



Province of the
EASTERN CAPE
EDUCATION



NATIONAL SENIOR CERTIFICATE

KEREITI YA 12

LOETSE 2023

**FISIKALE SAENSESE P2
(KHEMISTIRI)**

MATSHWAO: 150

NAKO: dihora tse 3

Pampiri ena e na le maqephe a 23 ho kenyelletsa
le datha shiti e nang le dipampiri tse 4.

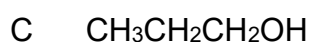
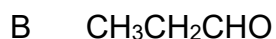
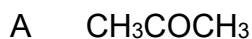
MELAO LE TLHAISO-LESEDING

1. Ngola LEBITSO le FANE ya hao ka botlalo dibakeng tse nepahetseng BUKENG YA HO ARABELA.
2. Pampiri ena e na le dipotso tse ROBONG. 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 nomorilwe 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 sebedisa khaltjhuleitha e sa prokeremuwang.
7. O ka sebedisa dihlobo tse nepahetseng tsa mathematikisi.
8. Bontsha difomulara TSOHLE le disabostitjhushene dikhaltjhuleisheneng TSOHLE.
9. QETELLONG atametsa dikarabo tsa hao ka ho bonyane dinomoro TSE PEDI tsa didesimale.
10. Fana ka tshehetso, dimanollo, le tse ding ka bokgutshwanyane moo ho hlokehang.
11. O eletswa ho sebedisa DIDATHA SHITI tse hokelletsweng.
12. Ngola ka makgethe le ka mongolo o balehang.

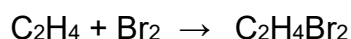
POTSO 1: DIPOTSO TSA KGETHO TSE FUWENG

Ho fanwe ka dikgetho tse fapaneng e le dikarabo tse ka nepahalang dipotsong tse latelang. Kgetha karabo o be o ngole tlhaku feela (A–D) pela dinomoro tsa dipotso (1.1 ho ya ho 1.10) BUKENG YA HO ARABELA, mohlala 1.11 E.

1.1 Ke efe E LE NNGWE ho tse latelang e nang le di-intermolecular force tse MATLA?



1.2 Shebisisa reekeshene e ka tlase:



Ke MOFUTA ofe wa reekeshene o emetsweng ke ekweishene e ka hodimo?

A Ke hydration

B Ke halogenation

C Ke hydrogenation

D Ke hydrohalogenation (2)

1.3 Lebitso la functional group ya di-aldehyde ke ...

A formyl.

B carbonyl.

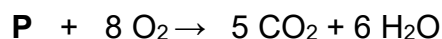
C hydroxyl.

D carboxyl. (2)

- 1.4 Khompaonde ya **Q** undergoes a cracking reaction ho hlahisa okanike khompaonde ya **P** le ethene, C_2H_4 ho ya ka moo ho bontshitsweng ka tlase:



Khompaonde ya **Q** further undergoes khombaseshene reekeshene ho latela balanced ekhweishene:

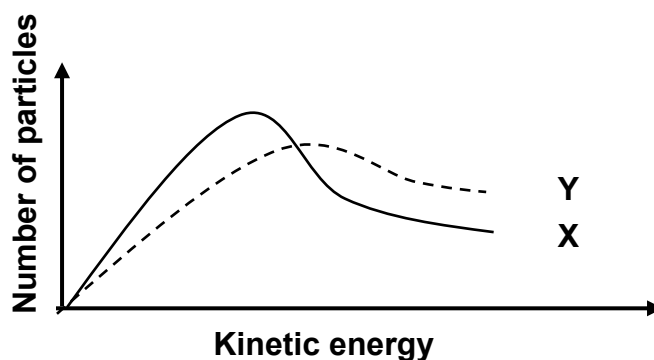


Lebitso la IUPAC la khompaonde ya **Q** ke ...

- A butane.
- B pentane.
- C hexane.
- D heptane.

(2)

- 1.5 Maxwell-Boltzmann distribution ya mothinya **X** e emetse number of molecules kgahlano le kinetic energy ho reekeshene e itseng. Mothinya **Y** o fumanwe ha e nngwe ya maemo a reekeshene e fetotswe.



Ke efe E LE NNGWE ho dintlha tse latelang e ileng ya fetoha ho fumana mothinya wa **Y**?

