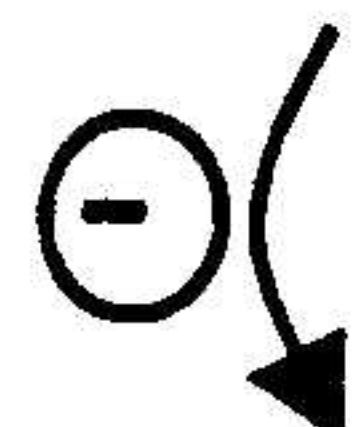
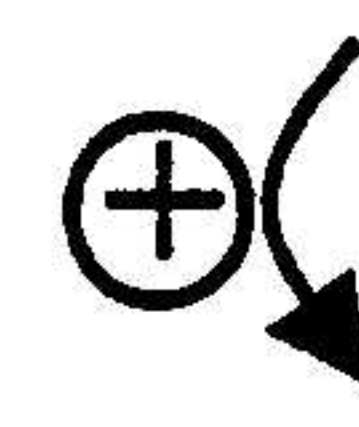


POSSIBLE ANSWERS FOR:

PHYSICAL SCIENCE HG PAPER 2
NATUUR- EN SKEIKUNDE HG VRAESTEL 2

04/11/2002

EXPLANATION OF SYMBOLS

	2.2.2	x	(0/2)
	2.2.3	Means that if 2.2.2 is wrong, then 2.2.3 will also be wrong according to rule 16.8 in the Guideline Document. <i>Beteken dat indien 2.2.2 verkeerd is, dan is 2.2.3 ook volgens reël 16.8, in die Riglyndokument, verkeerd.</i>	
			(0/3)
	3.2.1	x	(0/1)
	3.2.2	Means that if 3.2.1 is wrong, the error is carried to 3.2.2 and marked positively according to rule 16.8 in Guideline Document. <i>Beteken dat indien 3.2.1 verkeerd is, en die fout na 3.2.2 oorgedra word, word dit positief volgens reël 16.8 in die Riglyndokument, nagesien.</i>	

EXAMINERS' CONTACT NUMBERS / KONTAKNOMMERS VAN EKSAMINATORS:

K BAJRANGI : 082 258 7318

QUESTION 1 / VRAAG 1

- 1.1 D 1.2 A 1.3 D 1.4 D 1.5 C 1.6 C 1.7 B 1.8 C
 1.9 C 1.10 A 1.11 B 1.12 C 1.13 B 1.14 A 1.15 B

[60]

QUESTION 2 / VRAAG 2

2.1 2.1.1 He ✓✓ (2)

2.1.2 Van der Waals ✓✓ OR/OF London OR/OF Momentary dipoles/Momentele dipole
OR/OF Instantaneous dipoles/Tydlike dipole (2)

2.1.3 CCl₄ ✓✓ (2)

2.2 2.2.1 pV = nRT ✓

$$n = \frac{m}{M} = \frac{8}{64} = 0,125 \text{ mol}$$

$$\therefore p = \frac{nRT}{V} = \frac{(8/64) \times 8,31 \times (77 + 273) \text{ OR/OF } (350)}{1,5 \times 10^{-3}}$$

3 marks are for substitution/
3 punte is vir substitusie

If V substituted in dm³ or T in °C no mark for substitution and answer.
As V in dm³ gesubstitueer of T in °C, geen punt vir substitusie en antw.

= 242375 Pa ✓ OR/OF = 2,4 x 10⁵ Pa or 242 kPa = 242,38 kPa (5)

2.2.2 Higher/Hoër ✓✓ (2)

2.2.3 M_y < M_x ✓

$\therefore n_y > n_x$ ✓✓
 $\therefore P_y > P_x$

M_{He} < M_{SO₂} ✓
 $\therefore n_y > n_x$ ✓✓
 $\therefore P_y > P_x$

$n_y \propto \frac{1}{M_y}$ ✓
 $\therefore n_y > n_x$ ✓✓

Molecular mass of He is less than that of SO₂ ✓ therefore the no. of moles/particles of He must be more than that of SO₂ ✓✓
 Molekulêre massa van He is minder as dié van SO₂ ✓ daarom moet die aantal mol He (of He-deeltjies) meer wees as dié van SO₂ ✓✓

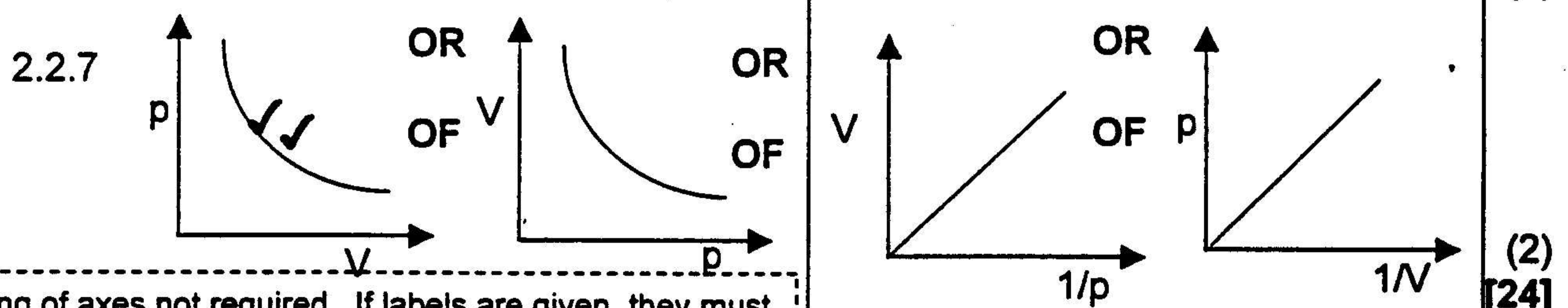
(3)

2.2.4 Higher/Hoër ✓✓ (2)

2.2.5 The temperature is an indication of the average kinetic energy of the molecules ✓ Since the mass of He molecules is less, their speed have to be greater to have the same kinetic energy ✓
 Die temperatuur is 'n aanduiding van die gemiddelde kinetiese energie van die molekule. Aangesien die massa van die He-molekule kleiner is, moet hulle 'n groter spoed hê om dieselfde kinetiese energie te hê. (2)

OR/OF $E_k \propto T$, $v^2 = \frac{2E_k}{m}$. Since/Aangesien $m_y < m_x$, $v_y > v_x$

2.2.6 Pressure/Druk ✓✓ (2)



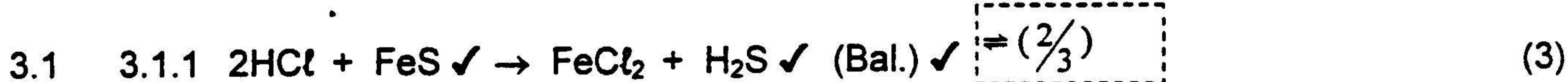
Labelling of axes not required. If labels are given, they must be correct. Benoeming van asse nie vereis. Indien gegee, moet dit korrek wees. If not/Indien nie: (0/2)

