



basic education

Department:
Basic Education
REPUBLIC OF SOUTH AFRICA

NATIONAL SENIOR CERTIFICATE

SEHLOPHA SA 12

THUTO YA TSA MAHLALE: CHEMISTRY (P2)

PREPARATORY 2021

MATSHWAO: 150

NAKO: Dihora tse 3

Pampiri ena e na le maqephe a 16 le di datha shiti tse 4.



Ha o a dumellwa ho kopa



Ka kopo phetla

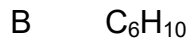
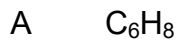
DITAELO LE TLHAISO-LESEDING

1. Ngola nomoro ya hao ya tlhahlobo le nomoro ya tulo eo o ngollang ho yona dibakeng tse nepahetseng BUKENG YA HO ARABELA.
2. Pampiri ena e na le dipotso tse LESHOME. Arabela dipotso tsohle BUKENG YA HO ARABELA.
3. Qala potso KA NNGWE leqepheng le LETJHA BUKENG YA HO ARABELA.
4. Nomora dikarabo ka nepo jwalo ka ha ho entswe pampiring ena ya dipotso.
5. Siya mola O LE MONG dipakeng tsa dipotswana tse pedi, mohlala, dipakeng tsa POTSO YA 2.1 le POTSO YA 2.2.
6. O ka se sebedisa sesebediswa sa ho bala (*calculator*) se sa *porokerengwang*.
7. O ka disebedisa dihlomo tse nepahetseng tsa dipalo.
8. Bontsha diforomo TSOHLE le tsela eo di kenyelleditsweng ka yona dipalong TSOHLE.
9. QETELLONG, phethela dikarabo tsa hao ka ho sebedisa bonnyane dinomoro TSE PEDI tsa di desimali.
10. Fana ka lebaka, tlhaloso, le tse ding ka bokgutshwanyane moo ho hlokehang.
11. O eletswa ho sebedisa DI DATHA SHITI tse hokelletsweng.
12. Ngola ka makgethe le ka mongolo o balehang.

POTSO YA 1: DIPOTSO TSA KGETHO

O filwe dikgetho tse fapaneng tse ka kgonehang tse latelang. Kgetha karabo e be o ngola feela tlhaku (A–D) pela nomoro ya potso (1.1 ho isa ho 1.10) bukeng ya ho arabela, mohlala 1.11 E.

1.1 Ke EFE ho tse latelang e leng ALEKAINE?



1.2 Di-Esta di fumaneha ka ketsahalo e pakeng tsa di-okaniki kompaonte, ya **X** le ya **Y**, moo ho nang le lequlwana la fankeshenale.

Maqulwana a fankeshenale ho dikompaonte tsena ke:

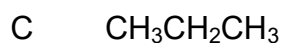
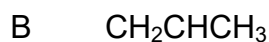
	Kompaonte ya X	Kompaonte ya Y
A	Lequlwana la hydroxyl	Lequlwana la carboxyl
B	Lequlwana la hydroxyl	Lequlwana la carbonyl
C	Hydroxide ion	Lequlwana la carboxyl
D	Hydroxide ion	Lequlwana la carbonyl

(2)

1.3 Ha buthane e le tlasa motjheso le kgatello tse hodimo, ho fumaneha ketsahalo e latelang:



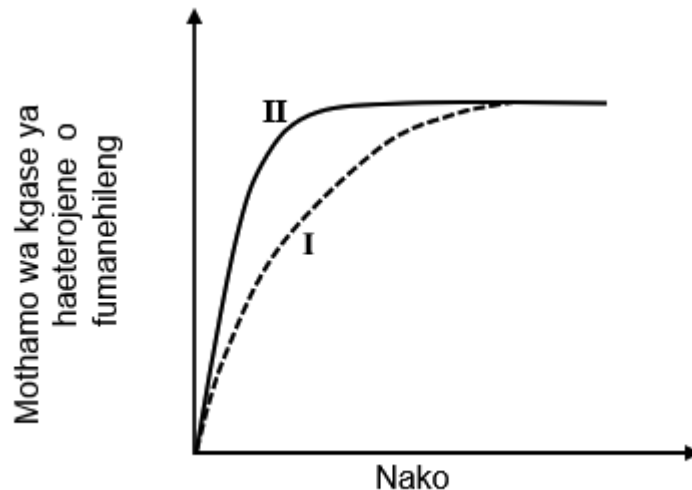
Ke EFE ho tse latelang e emetseng **Y**?



- 1.4 Motswako wa haeterokeloriki asiti, HCl(aq) , ya konsentereshene ya $1 \text{ mol} \cdot \text{dm}^{-3}$ o e eketswa ho makenesiamo YA PHOFO E SETSENG ho 25°C .

Mothinya wa **I** ka tlase o emetse mothamo wa kgase ya haeterojene ketsahalong.

Mothinya wa **II** o fumanehile maemong a fapaneng ka ho sebedisa MOTHAMO O TSHWANANG wa motswako wa haeterokeloriki asiti.

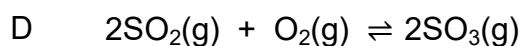
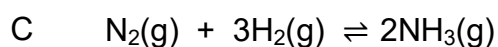
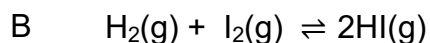
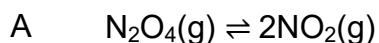


Ke efe ho tse latelang e emetseng maemo a sebedisitsweng ho fumana mothinya wa **II**?

	MAEMO A HO AROHANA A Mg	KONSENTERESHENE YA ASITI ($\text{mol} \cdot \text{dm}^{-3}$)	MOTJHESO ($^\circ\text{C}$)
A	Ribone	0,5	25
B	Ribone	2	25
C	Phofo	1	20
D	Phofo	1	30

(2)

- 1.5 Ke EFE ho tse latelang diketsahalo tsa ho lekana e FUMANTSHANG ho ata ha dihlahiswa ha MOTHAMO wa setshelo o nyolotswe ka motjheso o tshwanang?

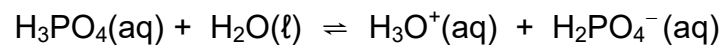


(2)

1.6 Ke EFE polelo ho tse latelang e NEPAHETSENG ho ketsahalo ya EKESOFEMIKI?

- A Matla a mangata a monngwe ho feta ho lokollwa.
- B Matla a mangata a lokollwa ho feta ho monngwa.
- C Motjheso wa ketsahalo (ΔH) o phosithifo.
- D Matla a sehlahiswa a maholo ho feta matla a di reaketente. (2)

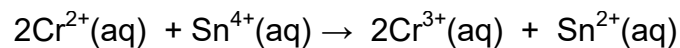
1.7 Shebisisa tekano e latelang.



