basic education

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SENIOR CERTIFICATE EXAMINATIONS/ NATIONAL SENIOR CERTIFICATE EXAMINATIONS
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PHYSICAL SCIENCES: CHEMISTRY (P2)
FISIESE WETENSKAPPE: CHEMIE (V2)

2019

MARKING GUIDELINES/*NASIENRIGLYNE*

MARKS/*PUNTE*: 150

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

QUESTION 1/*VRAAG 1*

1.1 C ✓✓ (2)

1.2 A ✓✓ (2)

1.3 C ✓✓ (2)

1.4 A ✓✓ (2)

1.5 D ✓✓ (2)

1.6 C ✓✓ (2)

1.7 D ✓✓ (2)

1.8 D ✓✓ (2)

1.9 C ✓✓ (2)

1.10 A ✓✓ (2)
[20]

QUESTION 2/*VRAAG 2*

2.1 Unsaturated/*Onversadig* ✓

ANY ONE/*ENIGE EEN*:

- C/It has a triple/multiple bond. ✓
  C/Dit het 'n trippelbinding/meervoudige-binding.
- C/It has a triple/multiple bond between C atoms.
  C/Dit het 'n trippelbinding/meervoudige-binding tussen C-atome.
- C/It does NOT contain the maximum number of H atoms bonded to C atoms.
  C/Dit bevat NIE die maksimum getal H-atome gebind aan C-atome nie.
- Compound C is an alkyne./*Verbinding C is 'n alkyn.* (2)

2.2

2.2.1 D ✓ (1)

2.2.2 B ✓ (1)

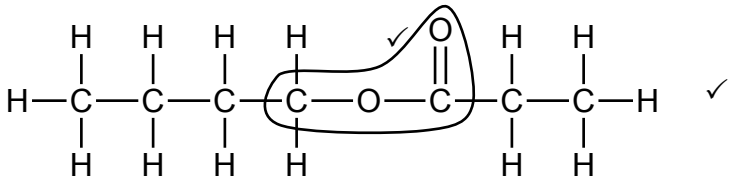
2.2.3 C ✓ (1)

2.2.4 E ✓ (1)

2.3

2.3.1 —C≡C— ✓ (1)

2.3.2



✓ ✓ (2)

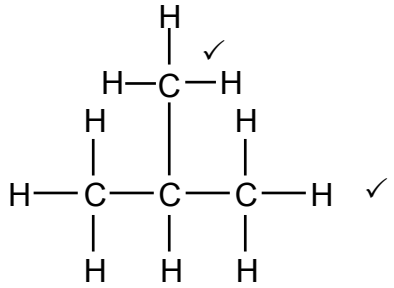
Marking criteria/*Nasienriglyne:*

- Whole structure correct:
  Hele struktuur korrek: $^{2}/_{2}$
- Only functional group correct:/*Slegs funksionele groep korrek:* Max/*Maks.*: $^{1}/_{2}$

IF/*INDIEN*:

- More than one functional group/*Meer as een funksionele groep:* $^{0}/_{2}$
- If condensed or semi structural formula used:/*Indien gekondenseerde of semi-struktuurformule gebruik:*
  Max/*Maks.* $^{1}/_{2}$

2.3.3



Marking criteria/*Nasienriglyne:*
- Three C atoms in longest chain. ✓
  Drie C-atome in langste ketting.
- One methyl substituent on C2. ✓
  Een metielsubstituent op C2.

IF/INDIEN
Any error e.g. omission of H atoms, condensed or semi structural formula/*Enige fout bv weglating van H-atome, gekondenseerde of semi-struktuurformule.* Max/*Maks.*: $\frac{1}{2}$ (2)

2.4

2.4.1 2,3-dibromo-5-methylheptane/2,3-dibromo-5-metielheptaan

Marking criteria/*Nasienriglyne:*
- Correct stem i.e. heptane./*Korrekte stam d.i. heptaan.* ✓
- All substituents (bromo and methyl) correctly identified./*Alle substituente (bromo en metiel) korrek geïdentifiseer.* ✓
- IUPAC name completely correct including numbering, sequence, hyphens and commas./*IUPAC-naam heeltemal korrek insluitende nommering, volgorde, koppeltekens en kommas .* ✓ (3)