Labels must be correct. Asse moet benoem word. If not/Indien nie: (0/2)

2.2.7 is marked independently from 2.2.6/
2.2.7 word onafhanklik van 2.2.6 nagesien

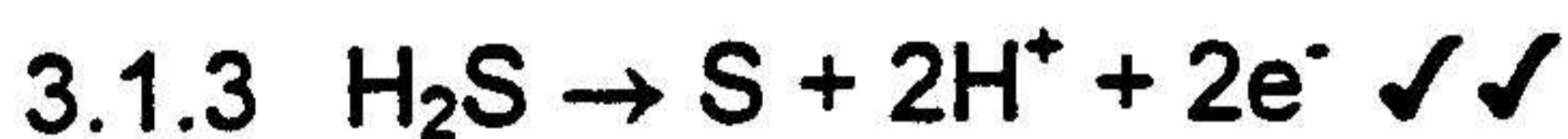
[24]

QUESTION 3 / VRAAG 3



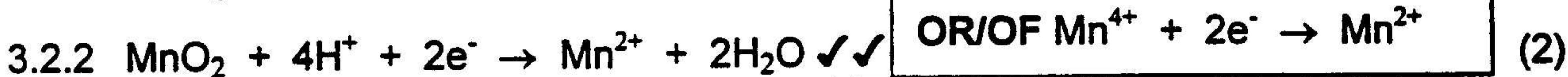
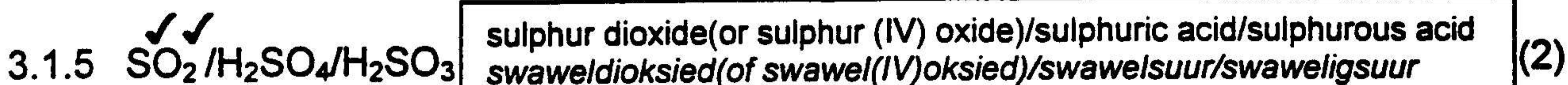
OR any other dichromate/
OF enige ander dichromaat

Name/naam (1/2)
Charge omitted or formula incorrect:
Lading uitgelaat of formule verkeerd: (0/2)



OR / OF $\text{S}^{2-} \rightarrow \text{S} + 2\text{e}^-$

$\text{H}_2\text{S} \rightleftharpoons \text{S} + 2\text{H}^+ + 2\text{e}^-$ (1/2)
 $\text{H}_2\text{S} \leftarrow \text{S} + 2\text{H}^+ + 2\text{e}^-$ (0/2)
 $\text{S} + 2\text{H}^+ + 2\text{e}^- \leftarrow \text{H}_2\text{S}$ (3/2)
 $\text{S} + 2\text{H}^+ + 2\text{e}^- \rightleftharpoons \text{H}_2\text{S}$ (0/2)



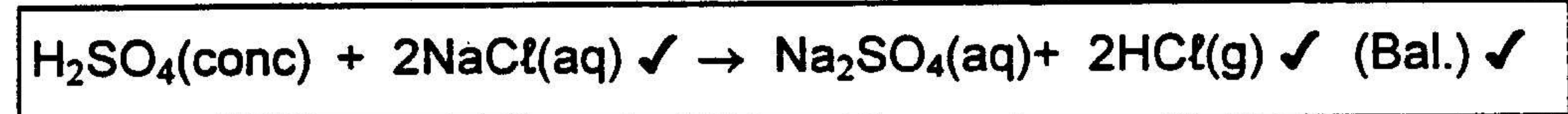
⊕ 3.2.1 $\text{KMnO}_4 \times$
3.2.2 $\text{MnO}_4^- + 8\text{H}^+ + 5\text{e}^- \rightarrow \text{Mn}^{2+} + 4\text{H}_2\text{O} \checkmark\checkmark$
(OR/OF $\text{Mn}^{7+} + 5\text{e}^- \rightarrow \text{Mn}^{2+}$)



→ also accepted/ook aanvaar



→ also accepted/ook aanvaar



NaCl OR/OF KCl OR/OF any other chloride/ enige ander chloried

Ignore phases/Ignoreer fases

QUESTION 4 / VRAAG 4

4.1 Nitrogen oxide/Stikstofoksied ✓✓ nitrogen (II) oxide/nitrogen monoxide/nitric oxide (2)
 stikstof(II)oksied/stikstofmonoksied/stikstofoksied

NO (1/2)

4.2 Cu²⁺ or/of Cu(H₂O)₆²⁺ ✓✓ copper ion/ koper-ioon (1/2) (2)

4.3 2NO + O₂ ✓ → 2NO₂ ✓ (Bal.) ✓ (3)

4.4 **Marking guide:** Two marks for comparing H₂SO₄ and HNO₃, and two marks for stating the action (oxidation or reduction).

Nasiennriglyn: Twee punte vir vergelyking tussen H₂SO₄ en HNO₃, twee punte vir die noem van die aksie (oksidasie of reduksie)

H₂SO₄ is a weaker oxidising agent than HNO₃, and therefore cannot oxidise Cu (to Cu²⁺).
 H₂SO₄ is 'n swakker oksideermiddel as HNO₃, kan daarom nie Cu (na Cu²⁺) oksideer nie. (4)

OR HNO₃ is a stronger OA than H₂SO₄ and can therefore oxidise Cu (to Cu²⁺) (4/4)

OF HNO₃ is 'n sterker OM as H₂SO₄ en kan dus Cu (na Cu²⁺) oksideer. (4/4)

OR Cu is a strong enough RA to reduce HNO₃ (to NO₂), but not a strong enough RA to reduce H₂SO₄ (to SO₂) (4/4)

OF Cu is 'n sterk genoeg RM om HNO₃ (tot NO₂) te reduseer, maar nie 'n sterk genoeg RM om H₂SO₄ (tot SO₂) te reduseer nie. (4/4)

OR The cell Cu/Cu²⁺//H₂SO₄/SO₂ has a negative emf (2/4) (no comparison made)

OF Die sel Cu/Cu²⁺//H₂SO₄/SO₂ het 'n negatiewe emk (2/4) (geen vergelyking)

OR The cell combination with H₂SO₄ gives a negative emf and the cell combination with HNO₃ gives a positive emf. (4/4)

OF Die selkombinasie met H₂SO₄ gee 'n negatiewe emf en die selkombinasie met HNO₃ gee 'n positiewe emf. (4/4)

OR The one cell combination gives a negative emf and the other positive (2/4)

OF Die een selkombinasie gee 'n negatiewe emf en die ander positief (2/4)

(Instead of OA electron acceptor can be used)
 (Ipv OM kan elektron akseptor gebruik word.)