Ke EFE ho tse latelang e leng bobedi ba konjakeiti asiti-base?

- A $\text{H}_3\text{O}^+(\text{aq})$ le $\text{H}_2\text{O}(\ell)$
- B $\text{H}_3\text{PO}_4(\text{aq})$ le $\text{H}_2\text{O}(\ell)$
- C $\text{H}_3\text{PO}_4(\text{aq})$ le $\text{H}_3\text{O}^+(\text{aq})$
- D $\text{H}_3\text{O}^+(\text{aq})$ le $\text{H}_2\text{PO}_4^-(\text{aq})$ (2)

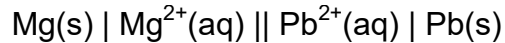
1.8 Shebisisa tekano e balansitseng ketsahalong e latelang:



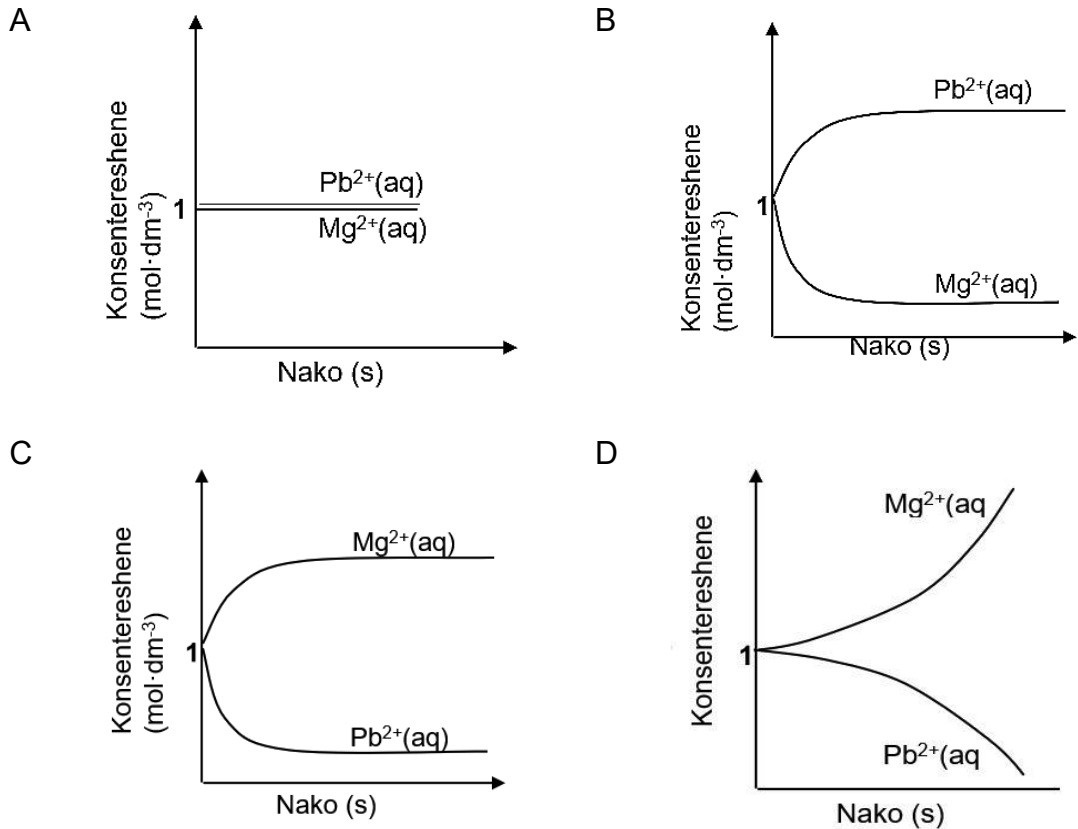
KEMEDI E OKESITAESANG ke:

- A $\text{Cr}^{2+}(\text{aq})$
- B $\text{Cr}^{3+}(\text{aq})$
- C $\text{Sn}^{2+}(\text{aq})$
- D $\text{Sn}^{4+}(\text{aq})$ (2)

- 1.9 Eleketerokemikale sele e hokelletswa ho latela maemo a lekaneng. Ho fanwe ka kemedi ya sele seleng e latelang.



Jwale sele e hokelletswa ho etsa sekete. Ke EFE kerafo ho tse latelang e emetseng konsentereshene ya di eleketerolayete ka NEPO ka mora nako e telele?



(2)

- 1.10 Mekotla e mmedi ya 50 kg, e nang le sematlafatsi sa **R** le sa **S** ka bonngwe, e nomoruwe ka ho latelang:

Sematlafatsi sa **R**: 3 : 1 : 5 (20)

Sematlafatsi sa **S**: 1 : 2 : 6 (20)

Kgetha sematlafatsi tse loketseng kgolo ya lehaba le matlafatseng le kgolo ya methapo e matlafatseng.

	KGOLO YA LEHABA	KGOLO YA MOTHAPU
A	R	R
B	S	R
C	R	S
D	S	S

(2)

[20]

POTSO 2 (Qala leqepheng le letjha.)

Ditlhaku tsa **A** ho isa ho **E** tafoleng e latelang di emetse diokanike kompaonte.

A	$ \begin{array}{ccccccc} & \text{H} & \text{Br} & \text{CH}_3 & \text{CH}_2\text{CH}_3 & & \\ & & & & & & \\ \text{H} & - \text{C} & - \text{C} & - \text{C} & - \text{C} & - \text{H} \\ & & & & & & \\ & \text{H} & \text{H} & \text{CH}_3 & \text{CH}_2\text{CH}_3 & & \end{array} $	B	C_xH_y
C	$ \begin{array}{ccccccc} & \text{H} & \text{H} & \text{H} & \text{O} & \text{H} & \\ & & & & & & \\ \text{H} & - \text{C} & - \text{C} & - \text{C} & - \text{C} & - \text{C} & - \text{H} \\ & & & & & & \\ & \text{H} & \text{H} & \text{H} & & \text{H} & \end{array} $	D	$\text{CH}_3(\text{CH}_2)_2\text{CH}(\text{OH})\text{CH}_2\text{CH}_3$
E	$\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{CHCH}_2$		

2.1 Ngola TLHAKU e emetseng E NNGWE LE E NNGWE ya tse latelang:

2.1.1 Ketone (1)

2.1.2 Hydrocarbon (1)

2.1.3 Alkene (1)

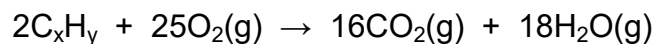
2.2 Ngola:

