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Basic Education
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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 20 pages./
Hierdie nasienriglyne bestaan uit 20 bladsye.**

Approved
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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)

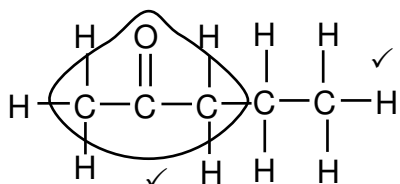
2.3
 2.3.1

Marking criteria/Nasienkriteria:

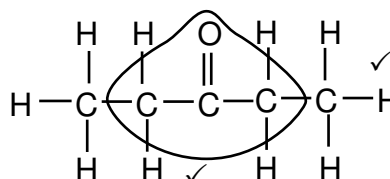
- Functional group. ✓
Funksionele groep.
- Whole structure correct. ✓
Hele struktuur korrek.

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

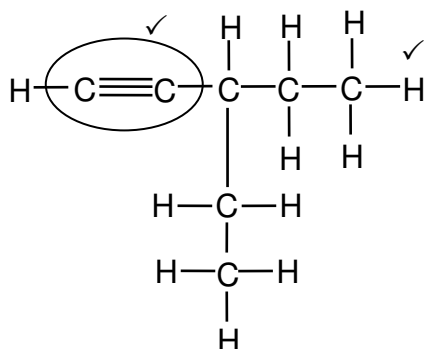


(2)

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 dimetiël) 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. $\frac{2}{3}$
- **ACCEPT:** multiple coefficients for this exam.
AANVAAR: veelvoude van koëffisiënte vir hierdie eksamen.

(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)

N.
Vig
G
K

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) ✓

(1)

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)

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4.1.4

Marking criteria:

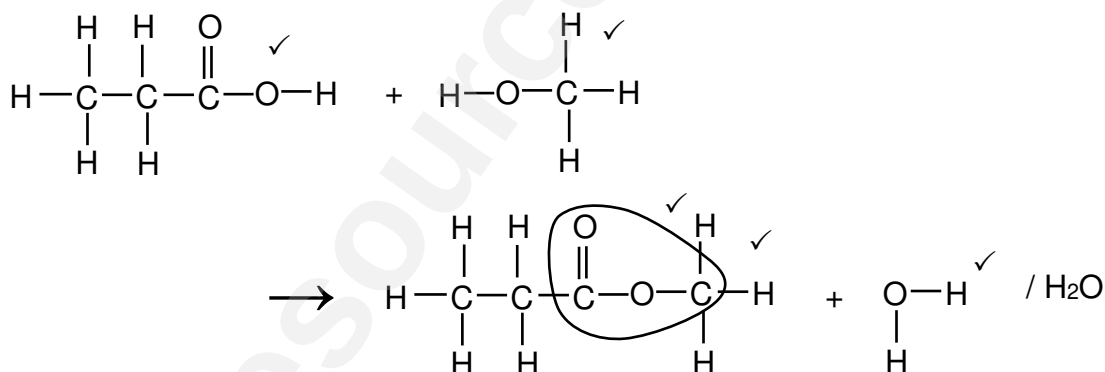
- Whole structural formula correct for propanoic acid. ✓
- Whole structural formula correct for methanol. ✓
- Functional group of ester correct. ✓
- Whole structural formula of ester correct. ✓
- H₂O ✓

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-dimethylbut-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 ✓ eliminاسie **OF** dehidrohalogenering

(1)

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

(1)

4.2.5 3,3-dimethylbutan-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. $\Delta H < 0/\Delta H$ negative / $\Delta H = -121,7$ kJ/More energy is released than absorbed. ✓

Laer (potensiële) energie van produkte as die reaktanse./ $\Delta H < 0/\Delta H$ 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)