QUESTION 5 / VRAAG 5

- 5.1 5.1.1 Greater than/Groter as ✓✓ (2)
 5.1.2 Less than/Kleiner as ✓✓ (2)
 5.1.3 Equal to/Gelyk aan ✓✓ (2)

5.2 B ✓✓ (2)

5.3 (⊖) The forward reaction is EXOTHERMIC OR $\Delta H < 0$. ✓
 Therefore the temperature is the lowest where the amount of SO_3 is the highest ✓
 OR this reaction will be disadvantaged by an increase in temperature, resulting in a decrease in the amount of SO_3 . ✓

OR

The reverse reaction is ENDOTHERMIC ✓, therefore the forward reaction will be disadvantaged by an increase in temperature, resulting in a decrease in the amount of SO_3 . ✓

Die voorwaartse reaksie is EKSOTERMIES OF $\Delta H < 0$ ✓
 Derhalwe is die temperatuur die laagste waar die hoeveelheid SO_3 die hoogste is ✓
 OF daarom sal hierdie reaksie benadeel word deur 'n verhoging in temperatuur, met 'n gevolglike vermindering in die hoeveelheid SO_3 . ✓ (2)

OR

Die terugwaartse reaksie is ENDOTERMIES ✓ en daarom sal die voorwaartse reaksie benadeel word deur 'n verhoging in temperatuur, met 'n gevolglike vermindering in die hoeveelheid SO_3 . ✓ (2)

5.4 B ✓✓ (2)

5.5 (⊖) $K_c = \frac{[\text{SO}_3]^2}{[\text{SO}_2]^2[\text{O}_2]}$ ✓ OR $K_c = \frac{[\text{Product}]}{[\text{Reagents}]}$ ∴ high amount of SO_3 means high K_c value. ✓

1 mark for the K_c expression (or relationship between K_c and [product]) and 1 mark for the amount of SO_3

$K_c = \frac{[\text{SO}_3]^2}{[\text{SO}_2]^2[\text{O}_2]}$ ✓ OF $K_c = \frac{[\text{Produk}]}{[\text{Reagense}]}$ ∴ groot hoeveelheid SO_3 beteken 'n hoë K_c -waarde. ✓
 1 punt vir K_c uitdrukking (of verwantskap tussen K_c and [produk]) en 1 punt vir die hoeveelheid SO_3 (2)

5.6 C ✓✓ (2)

5.7 (⊖) An increase in pressure will favour the forward reaction that will increase the amount of SO_3 . ✓
 'n Verhoging in druk sal die voorwaartse reaksie bevoordeel ✓ wat die hoeveelheid SO_3 sal verhoog. ✓ (2)

5.8

	SO_2	O_2	SO_3
n(Initial/Aanvanklik)	8	x	0
n(Produced/Geproduseer)	6	3	6
n(Equilibrium/Ewewig)	2	x - 3	6
[Equilibrium/Ewewig]	1 mol.dm ⁻³ ✓	$\frac{x-3}{2}$ mol.dm ⁻³ ✓	3 mol.dm ⁻³ ✓

(⊕) $K_c = \frac{[\text{SO}_3]^2}{[\text{SO}_2]^2 \times [\text{O}_2]}$ ✓

Any mistake made with the K_c expression – maximum 6/8
 Enige fout gemaak met K_c uitdrukking – maksimum 6/8

$9 \checkmark = \frac{3^2 \checkmark}{1^2 \times \frac{x-3}{2} \checkmark}$

3 marks for substitution (even if K_c is wrong)/
 3 punte vir substitusie (selfs al is K_c verkeerd)

∴ $9x - 27 = 18$ ∴ $9x = 45$ and/en $x = 5$ mol ✓ (8)

OR/OF

n(Initial/Aanvanklik)
 n(Produced/Geproduseer)
 n(Equilibrium/Ewewig)
 [Equilibrium/Ewewig]

SO ₂	O ₂	SO ₃
8	x	0
6	3	6
2	x - 3	6
1 mol.dm ⁻³ ✓	$\frac{x-3}{2}$ mol.dm ⁻³ ✓	3 mol.dm ⁻³ ✓

$$K_c = \frac{[\text{SO}_3]^2}{[\text{SO}_2]^2 \times [\text{O}_2]}$$

$$9 \checkmark = \frac{3^2 \checkmark}{1^2 \times [\text{O}_2]}$$

$$\therefore [\text{O}_2] = 1 \text{ (mol.dm}^{-3}\text{)} \checkmark$$

Any mistake made with the K_c expression – maximum 6/8
 Enige fout gemaak met K_c uitdrukking – maksimum 6/8

2 marks for substitution (even if K_c is wrong)/
 2 punte vir substitusie (selfs al is K_c verkeerd)

$$\text{and/en } [\text{O}_2] = (x-3)/2$$

$$\therefore (x-3)/2 = 1 \text{ and/en } x = 5 \text{ mol} \checkmark$$

OR/OF

n(Initial/Aanvanklik)
 n(Produced/Geproduseer)
 n(Equilibrium/Ewewig)
 [Equilibrium/Ewewig]

SO ₂	O ₂	SO ₃
8	x	0
6	3	6
2	[O ₂]	6
1 mol.dm ⁻³ ✓	[O ₂]	3 mol.dm ⁻³ ✓

$$K_c = \frac{[\text{SO}_3]^2}{[\text{SO}_2]^2 \times [\text{O}_2]}$$

$$9 \checkmark = \frac{3^2 \checkmark}{1^2 \times [\text{O}_2] \checkmark}$$

$$\therefore [\text{O}_2] = 1 \text{ mol.dm}^{-3}$$

$$\text{and/en } n = cV = (1)(2) = 2 \text{ (mol)} \checkmark$$

$$\text{and/en } 3 \text{ mol} + 2 \text{ mol} = 5 \text{ mol} \checkmark$$

Any mistake made with the K_c expression – maximum 6/8
 Enige fout gemaak met K_c uitdrukking – maksimum 6/8

3 marks for substitution (even if K_c is wrong)/
 3 punte vir substitusie (selfs al is K_c verkeerd)

OR/OF

[Initial/Aanvanklik]
 [Reaction/Reaksie]
 [Equilibrium/Ewewig]

[SO ₂]	[O ₂]	[SO ₃]
4	y	0
3	1,5	3
1 mol.dm ⁻³ ✓	(y - 1,5) mol.dm ⁻³	3 mol.dm ⁻³ ✓

$$K_c = \frac{[\text{SO}_3]^2}{[\text{SO}_2]^2 \times [\text{O}_2]}$$

$$9 \checkmark = \frac{3^2 \checkmark}{1^2 \times (y - 1,5) \checkmark}$$

$$\therefore y = 2,5 \text{ (mol.dm}^{-3}\text{)} \checkmark$$

$$\text{and/en } n = cV = (2,5)(2) = 5 \text{ mol} \checkmark$$

Any mistake made with the K_c expression – maximum 6/8
 Enige fout gemaak met K_c uitdrukking – maksimum 6/8

3 marks for substitution (even if K_c is wrong)/
 3 punte vir substitusie (selfs al is K_c verkeerd)

[26]

QUESTION 6 / VRAAG 6

6.1 No/Neer ✓ (1)

6.2 HF ionises only partially/HF ioniseer slegs gedeeltelik ✓✓ (2)

OR 0,01 mol.dm⁻³ HF does not yield 0,01 mol.dm⁻³ F⁻/
 OF 0,01 mol.dm⁻³ HF lewer nie 0,01 mol.dm⁻³ F⁻/
 OR/OF only 18% ionisation/slegs 18% ionisasie