2.2.1 Lebitso la IUPAC ya kompaonte ya **A** (3)

2.2.2 FOROMO YA SEEMO ya kompaonte ya **D** (2)

2.2.3 Lebitso la IUPAC la KETANE E TSEPAMENG YA AESOMARA YA TSHEBETSO ya kompaonte ya **C** (2)

2.3 Kompaonte ya **B** ke kompaonte ya ketane e tsepameng e etsahala ho latela ketsohalo ya ekesothemiki:



2.3.1 Ka ntle le hoba ekesothemiki, ke mofuta ofe wa ketsahalo e bontshitsweng ka hodimo? (1)

2.3.2 Fumana FOROMO YA MOLEKULARA ya kompaonte ya **B**. (2)

Ketsahalo e ka hodimo e etsahala setshelong se kwahetsweng motjhesong o sa fetoheng o ka hohimo ho 100 °C le kगतello e sa fetoheng.

2.3.3 Bala MOTHAMO O FELLETSENG wa kgase e entsweng ka setshelong ha 50 cm³ ya C_xH_y e kopana ka ho felletseng le okesejene.

(3)
[16]

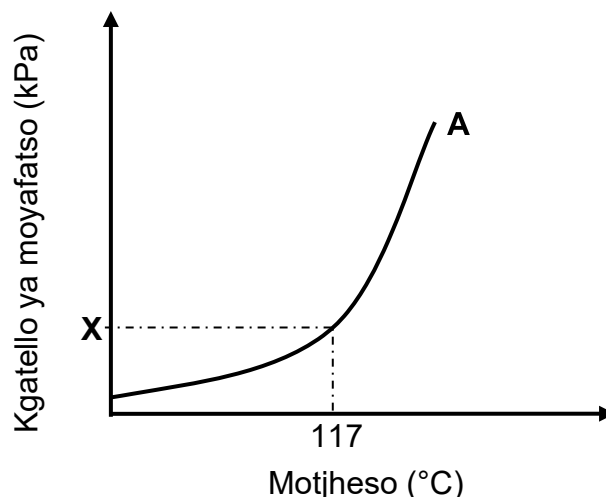


POTSO 3 (Qala leqepheng le letjha.)

Dikompaonte **A**, **B** le **C** di sebedisitswe ho fuputsa e nngwe ya tshusumetso ya ntlha ya ho bela ha di okaniki kompaonte. Ho fanwe ka diphetho tsa phuputso tafoleng e latelang.

KOMPAONTE		NTLHA YA HO BELA (°C)
A	Butan-1-ol	117
B	Butan-2-ol	100
C	2-methylpropan-2-ol	82

- 3.1 Ana ke phuputso e se nang leeme? Kgetha ho E kapa TJHE. (1)
- 3.2 Fana ka lebaka la karabo ya hao ho POTSO 3.1. (1)
- 3.3 Hlalosa ka botlalo phapang pakeng tsa ntlha ya ho bela ha dikompaonte **B** le **C**. (3)
- 3.4 Hlalosa lebitso *isomara ya tulo*. (2)
- 3.5 Ho dikompaonte **A**, **B** le **C**, kgetha ntlha e emetseng E NNGWE LE E NNGWE ho tse latelang:
- 3.5.1 Isomara ya tulo (1)
- 3.5.2 Tertiary alekohole
Fana ka lebaka la karabo ya hao. (2)
- 3.6 Kerafo e latelang e emetse kamano pakeng tsa kगतello ya moyafatso le motjheso wa kompaonte ya **A** (butan-1-ol).



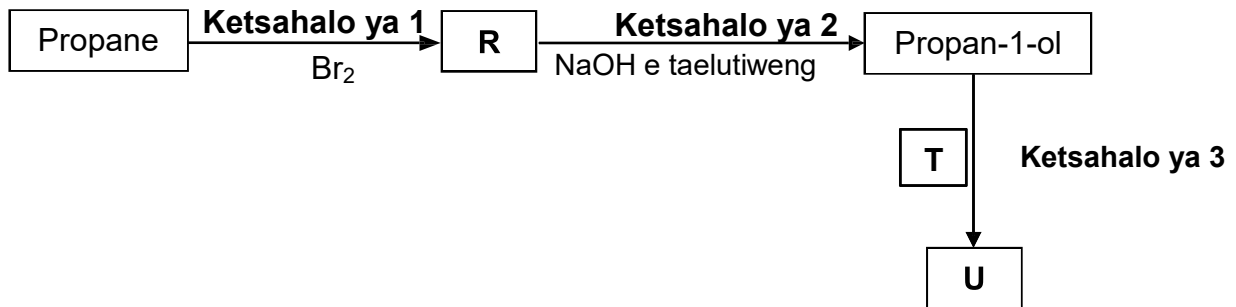
- 3.6.1 Ngola boleng ba **X**. (1)
- 3.6.2 Boela o taka kerafo e ka hodimo bukeng ya ho araba. Seteng e le nngwe ya akisisi, taka mothinya o tla fumaneha mabapi le kompaonte ya **C**. Bontsha methinya **A** le **C**. Bontsha dintlha tsa ho bela tsa bohlokwa kompaonteng ya **C** kerafong. (2)

[13]

POTSO 4 (Qala leqepheng le letjha.)

- 4.1 Nehelletsano setshwantshong se latelang e bontsha kopano ya diokaniki tse fapaneng ho sebediswa propane e le reaketente ya qalo. **R**, **T** le **U** di emetse diokaniki kompaonte tse fapaneng.

Kompaonte ya **T** ke CARBOXYLIC ASITI mme kompaonte ya **U** ke ISOMARA YA TSHEBETSO ya pentanoic asiti.



Ngola LEBITSO la mofuta wa ketsahalo e bontshitsweng ke:

4.1.1 Ketsahalo ya 1 (1)

4.1.2 Ketsahalo ya 2 (1)

Shebisisa **ketsahalo ya 1** le **ketsahalo ya 2**.

4.1.3 Ngola lebitso la IUPAC la kompaonte ya **R**. (2)

Ketsahalo ya 3 e etsahala botenng ba katalisiti le motjheso.

