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**SENIOR CERTIFICATE EXAMINATIONS/
NATIONAL SENIOR CERTIFICATE EXAMINATIONS
SENIORSERTIFIKAAT-EKSAMEN/
NASIONALE SENIORSERTIFIKAAT-EKSAMEN**

**PHYSICAL SCIENCES: CHEMISTRY (P2)
FISIESE WETENSKAPPE: CHEMIE (V2)**

MAY/JUNE/MEI/JUNIE 2024

MARKING GUIDELINES/NASIENRIGLYNE

MARKS/PUNTE: 150

**These marking guidelines consist of 18 pages./
*Hierdie nasienriglyne bestaan uit 18 bladsye.***

QUESTION 1/VRAAG 1

- 1.1 A ✓✓ (2)
- 1.2 C ✓✓ (2)
- 1.3 A ✓✓ (2)
- 1.4 D ✓✓ (2)
- 1.5 D ✓✓ (2)
- 1.6 C ✓✓ (2)
- 1.7 B ✓✓ (2)
- 1.8 A ✓✓ (2)
- 1.9 B ✓✓ (2)
- 1.10 B ✓✓ (2)
- [20]**

QUESTION 2/VRAAG 2

- 2.1 Organic compounds that consist of hydrogen and carbon only. ✓✓ (2 or 0)
 Organiese verbindings wat slegs uit waterstof en koolstof bestaan. (2 of 0) (2)
- 2.2.1 C and/en E ✓ (1)
- 2.2.2 D and/en H ✓✓ (2 or/of 0) (2)
- 2.2.3 A ✓ (1)

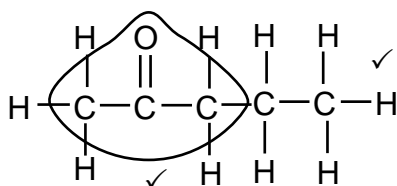
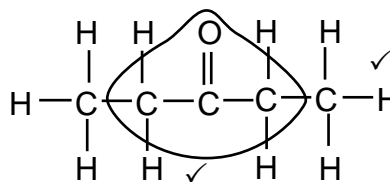
2.3
 2.3.1

Marking criteria/Nasienkriteria:

- Functional group. ✓
Funksionele groep.
- Whole structure correct. ✓
Hele struktuur korrek.

IF/INDIEN:

- More than one functional group/wrong functional group:
Meer as een funksionele groep/foutiewe funksionele groep: $\frac{0}{2}$
- If condensed structural formulae used/*Indien gekondenseerde struktuurformules gebruik:*
 Max/Maks. $\frac{1}{2}$

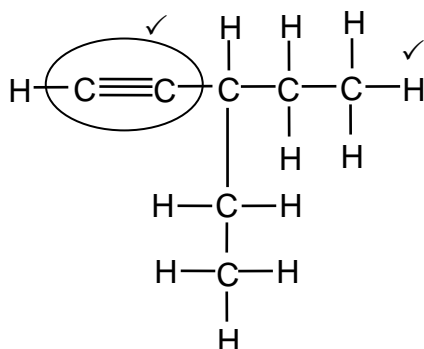
**OR/OF**

(2)

2.3.2 C_nH_{2n+2} ✓

(1)

2.3.3



Marking criteria/Nasienkriteria:

- Functional group $-C\equiv C-$. ✓
Funksionele groep $-C\equiv C-$.
- Whole structure correct. ✓
Hele struktuur korrek.

IF/INDIEN

- More than one functional group/wrong functional group:
Meer as een funksionele groep/foutiewe funksionele groep: $\frac{0}{2}$
- If condensed structural formulae used/*Indien gekondenseerde struktuurformules gebruik:*
Max/Maks. $\frac{1}{2}$

(2)

2.4.1 3-ethylhex-3-ene ✓✓✓/3-ethyl-3-hexene/3-etielheks-3-een/3-etiel-3-hekseen

Marking criteria:

- Correct stem i.e. hexene. ✓
- Substituent (ethyl) correctly identified. ✓
- IUPAC name completely correct including numbering, sequence, hyphens and commas. ✓

Nasienkriteria:

- *Korrekte stam d.i. hekseen.* ✓
- *Substituent (etiel) korrek geïdentifiseer.* ✓
- *IUPAC-naam heeltemal korrek insluitende nommering, volgorde, koppeltekens en kommas.* ✓

(3)

2.4.2 2,5-dichloro-2,4-dimethylhexane ✓✓✓/ 2,5-dichloro-2,4-dimetiëlheksaan

Marking criteria:

- Correct stem i.e. hexane. ✓
- All substituents (dichloro and dimethyl) correctly identified. ✓
- IUPAC name completely correct including numbering, sequence, hyphens and commas. ✓

Nasienkriteria:

- *Korrekte stam d.i. heksaan.* ✓
- *Alle substituenten (dichloro en dimetiel) korrek geïdentifiseer.* ✓
- *IUPAC-naam heeltemal korrek insluitende nommering, volgorde, koppeltekens en kommas.* ✓

(3)

2.4.3 2,2-dimethyl✓propanal✓/dimethylpropanal

2,2-dimetiëlpropanaal/dimetiëlpropanaal

NOTE/NOTA:

2,2-dimethyl✓propan-1-al (Max/Maks: $\frac{1}{2}$)

(2)

2.5

Marking criteria/Nasienkriteria:

- Correct molecular formula: C_7H_{16} ✓
Korrekte molekulêre formula: C_7H_{16}
- Correct molecular formula of inorganic reactant and products. ✓
Korrekte molekulêre formule vir die anorganiese reaktans en produkte.
- Balancing/Balansering ✓

**Notes/Aantekeninge:**

- 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 struktuurformules gebruik: Max/Maks. $\frac{2}{3}$

(3)
[22]**QUESTION 3/VRAAG 3**

3.1

Marking criteria/Nasienkriteria

If any one of the underlined key phrases in the **correct context** is omitted, deduct 1 mark./Indien enige van die onderstreepte frases in die **korrekte konteks** uitgelaat is, trek 1 punt af.