2.4.2 $2C_4H_{10} + 13O_2$ ✓ → $8CO_2 + 10H_2O$ ✓ Bal ✓

Notes/*Aantekeninge:*
- Reactants ✓ Products ✓ Balancing ✓
  Reaktanse *Produkte* *Balansering*
- Ignore double arrows and phases./*Ignoreer dubbelpyle en fases.*
- Marking rule 6.3.10/*Nasienreël 6.3.10.*
- If condensed structural formulae used:/*Indien gekondenseerde struktuur formules gebruik:* Max/*Maks.* $\frac{2}{3}$
- Accept coefficients that are multiples./*Aanvaar koëffisiënte wat veelvoude is.* (3)

[17]

QUESTION 3/*VRAAG 3*

3.1

3.1.1 Yes/*Ja* ✓ (-)

ANY ONE/*ENIGE EEN*:
- Compounds have the same molecular mass. ✓
  Verbindings het dieselfde molekulêre massa.
- Only one independent variable./*Slegs een onafhanklike veranderlike*. (2)

3.1.2 Functional group/Homologous series/Type of (organic) compound ✓
Funksionele groep/Homoloë reeks/Tipe (organiese) verbinding (1)

3.2 A/butane/*butaan* ✓ (-)

Lowest boiling point/weakest intermolecular forces. ✓
Laagste kookpunt/swakste intermolekulêre kragte. (2)

3.3

Marking guidelines/Nasienriglyne

- Type of IMF in A./*Tipe IMK in A*.
- BOTH B and C have hydrogen bonding./*BEIDE B en C het waterstofbinding*.
- Compare number of sites for hydrogen bonding in B and C./*Vergelyk aantal punte vir waterstofbinding in B en C.*
- Compare strength of IMFs./*Vergelyk sterkte van IMKe.*
- Compare energy required./*Vergelyk energie benodig.*

- Between molecules of butane/compound **A** are London forces/dispersion forces/induced dipole forces. ✓
- Molecules of compound **B**/propan-1-ol have one site for hydrogen bonding. ✓
- Molecules of compound **C**/ethanoic acid have two/more sites for hydrogen bonding. ✓
- Strength of intermolecular forces increases from compound **A**/butane to compound **B**/propan-1-ol to compound **C**/ethanoic acid. ✓
  OR
  Intermolecular forces in compound **A**/butane are the weakest and intermolecular forces in compound **C**/ethanoic acid are the strongest.
- More energy is needed to overcome/break intermolecular forces in compound **C** than in the other two compounds. ✓

- *Tussen molekule van butaan/verbinding **A** is Londonkragte/dispersie-kragte/geïnduseerde dipoolkragte.* ✓
- *Molekule van verbinding **B**/propan-1-ol het een punt vir waterstof-bindings*. ✓
- Molekule van verbinding ***C**/etanoësuur het twee punte vir waterstof-bindings*. ✓
- *Sterkte van intermolekulêre kragte neem toe van verbinding **A**/butaan na verbinding **B**/propan-1-ol na verbinding **C**/etanoësuur.* ✓
  OF
  *Intermolekulêre kragte tussen propaan is die swakste en intermolekulêre kragte in verbinding **C** is die sterkste.*
- *Meer energie word benodig om intermolekulêre kragte in verbinding **C** as in die ander twee verbindings te oorkom/breek.* ✓ (5)

3.4 Butan-1-ol ✓

(-)

Longer chain length./Larger molecule./Larger molecular mass./Larger molecular size./Stronger intermolecular forces./Larger surface area.✓
Langer kettinglengte./Groter molekuul./Groter molekulêre massa/Groter molekuul./Sterker intermolekulêre kragte./Groter oppervlakte. (2)
[12]

QUESTION 4/*VRAAG 4*

4.1

4.1.1 Addition (polymerisation)/*Addisie-(polimerisasie)* ✓ (1)

4.1.2 Ethene/*eteen* ✓ (1)

4.1.3 Polyethene/polythene ✓
Poli-eteen/politeen (1)

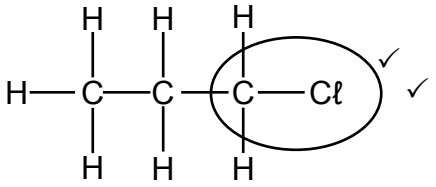
4.2

4.2.1 Dehydration/elimination ✓
Dehidrasie/dehidratering/eliminasie (1)

4.2.2 Catalyst/dehydrating agent/causes dehydration/removes water molecules ✓
Katalisator/dehidreermiddel/veroorsaak dehidrasie/verwyder watermolekule (1)