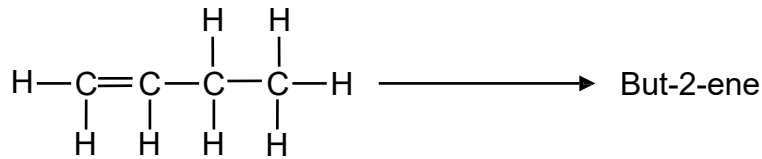
Ngola:

4.1.4 LEBITSO kapa FOROMO ya katalisiti (1)

4.1.5 Lebitso la IUPAC la kompaonte ya **T** (2)

4.1.6 FOROMO YA SEEMO ya kompaonte ya **U** (2)

- 4.2 Tekinishiene ya laboratoring e batla ho etsa but-2-ene e sebedisa but-1-ene e le reagente ya qalo, jwalo ka ho bontsitswe ka tlase.



Dikemikale tse latelang di fumaneha laboratoring:

Mokedikedi o loileng wa H_2SO_4	H_2O	Mokedikedi o loileng wa NaOH
----------------------------------------------------	----------------------	---------------------------------

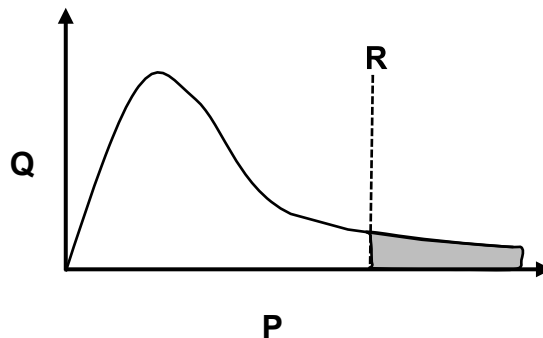
Kgetha kemikale e hlokehang ho itokisetsa kaho lethathamong le ka hodimo.

Kgatong ka NNGWE ya ho itokisa, fana ka FOROMO YA SEEMO mabapi le dikompaonte. Bontsha dikemikale tse hlokehang kgatong ka nngwe.

(6)
[15]

POTSO 5 (Qala leqepheng le letjha.)

- 5.1 Bala mothinya wa karolelwano ya Maxwell-Boltzmann ketsahalong e itseng e lateng.



P le **Q** di bontsha diakisisi. Ke boholo bo bokae bo bontshitsweng ke:

5.1.1 **P** (1)

5.1.2 **Q** (1)

- 5.2 Mola wa **R** o bontsha bonnyane ba matla a hlokehang hore ketsahalo e etsahale.

5.2.1 Fana ka lentswe le emetseng polelo e sehetsweng mola ka tlase. (1)

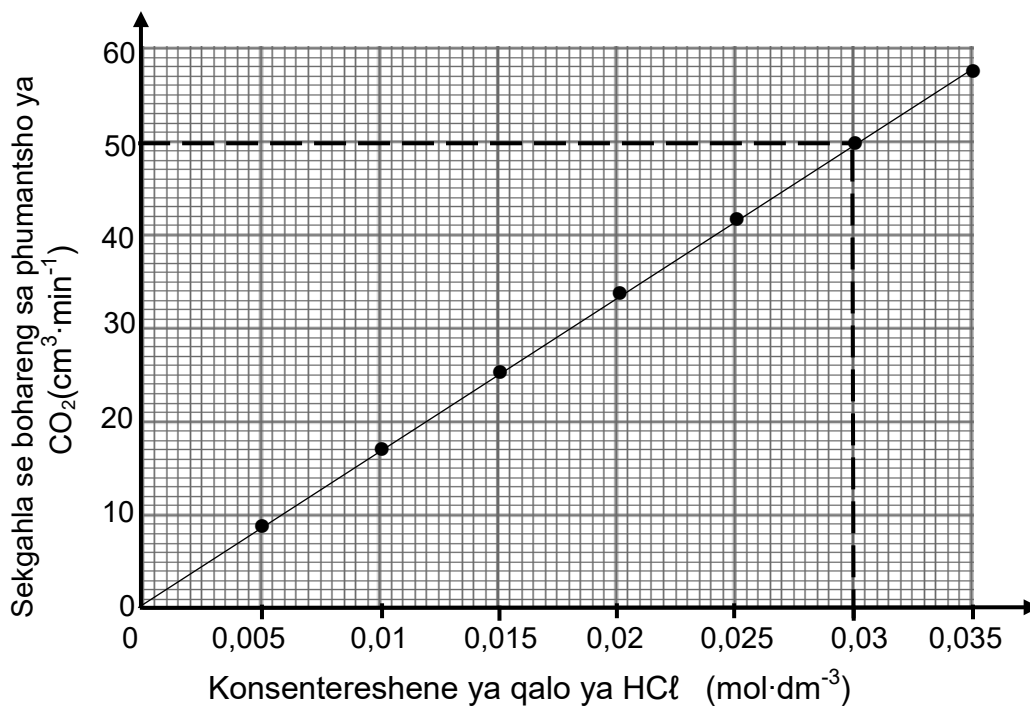
5.2.2 Sebaka se ditsweng kerafong se ameha jwang ha katalisiti e ekeditswe? Kgetha ho e a ATA, FOKOTSEHA kapa DULA E LE JWALO. (1)

- 5.3 Sebedisa fiyori ya thulano ho hlalosa hore katalisiti e se ama jwang sekgahla sa ketsahalo. (4)

- 5.4 Ketsahalo pakeng tsa calcium carbonate e PHOFO, $\text{CaCO}_3(\text{s})$, le hydrochloric asiti E SETSENG, $\text{HCl}(\text{aq})$, e sebediswa ho fuputsa sekgahla sa ketsahalo ho 25°C . Tekano e balansitseng ya ketsahalo ke:



Dipatlisiso tse mmalwa di entswe ka ho sebedisa boima bo lekanang ba calcium carbonate E SA HLWEKANG le dikonsentereshene tse fapaneng tsa qalo tsa hydrochloric asiti e taelutiweng. Kerafo e latelang e emetse diphetho tse fumanweng. Hakanya hore tse sa hlwekang ha di a kopana.



Phuputsong ena, ngola:

5.4.1 Bariebole e laolehang (1)

5.4.2 Sephetho (2)

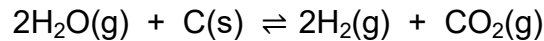
$\text{CaCO}_3(\text{s})$ ho 6 g ya sampole e sa hlwekang e kopana ka ho phethahala le $0,03 \text{ mol·dm}^{-3}$ ya $\text{HCl}(\text{aq})$ metsotsong e 26.

5.4.3 Sebedisa tlhaiso leseding kerafong ho bala peresente ya tlhweko ya calcium carbonate. Hakanya hore mothamo wa kgase wa molar ho 25°C ke $24\,000 \text{ cm}^3$.