The underlined phrases must be in the correct context. / Die onderstreepte frases moet in die korrekte konteks wees.

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

Die temperatuur waarby die dampdruk (van die stof) gelyk is aan atmosferiese druk.

(2)

3.2

C ✓

(1)

3.3

Marking criteria:

- Compare structures. ✓
- Compare the strength of intermolecular forces. ✓
- Compare the energy required to overcome intermolecular forces. ✓

Nasienkriteria:

- Vergelyk strukture. ✓
- Vergelyk die sterkte van intermolekulêre kragte. ✓
- Vergelyk die energie benodig om intermolekulêre kragte te oorkom. ✓

Accept: IMF for this exam/**Aanvaar:** IMK vir hierdie eksamen**A/CH₃CH₂CH₂CH₂Cl /1-chlorobutane**

- **Structure:**
Longer chain length/larger surface area (over which intermolecular forces act). ✓
- **Intermolecular forces:**
Stronger/more intermolecular forces/Van der Waals forces/London forces/dipole-dipole forces. ✓
- **Energy:**
More energy needed to overcome or break intermolecular forces/Van der Waals forces/dipole-dipole forces. ✓

OR**B/CH₃CH(CH₃)CH₂Cl/1-chloro-2-methylpropane**

- **Structure:**
Shorter chain length / branched / compact / more spherical / smaller surface area (over which intermolecular forces act). ✓
- **Intermolecular forces:**
Weaker/less intermolecular forces/Van der Waals forces/London forces/dipole-dipole forces. ✓
- **Energy:**
Less energy needed to overcome or break intermolecular forces/Van der Waals forces/dipole-dipole forces. ✓

A/CH₃CH₂CH₂CH₂Cl /1-chlorobutaan

- **Struktuur:**
Langer kettinglengte/groter oppervlak (waaroor intermolekulêre kragte werk). ✓
- **Intermolekulêre kragte:**
Sterker/meer intermolekulêre kragte/Van der Waalskragte/Londonkragte/dipool-dipoolkragte. ✓
- Meer energie benodig om intermolekulêre kragte/Van der Waalskragte/Londonkragte/dipool-dipoolkragte te oorkom/breek. ✓

OF**B/CH₃CH(CH₃)CH₂Cl/1-chloro-2-metielpropaan**

- **Struktuur:**
Korter kettinglengte / vertak / kompak / meer sferies / kleiner oppervlak (waaroor intermolekulêre kragte werk). ✓
- **Intermolekulêre kragte:**
Swakker/minder intermolekulêre kragte/Van der Waalskragte/Londonkragte/dipool-dipoolkragte. ✓
- **Energie:**
Minder energie benodig om intermolekulêre kragte/Van der Waalskragte/Londonkragte/dipool-dipoolkragte te oorkom/breek. ✓

(3)

3.4.1 75 (°C) ✓

3.4.2

Marking criteria:

- Compare the strength of intermolecular forces. ✓
- Compare the energy required to overcome intermolecular forces. ✓

Nasienkriteria:

- Vergelyk die sterkte van intermolekulêre kragte. ✓
- Vergelyk die energie benodig om intermolekulêre kragte te oorkom. ✓

- **Intermolecular forces:**

C ($\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{OH}$ /butanol) has stronger intermolecular forces than D ($\text{CH}_3\text{CH}_2\text{CH}_2\text{CHO}$ /butanal). ✓

- **Energy:**

More energy needed to overcome or break intermolecular forces. ✓

Accept: Boiling point of C will be more (in relation to C and D/118°C vs 75°C).

OR

- **Intermolecular forces:**

D ($\text{CH}_3\text{CH}_2\text{CH}_2\text{CHO}$ /butanal) has weaker intermolecular forces than C ($\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{OH}$ /butanol)

- **Energy:**

Less energy is needed to overcome or break intermolecular forces.

Accept: Boiling point of D will be less (in relation to C and D/118°C vs 75°C).

OR

- **Intermolecular forces:**

A ($\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{Cl}$) is a more polar molecule than D ($\text{CH}_3\text{CH}_2\text{CH}_2\text{CHO}$) increasing the intermolecular forces

- **Energy:**

More energy is needed to overcome or break intermolecular forces.

Accept: Boiling point of D will be less (in relation to A and D).

OR

- **Intermolecular forces:**

Electron density of A ($\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{Cl}$) is greater than D ($\text{CH}_3\text{CH}_2\text{CH}_2\text{CHO}$) increasing the intermolecular forces

- **Energy:**

More energy is needed to overcome or break intermolecular forces.

Accept: Boiling point of D will be less (in relation to A and D).

- **Intermolekulêre kragte:**

C ($\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{OH}$ /butanol) het sterker intermolekulêre kragte as D ($\text{CH}_3\text{CH}_2\text{CH}_2\text{CHO}$ /butanaal). ✓

- **Meer energie benodig om intermolekulêre kragte te oorkom/breek.** ✓

Aanvaar: Kookpunt van D sal minder wees (met betrekking tot C en D)

OF

- **Intermolekulêre kragte:**

D ($\text{CH}_3\text{CH}_2\text{CH}_2\text{CHO}$ /butanaal) het swakker intermolekulêre kragte as C ($\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{OH}$ /butanol).

- **Minder energie benodig om intermolekulêre kragte te oorkom/breek.**

Aanvaar: Kookpunt van C sal meer wees (met betrekking tot C en D)

OF

- **Intermolekulêre kragte:**

A ($\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{Cl}$) is 'n meer polêre molekule as D wat sterker intermolekulêre kragte tot gevolg het.

- Meer energie benodig om intermolekulêre kragte te oorkom/breek.

Aanvaar: Kookpunt van D sal minder wees (met betrekking tot A en D)

OF

- **Intermolekulêre kragte:**

Elektrondigtheid van A ($\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{Cl}$) is groter wat sterker intermolekulêre kragte tot gevolg het.

- Meer energie benodig om intermolekulêre kragte te oorkom/breek.