4.2.3 Prop-1-ene/propene/1-propene ✓✓ **(2 or 0)**
Prop-1-een/propeen/1-propeen **(2 of 0)** (2)

4.2.4



✓ ✓

Marking criteria/*Nasienriglyne:*
- Whole structure correct:
  Hele struktuur korrek: 2/2
- Only functional group correct:/*Slegs funksionele groep korrek:* Max/*Maks.*: 1/2

IF/*INDIEN*:
- More than one functional group/*Meer as een funksionele groep:* 0/2
- If condensed or semi structural formula used:/*Indien gekondenseerde of semi-struktuurformule gebruik:*
  Max/*Maks.* 1/2

(2)

4.2.5 Addition/Hydration ✓
Addisie/Hidrasie/Hidratering (1)

4.2.6 Propan-2-ol/2-propanol✓✓

Marking criteria/*Nasienriglyne:*
- Correct stem and functional group i.e propanol/*Korrekte stam en funksionele groep d.i* propanol ✓
- Name completely correct/*Naam volledig korrek:* Propan-2-ol/2-propanol ✓✓

(2)
[12]

QUESTION 5/*VRAAG 5*

5. 1

NOTE/*LET WEL*
Give the mark for per unit time only if in context of reaction rate.
Gee die punt vir per eenheidtyd slegs indien in konteks met reaksietempo.

ANY ONE/*ENIGE EEN*

- Change in concentration ✓ of products/reactants per (unit) time. ✓
  Verandering in konsentrasie van produkte/reaktanse per (eenheid) tyd.
- Change in amount/number of moles/volume/mass of products or reactants per (unit) time.
  Verandering in hoeveelheid/getal mol/volume/massa van produkte of reaktanse per (eenheid) tyd.
- Amount/number of moles/volume/mass of products formed/reactants used per (unit) time.
  Hoeveelheid/getal mol/volume/massa van produkte gevorm/reaktanse gebruik per (eenheid) tyd.
- Rate of change in concentration/amount/number of moles/volume/mass.
  Tempo van verandering in konsentrasie/ hoeveelheid/getal mol/ volume/massa. ✓✓ **(2 or/*of* 0)** (2)

5.2

5.2.1 Rate of the reaction/*Reaksietempo* ✓ (1)

5.2.2

Criteria for conclusion/*Kriteria vir gevolgtrekking*:	
Dependent (reaction rate) and independent (concentration) variables correctly identified./*Afhanklike(reaksietempo) en onafhanklike (konsentrasie) veranderlikes korrek geïdentifiseer.*	✓
Relationship between the independent and dependent variables correctly stated. *Verwantskap tussen die afhanklike en onafhanklike veranderlikes korrek genoem.*	✓

Example/*Voorbeeld*:
Reaction rate increases with increase in concentration./Reaction rate is proportional to concentration.
Reaksietempo neem toe met toename in konsentrasie./Reaksietempo is eweredig aan konsentrasie.
IF/INDIEN
DIRECTLY proportional/*DIREK eweredig:* Max/*Maks.*: $\frac{1}{2}$ (2)

5.3

5.3.1 Activation energy/(The boundary line for the) molecules with (adequate) kinetic energy to make effective collisions. ✓
Aktiveringsenergie/(Die grenslyn vir die) molekule met (genoeg) kintiese energie vir effektiewe botsings. (1)

5.3.2 B ✓ (1)

5.3.3
- At a higher temperature particles move faster/have a higher kinetic energy. ✓
  By 'n hoër temperatuur beweeg die deeltjies vinniger/het die deeltjies hoër kinetiese energie.
- More molecules have enough/sufficient (kinetic) energy. ✓
  Meer molekule het genoeg/voldoende (kinetiese) energie.
  OR/*OF*
  More molecules have (kinetic) energy equal to or greater than activation energy.
  Meer molekule het (kinetiese) energie gelyk aan of groter as aktiveringsenergie.
- More effective collisions per unit time/second./Increased frequency of effective collisions.
  Meer effektiewe botsings per eenheidtyd/sekonde./Frekwensie van effektiewe botsings neem toe.
- Reaction rate increases. ✓
  Reaksietempo neem toe. (4)