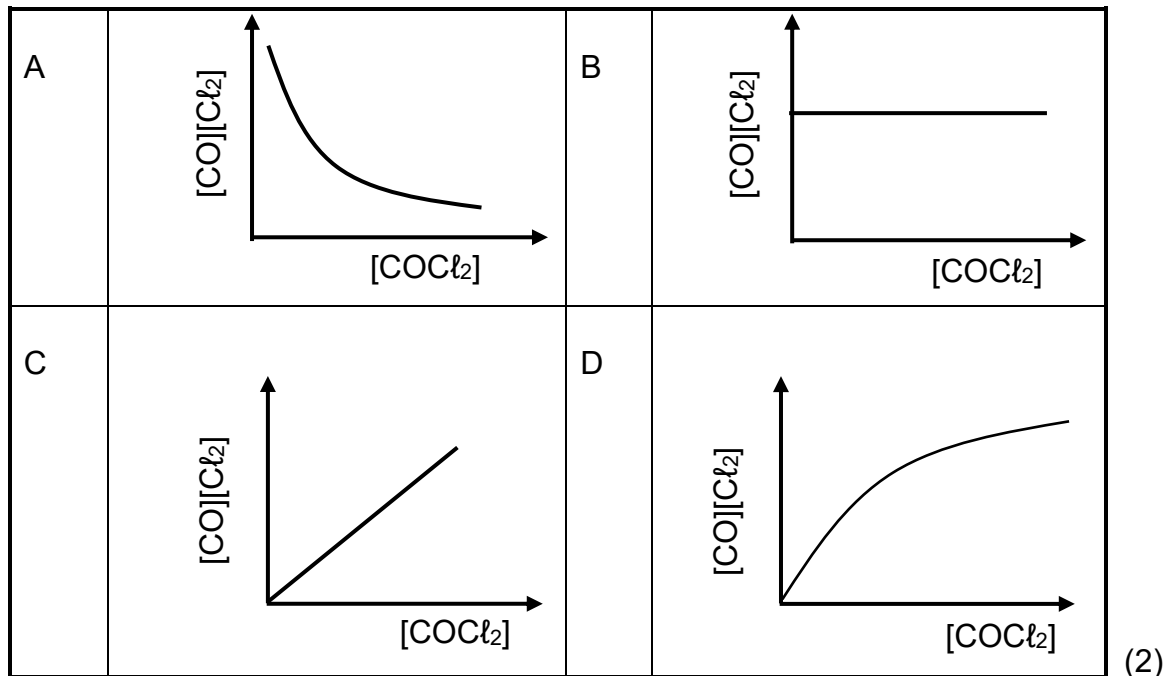
- A Poresha
- B Motjheso
- C Konsentereishene
- D Ho eketswa ha katalisiti

(2)

1.6 Dekhomposishene reekeshene e latelang e fihlelletse ekwiliboriamo:



Ke efe E LE NNGWE ho dikerafo tse latelang ya $[\text{CO}][\text{Cl}_2]$ kgahlanong le $[\text{COCl}_2]$ e NEPAHETSENG e ho ekwiliboriamo?

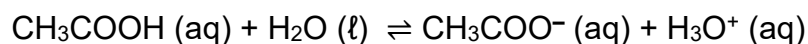


1.7 Ke LEFE letswai ho a ka tlase le ka hlahiswang ke reekeshene ya beisi e strong le weak asiti?

- A Na_2SO_4
- B NH_4Cl
- C NaCl
- D KHCO_3

(2)

- 1.8 Reekeshene e emetsweng ke ekhweishene e ka tlase e fihlella ekwiliboriamo:



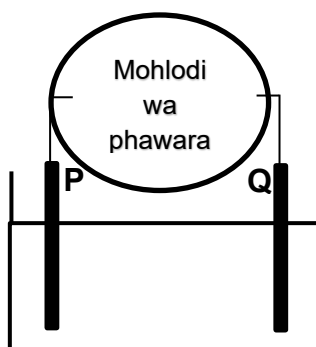
Marothodi a mmalwa a solushene e khonsenteretuweng a $\text{CH}_3\text{COONa (aq)}$ a ekeditswe ho mixture e ekwiliboriamong.

Ke efe E LE NNGWE ho tse latelang mabapi le pH le maemo a ekwiliboriamo e NEPAHETSENG ha reekeshene e atamela ekwiliboriamo e ntjha?

	pH	Maemo a ekwiliboriamo a shifitela ka ho le:
A	E a ata	Letshehadi
B	E a fokotseha	Letona
C	E a ata	Letona
D	E a fokotseha	Letshehadi

(2)

- 1.9 Tayakeramo e bebofaditsweng e ka tlase e emetse electrolytic sele e sebedisitsweng tlhwekisong ya koporo (Cu).



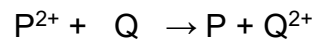
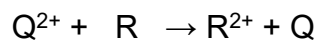
Eleketerote ya **P** ke CATHODE ya sele.

