaCO_3 : CO_2$
c) Formule n = m/M
d) Vervanging in n = m/M
e) Finale antwoord

$n(CO_2) = \frac{V}{V_m}$

$= \frac{0,325}{22,4}$ (a) ✓

$= 0,0145$ mol

$CaCO_3 : CO_2$
1 : 1
$n(CaCO_3) = 0,0145$ mol (b) ✓

$n = \frac{m}{M}$ (c) ✓

$0,0145 = \frac{m}{M}$

$m = (0,0145)(100)$ (d) ✓

$m = 1,45$ (e) ✓ (5)

7.3 $\%\ \text{purity} = \frac{\text{mass } CaCO_3}{\text{mass of sample}} \times 100$

$= \frac{1,45}{1,5} \times 100$ ✓

$= 96,67\ \%$ ✓ (2)

7.4

Marking Criteria

a) Use of mol ratio $CaCO_3$: HCℓ
b) Formula $n = N / N_A$
c) Substitution into $n = N / N_A$
d) Final answer

Nasienkriteria

a) Gebruik van mol verhouding $CaCO_3$: HCℓ
b) Formule $n = N / N_A$
c) Vervanging in $n = N / N_A$
d) Finale antwoord

$CaCO_3$: HCℓ
1 : 2

n (HCℓ) = 2(0,0145) (a) ✓
= 0,029 mol

$n = \frac{N}{N_A}$ (b) ✓

$N = 0,029 \times 6,02 \times 10^{23}$ (c) ✓

$N = 1,7458 \times 10^{22}$ particles of / *deeltjie van* HCℓ (d) ✓ (4)

7.5 Equal to ✓
After calcium carbonate completely reacted (at 5 min) there was no more CO_2 produced ✓
Gelyk aan
Nadat kalsiumkarbonaat volledig gereageer het (na 5 min) is daar geen verdere CO_2 geproduseer nie (2)

[15]

QUESTION 8/*VRAAG 8*

8.1

Marking criteria/Nasienriglyne
If any of the underlined key words/phrases in the **correct context** are omitted: - 1 mark per word/phrase.
Indien enige van die sleutelwoorde/frases in die korrekte konteks weggelaat word: - 1 punt per word/frase.

An acid is a substance that produces hydrogen ions (H^+)/hydronium ions (H_3O^+) when it dissolves in water. ✓✓
'n Suur is 'n stof wat waterstofione (H^+)/hidroniumione (H_3O^+) produseer wanneer dit in water oplos. (2)

8.2 8.2.1 HSO_4^- ✓and/*en* H_2O ✓ (2)

8.2.2 SO_4^{2-} ✓ (1)

8.3 8.3.1 An acid-base indicator is a weak acid, or a weak base, which color changes as the H^+ ion concentration or the OH^- ion concentration in a solution changes. ✓✓
'n Suur-basis-indikator is 'n swak suur, of 'n swak basis, waarvan die kleur verander soos die H^+-ioonkonsentrasie of die OH^--ioonkonsentrasie in 'n oplossing verander. (2)

8.3.2 Yellow/*Geel* ✓ (1)

8.3.3 Exothermic / Eksotermies ✓
It gives off heat / temperature rises / *Dit gee hitte af / temperatuur styg* ✓ (2)

8.3.4 $pH = -\log[H_3O^+]$ ✓
2,8 ✓ $= -\log[H_3O^+]$
$[H_3O^+] = 10^{-2,8}$
$[H_3O^+] = 1,58 \times 10^{-3}$ mol·dm^{-3} ✓
(3)

8.3.5 **POSITIVE MARKING FROM QUESTION 8.3.4/*POSITIEWE NASIEN VANAF VRAAG 8.3.4***

MARKING CRITERIA

a. Calculating n(HNO_3) initial by substituting to n = cV
b. Calculating n(HNO_3) excess by substituting to n = cV
c. Calculating n(HNO_3) reacted
d. Use of a molar ratio of NaOH : HNO_3
e. Formula c = n/V
f. Substitution in c = n/V
g. Final answer

Nasienkriteria

a. Bereken aanvangs n(HNO_3) deur te vervang in n = cV
b. Bereken oormaat n(HNO_3) deur te vervang in n = cV
c. Bereken n(HNO_3) wat gereageer het
d. Gebruik mol verhouding NaOH : HNO_3
e. Formule c = n/V
f. Vervang in c = n/V
g. Finale antwoord

$n(HNO_3)_{initial} = cV$
$= (0,25)(0,5)$ (a) ✓
$= 0,125$ mol

$n(HNO_3)$ excess/*oormaat* $= cV$
$= (1,58 \times 10^{-3})(1)$ (b) ✓
$= 1,58 \times 10^{-3}$ mol

Reaction: $HNO_3 + NaOH \rightarrow NaNO_3 + H_2O$

$n(HNO_3)_{reacted} = n(HNO_3)$ initial/*aanvangs* - $n(HNO_3)$ excess/*oormaat*

$= 0,125 - 1,58 \times 10^{-3}$ (c) ✓
$= 0,123$ mol

NaOH : HNO_3
1 : 1
N (NaOH) = n (HNO_3) = 0,123 mol (d) ✓

$[NaOH]_{initial} = \frac{n}{V}$ (e) ✓

$= \frac{0,123}{0,5}$ (f) ✓
$= 0,246$ mol·dm^{-3} (g)✓ (7)

[20]

QUESTION 9/*VRAAG 9*

9.1 It is a number that shows the number of electrons an atom has gained, lost, or shared in a chemical compound, compared to its elemental state. ✓✓
Dit is 'n getal wat die aantal elektrone aandui wat 'n atoom in 'n chemiese verbinding verkry, verloor of gedeel het, in vergelyking met sy elementêre toestand. (2)

9.2 9.2.1 Aℓ ✓✓ (2)

9.2.2 Cu^{2+}✓✓ (2)

9.3 REMAIN THE SAME/*BLY DIESELFDE* ✓

It is the spectator ion/*Dit is 'n toeskouer ioon* ✓ (2)

9.4 9.4.1 $Cr_2O_7^{2-}$
$2x + 7(-2) = -2$ ✓
$x = +6$ ✓ (2)

9.4.2 Decreases/*Neem af* ✓

$Cr_2O_7^{2-} + 14H^+ + 6e^- \rightarrow 2Cr^{3+} + 7\ H_2O$✓✓
$Cr_2O_7^{2-}$ were reduced to/*was gereduseer na* Cr^{3+} ✓ (4)

9.4.3 **MARKING CRITERIA**
a) balancing electrons by multiplying oxidation half reaction by 6✓
b) correct balanced net reaction (1mark reactants and 1 mark products) ✓✓

NASIENKRITERIA
a) balansering van elektrone deur die oksidasiehalfreaksie met 6 te vermenigvuldig
b) *korrekte gebalanseerde netto reaksie (1 punt reaktanse en 1 punt produkte)*

$Cr_2O_7^{2-} + 14H^+ + 6e^- \rightarrow 2Cr^{3+} + 7\ H_2O$

$6\ (\ Fe^{2+} \rightarrow Fe^{3+} + e^-\ )$ ✓

$Cr_2O_7^{2-} + 6\ Fe^{2+} + 14H^+$ ✓ $\rightarrow 2Cr^{3+} + 6\ Fe^{3+} + 7\ H_2O$ ✓ (3)
[17]

TOTAL/TOTAAL: 150