6.3 Increases/Neem toe ✓✓ (2)

6.4 [F⁻] – ions increase(OR due to the common ion effect), ✓ equilibrium shifts to the left, ✓
 [H⁺] decreases ✓ and pH increases/
 [F⁻] – ione verhoog(OF a.g.v. gemeenskaplike ioon-effek), ✓ ewewig skuif links, ✓
 [H⁺] verlaag ✓ en pH verhoog (3)



n(HF) = cV ✓ = 0,5 x 0,1
 = 0,05 mol ✓
 n(OH⁻) reacted/gereageer = 0,05 mol ✓
 n(NaOH) = cV = 0,8 x 0,25
 = 0,2 mol ✓
 n(excess OH⁻) = 0,2 – 0,05 mol ✓
 = 0,15 mol ✓

$\frac{c_a V_a}{c_b V_b} = \frac{n_a}{n_b}$
 $\frac{c_b \times 0,8}{0,1 \times 0,5} = \frac{1}{1} \checkmark \checkmark$
 $c_b = 0,0625$
 $\therefore [\text{OH}^-] = 0,25 - 0,0625 \checkmark$
 $= 0,1875 \text{ mol.dm}^{-3} \checkmark$
 $\therefore n = cV \checkmark = 0,1875 \times 0,8$
 $= 0,15 \text{ mol} \checkmark$

6.6 [OH⁻] = $\frac{0,15}{1,3} \checkmark = 0,115 \text{ mol.dm}^{-3}$
 [H⁺][OH⁻] = 10⁻¹⁴ ✓
 $\therefore [\text{H}^+] = \frac{10^{-14}}{0,115} \checkmark = 8,69 \times 10^{-14}$
 and/en pH = - log [H⁺] ✓
 $\therefore \text{pH} = - \log (8,69 \times 10^{-14}) \checkmark$
 = 13,06 ✓

OR/OF [OH⁻] = $\frac{0,15}{1,3} \checkmark$
 pOH = - log [OH⁻] ✓ = - log (0,115) ✓
 = 0,94
 $\therefore \text{pH} = 14 - 0,94 \checkmark$
 = 13,06 ✓

(6)
[20]

QUESTION 7 / VRAAG 7

7.1 7.1.1 $E^{\ominus}_{\text{cell/set}} = E^{\ominus}_{\text{cathode/katode}} - E^{\ominus}_{\text{anode}}$ ✓

OR/OF $E^{\ominus}_{\text{cell/set}} = E^{\ominus}_{\text{OAJOM}} - E^{\ominus}_{\text{RAARM}}$

$2,12 \checkmark = -0,25 - E^{\ominus}_{\text{anode}}$

$E^{\ominus}_{\text{anode}} = -0,25 - 2,12$
 $= -2,37 \text{ V } \checkmark$

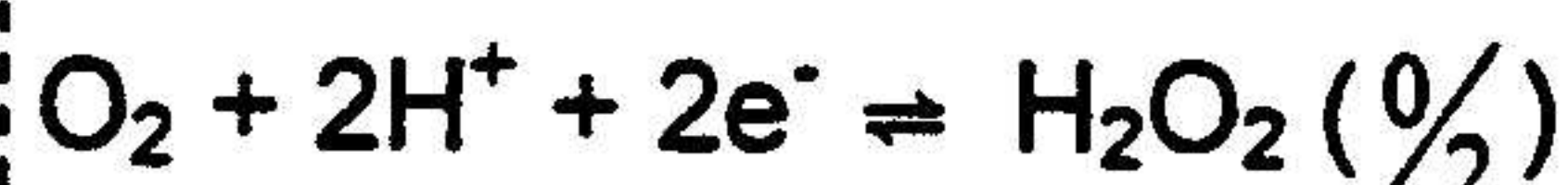
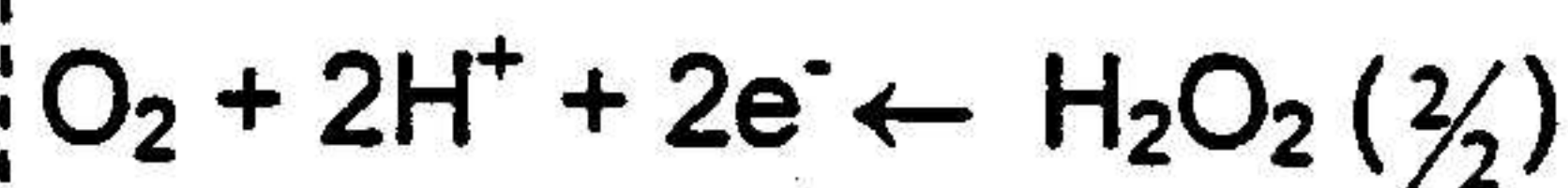
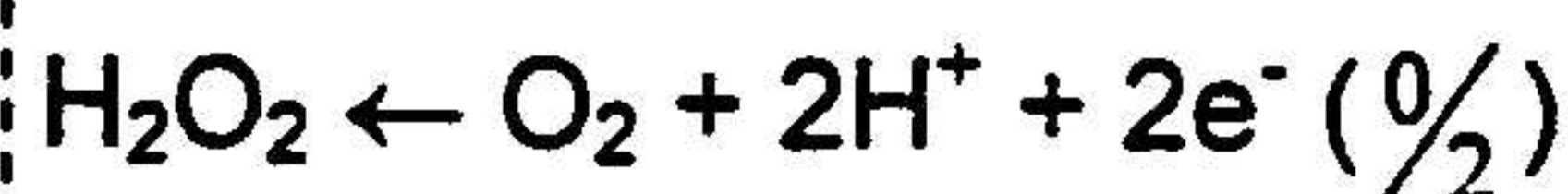
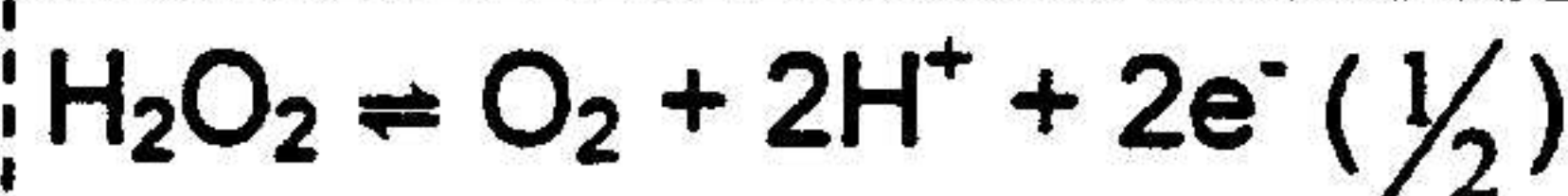
∴ Negative electrode is Mg/
 Negatiewe elektrode is Mg ✓ (5)