- Aanvaar: Kookpunt van D sal minder wees (met betrekking tot A en D)

(2)

3.5 Decreases/Neem af ✓

(1)

[10]**QUESTION 4/VRAAG 4**

4.1

4.1.1 (Concentrated) sulphuric acid/ $\text{H}_2\text{SO}_4(\text{aq})$ ✓
(Gekonsentreerde) swawelsuur

(1)

4.1.2 Esterification / Condensation ✓ / Verestering / Esterifikasie / Kondensasie

(1)

4.1.3 **ANY TWO/ENIGE TWEE:**

- Alcohol/methanol/reactant is flammable/catches fire easily. ✓

Alkohol/metanol/reaktans is vlambaar/slaan maklik aan die brand.

- To heat evenly/A steady/controlled/gradual increase in temperature. ✓
Om eweredig/gekontroleerd/gelydelik te verhit'n Eweredige toename in temperatuur.

- Alcohol/methanol will evaporate too quickly/is volatile.

Alkohol/metanol sal te vinnig verdamp/is vlugtig.

(2)

4.1.4

Marking criteria:

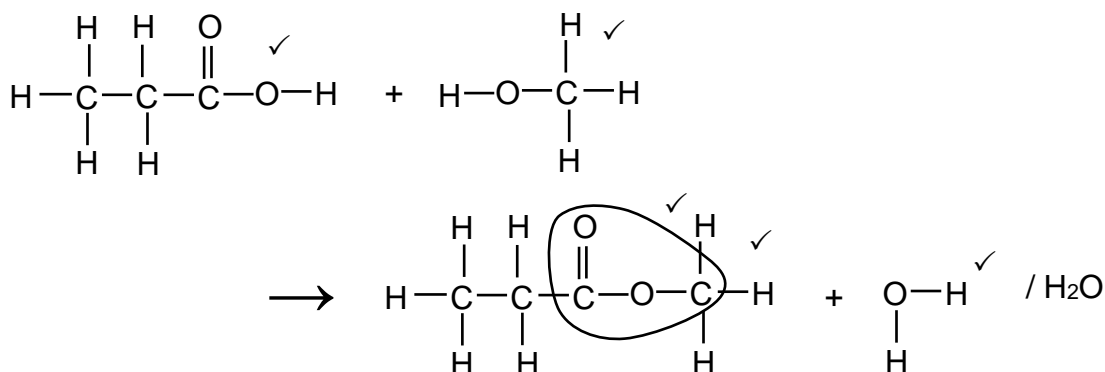
- Whole structural formula correct for propanoic acid. ✓
- Whole structural formula correct for methanol. ✓
- Functional group of ester correct. ✓
- Whole structural formula of ester correct. ✓
- H₂O ✓

Nasienkriteria:

- Hele struktuurformule vir propaansuur korrek. ✓
- Hele struktuurformule vir metanol korrek. ✓
- Funksionele groep van ester korrek. ✓
- Hele struktuurformule van ester korrek. ✓
- H₂O ✓

IF/INDIEN

- Any error e.g. omission of all H atoms, condensed or semi structural formula/*Enige fout bv. weglating van alle H-atome, gekondenseerde of semi-struktuurformule: Max/Maks. 2/5* (Functional group, H₂O/*Funksionele groep, H₂O*)
- Any additional reactants or products /*Enige addisionele reaktanse of produkte: Subtract 1 mark./Trek 1 punt af.*
- Molecular formulae used:/*Molekulêre formule gebruik: Max/Maks. 1/5* (water)
- No arrows: The first two structures given are considered as reactants and can be marked/*Geen pyltjie: die eerste twee strukture geskryf, word beskou as reaktanse en kan gemerk word.*



(5)

4.1.5 Methyl ✓propanoate ✓/*Metielpropanoaat*

(2)

4.2.1 Hydrogen/H₂ ✓/*Waterstof(gas)*

(1)

4.2.2 3,3-dimethyl ✓but-1-ene ✓/3,3-dimethyl-1-butene
3,3-dimetiel but-1-een/3,3-dimetiel-1-buteen

(2)

4.2.3 elimination **OR** dehydrohalogenation ✓ *eliminasi* **OF** dehidrohalogenering

(1)

4.2.4 H₂SO₄/H₃PO₄ **OR/OF** Sulphuric acid/Phosphoric acid ✓
Swawelsuur/Fosforsuur

(1)

4.2.5 3,3-dimethyl ✓butan-2-ol ✓/3,3-dimethyl-2-butanol
3,3-dimetiel butan-2-ol/3,3-dimetiel-2-butanol

(2)

4.2.6 Addition/hydration ✓ *Addisie/hidrasie*

(1)

4.2.7 Secondary ✓/*Sekondêr*

(1)

[20]

QUESTION 5/VRAAG 5

5.1.1 Exothermic/Eksotermies ✓

Lower (potential) energy of the products than reactants. $\Delta H < 0$ / ΔH negative / $\Delta H = -121,7$ kJ / More energy is released than absorbed. ✓

Laer (potensiële) energie van produkte as die reaktanse. $\Delta H < 0$ / ΔH negatief / $\Delta H = -121,7$ kJ / Meer energie word afgegee as wat opgeneem is. (2)

5.1.2 (The number of) particles with sufficient/enough (kinetic) energy (with a catalyst) OR $E_K \geq E_A$ (which can undergo effective collisions.) ✓

(Die hoeveelheid) deeltjies met genoeg/voldoende (kinetiese) energie (met 'n katalisator) OF $E_K \geq E_A$ (om effektiewe botsings te ondergaan). (1)

5.1.3 240,8 – 208,2 ✓ = 32,6 (kJ) ✓

IF: only answer award 2 marks / **INDIEN:** slegs antwoord gee 2 punte (2)

5.2

5.2.1 Decreases/Afneem ✓ (1)

5.2.2 Remains the same/Bly dieselfde ✓ (1)

5.2.3 Remains the same/Bly dieselfde ✓ (1)

5.3.1 Concentration (of sulphuric acid/ $H_2SO_4(aq)$) / Konsentrasie (van swawelsuur) ✓ (1)5.3.2 • More (H_2SO_4) particles per unit volume. ✓