(6)
[17]

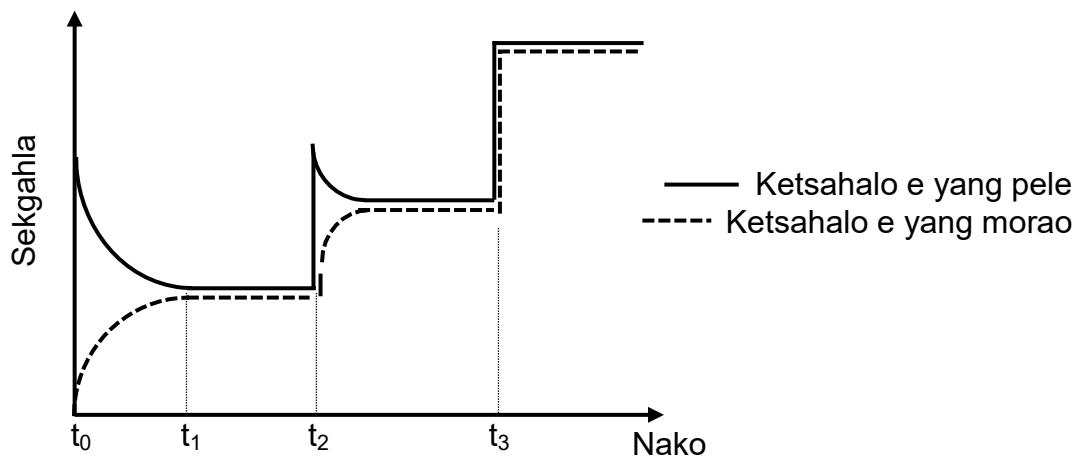
POTSO 6 (Qala leqepheng le letjha.)

Mmowane, $\text{H}_2\text{O}(\text{g})$, o kopana le carbon e tjhesang, $\text{C}(\text{s})$, ho $1\,000\,^\circ\text{C}$ ho latela tekano e latelang e balansitseng:



Qalong, 36 g ya mmowane le boima bo itseng ba carbon di ile tsa bewa ho $2\,\text{dm}^3$ setshelo se kwahetsweng mme tsa lokollwa hore di kopane. Maemong a tekanyo, ho ile ha fumanwa hore boima bo itseng ba carbon bo fetohile ka 0,225 mol.

- 6.1 Hlalosa lebitso *boemo bo lekaneng ba dynamic*. (2)
- 6.2 Bala konsetente ya boemo bo lekaneng, K_c , ketsahalong e ho $1\,000\,^\circ\text{C}$. (8)
- 6.3 Kerafo e bontsha kamoo sekgahla sa diketsahalo, e yang pele le eyang morao, di fetohang ha nako e tsamaya.



- 6.3.1 Fan aka lebaka la hore hobaneng sekgahla sa ketsahalo e yang pele se fokotseha pakeng tsa t_0 le t_1 . (1)
- 6.3.2 Ke efe phetoho e etsahetseng motswakong wa boemo ba tekanyo ka t_3 ? (1)
- Ha nako e le t_2 , motjheso wa sisitimo o a nyoloha.
- 6.3.3 Ana ketsahalo e yang pele ke EKESOFEMIKI kapa ENTOFEMIKI? (1)
- 6.3.4 Sebedisa porinsepole wa Le Chatelier's ho hlalosa karabo ya POTSO 6.3.3. (2)

[15]

POTSO 7 (Qala leqepheng le letjha.)

Dikopi tse pedi, ya **A** le ya **B**, di na le di-base tse matla.

Kopi ya **A**: 500 cm^3 ya barium hydroxide, $\text{Ba}(\text{OH})_2(\text{aq})$ e nang le konsentereshene e sa tsebisahaleng ya **X**

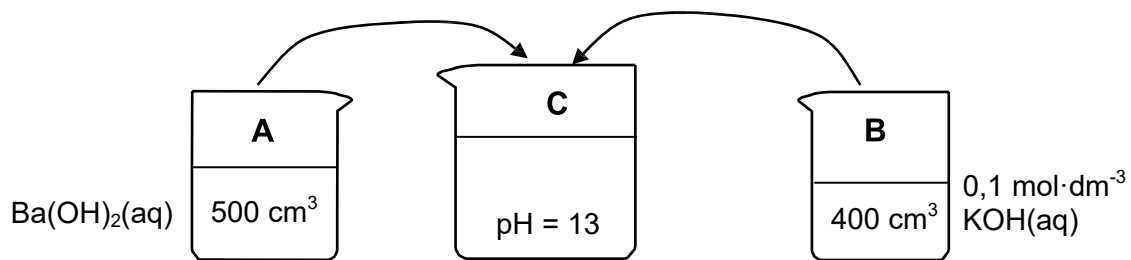
Kopi ya **B**: 400 cm^3 e nang le potassium hydroxide, $\text{KOH}(\text{aq})$ ya konsentereshene ya $0,1\text{ mol}\cdot\text{dm}^{-3}$

7.1 Hlalosa *base* ho latela molao wa Arrhenius. (2)

7.2 Bala dinomoro tsa domole tsa (OH^-) koping ya **B**. (2)

7.3 Dikarahe tse dikoping tsa **A** le **B** di kopantswe mmoho koping ya **C**.
Motswako o koping ya **C** o na le pH ya 13.

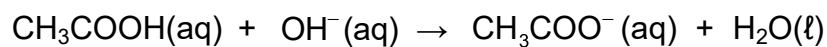
Ho hakanngwa hore methamo e ka eketseha le motjheso wa metswako ke $25\text{ }^\circ\text{C}$.



7.3.1 Bala konsentereshene, ya **X**, ho $\text{Ba}(\text{OH})_2$ koping ya **A**. (8)

Motswako koping ya **C** e thaetereituweng le ethanoic asiti. Ho fumanehile hore 15 cm^3 e lekanya 30 cm^3 ya asiti.

Tekano e balansitseng ke:



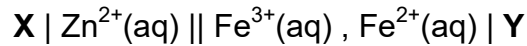
7.3.2 Ana ethanoic asiti, $\text{CH}_3\text{COOH}(\text{aq})$, ke asiti e FOKOLANG kapa asiti e MATLA?

Fana ka ka tlhaloso karabong ya hao. (2)

7.3.3 Bala konsentereshene ya ethanoic asiti. (4)
[18]

POTSO 8 (Qala leqepheng le letjha.)

Sele ya galvanic e maemong a lekaneng e bontshitswe ka kemedi ya sele jwalo ka ha e bontshitswe ka tlase. **X** le **Y** ke dieleketerote tse tsa tsebisahaleng.