7.1.2 $\checkmark\checkmark$ Ni^{2+} (2) **Nickel-ion/Nikkel-ioon** (1/2)

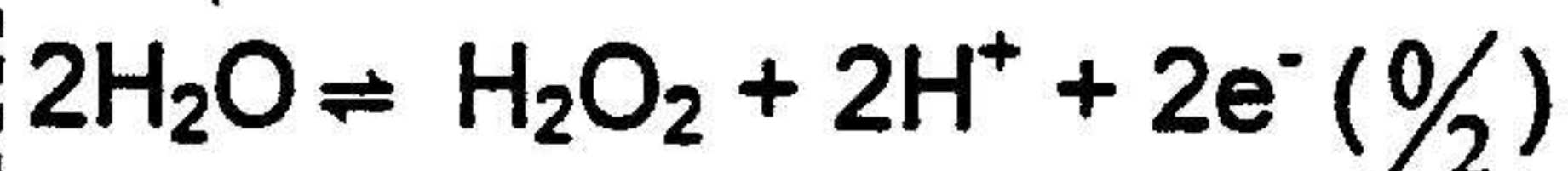
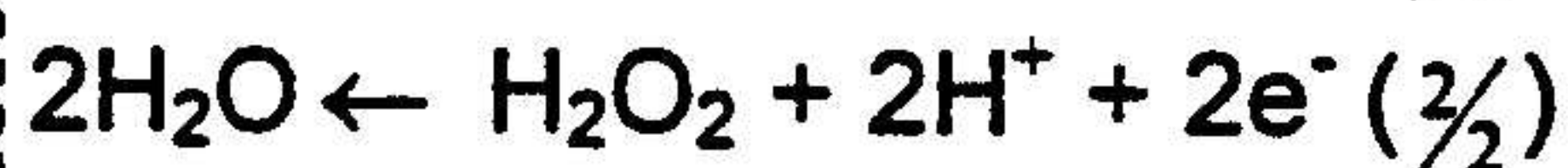
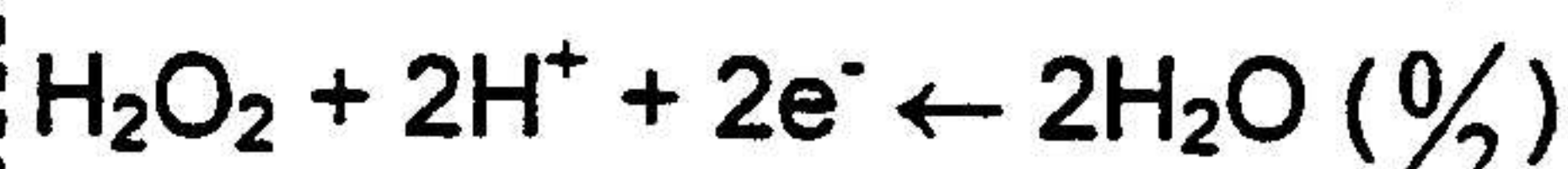
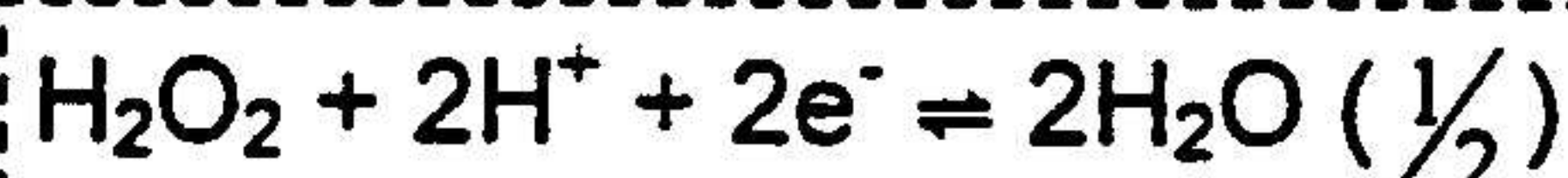
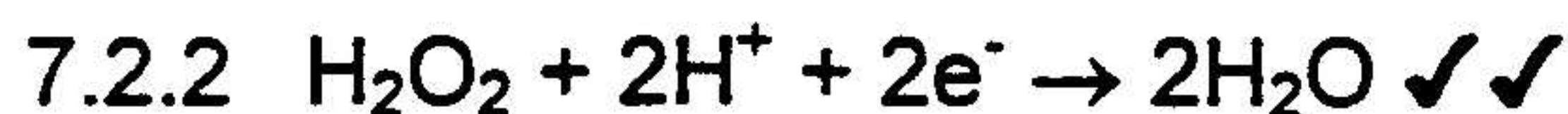


Ni (0/2)

* IF unit of $-2,37 \text{ V}$ is omitted, the mark for $-2,37 \text{ V}$ is forfeited
INDIEN die eenheid van $-2,37 \text{ V}$ uitgelaat, word die punt vir $-2,37 \text{ V}$ verbeur.
 * IF $+2,37\text{V}$, no marks for Mg
INDIEN $+2,37\text{V}$, geen punte vir Mg
 * 4 marks awarded for $-2,37 \text{ V}$ obtained by using any correct method
4 punte toegeken vir $-2,37 \text{ V}$ op enige korrekte wyse bereken.
 * IF only Mg (no working), only 1 mark
INDIEN slegs Mg (geen bewerking), slegs 1 punt
 * No other metal except Mg will be accepted/
Geen ander metaal behalwe Mg sal aanvaar word nie



(2)

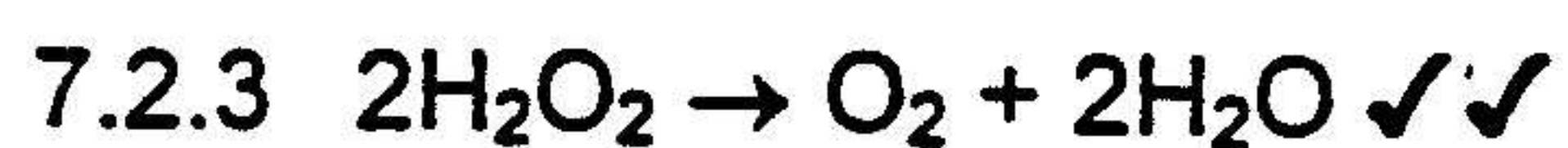


(2)

IF ionic charges are omitted, 1 mark is forfeited per equation (not applicable to electrons)
AS ionlading weggelaat is, word 1 punt per vergelyking verbeur. (nie van toepassing op e^{-})

IF equation is unbalanced, 1 mark is forfeited per equation
INDIEN vergelyking ongebalanseerd is, word 1 punt per vergelyking verbeur.
 IF equation is incomplete/*INDIEN vergelyking onvolledig is - ($\frac{0}{2}$)*

No positive marking from 7.2.1 or 7.2.2 to 7.2.3
 Geen positiewe nasien van 7.2.1 of 7.2.2 na 7.2.3



reagents (1), bal (1)

Accept \rightleftharpoons / Aanvaar \rightleftharpoons

(2)