• More effective collisions per unit time. / Higher frequency of effective collisions. ✓

• Higher reaction rate. ✓

OR

• Less (H_2SO_4) particles per unit volume. ✓

• Less effective collisions per unit time. / Lower frequency of effective collisions. ✓

• Lower reaction rate ✓

• Meer (H_2SO_4) deeltjies per eenheid volume. ✓

• Meer effektiewe botsings per eenheidtyd. / Hoër frekwensie van effektiewe botsings. ✓

• Hoër reaksietempo. ✓

OF

• Minder (H_2SO_4)-deeltjies per eenheid volume. ✓

• Minder effektiewe botsings per eenheidtyd. / Laer frekwensie van effektiewe botsings. ✓

• Laer reaksietempo. ✓ (3)

5.3.3

Marking criteria:

- (a) Substitute $(2,6)(60)(40) \text{ cm}^3$ OR $(156)(40)$ in rate formula ✓
 (b) Substitute $27\,000 \text{ cm}^3 / 27 \text{ dm}^3$ and volume in $n(\text{H}_2) = \frac{V}{V_m}$ ✓
 (c) USE mole ratio $n(\text{Al}) = \frac{2}{3}n(\text{H}_2)$ ✓
 (d) Substitution 27 and reacting mole in $n(\text{Al}) = \frac{m}{M}$ ✓
 (e) Substitution of $\frac{4,05}{5}(100)$ ✓
 (f) Final answer: 83,2 % ✓
 Range: 81 – 83,3 %

OPTION 1/OPSIE 1:

$$\text{Rate/Tempo} = \frac{\Delta V_{\text{H}_2}}{\Delta t}$$

$$40 = \frac{\Delta V_{\text{H}_2}}{2,6(60)} \quad \checkmark \text{ (a)}$$

$$V(\text{H}_2) = 6\,240 \text{ cm}^3$$

$$n(\text{H}_2) = \frac{V}{V_m}$$

$$= \frac{6\,240}{27\,000} \quad \checkmark \text{ (b)}$$

$$= 0,23 \text{ mol}$$

$$n(\text{Al}) = \frac{2}{3}n(\text{H}_2)$$

$$n(\text{Al}) = \frac{2}{3}(0,23) \quad \checkmark \text{ (c)}$$

$$= 0,15 \text{ mol}$$

$$n(\text{Al}) = \frac{m}{M}$$

$$0,15 = \frac{m}{27} \quad \checkmark \text{ (d)}$$

$$m = 4,05 \text{ g}$$

$$\% \text{ purity/suiwerheid} = \frac{4,05}{5}(100) \quad \checkmark \text{ (e)}$$

$$= 81 \% \quad \checkmark \text{ (f)}$$

Nasienkriteria:

- (a) Vervang $2,6(60)(40) \text{ cm}^3$ OF $(156)(40)$ in tempo formule ✓
 (b) Vervang $27\,000 \text{ cm}^3 / 27 \text{ dm}^3$ en volume in $n(\text{H}_2) = \frac{V}{V_m}$ ✓
 (c) GEBRUIK molverhouding $n(\text{Al}) = \frac{2}{3}n(\text{H}_2)$ ✓
 (d) Vervang 27 en mol gereageer in $n(\text{Al}) = \frac{m}{M}$ ✓
 (e) Vervang van $\frac{4,05}{5}(100)$ ✓
 (f) Finale antwoord: 81 % ✓
 Gebied: 81 – 83,3 %

OPTION 2/OPSIE 2:

$$\text{rate H}_2 = 40 \text{ cm}^3 \cdot \text{s}^{-1}$$

$$\text{Rate in } n(\text{H}_2) = \frac{V}{V_m}$$

$$= \frac{40}{27\,000} \quad \checkmark \text{ (b)}$$

$$= 0,00148 \text{ mol} \cdot \text{s}^{-1}$$

$$\text{Rate(Al)} = \frac{2}{3}n(\text{H}_2)$$

$$= \frac{2}{3}(0,00148) \quad \checkmark \text{ (c)}$$

$$= 9,88 \times 10^{-4} \text{ mol} \cdot \text{s}^{-1}$$

$$n(\text{Al}) = \frac{m}{M}$$

$$9,88 \times 10^{-4} = \frac{m}{27} \quad \checkmark \text{ (d)}$$

$$m = 0,0267 \text{ g} \cdot \text{s}^{-1}$$

$$\text{Rate/Tempo} = \frac{\Delta m_{\text{Al}}}{\Delta t}$$

$$0,0267 = \frac{\Delta m_{\text{Al}}}{2,6(60)}$$

$$m(\text{Al}) = 4,16 \text{ g}$$

$$\% \text{ purity/suiwerheid} = \frac{4,16}{5}(100) \quad \checkmark \text{ (e)}$$

$$= 83,2 \% \quad \checkmark \text{ (f)}$$

(a) both/ beide

(6)
[18]

QUESTION 6/VRAAG 6

6.1

Marking criteria/Nasienkriteria:

If any one of the underlined key phrases in the **correct context** is omitted, deduct 1 mark./Indien enige van die onderstreepte frases in die **korrekte konteks** uitgelaat is, trek 1 punt af.

The underlined phrases must be in the correct context. / Die onderstreepte frases moet in die korrekte konteks wees.

When the equilibrium in a closed system is disturbed, the system will re-instate a new equilibrium by favouring the reaction that will cancel/oppose the disturbance. ✓✓

Wanneer die ewewig in 'n geslote sisteem versteur word, sal die sisteem 'n nuwe ewewig instel deur die reaksie te bevoordeel wat die versteuring kanselleer/teenwerk.

IF “isolated” system -1/**INDIEN:** “geïsoleerde” sisteem -1)

(2)

6.2

(Chemical) equilibrium/Concentrations of reactants and products remain constant./Rate of the forward and reverse reactions are equal. ✓

(Chemiese) ewewig/Konsentrasies van reaktante en produkte bly konstant./Tempo van voorwaartse en terugwaartse reaksie is gelyk.