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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 %	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 1/OPSIE 1: Rate/Tempo = $\frac{\Delta V_{\text{H}_2}}{\Delta t}$ $40 = \frac{\Delta V_{\text{H}_2}}{2,6(60)}$ ✓ (a) $V(\text{H}_2) = 6\,240 \text{ cm}^3$ $n(\text{H}_2) = \frac{V}{V_m}$ $= \frac{6\,240}{27\,000}$ ✓ (b) $= 0,23 \text{ mol}$ $n(\text{Al}) = \frac{2}{3}n(\text{H}_2)$ $n(\text{Al}) = \frac{2}{3}(0,23)$ ✓ (c) $= 0,15 \text{ mol}$ $n(\text{Al}) = \frac{m}{M}$ $0,15 = \frac{m}{27}$ ✓ (d) $m = 4,05 \text{ g}$ $\% \text{ purity/suiwerheid} = \frac{4,05}{5}(100)$ ✓ (e) $= 81 \%$ ✓ (f)	OPTION 2/OPSIE 2: rate $\text{H}_2 = 40 \text{ cm}^3 \cdot \text{s}^{-1}$ Rate in $n(\text{H}_2) = \frac{V}{V_m}$ $= \frac{40}{27\,000}$ ✓ (b) $= 0,00148 \text{ mol} \cdot \text{s}^{-1}$ Rate $(\text{Al}) = \frac{2}{3}n(\text{H}_2)$ $= \frac{2}{3}(0,00148)$ ✓ (c) $= 9,88 \times 10^{-4} \text{ mol} \cdot \text{s}^{-1}$ $n(\text{Al}) = \frac{m}{M}$ $9,88 \times 10^{-4} = \frac{m}{27}$ ✓ (d) $m = 0,0267 \text{ g} \cdot \text{s}^{-1}$ Rate/Tempo = $\frac{\Delta m_{\text{Al}}}{\Delta t}$ $0,0267 = \frac{\Delta m_{\text{Al}}}{2,6(60)}$ $m(\text{Al}) = 4,16 \text{ g}$ $\% \text{ purity/suiwerheid} = \frac{4,16}{5}(100)$ ✓ (e) $= 83,2 \%$ ✓ (f)

(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

OPTION 1/OPSIE 1:

Exothermic/Eksotermies ✓



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



6.5

Less than/Kleiner as ✓

OPTION 2/OPSIE 2:

Endothermic/Endotermies ✓



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



Greater than/Groter as ✓

(1)

(2)

(1)

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K.

6.6

METHOD 1/METODE 1: Using lines/Gebruik lyne

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 invang 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

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

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

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

$$n(P_2Q) = cV$$

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

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

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. $\frac{5}{8}$

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OPTION2/OPSIE 2:

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

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

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

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. $\frac{5}{8}$

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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

METHOD 2/METODE 2: Using labels/Gebruik byskrifte

OPTION 1/OPSIE 1:

	P_2Q	PQ_2
Initial concentration ($\text{mol} \cdot \text{dm}^{-3}$) Aanvangskonsentrasie ($\text{mol} \cdot \text{dm}^{-3}$)	x	0
Change in concentration ($\text{mol} \cdot \text{dm}^{-3}$) Verandering in konsentrasie ($\text{mol} \cdot \text{dm}^{-3}$)	$\checkmark \text{ (e)}$ -0,207	0,414 $\checkmark \text{ (d)}$
Equilibrium concentration ($\text{mol} \cdot \text{dm}^{-3}$) Ewewigskonsentrasie ($\text{mol} \cdot \text{dm}^{-3}$)	0,35	0,414

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

$$\text{(b)} \quad \checkmark \quad 0,49 = \frac{[PQ_2]^2}{(0,35)} \quad \checkmark \text{ (c)}$$

$$[PQ_2] = 0,414 \text{ mol} \cdot \text{dm}^{-3}$$

$$\text{initial } n(P_2Q) = (0,35 + 0,207)(2) \quad \checkmark \text{ (f)}$$

$$= 1,11 \text{ mol} \quad \checkmark \text{ (g)}$$

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. $\frac{5}{8}$

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OPTION 2/OPSIE 2:

	P ₂ Q	PQ ₂
Initial quantity (mol) Aanvangshoeveelheid (mol)	x	0
Change (mol) Verandering (mol)	0,414	0,828 ✓ (e)
Quantity at equilibrium (mol) Hoeveelheid by ewewig (mol)	0,7	0,828
Equilibrium concentration (mol·dm ⁻³) Ewewigskonsentrasie (mol·dm ⁻³)	0,35 ✓ (f)	0,414

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

$$(b) \checkmark 0,49 = \frac{[PQ_2]^2}{(0,35)} \quad \checkmark \text{ (c)}$$

$$[PQ_2] = 0,414 \text{ mol·dm}^{-3}$$

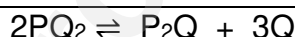
$$x - 0,414 = 0,7 \quad \checkmark \text{ (d)}$$

$$x = 1,11 \text{ mol P}_2\text{Q} \quad \checkmark \text{ (g)}$$

No K_c expression, correct substitution/Geen K_c-uitdrukking, korrekte substitusie: Max./Maks. 6/8