7.2.4 Catalyst/Katalisator ✓✓

(2)

7.2.5 Oxidising ability/Oksideervermoë ✓✓

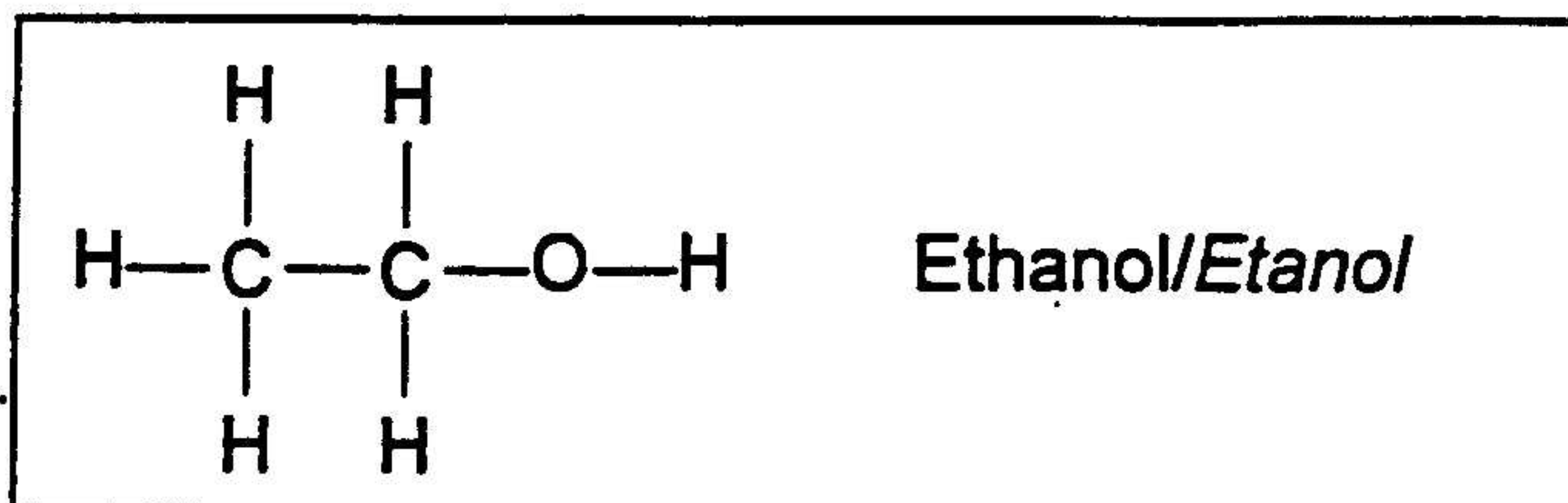
(2)

[17]

QUESTION 8 / VRAAG 8

8.1 Ethyl methanoate/Etielmetanoaat ✓✓ (2)

8.2 G ✓✓

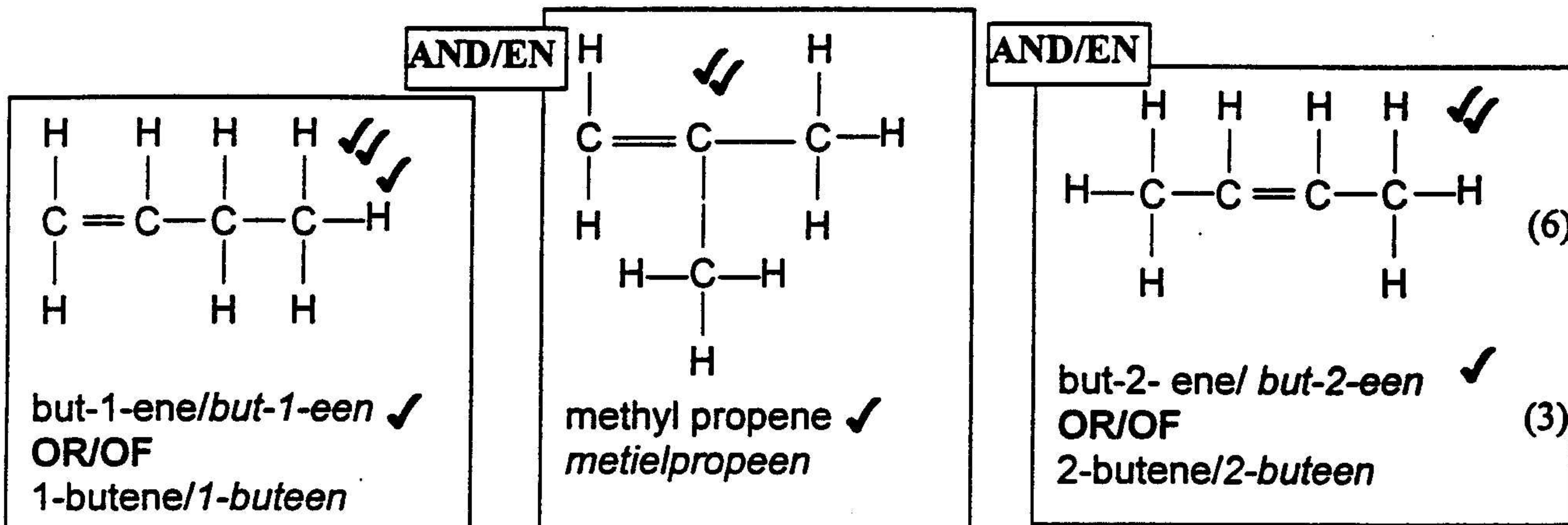


(2)