(1)

6.3

Exothermic/Eksotermies ✓

(1)

6.4

- With an increase in temperature the endothermic reaction is favoured. ✓
- The reverse reaction is favoured./ Equilibrium shifts to the left. / Reactants / $[P_2Q]$ increases OR Products / $[PQ_2]$ decreases ✓
- 'n Toename in temperatuur bevoordeel die endotermiese reaksie.
- Die terugwaartse reaksie word bevoordeel./ Ewewig skuif na links. / Reaktante / $[P_2Q]$ neem toe OF Produkte / $[PQ_2]$ neem af

(2)

6.5

Less than/Kleiner as ✓

(1)

6.6

CALCULATIONS USING CONCENTRATION**Marking criteria:**

- (a) Correct K_c expression (formulae in square brackets). ✓✓
(If solid is included deduct 1 mark)
- (b) Substitute 0,49 into K_c expression. ✓
- (c) Substitute equilibrium concentration (0,35) into correct K_c expression. ✓
- (d) Change in concentration/mole ✓
- (e) **USE** ratio: $P_2Q : 2PQ_2 = 1 : 2$ ✓
- (f) Substitute 2 dm^3 in $n = cV$. ✓
- (g) Final answer = 0,85 (mol) OR 1,11 (mol) OR 3,09 (mol) ✓

Nasienkriteria:

- (a) Korrekte K_c uitdrukking (formules in vierkantige hakies). ✓✓
(Indien vastestof inervang is, trek 1 punt af)
- (b) Vervang 0,49 in K_c -uitdrukking. ✓
- (c) Vervang ewewigkonsentrasie (0,35) in korrekte K_c -uitdrukking. ✓
- (d) Verandering in konsentrasie/mol ✓
- (e) **GEBRUIK** verhouding: $P_2Q : PQ_2 = 1 : 2$ ✓
- (f) Vervang 2 dm^3 in $n = cV$. ✓
- (g) Finale antwoord = 0,85 (mol) OF 1,11 (mol) OF 3,09 (mol) ✓

OPTION 1/OPSIE 1:

| | P_2Q | PQ_2 |
|--|----------------|--------|
| Initial concentration ($\text{mol} \cdot \text{dm}^{-3}$) <i>Aanvangskonsentrasie ($\text{mol} \cdot \text{dm}^{-3}$)</i> | x | 0 |
| Change in concentration ($\text{mol} \cdot \text{dm}^{-3}$) <i>Verandering in konsentrasie ($\text{mol} \cdot \text{dm}^{-3}$)</i> | 0,175 ✓(e) | 0,35 |
| Equilibrium concentration ($\text{mol} \cdot \text{dm}^{-3}$) <i>Ewewigskonsentrasie ($\text{mol} \cdot \text{dm}^{-3}$)</i> | ✓(d) x - 0,175 | 0,35 |

$$K_c = \frac{[PQ_2]^2}{[P_2Q]} \quad \checkmark\checkmark \text{ (a)}$$

$$0,49 \quad \checkmark \text{ (b)} = \frac{(0,35)^2 \quad \checkmark \text{ (c)}}{(x - 0,175)}$$

$$x = 0,425 \text{ mol} \cdot \text{dm}^{-3}$$

$$n(P_2Q) = cV \quad \swarrow$$

$$= 0,425 \times 2 \quad \checkmark \text{ (f)}$$

$$= 0,85 \text{ mol} \quad \checkmark \text{ (g)}$$

No K_c expression, correct substitution/Geen K_c -uitdrukking, korrekte substitusie: Max./Maks. $\frac{6}{8}$

Wrong K_c expression/
Verkeerde K_c -uitdrukking: Max./Maks. $\frac{5}{8}$

OPTION2/OPSIE 2:

$$K_c = \frac{[PQ_2]^2}{[P_2Q]}$$

$$0,49 \checkmark (b) = \frac{(0,35)^2 \checkmark (c)}{P_2Q}$$

$$P_2Q = 0,25 \text{ mol} \cdot \text{dm}^{-3}$$

No K_c expression, correct substitution/Geen K_c -uitdrukking, korrekte substitusie: Max./Maks. $\frac{6}{8}$

Wrong K_c expression/
Verkeerde K_c -uitdrukking: Max./Maks. $\frac{5}{8}$

| | P_2Q | PQ_2 |
|--|------------------------|-----------------------|
| Initial concentration ($\text{mol} \cdot \text{dm}^{-3}$) Aanvangskonsentrasie ($\text{mol} \cdot \text{dm}^{-3}$) | $\checkmark (d)$ 0,425 | 0 |
| Change in concentration ($\text{mol} \cdot \text{dm}^{-3}$) Verandering in konsentrasie ($\text{mol} \cdot \text{dm}^{-3}$) | -0,175 | $\checkmark (e)$ 0,35 |
| Equilibrium concentration ($\text{mol} \cdot \text{dm}^{-3}$) Ewewigskonsentrasie ($\text{mol} \cdot \text{dm}^{-3}$) | 0,25 | 0,35 |

$$n(P_2Q) = cV$$

$$= 0,425(2) \checkmark (f)$$

$$= 0,85 \text{ mol} \checkmark (g)$$

CALCULATIONS USING NUMBER OF MOLES**OPTION 3/OPSIE 3:**

| | P_2Q | PQ_2 |
|--|---------------------------------------|--------|
| Initial quantity (mol) Aanvangshoeveelheid (mol) | x | 0 |
| Change (mol) Verandering (mol) | $\checkmark (e)$ 0,35 | 0,7 |
| Quantity at equilibrium (mol) Hoeveelheid by ewewig (mol) | $\checkmark (d)$ $x - 0,35$ | 0,7 |
| Equilibrium concentration ($\text{mol} \cdot \text{dm}^{-3}$) Ewewigskonsentrasie ($\text{mol} \cdot \text{dm}^{-3}$) | $\checkmark (f)$ $\frac{x - 0,35}{2}$ | 0,35 |

$$K_c = \frac{[PQ_2]^2}{[P_2Q]} \checkmark \checkmark (a)$$

$$0,49 \checkmark (b) = \frac{(0,35)^2 \checkmark (c)}{\left(\frac{x - 0,35}{2}\right)}$$

$$x = 0,85 \text{ mol} \checkmark (g)$$

No K_c expression, correct substitution/Geen K_c -uitdrukking, korrekte substitusie: Max./Maks. $\frac{6}{8}$