Wrong K_c expression/
Verkeerde K_c-uitdrukking: Max./Maks. 5/8

METHOD 3/METODE 3: (Equation written as reverse/Vergelyking omgekeerd geskryf)



	PQ ₂	P ₂ Q
Initial quantity (mol) Aanvangshoeveelheid (mol)	x	0
Change (mol) Verandering (mol)	1,4	0,7 ✓ (e)
Quantity at equilibrium (mol) Hoeveelheid by ewewig (mol) (d) ✓	x - 1,4	0,7
Equilibrium concentration (mol·dm ⁻³) Ewewigskonsentrasie (mol·dm ⁻³)	$\frac{x - 1,4}{2}$	0,35

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

$$(b) \checkmark 0,49 = \frac{(0,35)}{[PQ_2]^2} \quad \checkmark \text{ (c)}$$

$$\frac{x - 1,4}{2} = 0,845 \quad \checkmark \text{ (f)}$$

$$x = 3,09 \text{ mol P}_2\text{Q} \quad \checkmark \text{ (g)}$$

No K_c expression, correct substitution/Geen K_c-uitdrukking, korrekte substitusie: Max./Maks. 6/8

Wrong K_c expression/
Verkeerde K_c-uitdrukking: Max./Maks. 5/8

METHOD 4/METODE 4: Reading from graph/Af lees van grafiek

OPTION 1/OPSIE 1

$$K_c = \frac{[PQ_2]^2}{[P_2Q]} = 0,49 \quad \text{Initial } [P_2Q] = 0$$

$$n = 0 \text{ (mol)} \quad \checkmark \checkmark \checkmark \checkmark \checkmark \checkmark \checkmark \checkmark \text{ (8/8)}$$

OPTION 2/OPSIE 2:

	P ₂ Q	PQ ₂
Initial concentration (mol·dm ⁻³) Aanvangskonsentrasie (mol·dm ⁻³)	→ 0	y
Change in concentration (mol·dm ⁻³) Verandering in konsentrasie (mol·dm ⁻³)	-0,207	0,414
Equilibrium concentration (mol·dm ⁻³) Ewewigskonsentrasie (mol·dm ⁻³)	0,35	0,414

n = 0 (mol) ✓✓✓✓✓✓✓✓ (8/8)

(8)

- 6.7 Pressure was decreased/volume of the container was increased. ✓
Druk is verlaag/volume van die houer is vergroot. (1)

- 6.8 **OPTION 1/OPSIE 1:** Using labels/Gebruik byskrifte

- Favours the reaction that increases the number of moles (of gas) ✓/
Bevoordeel die reaksie wat aantal mol (gas) laat toeneem
- [P₂Q] increased/neem toe ✓ **OR/OF** [PQ₂] decreased/neem af

OPTION 2/OPSIE 2: Using lines/Gebruik lyne

- Favours the reaction that increases the number of moles (of gas) ✓/
Bevoordeel die reaksie wat aantal mol (gas) laat toeneem
- [PQ₂] increased/neem toe ✓ **OR/OF** [P₂Q] decreased/neem af

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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 mol·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 mol·dm⁻³ ✓
7.1.1	OPTION 1/OPSIE 1: $c = \frac{m}{MV}$ $= \frac{10}{(106)(0,7)}$ $= 0,13 \text{ mol·dm}^{-3}$	OPTION 2/OPSIE 2: $n = \frac{m}{M}$ $= \frac{10}{106}$ $= 0,09$ $c = \frac{n}{V}$ $= \frac{0,09}{0,7}$ $= 0,13 \text{ mol·dm}^{-3}$ Any one/Enige een ✓

(3)

7.1.2 Greater than/Groter as ✓

(1)

7.1.3 $\text{CO}_3^{2-}(\text{aq}) + \text{H}_2\text{O}(\ell) \rightleftharpoons \text{HCO}_3^-(\text{aq}) + \text{OH}^-(\text{aq})$ ✓
OR/OF
 $\text{CO}_3^{2-}(\text{aq}) + 2\text{H}_2\text{O}(\ell) \rightleftharpoons \text{H}_2\text{CO}_3(\text{aq}) + 2\text{OH}^-(\text{aq})$ ✓
OR/OF
 $\text{Na}_2\text{CO}_3(\text{aq}) + \text{H}_2\text{O}(\ell) \rightleftharpoons \text{NaHCO}_3(\text{aq}) + \text{NaOH}(\text{aq})$ ✓
OR/OF
 $\text{Na}_2\text{CO}_3(\text{aq}) + 2\text{H}_2\text{O}(\ell) \rightleftharpoons \text{H}_2\text{CO}_3(\text{aq}) + 2\text{NaOH}(\text{aq})$ ✓

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.