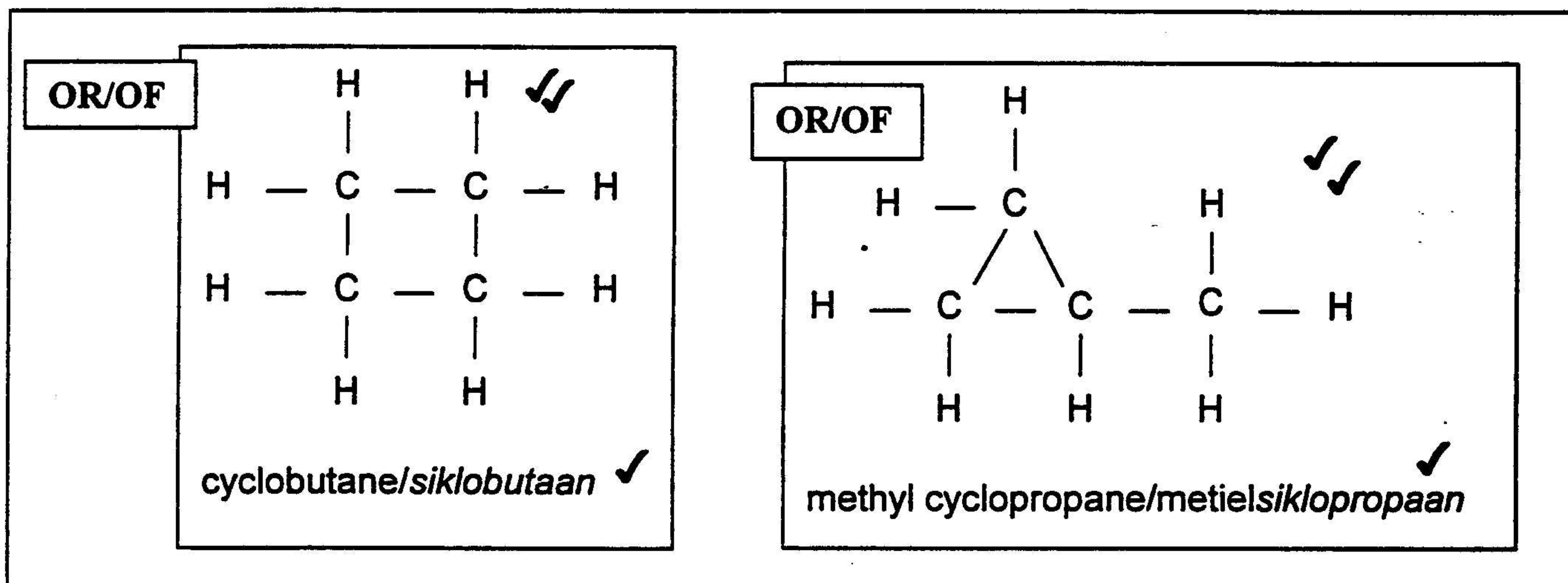
8.3 (Concentrated) sulphuric acid/(Gekonsentreerde) swawelsuur ✓✓ H₂SO₄ (1/2) (2)

8.4 D ✓✓ Ethanoic acid/*Etanoësuur* (2)

8.5



8.6



ALTERNATIVES FOR 8.5 / ALTERNATIEVE VIR 8.5:

Hydrogen atoms omitted: Deduct one mark only once in 8.5. Maximum marks then ($\frac{5}{6}$) provided structures are correct (all bonds shown).

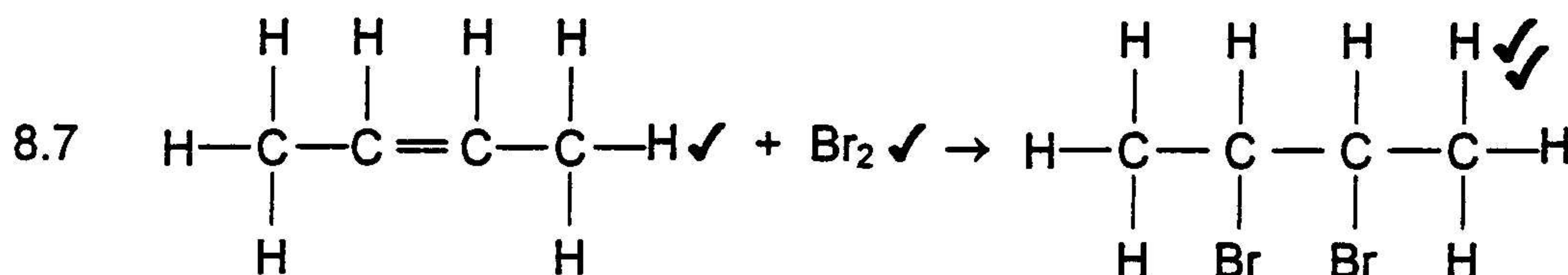
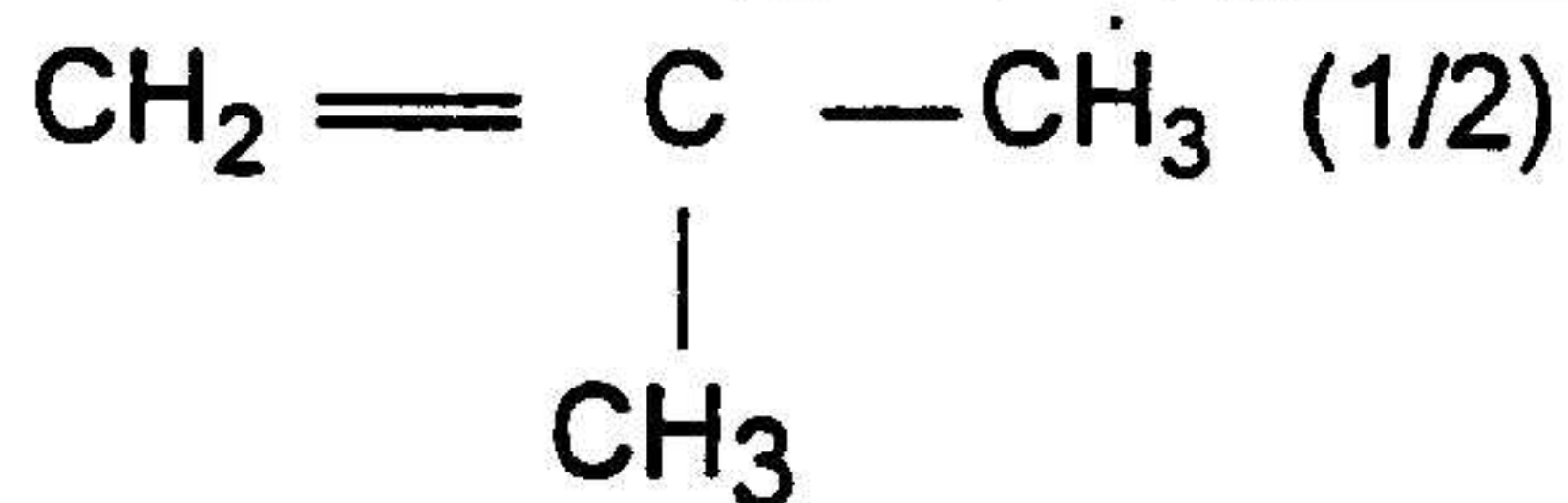
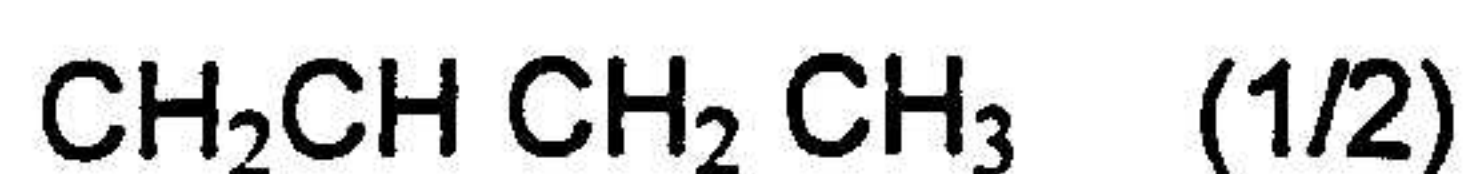
Waterstof atome weggelaat: Trek een punt slegs een keer in 8.5 af. Maksimum punte dus ($\frac{5}{6}$), op voorwaarde dat die structure korrek is (alle bindings aangetoon).