Wrong K_c expression/
Verkeerde K_c -uitdrukking: Max./Maks. $\frac{5}{8}$

OPTION 4/OPSIE 4:

$$K_c = \frac{[PQ_2]^2}{[P_2Q]} \quad \checkmark \checkmark \text{ (a)}$$

$$0,49 \checkmark \text{ (b)} = \frac{(0,35)^2}{[P_2Q]} \quad \checkmark \text{ (c)}$$

$$[P_2Q] = 0,25 \text{ mol} \cdot \text{dm}^{-3}$$

Wrong K_c expression/Verkeerde K_c -uitdrukking: Max./Maks. $\frac{5}{8}$ No K_c expression, correct substitution/Geen K_c -uitdrukking, korrekte substitusie: Max./Maks. $\frac{6}{8}$

| | P_2Q | PQ_2 |
|--|--------------------------------|------------------------------|
| Initial quantity (mol) Aanvangshoeveelheid (mol) | $\checkmark \text{ (g)}$ 0,85 | 0 |
| Change (mol) Verandering (mol) | $\checkmark \text{ (e)}$ -0,35 | 0,7 $\checkmark \text{ (d)}$ |
| Quantity at equilibrium (mol) Hoeveelheid by ewewig (mol) | 0,5 $\checkmark \text{ (f)}$ | 0,7 |
| Equilibrium concentration ($\text{mol} \cdot \text{dm}^{-3}$) Ewewigskonsentrasie ($\text{mol} \cdot \text{dm}^{-3}$) | 0,25 | 0,35 |

- 6.7 Pressure was decreased/volume of the container was increased. \checkmark
Druk is verlaag/volume van die houer is vergroot.

(1)

- 6.8
- Favours the reaction that increases the number of moles (of gas) \checkmark /
Bevoordeel die reaksie wat aantal mol (gas) laat toeneem
 - $[P_2Q]$ increased/*neem toe* \checkmark

(2)

[18]

QUESTION 7/VRAAG 7

7.1

Marking criteria:

- Any formula $c = \frac{m}{MV}$ or $n = \frac{m}{M}$ or $c = \frac{n}{V}$ ✓
- Substitute 10, 106 and 0,7 into formula ✓
- Final answer: $0,13 \text{ mol} \cdot \text{dm}^{-3}$ ✓

Nasienkriteria:

- Enige formule $c = \frac{m}{MV}$ of $n = \frac{m}{M}$ of $c = \frac{n}{V}$ ✓
- Vervang 10, 106 and 0,7 in formula ✓
- Finale antwoord: $0,13 \text{ mol} \cdot \text{dm}^{-3}$ ✓

7.1.1

OPTION 1/OPSIE 1:

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

$$= \frac{10}{(106)(0,7)} \checkmark$$

$$= 0,13 \text{ mol} \cdot \text{dm}^{-3} \checkmark$$

OPTION 2/OPSIE 2:

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

$$= \frac{10}{106} \checkmark$$

$$= 0,09 \checkmark$$

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

$$= \frac{0,09}{0,7} \checkmark$$

$$= 0,13 \text{ mol} \cdot \text{dm}^{-3} \checkmark$$

Any one/Enige een ✓

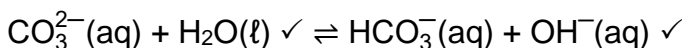
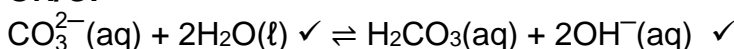
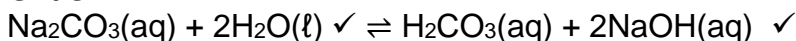
(3)

7.1.2

Greater than/Groter as ✓

(1)

7.1.3

**OR/OF****OR/OF****OR/OF****Marking criteria/Nasienkriteria:**

- Reactants ✓ Products ✓
Reaktanse ✓ Produkte ✓
- Ignore/Ignoreer → and phases/en fases
- Marking rule 6.3.10/Nasienreël 6.3.10

(2)

7.1.4



P ✓

(Titration of) weak base and a strong acid./The equivalence point is lower than pH 7. ✓

(Titrasië van) 'n swak basis en 'n sterk suur./ Die ekwivalente punt is laer as 'n pH van 7.

(2)

7.2

7.2.1

Dilute acid contains small amount/number of moles of acid in proportion to the volume of water. ✓✓ **(2 or/of 0)**

Verdunde sure bevat 'n klein hoeveelheid/getal mol suur in verhouding met die volume water.

(2)