8.1 Ngola LEBITSO le FOROMO ya:

8.1.1 Eleketerote ya **X** (1)

8.1.2 Eleketerote ya **Y** (1)

8.1.3 Kemedi e okesitaesang (1)

8.2 Ngola:

8.2.1 Mosebetsi O LE MONG wa eleketerote ya **Y** (1)

8.2.2 Ketsahalo e mahareng e etsahala eleketeroteng ya **Y** (2)

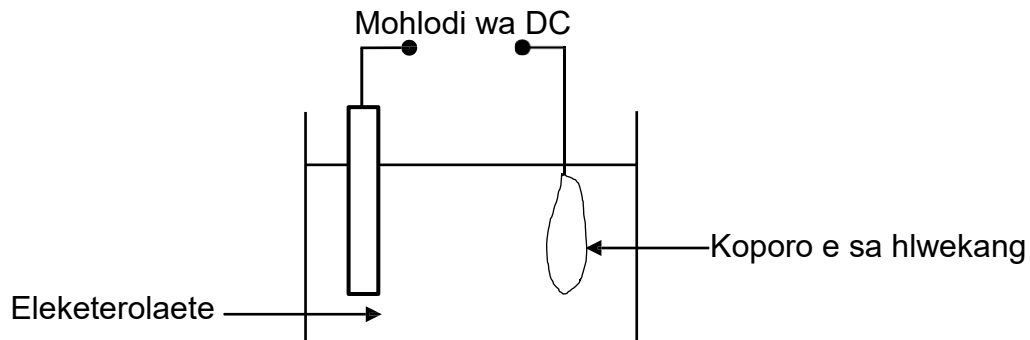
8.2.3 Tekano ya nete (kaofela) ya kemedi ya sele e etsahala seleng ena. (3)

8.3 Bala emf ya qalo seleng ena. (4)

8.4 Ekaba emf ya qalo ya sele e anngwa jwang ke konsentereshene ya di-ion tsa tshepe(III) e fetohela ho $0,6 \text{ mol} \cdot \text{dm}^{-3}$? Kgetha ho e a ATA, FOKOTSEHA kapa e DULA E TSHWANA. (1)
[14]

POTSO 9 (Qala leqepheng le letjha.)

Setshwantso se latelang se bebofaditsweng se emetse sele ya eleketerokemikale e sebedisitsweng ho hlwekisa koporo. Koporo e sa hlwekang e na le boima bo itseng ba silibera (Ag) le senke (Zn) e le tsona ditshilafatsi.

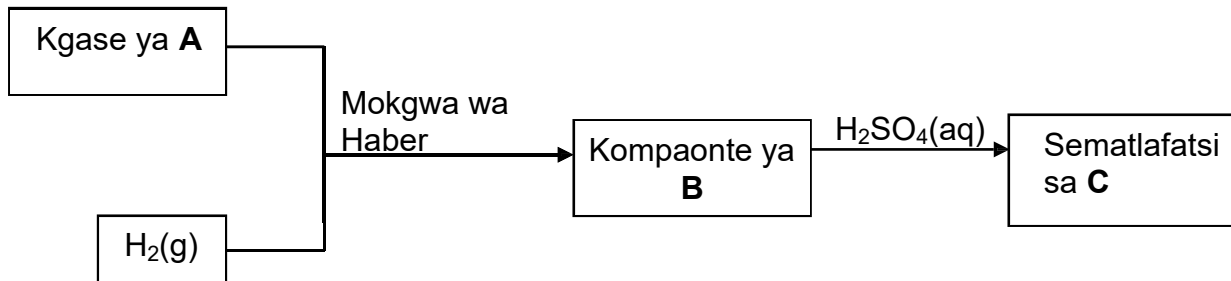


- 9.1 Hlalosa lebitso *eleketerolaesese*. (2)
- 9.2 Ngola LEBITSO le FOROMO ya di-ion tse pedi tse fumanehang ho eleketerolaete. (2)
- 9.3 Ngola ketsahalo e mahareng e etsahalang ho kafote. (2)
- 9.4 Sheba Tafole ya Maemo a diretakeshene Potential o be o hlalose hore hobaneng koporo e hlwekisitsweng E KEKE e be le lesenke. (3)
- 9.5 Bala boima bo hodimo ba Cu e etsahetseng haeba dimole tse 0,6 tsa dieleketerone di fetisitswe. (3)

[12]

POTSO 10 (Qala leqepheng le letjha.)

- 10.1 Neheletswano setshwantshong se latelang e bontsha mokgwa neng o fumaneha ha ho etswuwa sematlafatsi sa **C**.



Ngola LEBITSO le FOROMO ya:

- 10.1.1 Kgase ya **A** (1)
- 10.1.2 Katalisiti e sebedisitsweng mokgweng wa Haber (1)
- 10.1.3 Kompaonte ya **B** (1)

Ngola:

- 10.1.4 Lebitso la mokgwa o sebedisitsweng ho hlahisa kgase ya **A** (1)
- 10.1.5 Tekano e balansitseng ha ho etswa sematlafatsi sa **C** (3)

- 10.2 Mokotla wa 40 kg wa sematlafatsi o na le 65% ya setlatselletsisi. Boima ba manoni mokotleng bo bontshitswe tafoleng e latelang.

MANONI	BOIMA (kg)
Naeterojene	x
Foseforase	2x
Potasiamo	5

Bala dikarolwana tsa NPK sematlafatsing.

(3)
[10]

KAKARETSO YA MATSHWAO: 150

a



**DATA FOR PHYSICAL SCIENCES GRADE 12
PAPER 2 (CHEMISTRY)**

**DATHA YA THUTO YA TSA MAHLALE SEHLOPHA
SA 12PAMPIRI YA 2 (CHEMISTRY)**

TABLE 1: PHYSICAL CONSTANTS/TAFOLE YA 1: D I FISIKALE KONSETENTE

NAME/LEBITSO	SYMBOL/LETSHWAO	VALUE/BOLENG
Standard pressure <i>Kgatello e lekantsweng</i>	p^{θ}	$1,013 \times 10^5 \text{ Pa}$
Molar gas volume at STP <i>Kgase ya mothamo wa molara ho STD</i>	V_m	$22,4 \text{ dm}^3 \cdot \text{mol}^{-1}$
Standard temperature <i>Motjheso o lekantsweng</i>	T^{θ}	273 K
Charge on electron <i>Tjhatjhe ya eleketerone</i>	e	$-1,6 \times 10^{-19} \text{ C}$
Avogadro's constant <i>Lenane le sa fetoheng la Avogadro</i>	N_A	$6,02 \times 10^{23} \text{ mol}^{-1}$