5.4 Curve **Y/**it was obtained for the reaction where a catalyst was added. ✓
*Kurwe **Y**/dit is vir die reaksie waar 'n katalisator bygevoeg is, verkry.*

OR/*OF*
Curve **X** was obtained for the reaction in the absence of a catalyst.
*Kurwe **X** is verkry vir die reaksie sonder 'n katalisator.* (1)

5.5

Marking guidelines/*Nasienriglyne*

- Any formula/*Enige formule*: $n = \frac{m}{M}$ or/*of* $c = \frac{n}{V}$ ✓
- Substitute/*Vervang* 0,1 dm^3 in n = cV ✓
- Use mole ratio/*Gebruik molverhouding*:
  $n(S)_{expected/verwag} = ½n(HC\ell)_{used/gebruik}$ ✓
- Substitution of/*Vervanging van* 32 $g \cdot mol^{-1}$ in $n = \frac{m}{M}$ ✓
- SUBSTITUTE in/*VERVANG in:*
  $\frac{n(S)_{produced/bereik}}{n(S)_{expected/verwag}} \times 100 / \frac{m(S)_{produced/bereik}}{m(S)_{expected/verwag}} \times 100$ ✓
- Final answer/*Finale antwoord:* 56,25% to 60% ✓

OPTION 1/*OPSIE 1*

$n(HC\ell)_{used/gebruik} = cV$ ✓
$= 0,2 \times 0,1$ ✓
$= 0,02$ mol

$n(S)_{expected/verwag} = \frac{1}{2}n(HC\ell)_{used/gebruik}$
$= \frac{1}{2}(0,02)$ ✓
$= 0,01$ mol

$n(S)_{produced/berei} = \frac{m}{M}$
$= \frac{0,18}{32}$ ✓
$= 0,0056$ mol

$\%yield/opbrengs = \frac{n(S)_{prod/berei}}{n(S)_{exp/verwag}} \times 100$
$= \frac{0,0056}{0,01} \times 100$ ✓
$= 56,25\%$ ✓

OPTION 2/*OPSIE 2*

$n(HC\ell)_{used/gebruik} = cV$ ✓
$= 0,2 \times 0,1$ ✓
$= 0,02$ mol

$n(S)_{expected/verwag} = \frac{1}{2}n(HC\ell)_{used/gebruik}$
$= \frac{1}{2}(0,02)$ ✓
$= 0,01$ mol

$m(S)_{expected/verwag} = nM$
$= (0,01)(32)$ ✓
$= 0,32$ g

$\%yield/opbrengs = \frac{m(S)_{prod/berei}}{m(S)_{exp/verwag}} \times 100$
$= \frac{0,18}{0,32} \times 100$ ✓
$= 56,25\%$ ✓

(6)
[18]

QUESTION 6/*VRAAG 6*

6.1 Reversible reaction/Both forward and reverse reactions can take place./Products can be converted back to reactants. ✓
Omkeerbare reaksie/Beide voorwaartse en terugwaartse reaksies kan plaasvind./Produkte kan terugverander word na reaktanse. (1)

6.2 To favour the forward reaction/production of ammonia./To increase the yield of ammonia./Prevent the decomposition of NH_3. ✓
Om die voorwaartse reaksie/produksie van ammoniak te bevoordeel./Om die ammoniak-opbrengs te verhoog./Voorkom die ontbinding van NH_3. (1)

6.3 20(%) ✓ (1)

6.4

6.4.1 At 500 °C lower yield of ammonia:

- The (forward) reaction is exothermic./Reverse reaction is endothermic. ✓
  Die (voorwaartse) reaksie is eksotermies./Terugwaartse reaksie is endotermies.
- An increase in temperature favours the endothermic reaction. ✓
  'n Toename in temperatuur bevoordeel die endotermiese reaksie.
- The reverse reaction is favoured.✓
  Die terugwaartse reaksie word bevoordeel.