7.2.2

| Marking criteria: | Nasienkriteria: |
|--|---|
| <p>(a) USE of ratio: $n(\text{KOH})_{\text{reacted}} = 2n(\text{H}_2\text{SO}_4)_{\text{reacted}}$ $[\text{KOH}]_{\text{reacted}} = 2n[\text{H}_2\text{SO}_4]_{\text{reacted}}$ ✓</p> <p>(b) Subtract: $n(\text{KOH})_{\text{initial}} - n(\text{KOH})_{\text{reacted}}$ $[\text{KOH}]_{\text{initial}} - [\text{KOH}]_{\text{reacted}}$ ✓✓</p> <p>(c) Divide n by 0,20 dm³ in c = $\frac{n}{V}$ ✓</p> <p>(d) Either formulae: $\text{pH} = -\log[\text{H}_3\text{O}^+]$ / $\text{pH} = -\log[\text{H}^+] / \text{pOH} = -\log[\text{OH}^-]$ AND $[\text{H}_3\text{O}^+][\text{OH}^-] = 10^{-14}$ / $\text{pH} + \text{pOH} = 14$ ✓</p> <p>(e) Substitute calculated $[\text{OH}^-]$ in $[\text{H}_3\text{O}^+][\text{OH}^-]$ / in $\text{pOH} = -\log[\text{OH}^-]$ ✓</p> <p>(f) Substitute calculated $[\text{H}_3\text{O}^+]$ in pH formula/ pOH in $\text{pH} + \text{pOH} = 14$ ✓</p> <p>(g) Final answer: 12,3 ✓</p> | <p>(a) GEBRUIK verhouding: $n(\text{KOH})_{\text{gereageer}} = 2n(\text{H}_2\text{SO}_4)_{\text{gereageer}}$ $[\text{KOH}]_{\text{gereageer}} = 2n[\text{H}_2\text{SO}_4]_{\text{gereageer}}$ ✓</p> <p>(b) Aftrek: $n(\text{KOH})_{\text{aanvanklik}} - n(\text{KOH})_{\text{gereageer}}$ $[\text{KOH}]_{\text{aanvanklik}} - [\text{KOH}]_{\text{gereageer}}$ ✓✓</p> <p>(c) Deel n deur 0,20 dm³ in c = $\frac{n}{V}$ ✓</p> <p>(d) Enige een v formules: $\text{pH} = -\log[\text{H}_3\text{O}^+]$ / $\text{pH} = -\log[\text{H}^+] / \text{pOH} = -\log[\text{OH}^-]$ EN $[\text{H}_3\text{O}^+][\text{OH}^-] = 10^{-14}$ / $\text{pH} + \text{pOH} = 14$ ✓</p> <p>(e) Vervang berekende $[\text{OH}^-]$ in $[\text{H}_3\text{O}^+][\text{OH}^-]$ / in $\text{pOH} = -\log[\text{OH}^-]$ ✓</p> <p>(f) Vervang berekende $[\text{H}_3\text{O}^+]$ in pH formule/ pOH in $\text{pH} + \text{pOH} = 14$ ✓</p> <p>(g) Finale antwoord: 12,3 ✓</p> |
| <p>OPTION 1/OPSIE 1: $n(\text{KOH})_{\text{reacted}} = 2n(\text{H}_2\text{SO}_4)_{\text{reacted}}$ $= 2(0,01)$ ✓(a) $= 0,02$</p> <p>$n(\text{KOH})_{\text{excess}} = 0,024 - 0,02$ ✓✓ (b) $= 0,004 \text{ mol}$</p> <p>$[\text{OH}^-] = \frac{n}{V}$ $= \frac{0,004}{0,20}$ ✓(c) $= 0,02 \text{ mol} \cdot \text{dm}^{-3}$</p> <p>$[\text{H}_3\text{O}^+][\text{OH}^-] = 10^{-14}$ $[\text{H}_3\text{O}^+] (0,02) = 1 \times 10^{-14}$ ✓(e) $[\text{H}_3\text{O}^+] = 5 \times 10^{-13} \text{ mol} \cdot \text{dm}^{-3}$</p> <p>$\text{pH} = -\log[\text{H}_3\text{O}^+]$ $= -\log(5 \times 10^{-13})$ ✓(f) $= 12,3$ ✓(g)</p> <p>Either/ Enige een ✓(d)</p> | <p>OPTION 2/OPSIE 2: $[\text{KOH}] = \frac{n}{V}$ $= \frac{0,024}{0,20}$ ✓(c) $= 0,12 \text{ mol} \cdot \text{dm}^{-3}$</p> <p>$[\text{H}_2\text{SO}_4] = \frac{n}{V}$ $= \frac{0,01}{0,20}$ $= 0,05 \text{ mol} \cdot \text{dm}^{-3}$</p> <p>$[\text{KOH}]_{\text{reacted}} = 2[\text{H}_2\text{SO}_4]_{\text{reacted}}$ $= 2(0,05)$ ✓(a) $= 0,1 \text{ mol} \cdot \text{dm}^{-3}$</p> <p>$[\text{KOH}]_{\text{excess}} = 0,12 - 0,1$ ✓✓ (b) $= 0,02 \text{ mol} \cdot \text{dm}^{-3}$</p> <p>$[\text{H}_3\text{O}^+][\text{OH}^-] = 10^{-14}$ $[\text{H}_3\text{O}^+] (0,02) = 1 \times 10^{-14}$ ✓(e) $[\text{H}_3\text{O}^+] = 5 \times 10^{-13} \text{ mol} \cdot \text{dm}^{-3}$</p> <p>$\text{pH} = -\log[\text{H}_3\text{O}^+]$ $= -\log(5 \times 10^{-13})$ ✓(f) $= 12,3$ ✓(g)</p> <p>Both/ Beide ✓(d)</p> |
| <p>OPTION 3/OPSIE 3 $\text{pOH} = -\log[\text{OH}^-]$ $\text{pOH} = -\log(0,02)$ ✓(e) $\text{pOH} = 1,7$</p> <p>$\text{pH} + \text{pOH} = 14$ $\text{pH} + 1,7 = 14$ ✓(f) $\text{pH} = 12,3$ ✓(g)</p> <p>Any one/Enige een ✓(d)</p> | |

QUESTION 8/VRAAG 8

8.1 Aluminium/Al ✓ (1)

8.2 0,325 (mol·dm⁻³) ✓✓
Range/Gebied: 0,32 – 0,33 (mol·dm⁻³) (2)

8.3 Decreases / Neem af ✓
M²⁺ is reduced/ M²⁺ used up/M²⁺ is the oxidising agent. ✓ (2)
M²⁺ word gereduseer/ M²⁺ opgebruik/M²⁺ is die oksideermiddel.