TABLE 2: FORMULAE/TAFOLE YA 2: DIFOROMO

$n = \frac{m}{M}$	$n = \frac{N}{N_A}$
$c = \frac{n}{V}$ or/of $c = \frac{m}{MV}$	$n = \frac{V}{V_m}$
$\frac{c_a v_a}{c_b v_b} = \frac{n_a}{n_b}$	$\text{pH} = -\log[\text{H}_3\text{O}^+]$
$K_w = [\text{H}_3\text{O}^+][\text{OH}^-] = 1 \times 10^{-14} \text{ at/by } 298 \text{ K}$	
$E_{\text{cell}}^{\theta} = E_{\text{cathode}}^{\theta} - E_{\text{anode}}^{\theta} \quad / E_{\text{sele}}^{\theta} = E_{\text{kafote}}^{\theta} - E_{\text{anote}}^{\theta}$ or/kapa $E_{\text{cell}}^{\theta} = E_{\text{reduction}}^{\theta} - E_{\text{oxidation}}^{\theta} \quad / E_{\text{sele}}^{\theta} = E_{\text{redakeshene}}^{\theta} - E_{\text{okeseteeshene}}^{\theta}$ or/kapa $E_{\text{cell}}^{\theta} = E_{\text{oxidisingagent}}^{\theta} - E_{\text{reducingagent}}^{\theta} \quad / E_{\text{sele}}^{\theta} = E_{\text{kemedi e okesetaesang}}^{\theta} - E_{\text{kemedi e-rejusehang}}^{\theta}$	



TABLE 3: THE PERIODIC TABLE OF ELEMENTS

KEY/ SLEUTEL																		
Atomgetal Atomic number																		
(I)	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	
(II)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1	H 1	He 2																
3	Li 3	Be 4																
11	Na 11	Mg 12																
19	K 19	Ca 20																
37	Rb 37	Sr 38																
55	Cs 55	Ba 56																
87	Fr 87	Ra 88																

TABLE 4A: STANDARD REDUCTION POTENTIALS/TEKANYO YA DIRETAKESHENE POTENTIAL

Half-reactions/Halfreaksies	E^{θ} (V)
$F_2(g) + 2e^- \rightleftharpoons 2F^-$	+ 2,87
$Co^{3+} + e^- \rightleftharpoons Co^{2+}$	+ 1,81
$H_2O_2 + 2H^+ + 2e^- \rightleftharpoons 2H_2O$	+1,77
$MnO_4^- + 8H^+ + 5e^- \rightleftharpoons Mn^{2+} + 4H_2O$	+ 1,51
$Cl_2(g) + 2e^- \rightleftharpoons 2Cl^-$	+ 1,36
$Cr_2O_7^{2-} + 14H^+ + 6e^- \rightleftharpoons 2Cr^{3+} + 7H_2O$	+ 1,33
$O_2(g) + 4H^+ + 4e^- \rightleftharpoons 2H_2O$	+ 1,23
$MnO_2 + 4H^+ + 2e^- \rightleftharpoons Mn^{2+} + 2H_2O$	+ 1,23
$Pt^{2+} + 2e^- \rightleftharpoons Pt$	+ 1,20
$Br_2(l) + 2e^- \rightleftharpoons 2Br^-$	+ 1,07
$NO_3^- + 4H^+ + 3e^- \rightleftharpoons NO(g) + 2H_2O$	+ 0,96
$Hg^{2+} + 2e^- \rightleftharpoons Hg(l)$	+ 0,85
$Ag^+ + e^- \rightleftharpoons Ag$	+ 0,80
$NO_3^- + 2H^+ + e^- \rightleftharpoons NO_2(g) + H_2O$	+ 0,80
$Fe^{3+} + e^- \rightleftharpoons Fe^{2+}$	+ 0,77
$O_2(g) + 2H^+ + 2e^- \rightleftharpoons H_2O_2$	+ 0,68
$I_2 + 2e^- \rightleftharpoons 2I^-$	+ 0,54
$Cu^+ + e^- \rightleftharpoons Cu$	+ 0,52
$SO_2 + 4H^+ + 4e^- \rightleftharpoons S + 2H_2O$	+ 0,45
$2H_2O + O_2 + 4e^- \rightleftharpoons 4OH^-$	+ 0,40
$Cu^{2+} + 2e^- \rightleftharpoons Cu$	+ 0,34
$SO_4^{2-} + 4H^+ + 2e^- \rightleftharpoons SO_2(g) + 2H_2O$	+ 0,17
$Cu^{2+} + e^- \rightleftharpoons Cu^+$	+ 0,16
$Sn^{4+} + 2e^- \rightleftharpoons Sn^{2+}$	+ 0,15
$S + 2H^+ + 2e^- \rightleftharpoons H_2S(g)$	+ 0,14
$2H^+ + 2e^- \rightleftharpoons H_2(g)$	0,00
$Fe^{3+} + 3e^- \rightleftharpoons Fe$	- 0,06
$Pb^{2+} + 2e^- \rightleftharpoons Pb$	- 0,13
$Sn^{2+} + 2e^- \rightleftharpoons Sn$	- 0,14
$Ni^{2+} + 2e^- \rightleftharpoons Ni$	- 0,27
$Co^{2+} + 2e^- \rightleftharpoons Co$	- 0,28
$Cd^{2+} + 2e^- \rightleftharpoons Cd$	- 0,40
$Cr^{3+} + e^- \rightleftharpoons Cr^{2+}$	- 0,41
$Fe^{2+} + 2e^- \rightleftharpoons Fe$	- 0,44
$Cr^{3+} + 3e^- \rightleftharpoons Cr$	- 0,74
$Zn^{2+} + 2e^- \rightleftharpoons Zn$	- 0,76
$2H_2O + 2e^- \rightleftharpoons H_2(g) + 2OH^-$	- 0,83
$Cr^{2+} + 2e^- \rightleftharpoons Cr$	- 0,91
$Mn^{2+} + 2e^- \rightleftharpoons Mn$	- 1,18
$Al^{3+} + 3e^- \rightleftharpoons Al$	- 1,66
$Mg^{2+} + 2e^- \rightleftharpoons Mg$	- 2,36
$Na^+ + e^- \rightleftharpoons Na$	- 2,71
$Ca^{2+} + 2e^- \rightleftharpoons Ca$	- 2,87
$Sr^{2+} + 2e^- \rightleftharpoons Sr$	- 2,89
$Ba^{2+} + 2e^- \rightleftharpoons Ba$	- 2,90
$Cs^+ + e^- \rightleftharpoons Cs$	- 2,92
$K^+ + e^- \rightleftharpoons K$	- 2,93
$Li^+ + e^- \rightleftharpoons Li$	- 3,05