Ke efe E LE NNGWE dikopano ho tse latelang mabapi le eleketerote ya **P** e nepahetseng?

	Reekeshene e etsahalang ho eleketerote ya P	Theminala eo eleketerote ya P e hokahantsweng ho yona
A	Okeseteishene	Posetifo
B	Okeseteishene	Neketifo
C	Redakeshene	Posetifo
D	Redakeshene	Neketifo

(2)

1.10 Shebisisa hypothetical spontaneous reekeshene e latelang:



Ke efe E LE NNGWE ho lethathama la ho ata ha matla a di-oxidising agent ho tse latelang ho ya ka tatellano?

A Q^{2+} , R^{2+} , P^{2+}

B R^{2+} , Q^{2+} , P^{2+}

C P^{2+} , Q^{2+} , R^{2+}

D P^{2+} , R^{2+} , Q^{2+}

(2)
[20]

POTSO 2 (Qala leqepheng le letjha.)

2.1 Shebisisa diokanike khompaonde **A** ho ya ho **F** ka tlase.

A 2-methylpent-2-ene	B $(\text{CH}_3)_3\text{COH}$
C 2,3-dimethylpentanoic acid	D $ \begin{array}{c} \text{CH}_2\text{CH}_3 \qquad \text{CH}_3 \\ \qquad \qquad \\ \text{H} - \text{C} - \text{C} \equiv \text{C} - \text{C} - \text{H} \\ \qquad \qquad \\ \text{H} \qquad \qquad \text{H} \end{array} $
E $ \begin{array}{c} \text{H} \quad \text{H} \quad \text{O} \\ \quad \quad \\ \text{H} - \text{C} - \text{C} - \text{C} \\ \quad \quad \diagdown \\ \text{H} \quad \text{H} \quad \text{H} \end{array} $	F. $\text{CH}_3\text{CH}_2\text{Br}$

2.1 Ngola TLHAKU ya khompaonde eo:

2.1.1 E leng alkyne (1)

2.1.2 E leng haloalkane (1)

2.1.3 E nang le general formula $\text{C}_n\text{H}_{2n+2}\text{O}$ (1)

2.2 Na khompaonde ya **A** e SATURATED kapa UNSATURATED?

Fana ka lebaka la karabo. (2)

2.3 Ngola:

2.3.1 Seteraketjharale fomulara ya kompaonte ya **C** (2)

2.3.2 Lebitso la IUPAC ya khompaonde ya **D** (2)

2.4 Na khompaonde ya **B** ke PORAIMARI, SEKHONDARI kapa THESHIARI alekohole?

Fana ka lebaka la karabo. (2)

2.5 Ngola lebitso la IUPAC ya CHAIN isomer ya khompaonde ya **B**. (2)

2.6 Khompaonde ya **E** e na le functional isomer.

2.6.1 Ke eng di-functional isomer? (2)

2.6.2 Ngola SETERAKETJHARALE FOMULARA SE KONDENSUWENG sa functional isomer ya kompaonte ya **E**. (2)

[17]

POTSO 3 (Qala leqepheng le letjha.)

Dikhompaonde **A** ho ya ho **C** disebedisitswe ho fuputsa ntlha e susumetsang ntlha ya ho bela ya diokanike khompaonde. Tafole e ka tlase e bontsha diphetho tse fumanweng.

	Kompaonte	Ntlha ya ho bela (°C)
A	Propan-1-ol	97
B	Butan-1-ol	117,7
C	Pentan-1-ol	138

3.1 Hlalosa *ntlha ya ho bela*. (2)

3.2 Mabapi le phuputso ena, ngola:

3.2.1 Fariebole e ikemetseng (1)

3.2.2 Fariebole e laotsweng (1)

3.3 Fana ka intermolecular fose e ikarabellang tatellisanong e bonahetseng dintlheng tsa ho bela. (1)

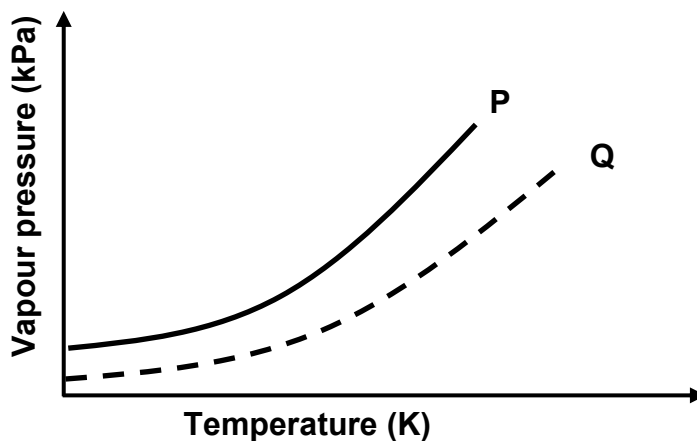
3.4 Dintlha tsa ho bela tsa dialekhohole tse branched tse tharo tse fanweng ka tlase:

108 °C	129 °C	149 °C
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Ke ofe O LE MONG motjheso ho e meraro eo e ka bang ntlha ya ho bela ha 2-methylbutan-1-ol? (1)

3.5 Hlalosa ka botlalo karabo ho POTSO ya 3.4. (4)

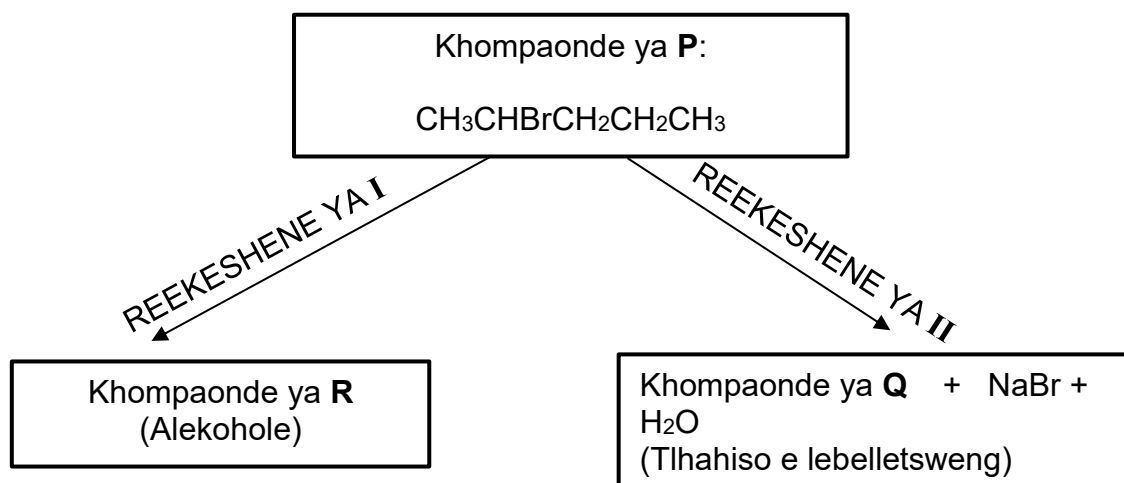
- 3.6 Dikerafo tse ka tlase di emetse kamano pakeng tsa vapour pressure le motjheso wa propan-1-ol le propanal.



- 3.6.1 Hlalosa *vapour pressure*. (2)
- 3.6.2 Ke ofe mothinya, **P** kapa **Q**, o emetseng kerafo ya propan-1-ol? (1)
- 3.6.3 Hlalosa karabo ya POTSO ya 3.6.2 ka ho ikamahanya le MOFUTA wa diintamolekulara fose. (4)
- [17]

POTSO 4 (Qala leqepheng le letjha.)

- 4.1 Tayakeramo ya nehelletsano e ka tlase e bontsha ka moo khompaonde ya **P** e ka fetolelwang ho okanike khompaonde ya **Q** le **R**.



Mabapi le reekeshene ya **I** ngola:

4.1.1 Ngola mofuta wa sabusetitushene reekeshene (1)

4.1.2 Lebitso la IUPAC ya khompaonde ya **R** (2)

Mabapi le reekeshene ya **II** ngola:

4.1.3 Boemo bo le bong ba reekeshene ntle le motjheso (1)

4.1.4 Seteraketjharale fomulara sa khompaonde ya **Q** (2)

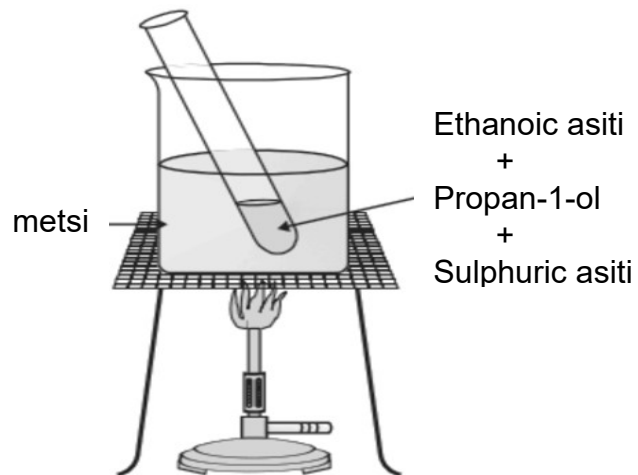
Khompaonde ya **R** e ka fetolelwa ho khompaonde ya **Q**.