8.4 M ✓ (1)

8.5

| | |
|---|--|
| <p>OPTION 1/OPTION 1</p> <p>$E_{\text{cell}}^{\theta} = E_{\text{reduction}}^{\theta} - E_{\text{oxidation}}^{\theta}$ ✓</p> <p>$2 \checkmark \checkmark = E_{\text{cathode}}^{\theta} - (-1,66)$ ✓</p> <p>$E_{\text{cathode}}^{\theta} = 0,34 \text{ (V)}$ ✓</p> <p>M is copper/Cu/koper ✓</p> | <p>NOTE/LET WEL</p> <ul style="list-style-type: none"> Accept any other correct formula from the data sheet. /Aanvaar enige ander korrekte formule vanaf gegewensblad. Any other formula using unconventional abbreviations, e.g. $E_{\text{cell}}^{\circ} = E_{\text{OA}}^{\circ} - E_{\text{RA}}^{\circ}$ followed by correct substitutions: /Enige ander formule wat onkonvensionele afkortings gebruik, bv. $E_{\text{sel}}^{\circ} = E_{\text{OM}}^{\circ} - E_{\text{RM}}^{\circ}$ gevolg deur korrekte vervangings ⁵/₆ |
| <p>OPTION 2/OPSIE 2</p> <p> $\begin{cases} \text{M}^{2+}(\text{aq}) + 2\text{e}^{-} \rightarrow \text{M}(\text{aq}) & E = +x \text{ V} \\ \text{Al}(\text{s}) \rightarrow \text{Al}^{3+}(\text{aq}) + 3\text{e}^{-} & E = +1,66 \text{ V } \checkmark \end{cases}$ </p> <p>$2\text{Al}(\text{s}) + 3\text{M}^{2+}(\text{aq}) \rightarrow 2\text{Al}^{3+}(\text{aq}) + 3\text{M}(\text{s})$ $E = 2,00 \text{ (V)} \checkmark \checkmark$</p> <p>$x = 0,34 \text{ (V)} \checkmark$</p> <p>M is copper/Cu/koper ✓</p> | |

(6)

8.6.1 Magnesium/Mg ✓ (1)

8.6.2 Al³⁺ is a stronger oxidising agent than Mg²⁺ ✓, therefore, Mg will be oxidised ✓ (to Mg²⁺). /
Mg²⁺ is a weaker oxidising agent than Al³⁺ ✓, therefore, Mg will be oxidised ✓ (to Mg²⁺).

Al³⁺ is 'n sterker oksideermiddel as Mg²⁺, daarom sal Mg geoksideer word (tot Mg²⁺). /

Mg²⁺ is 'n swakker oksideermiddel as Al³⁺, daarom sal Mg geoksideer word (tot Mg²⁺).

(2)
[15]

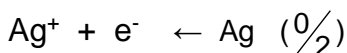
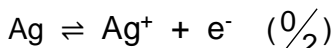
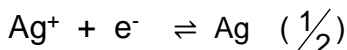
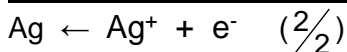
QUESTION 9/VRAAG 9

9.1 Electrical to chemical (energy)/Elektriese na chemiese (energie) ✓ (1)

9.2 P ✓ (1)

9.3 $\text{Ag}^+ + \text{e}^- \rightarrow \text{Ag}$ ✓✓

Marking criteria/Nasienkriteria:



Ignore if charge omitted on electron./Ignoreer indien lading weggelaat op elektron.

(2)

9.4

Marking criteria:

(a) Substitute 3,25 and 108 in the formula $n = \frac{m}{M}$ ✓

(b) Substitute $6,02 \times 10^{23}$ in $n(\text{e}^-) = \frac{N}{N_A}$ ✓

(c) Substitute 0,03 mol in $n(\text{e}^-) = \frac{N}{N_A}$ ✓
(Substitute 96 500 in formula $Q = nF$)

(d) Substitute 30(60) OR 1 800 ✓

(e) Final answer: 1,61 A ✓

Nasienkriteria:

(a) Vervang 3,25 en 108 in die formule $n = \frac{m}{M}$ ✓

(b) Vervang $6,02 \times 10^{23}$ in $n(\text{e}^-) = \frac{N}{N_A}$ ✓

(c) Vervang 0,03 mol in $n(\text{e}^-) = \frac{N}{N_A}$ ✓
(Vervang 96 500 in formule $Q = nF$)

(d) Vervang 30(60) OF 1 800 ✓

(e) Finale antwoord: 1,61 A ✓

OPTION 1/OPSIE 1:

$$n(\text{Ag}) = \frac{m}{M}$$

$$= \frac{3,25}{108} \quad \checkmark \text{ (a)}$$

$$= 0,03 \text{ mol}$$

$$n(\text{e}^-) = \frac{N}{N_A}$$

$$\text{(c) } \checkmark 0,03 = \frac{N}{6,02 \times 10^{23}} \quad \checkmark \text{ (b)}$$

$$N \text{ e}^- = 1,81 \times 10^{22}$$

$$N \text{ e}^- = \frac{Q}{e} \quad \text{OF/OR} \quad \frac{Q}{q_e}$$

$$1,81 \times 10^{22} = \frac{Q}{1,6 \times 10^{-19}}$$

$$Q = 2\,889,6 \text{ C}$$

$$I = \frac{Q}{\Delta t}$$

$$= \frac{2\,889,6}{30(60)} \quad \checkmark \text{ (d)}$$

$$= 1,61 \text{ A} \quad \checkmark \text{ (e)}$$

OPTION 2/OPSIE 2:

$$n(\text{Ag}) = \frac{m}{M}$$

$$= \frac{3,25}{108} \quad \checkmark \text{ (a)}$$

$$= 0,03 \text{ mol} = n \text{ e}^-$$

$$Q = 0,03 \times 96\,500 \quad \checkmark \text{ (c)}$$

$$= 2\,895 \text{ C}$$

$$I = \frac{Q}{\Delta t}$$

$$= \frac{2\,895}{30(60)} \quad \checkmark \text{ (d)}$$

$$= 1,61 \text{ A} \quad \checkmark \text{ (e)}$$

(5)

[9]

TOTAL/TOTAAL:

150