No marks for incorrect structural formulae (e.g. one extra hydrogen).

Geen punte vir verkeerde struktuurformules (bv. Een ekstra waterstof).

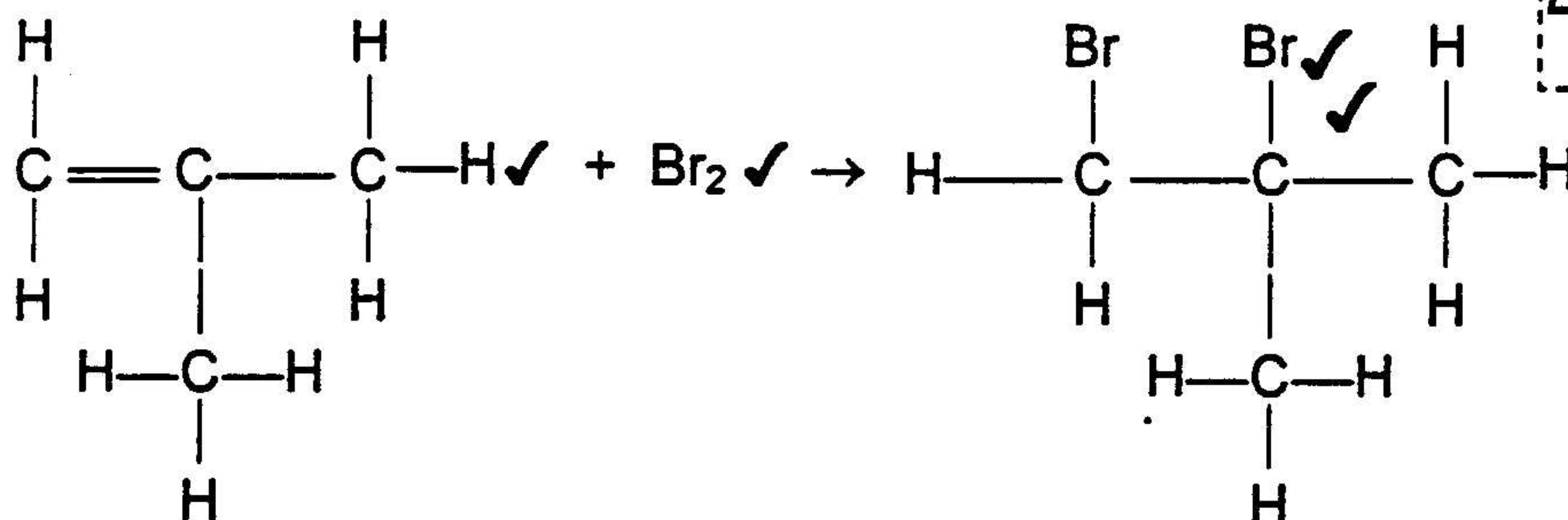
One mark is awarded for (correct) condensed structural formulae:

Een punt word toegeken vir (korrekte) gekondenseerde struktuurformules:



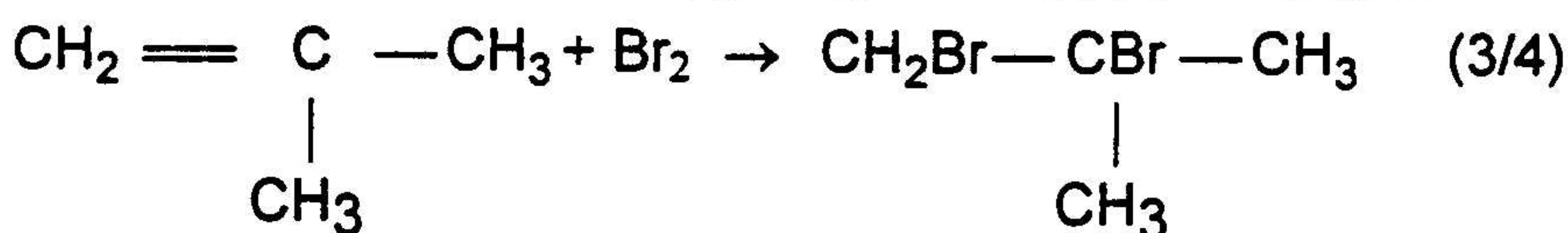
Hydrogen atoms omitted: Deduct one mark
Waterstof atome weggelaat: Trek een punt af

(4)

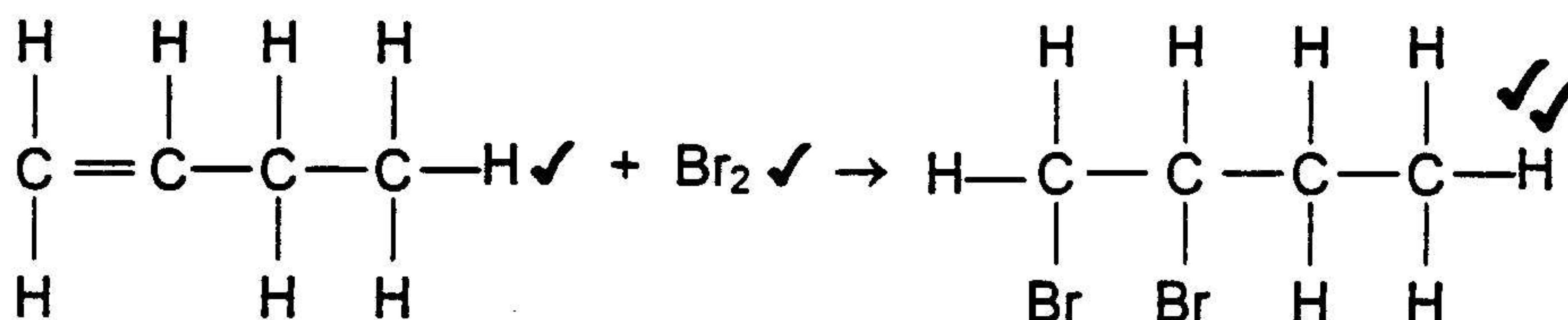


NB : 2 x Br atoms on different C-atoms
LW : 2 x Br-atome op verskillende C-atome

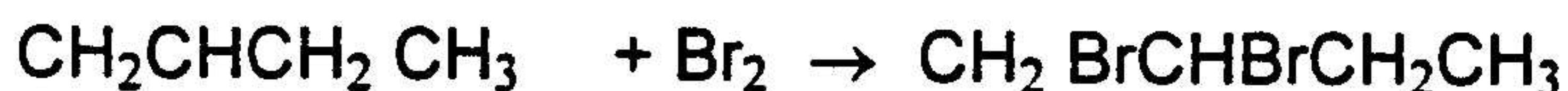
Hydrogen atoms omitted: Deduct one mark
Waterstof atome weggelaat: Trek een punt af



OR/OF



Hydrogen atoms omitted: Deduct one mark
Waterstof atome weggelaat: Trek een punt af



NB : 2 x Br atoms on different C-atoms
LW : 2 x Br-atome op verskillende C-atome

[21]

END / EINDE