Mabapi le phethoho ya khompaonde ya **R** ho ya ho khompaonde ya **Q** ngola:

4.1.5 Fomulara kapa lebitso la inorganic reagent e hlokehang (1)

4.1.6 Mofuta wa reekeshene (1)

- 4.2 Motswako wa ethanoic asiti (CH_3COOH) le propan-1-ol ($\text{CH}_3\text{CH}_2\text{CH}_2\text{OH}$) o futhumatswa botenng ba sulphuric asiti (H_2SO_4) e konsentereituweng ho bate ya metsi ka ho bontshwa ka tlase.



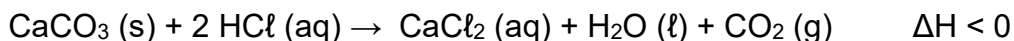
- 4.2.1 Ngola lebitso la reekeshe e etsahetseng. (1)
- 4.2.2 Fana ka lebaka la ho futhumetswa ha motswako wa reekeshene ho bate ya metsi. (1)
- 4.2.3 Ngola seteraketjharale fomulara le lebitso la IUPAC ya tlhahiso e fumanehileng. (4)

[14]

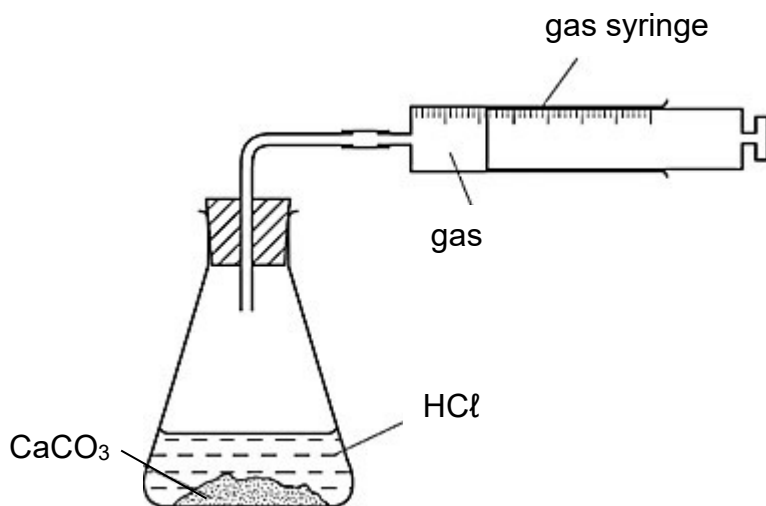
POTSO 5 (Qala leqepheng le letjha.)

Lequlwana la baithuti le fuputsa kamano dipakeng tsa reaction rate le konsentereishene. Ba sebedisitse reekeshene ya phofo ya, $\text{CaCO}_3(\text{s})$ le motswako wa hydrochloric asiti E FETANG TEKANYO, $\text{HCl}(\text{aq})$, ho 25°C .

Ekweishene e balansitsweng ya reekeshene ena ke:



Disebediswa tse sebedisitsweng dibontshitswe ka tlase.



Tafole e ka tlase e bontsha maemo a reekeshene ya Diekeseperimente ya 1 le ya 2.

EKESEPERIMENTE	KONSENTEREISHENE YA HCl (mol.dm^{-3})	MOTHAMO WA HCl (cm^3)	NAKO E NKUWENG KE REEKESHENE HO FIHLELA MAPHETHELONG (minutes)
1	0,9	50	5,28
2	1,2	50	Y

- 5.1 Hlalosa lentswe *reaction rate*. (2)
- 5.2 Fana ka lebitso la sesebediswa se hlokahalang phuputsong ena se sa hlalishwang setshwantshong se ka hodimo. (1)
- 5.3 Fana ka lebaka le etsang hore motjheso wa motswako wa reekeshene o se ke wa dula o sa fetohe nakong ya reekeshene. (1)
- 5.4 Ebe nako ya Y mabapi le ekeperimente ya 2 e tla ba TELELE kapa KGUTSHWANYANE ho metsotso e 5,28? (1)
- 5.5 Hlalosa karabo ya POTSO ya 5.4 ka ho ikamanya le collision theory. (2)