OR/*OF*

At 350 °C higher yield of ammonia:

- The (forward) reaction is exothermic./Reverse reaction is endothermic. ✓
  Die (voorwaartse) reaksie is eksotermies./Terugwaartse reaksie is endotermies.
- A decrease in temperature favours the exothermic reaction. ✓
  'n Afname in temperatuur bevoordeel die eksotermiese reaksie.
- The forward reaction is favoured. ✓
  Die voorwaartse reaksie word bevoordeel. (3)

6.4.2 At 350 atm higher yield of ammonia:

- An increase in pressure favours the reaction that produces the lower number of moles/number of molecules/volume of gas. ✓
  'n Toename in druk bevoordeel die reaksie wat die kleiner aantal mol/aantal molekule/volume gas lewer.
- The forward reaction is favoured. ✓
  Die voorwaartse reaksie word bevoordeel.

OR/*OF*

At 150 atm lower yield of ammonia:

- A decrease in pressure favours the reaction that produces the higher number of moles/number of molecules/volume of gas. ✓
  'n Afname in druk bevoordeel die reaksie wat die groter aantal mol/aantal molekule/volume gas lewer.
- Reverse reaction is favoured. ✓
  Die terugwaartse reaksie word bevoordeel. (2)

6.5

6.5.1 1 mol N_2 reacts with 3 mol H_2 to produce 2 mol NH_3
∴ 2 mol N_2 reacts with 6 mol H_2 to produce 4 (mol) NH_3 ✓✓ (**2 or 0**)

1 mol N_2 reageer met 3 mol H_2 om 2 mol NH_3 te lewer
∴ 2 mol N_2 reageer met 6 mol H_2 om 4 (mol) NH_3 te vorm ***(2 of 0)*** (2)

6.5.2 **POSITIVE MARKING FROM QUESTION 6.5.1.**

Marking criteria/*Nasienriglyne:*

- Calculate 35% of 4 mol NH_3 (answer from Q6.5.1). ✓
- Use mol ratio/*Gebruik molverhouding* $n(N_2) : n(H_2) : n(NH_3) = 1 : 3 : 2$ ✓
- Equilibrium/*Ewewig* $n(N_2)$ = initial/*aanvanklike* $n(N_2) - \Delta n(N_2)$
  Equilibrium/*Ewewig* $n(H_2)$ = initial/*aanvanklike* $n(H_2) - \Delta n(H_2)$ ✓
- Divide by/*Deel deur* 0,5 dm^3. ✓
- Correct K_c expression (formulae in square brackets). ✓
  Korrekte K_c uitdrukking (formules in vierkantige hakies).
- Substitution of concentrations into correct K_c expression. ✓
  Vervanging van konsentrasies in korrekte K_c-uitdrukking.
- Final answer/*Finale antwoord*: 0,002 ✓
  Range/*Gebied*: 0,00155 to 0,002 ($1{,}55 \times 10^{-3}$ to 2×10^{-3})

$$n(NH_3) = \frac{35}{100} \times 4 \checkmark$$
$$= 1{,}4 \text{ mol}$$

	N_2	H_2	NH_3
Initial amount (moles) *Aanvangs hoeveelheid (mol)*	6	6	0
Change in amount (moles) *Verandering in hoeveelheid (*mol)	0,7	2,1	1,4
Equilibrium amount (moles) *hoeveelheid (*mol)	5,3	3,9 ✓	1,4
Equilibrium concentration ($mol \cdot dm^{-3}$) *Ewewigskonsentrasie ($mol \cdot dm^{-3}$)*	10,6	7,8	2,8

ratio ✓
verhouding

Divide by 0,5 dm^3 ✓

$$K_c = \frac{[NH_3]^2}{[H_2]^3[N_2]} \checkmark$$
$$= \frac{(2{,}8)^2}{(7{,}8)^3(10{,}6)} \checkmark$$
$$= 0{,}002 \checkmark$$

No K_c expression, correct substitution/*Geen K_c-uitdrukking*, *korrekte substitusie*: Max./*Maks.* $\frac{6}{7}$

Wrong K_c expression/*Verkeerde K_c-uitdrukking*: Max./*Maks.* $\frac{4}{7}$

(7)
[17]

QUESTION 7/*VRAAG 7*

7.1 A base forms hydroxide ions (OH^-) in water/aqueous solution. ✓✓
'n Basis vorm hidroksiedione (OH^-) in water/waterige oplossing.