Increasing oxidising ability/Ho eketseha ha bokgoni ba ho okesetaesa

Increasing reducing ability/Ho eketseha ha bokgoni bo rejusang

20.
SC/NSCTABLE 4B: STANDARD REDUCTION POTENTIALS
TABEL 4B: STANDAARD-REDUKSIEPOTENSIALE

Half-reactions/Halfreaksies	E^θ (V)
$\text{Li}^+ + e^- \rightleftharpoons \text{Li}$	-3,05
$\text{K}^+ + e^- \rightleftharpoons \text{K}$	-2,93
$\text{Cs}^+ + e^- \rightleftharpoons \text{Cs}$	-2,92
$\text{Ba}^{2+} + 2e^- \rightleftharpoons \text{Ba}$	-2,90
$\text{Sr}^{2+} + 2e^- \rightleftharpoons \text{Sr}$	-2,89
$\text{Ca}^{2+} + 2e^- \rightleftharpoons \text{Ca}$	-2,87
$\text{Na}^+ + e^- \rightleftharpoons \text{Na}$	-2,71
$\text{Mg}^{2+} + 2e^- \rightleftharpoons \text{Mg}$	-2,36
$\text{Al}^{3+} + 3e^- \rightleftharpoons \text{Al}$	-1,66
$\text{Mn}^{2+} + 2e^- \rightleftharpoons \text{Mn}$	-1,18
$\text{Cr}^{2+} + 2e^- \rightleftharpoons \text{Cr}$	-0,91
$2\text{H}_2\text{O} + 2e^- \rightleftharpoons \text{H}_2(\text{g}) + 2\text{OH}^-$	-0,83
$\text{Zn}^{2+} + 2e^- \rightleftharpoons \text{Zn}$	-0,76
$\text{Cr}^{3+} + 3e^- \rightleftharpoons \text{Cr}$	-0,74
$\text{Fe}^{2+} + 2e^- \rightleftharpoons \text{Fe}$	-0,44
$\text{Cr}^{3+} + e^- \rightleftharpoons \text{Cr}^{2+}$	-0,41
$\text{Cd}^{2+} + 2e^- \rightleftharpoons \text{Cd}$	-0,40
$\text{Co}^{2+} + 2e^- \rightleftharpoons \text{Co}$	-0,28
$\text{Ni}^{2+} + 2e^- \rightleftharpoons \text{Ni}$	-0,27
$\text{Sn}^{2+} + 2e^- \rightleftharpoons \text{Sn}$	-0,14
$\text{Pb}^{2+} + 2e^- \rightleftharpoons \text{Pb}$	-0,13
$\text{Fe}^{3+} + 3e^- \rightleftharpoons \text{Fe}$	-0,06
$2\text{H}^+ + 2e^- \rightleftharpoons \text{H}_2(\text{g})$	0,00
$\text{S} + 2\text{H}^+ + 2e^- \rightleftharpoons \text{H}_2\text{S}(\text{g})$	+0,14
$\text{Sn}^{4+} + 2e^- \rightleftharpoons \text{Sn}^{2+}$	+0,15
$\text{Cu}^{2+} + e^- \rightleftharpoons \text{Cu}^+$	+0,16
$\text{SO}_4^{2-} + 4\text{H}^+ + 2e^- \rightleftharpoons \text{SO}_2(\text{g}) + 2\text{H}_2\text{O}$	+0,17
$\text{Cu}^{2+} + 2e^- \rightleftharpoons \text{Cu}$	+0,34
$2\text{H}_2\text{O} + \text{O}_2 + 4e^- \rightleftharpoons 4\text{OH}^-$	+0,40
$\text{SO}_2 + 4\text{H}^+ + 4e^- \rightleftharpoons \text{S} + 2\text{H}_2\text{O}$	+0,45
$\text{Cu}^+ + e^- \rightleftharpoons \text{Cu}$	+0,52
$\text{I}_2 + 2e^- \rightleftharpoons 2\text{I}^-$	+0,54
$\text{O}_2(\text{g}) + 2\text{H}^+ + 2e^- \rightleftharpoons \text{H}_2\text{O}_2$	+0,68
$\text{Fe}^{3+} + e^- \rightleftharpoons \text{Fe}^{2+}$	+0,77
$\text{NO}_3^- + 2\text{H}^+ + e^- \rightleftharpoons \text{NO}_2(\text{g}) + \text{H}_2\text{O}$	+0,80
$\text{Ag}^+ + e^- \rightleftharpoons \text{Ag}$	+0,80
$\text{Hg}^{2+} + 2e^- \rightleftharpoons \text{Hg}(\text{l})$	+0,85
$\text{NO}_3^- + 4\text{H}^+ + 3e^- \rightleftharpoons \text{NO}(\text{g}) + 2\text{H}_2\text{O}$	+0,96
$\text{Br}_2(\text{l}) + 2e^- \rightleftharpoons 2\text{Br}^-$	+1,07
$\text{Pt}^{2+} + 2e^- \rightleftharpoons \text{Pt}$	+1,20
$\text{MnO}_2 + 4\text{H}^+ + 2e^- \rightleftharpoons \text{Mn}^{2+} + 2\text{H}_2\text{O}$	+1,23
$\text{O}_2(\text{g}) + 4\text{H}^+ + 4e^- \rightleftharpoons 2\text{H}_2\text{O}$	+1,23
$\text{Cr}_2\text{O}_7^{2-} + 14\text{H}^+ + 6e^- \rightleftharpoons 2\text{Cr}^{3+} + 7\text{H}_2\text{O}$	+1,33
$\text{Cl}_2(\text{g}) + 2e^- \rightleftharpoons 2\text{Cl}^-$	+1,36
$\text{MnO}_4^- + 8\text{H}^+ + 5e^- \rightleftharpoons \text{Mn}^{2+} + 4\text{H}_2\text{O}$	+1,51
$\text{H}_2\text{O}_2 + 2\text{H}^+ + 2e^- \rightleftharpoons 2\text{H}_2\text{O}$	+1,77
$\text{Co}^{3+} + e^- \rightleftharpoons \text{Co}^{2+}$	+1,81
$\text{F}_2(\text{g}) + 2e^- \rightleftharpoons 2\text{F}^-$	+2,87

Increasing oxidising ability
↓↑
Increasing reducing ability/Toenemende reduserende vermoë