5.6 Ho ekeseperimente ya **1**, 250 cm^3 ya CO_2 ka botlalo e hlahisitswe ka metsotso e 5,28.

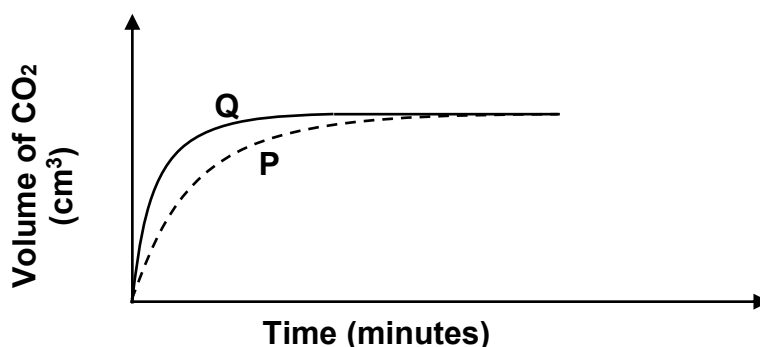
5.6.1 Khaltjhuleitha average rate ya tlhahiso ya CO_2 ka $\text{cm}^3 \cdot \text{min}^{-1}$. (3)

Ka mora nakwana ho ekeseperimente ya **1** e maphethetswe, folaseke e kwahedisitswe mme ho fumaneha hore 100 cm^3 ya CO_2 e ile ya itswela ka ntle ho folaseke.

5.6.2 Khaltjhuleitha boima ba CO_2 e setseng folasekeng ka mora hore folaseke e kwalwe. Nka molar volume ya CO_2 ka 25°C e le $25\,000 \text{ cm}^3 \cdot \text{mol}^{-1}$. (4)

5.7 Ho **ekeseperimente ya 3** jwale baithuti ba eketsa 50 cm^3 ya motswako o FETANG TEKANYO wa ethanoic asiti ($\text{C}_2\text{H}_4\text{O}_2$) le konsentereishene ya $0,9 \text{ mol} \cdot \text{dm}^{-3}$ ho phofo ya CaCO_3 e ho 25°C mme ba bapisa diphetho tse ho ekeseperimente ya **1**.

Kerafo ya volume of CO_2 against time mabapi le diekeseperimene tse pedi tse bontshitsweng ka tlase.



5.7.1 Ke efe kerafo ya **P** kapa **Q** e bontshang diphetho tsa ekeseperimente ya **3**? (1)

5.7.2 Hlalosa karabo ho POTSO ya 5.7.1. (2)

5.7.3 Amaonte ya CaCO_3 e sebedisitsweng ekeseperimenteng ya **1** e bapiswa jwang le amaonte ya CaCO_3 e sebedisitsweng ekeseperimenteng ya **3**?

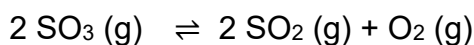
Kgetha ho E KGOLO HO, E NYANE HO kapa E LEKANA LE

Fana ka lebaka la karabo.

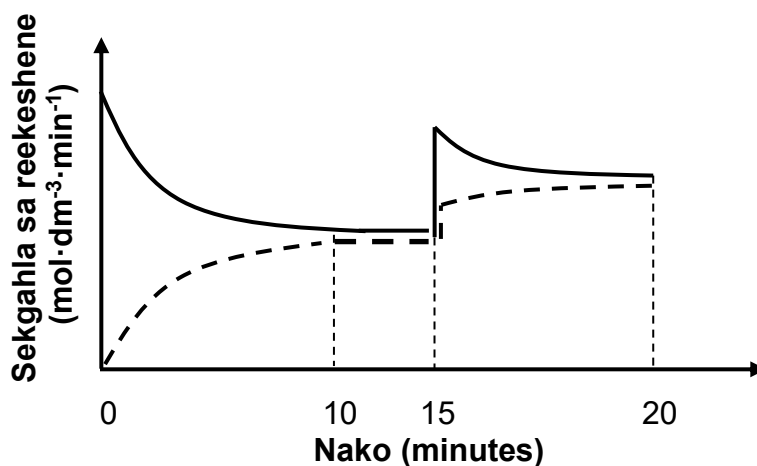
(2)
[19]

POTSO 6 (Qala leqepheng le letjha.)

- 6.1 Kgase ya sulphur trioxide (SO_3) e futhelwa ka hara setshelo se senang letho mme e kwetswe. Reekeshene e latelang e etsahala ka hara setshelo:



Kerafo e ka tlase e bontsha diphetoho ho sekgahla sa reekeshene kgahlanong le nako metsotsong e 20 ya pele.



- 6.1.1 Ngola moelelo wa double arrow " \rightleftharpoons " ho ekweishene. (1)

- 6.1.2 Ke eng e emetsweng ke karolo e tsepameng ya kerafo pakeng tsa $t = 10$ minutes le $t = 15$ minutes (1)

Ho $t = 15$ minutes motjheso wa motswako wa reekeshene setshelong o ile wa fetoha.