IF/*INDIEN*:
A base ionises to form hydroxide ions (OH^-). ✓
'n Basis ioniseer om hidroksiedione (OH^-) te vorm. *Max./Maks.* $\frac{1}{2}$ (2)

7.2 A strong base ionises/dissociates completely ✓ and a weak base ionises/dissociates incompletely. ✓
'n Sterk basis ioniseer/dissosieer volledig en 'n swak basis ioniseer/dissosieer onvolledig. (2)

7.3 $HCO_3^-(aq) + H_2O(\ell)$ ✓ $\rightleftharpoons H_2CO_3(aq) + OH^-(aq)$ ✓ Bal. ✓

Accept/*Aanvaar*
$NaHCO_3(aq) + H_2O(\ell) \rightleftharpoons H_2CO_3(aq) + NaOH(aq)$

Notes/*Aantekeninge:*
- Reactants/*Reaktanse* ✓ Products/*Produkte* ✓ Balancing/*Balansering* ✓
- Ignore single arrow./*Ignoreer enkelpyl.*
- Marking rule 6.3.10./*Nasienreël 6.3.10.*
- Ignore phases/*Ignoreer fases.* (3)

7.4

7.4.1 $pH = -\log[H_3O^+]$ ✓
$= -\log(0,2)$ ✓
$= 0,70$ ✓ (0,699) (3)

7.4.2 Titration of a weak base and a strong acid. ✓
Titrasie van 'n swak basis en 'n sterk suur.

OR/*OF*
The endpoint will be at pH < 7./*Die eindpunt sal by 'n pH < 7.* (1)

7.4.3

Marking guidelines/*Nasienriglyne:*

- Any formulae/*Enige formule:* $c = \frac{n}{V} / n = \frac{m}{M} / \frac{c_a \times V_a}{c_b \times V_b} = \frac{n_a}{n_b} / c = \frac{m}{MV}$ ✓
- Substitute/*Vervang* 0,2 mol·dm^{-3} & 20 x 10^{-3}/0,02 dm^3 or 20 cm^3. ✓
- Use mol ratio/*Gebruik molverhouding* n($XHCO_3$) : n(HCℓ) = 1 : 1 ✓
- Substitute/*Vervang* n($XHCO_3$) or/*of* c($XHCO_3$) AND/*EN* 0,4 g. ✓
- M(X) = 39 g·mol^{-1} ✓
- X = K/potassium/*kalium*. ✓

OPTION 1/*OPSIE 1*

c(HCℓ) = $\frac{n}{V}$ ✓

$\therefore$ 0,2 = $\frac{n}{20 \times 10^{-3}}$ ✓

n(HCℓ) = 4 x 10^{-3} mol

n($XHCO_3$) = n(HCℓ) ✓
= 4 x 10^{-3} mol

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

$\therefore 4 \times 10^{-3} = \frac{0,4}{M}$ ✓

M = 100 g·mol^{-1}

M($XHCO_3$) = M(X) + 61
= 100

$\therefore$ M(X) = 39 g·mol^{-1} ✓

X = K ✓
OR/*OF*
potassium/*kalium*

1 mol → M($XHCO_3$) 4 x 10^{-3} mol → 0,4 g ✓

M($XHCO_3$) = 100 g·mol^{-1}

M($XHCO_3$) = M(X) + 61
= 100

$\therefore$ M(X) = 39 g·mol^{-1} ✓

X = K ✓
OR/*OF*
potassium/*kalium*

OPTION 2/*OPSIE 2*

$\frac{c_a \times V_a}{c_b \times V_b} = \frac{n_a}{n_b}$ ✓

$\frac{0,2 \times 20}{c_b \times 100} = \frac{1}{1}$ ✓

c_b = 0,04 mol·dm^{-3}

$c(XHCO_3) = \frac{m}{MV}$

$\therefore 0,04 = \frac{0,4}{M(0,1)}$ ✓

M($XHCO_3$) = 100 g·mol^{-1}

M($XHCO_3$) = M(X) + 61
= 100

$\therefore$ M(X) = 39 g·mol^{-1} ✓

X = K ✓
OR/*OF*
potassium/*kalium*

(6)
[17]

QUESTION 8/*VRAAG 8*

8.1 It is a conductor of electricity/a solid to connect wires to./Pt is inert or unreactive. ✓
Dit is 'n geleier van elektrisiteit/'n vaste stof waaraan drade geskakel kan word./Pt is inert of onreaktief.