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7.2.2

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

(8)
[18]

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)

OPTION 1/OPTION 1 $E_{\text{cell}}^{\theta} = E_{\text{reduction}}^{\theta} - E_{\text{oxidation}}^{\theta}$ ✓ 2 ✓✓ = $E_{\text{cathode}}^{\theta} - (-1,66)$ ✓ $E_{\text{cathode}}^{\theta} = 0,34$ (V) ✓ M is copper/Cu/<i>koper</i> ✓	NOTE/LET WEL - Accept any other correct formula from the data sheet. /<i>Aanvaar enige ander korrekte formule vanaf gegewensblad.</i> - Any other formula using unconventional abbreviations, e.g. $E_{\text{cell}}^{\theta} = E_{\text{OA}}^{\theta} - E_{\text{RA}}^{\theta}$ followed by correct substitutions: /<i>Enige ander formule wat onkonvensionele afkortings gebruik, bv. $E_{\text{sel}}^{\theta} = E_{\text{OM}}^{\theta} - E_{\text{RM}}^{\theta}$ gevolg deur korrekte vervangings</i> ^{5/6}						
OPTION 2/OPSIE 2 <table border="0"> <tr> <td>$M^{2+}(\text{aq}) + 2e^{-} \rightarrow M(\text{aq})$</td> <td>$E = +x$ V</td> </tr> <tr> <td>$Al(\text{s}) \rightarrow Al^{3+}(\text{aq}) + 3e^{-}$</td> <td>$E = +1,66$ V ✓</td> </tr> <tr> <td>$2Al(\text{s}) + 3M^{2+}(\text{aq}) \rightarrow 2Al^{3+}(\text{aq}) + 3M(\text{s})$</td> <td>$E = 2,00$ (V) ✓✓</td> </tr> </table> $x = 0,34$ (V) ✓ M is copper/Cu/<i>koper</i> ✓		$M^{2+}(\text{aq}) + 2e^{-} \rightarrow M(\text{aq})$	$E = +x$ V	$Al(\text{s}) \rightarrow Al^{3+}(\text{aq}) + 3e^{-}$	$E = +1,66$ V ✓	$2Al(\text{s}) + 3M^{2+}(\text{aq}) \rightarrow 2Al^{3+}(\text{aq}) + 3M(\text{s})$	$E = 2,00$ (V) ✓✓
$M^{2+}(\text{aq}) + 2e^{-} \rightarrow M(\text{aq})$	$E = +x$ V						
$Al(\text{s}) \rightarrow Al^{3+}(\text{aq}) + 3e^{-}$	$E = +1,66$ V ✓						
$2Al(\text{s}) + 3M^{2+}(\text{aq}) \rightarrow 2Al^{3+}(\text{aq}) + 3M(\text{s})$	$E = 2,00$ (V) ✓✓						

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⁺).

ACCEPT/AANVAAR:

Mg ion and Al ion/Mg *ioon* en Al *ioon*

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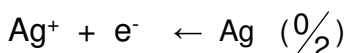
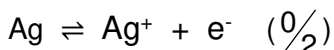
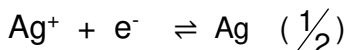
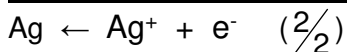
QUESTION 9/VRAAG 9

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:

$$n(\text{Ag}) = \frac{m}{M} = \frac{3,25}{108} \quad \checkmark(a) = 0,03 \text{ mol}$$

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

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

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

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

$$1,81 \times 10^{22} = \frac{Q}{1,6 \times 10^{-19}} \quad Q = 2\,889,6 \text{ C}$$

$$I = \frac{Q}{\Delta t} = \frac{2\,889,6}{30(60)} \quad \checkmark(d) = 1,61 \text{ A} \quad \checkmark(e)$$

OPTION 2/OPSIE 2:

$$n(\text{Ag}) = \frac{m}{M} = \frac{3,25}{108} \quad \checkmark(a) = 0,03 \text{ mol} = n \text{ e}^-$$

$$Q = 0,03 \times 96\,500 \quad \checkmark(b) \quad \checkmark(c) = 2\,895 \text{ C}$$

$$I = \frac{Q}{\Delta t} = \frac{2\,895}{30(60)} \quad \checkmark(d) = 1,61 \text{ A} \quad \checkmark(e)$$

(5)

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TOTAL/TOTAAL:

150