- 6.1.3 Na setshelo se ile sa FODISWA kapa sa FUTHUMATSWA ho $t = 15$ minutes? (1)

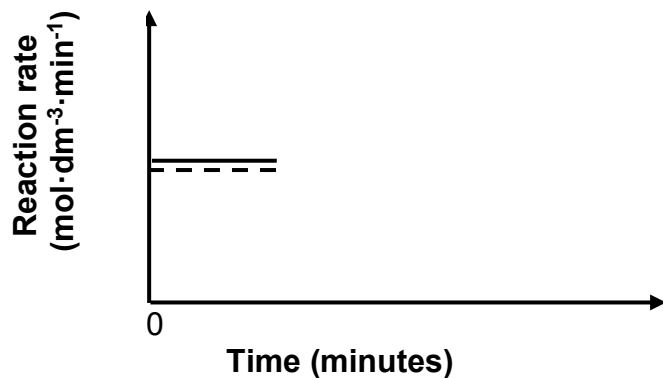
- 6.1.4 Na reekeshene yang pele e EXOTHERMIC kapa ENDOTHERMIC? (1)

- 6.1.5 Hlalosa karabo ya POTSO ya 6.1.4 o itshetlehile ka porinsipole ya Le Chatelier. (2)

Ka mora metsotso e 20 kgatello ya moya ka hara setshelo e nyollotswe ka ho theola mothamo motjhesong o sa fetoheng.

- 6.1.6 Teroya hape kerafo e ka tlase o be o bontshe kgahlamelo eo ho nyolla kgatello ya moya e tla bang le yona ho sekgahla sa reekeshene ho fihlela ekwiliboriamo e ntjha e fihlelletswe.

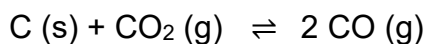
KERAFO YA RATE VERSUS TIME



(2)

- 6.2 Carbon (C) le carbon dioxide (CO₂) di tswakuwe setshelong se senang letho sa 2 dm³ e ileng ya kwalwa.

Ekwishene e latelang e balansitseng e emetse reekeshene e fihlelang ekwiliboriamo ka hara setshelo ho 700 °C.



Ho ekwiliboriamo, ho fumanwe hore konsentereishene ya CO₂ ke 0,05 mol·dm⁻³ le 0,4 moles ya C (s) di teng. Ekwiliboriamo konsetente ya reekeshene ena ho 700 °C ke 0,05.

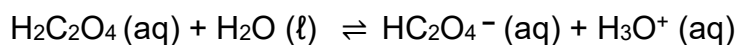
Khaltjhuleitha peresente ya carbon e ileng ya reeketa.

(8)

[16]

POTSO 7 (Qala leqepheng le letjha.)

- 7.1 Shebisisa ionisation ya oxalic acid, $\text{H}_2\text{C}_2\text{O}_4(\text{aq})$, e emetsweng ke ekweishene e latelang e balansitsweng:



Konsentereshene ya sabosetense KA NNGWE e fumanweng ho motswako wa $0,1 \text{ mol} \cdot \text{dm}^{-3}$ ya $\text{H}_2\text{C}_2\text{O}_4$ ho ekwiliboriamo e fanwe tafoleng e latelang:

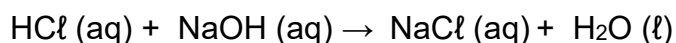
Disabosetense	$\text{H}_2\text{C}_2\text{O}_4$	HC_2O_4^-	H_3O^+
Konsentereishene ($\text{mol} \cdot \text{dm}^{-3}$)	0,046	0,054	0,054

- 7.1.1 Hlalosa asiti ho ya ka theory ya Lowry-Brønsted. (2)
- 7.1.2 Ngola fomulara ya beise reekesheneng e ka hodimo kante ho H_2O . (1)
- 7.1.3 Na oxalic asiti ($\text{H}_2\text{C}_2\text{O}_4$) ke asiti e MATLA kapa e MATLA A FOKOLANG? (1)
- 7.1.4 Hlalosa karabo ho POTSO ya 7.1.3 o itshetleha ho datha e tafoleng. (2)

- 7.2 Motswako wa sodium hydroxide e konsenteretuweng, $\text{NaOH}(\text{aq})$, e hlapollotswe ka metsi ho karolo ya leshome ya konsentereishene ya mantlha.

35 cm^3 ka botlalo ya sodium hydroxide e hlapollotsweng e tswakuwe le motswako wa 25 cm^3 ya hydrochloric asiti, $\text{HCl}(\text{aq})$ ya konsentereishene ya $0,1 \text{ mol} \cdot \text{dm}^{-3}$ folasekeng.