OR/*OF*
$C\ell^-$(aq) and chlorine gas are not solids and cannot be used as an electrode.
$C\ell^-$(aq) en chloorgas is nie vaste stowwe nie en kan nie as 'n elektrode gebruik word nie. (1)

8.2

8.2.1 Chemical (energy) to electrical (energy) ✓
Chemiese (energie) na elektriese (energie) (1)

8.2.2 $C\ell_2 + 2e^- \rightarrow 2C\ell^-$ ✓✓

Marking guidelines/*Nasienriglyne*	
• $C\ell_2 + 2e^- \rightleftharpoons 2C\ell^-$ $\frac{1}{2}$	$2C\ell^- \rightleftharpoons C\ell_2 + 2e^-$ $\frac{0}{2}$
$2C\ell^- \leftarrow C\ell_2 + 2e^-$ $\frac{2}{2}$	$2C\ell^- \rightarrow C\ell_2 + 2e^-$ $\frac{0}{2}$
• Ignore if charge omitted on electron./*Ignoreer indien lading weggelaat op elektron.*	
• If charge (-) omitted on $C\ell^-$/*Indien lading (-) weggelaat op* $2C\ell^-$: Max./*Maks:* $\frac{1}{2}$	Example/*Voorbeeld:* $C\ell_2 + 2e^- \rightarrow 2C\ell$ ✓

(2)

8.2.3 $\underline{Cr(s) \mid Cr^{3+}(aq)}$ ✓ || $\underline{C\ell_2(g) \mid C\ell^-(aq) \mid Pt(s)}$ ✓

OR/*OF*
$Cr(s) \mid Cr^{3+}(1\ mol{\cdot}dm^{-3}) \parallel C\ell_2(g) \mid C\ell^-\ (1\ mol{\cdot}dm^{-3}) \mid Pt(s)$

Accept/*Aanvaar*:
$Cr \mid Cr^{3+} \parallel C\ell_2 \mid C\ell^- \mid Pt$ (3)

8.3

OPTION 1/*OPSIE 1*	**Notes/*Aantekeninge***
$E^\theta_{cell} = E^\theta_{reduction} - E^\theta_{oxidation}$ ✓ $= 1{,}36$ ✓ $- (-0{,}74)$ ✓ $E^\theta_{cell} = 2{,}10$ V ✓	• Accept any other correct formula from the data sheet./*Aanvaar enige ander korrekte formule vanaf gegewensblad.* • Any other formula using unconventional abbreviations, e.g. $E°_{cell} = E°_{OA} - E°_{RA}$ followed by correct substitutions:/*Enige ander formule wat onkonvensionele afkortings gebruik bv.* $E°_{sel} = E°_{OM} - E°_{RM}$ *gevolg deur korrekte vervangings*: $\frac{3}{4}$

OPTION 2/*OPSIE 2*	
$C\ell_2 + 2e^- \rightarrow 2C\ell^-$ ✓	E^θ = 1,36 V ✓
$\underline{Cr(s) \rightarrow Cr^{3+}(aq) + 3e^-}$	E^θ = +0,74 V ✓
$2Cr(s) + 3C\ell_2(g) \rightarrow 2Cr^{3+}(aq) + 6C\ell^-(aq)$	E^θ = +2,10 V ✓

(4)

8.4 Increases/*Verhoog* ✓✓ (2)
[13]

QUESTION 9/*VRAAG 9*

9.1 Electrolytic/*Elektrolities* ✓ (1)

9.2 $2H_2O + 2e^- \rightarrow H_2 + 2OH^-$ ✓✓

Marking guidelines/*Nasienriglyne*
- $2H_2O + 2e^- \rightleftharpoons H_2 + 2OH^-$ $^1/_2$ $H_2 + 2OH^- \rightleftharpoons 2H_2O + 2e^-$ $^0/_2$
  $H_2 + 2OH^- \leftarrow 2H_2O + 2e^-$ $^2/_2$ $H_2 + 2OH^- \rightarrow 2H_2O + 2e^-$ $^0/_2$
- Ignore if charge omitted on electron./*Ignoreer indien lading weggelaat op elektron.*
- If charge (-) omitted on OH^-/*Indien lading (-) weggelaat op* OH^-: Max./*Maks:* $^1/_2$ Example/*Voorbeeld:* $2H_2O + 2e^- \rightarrow H_2 + 2OH$ ✓

(2)

9.3
9.3.1 Chlorine (gas) / $C\ell_2$ /*Chloor(gas)* ✓ (1)

9.3.2 P ✓ & Y ✓ (2)

9.4 Cathode/*Katode* ✓
Reduction takes place here./Gains electrons.✓
Reduksie vind hier plaas./Wins van elektrone. (2)

9.5 $CuC\ell_2(aq)$ ✓ → $Cu(s) + C\ell_2(g)$✓ Bal ✓
OR/OF
$Cu^{2+}(aq) + 2C\ell^- \rightarrow Cu(s) + C\ell_2(g)$

Notes/*Aantekeninge:*
- Reactants/*Reaktanse* ✓ Products/*Produkte* ✓ Balancing/*Balansering* ✓
- Ignore double arrows./*Ignoreer dubbelpyle.*
- Marking rule 6.3.10./*Nasienreël 6.3.10.*
- Ignore phases/*Ignoreer fases.*

(3)
[11]

QUESTION 10/*VRAAG 10*

10.1

10.1.1 II – IV – III - I ✓ (1)

10.1.2 $2NH_3 + H_2SO_4$ ✓ → $(NH_4)_2SO_4$ ✓ Bal ✓

Notes/*Aantekeninge:*
• Reactants/*Reaktanse* ✓ Products/*Produkte* ✓ Balancing/*Balansering* ✓
• Ignore double arrows./*Ignoreer dubbelpyle.*
• Marking rule 6.3.10./*Nasienreël 6.3.10.*

(3)

10.1.3 Vanadium pentoxide/*Vanadiumpentoksied* ✓ (1)

10.1.4 $SO_3(g) + H_2SO_4$ ✓→ $H_2S_2O_7$ ✓ Bal ✓

Notes/*Aantekeninge:*
• Reactants/*Reaktanse* ✓ Products/*Produkte* ✓ Balancing/*Balansering* ✓
• Ignore double arrows./*Ignoreer dubbelpyle.*
• Marking rule 6.3.10./*Nasienreël 6.3.10.*

(3)

10.1.5 Sulphuric acid will form (white) mists./The reaction is very exothermic/gives off too much heat./Corrosive reaction. ✓
Swawelsuur sal (wit) mis vorm./Die reaksie is té eksotermies/gee te veel warmte af./Vretende reaksie. (1)

10.2

Marking criteria/*Nasienriglyne:*
- Calculate m(fertiliser)./*Bereken m(kunsmis).* ✓
- Use ratio/*gebruik verhouding:* $\frac{2}{X+3}$/m(P) = ½m(K) ✓
- Use/*Gebruik* m(K) = 3,33 kg ✓
- Final answer/*Finale antwoord:* 3 ✓

OPTION 1/*OPSIE 1*

$m(\text{fertiliser}) = \frac{20}{100} \times 50$ ✓
= 10 kg

$m(K) = \frac{2}{X+3} \times 10$

$\therefore 3{,}33$ ✓ $= \frac{2}{X+3}$ ✓ $\times 10$

$\therefore X = 3$ ✓

OPTION 2/*OPSIE 2*

$m(K) = \frac{2}{X+3}$ ✓ $\times \frac{20}{100}$ x 50 ✓ = 3,33 ✓

X = 3 ✓

OPTION 3/*OPSIE 3*

$(\text{fertiliser}) = \frac{20}{100} \times 50$ ✓
= 10 kg

m(P) = ½m(K) ✓
= ½(3,33) = 1,665 kg

m(X) = 10 – 3,33 ✓– 1,665
= 5,005

N : P : K = 5,005 : 1,665 : 3,33
= 3 : 1 : 2

$\therefore X = 3$ ✓

(4)

[13]

TOTAL/*TOTAAL*: 150