Reekeshene ya nyoteralaeseishene e etsahala folasekeng ho latela ekweishene e balansitsweng:



- 7.2.1 Khaltjhuleitha nomoro ya dimolara tsa qalong tsa HCl ka folasekeng. (3)

pH ya motswako wa qetelo ke 12.

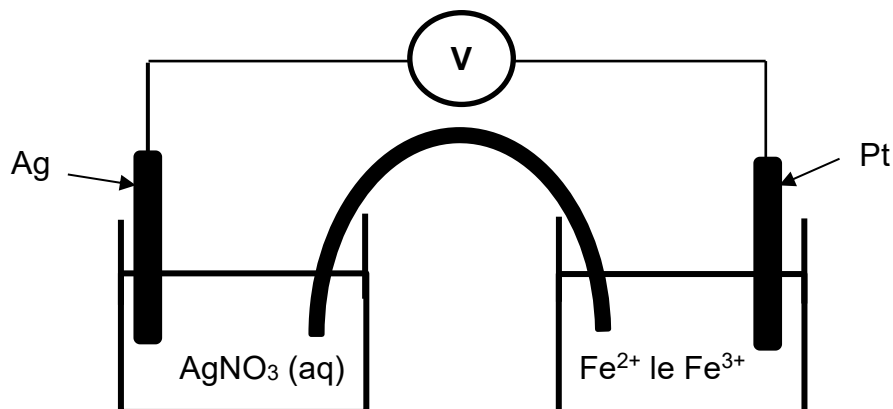
Khaltjhuleitha KONSENTEREISHENE ya:

- 7.2.2 Di-hydroxide ion (OH^-) ho motswako wa qetelo. (4)
- 7.2.3 Sodium hydroxide (NaOH) e konsentereituweng. (6)

[19]

POTSO 8 (Qala leqhepheng le letjha.)

Sele ya kalefaniki e hokahantswe tlasa maemo a lekantsweng. Hafo-sele e nngwe e na le poleiti ya silver, Ag, motswakong o aqueous wa AgNO_3 , ha e nngwe hafo-sele e na le poleite ya inert platinum motswakong o aqueous o nang le, Fe^{2+} le Fe^{3+} , ho ya ka moo ho bontshitweng ka tlase tayakeramong e bebofaditsweng.



- 8.1 Ngola phethoho ya eneji e etsahalang ha sele ena e le tshebetsong. (2)
- 8.2 Mabapi le kalefaniki sele ena, ngola:
- 8.2.1 Hafo-reekeshene ya Okeseteishene (2)
- 8.2.2 Cell notation (3)
- 8.2.3 Maemo a lekantsweng a MABEDI a Fe^{2+} , Fe^{3+} hafo-sele (2)
- 8.3 Khaltjhuleitha emf ya qalo ya sele ena. (4)
- 8.4 Ho tla etsahala eng ho emf e khaltjhuleithuweng ho POTSO ya 8.3, ha motswako wa NaCl o ne o ka sebediswa e le borokgo ba letswai ho sele tlasa maemo a lekantsweng?

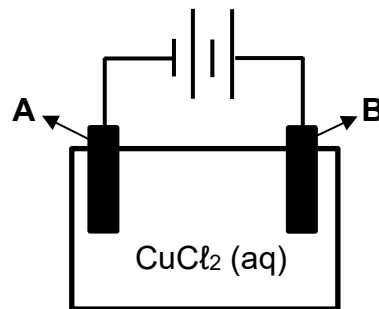
Ngola feela E A ATA, E A FOKOTSEHA kapa E DULA E TSHWANA. (1)

- 8.5 Hlalosa karabo ya POTSO ya 8.4. (2)

[16]

POTSO 9 (Qala leqepheng le letjha.)

Sele ya eleketerolitike e bontshitsweng ka tlase e sebedisitswe e le eleketerolesese ya motswako wa CuCl_2 .



A le **B** ke dieleketerote tsa carbon.

- 9.1 Hlalosa *electrolysis*. (2)
- 9.2 Na process ya eleketerolesese e EXOTHERMIC kapa ENDOTHERMIC? (1)
- 9.3 Ngola hafo-reekeshene e etsahalang ho eleketerote ya **B**.
0,369 g ya Cu e dephosituweng ho cathode metsotsong e 27. (2)
- 9.4 Khaltjhuleita elektrikhale kharente e sebedisitsweng nakong ya porosese ena. (7)
- [12]

MATSHWAO KAOFELA: 150

**NATIONAL SENIOR CERTIFICATE
NASIONALE SENIOR SERTIFIKAAT**

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

**DATHA YA FISIKALE SAENSESE KEREITI YA 12
PAMPIRI YA 2 (KHEMISITIRI)**

TABLE 1: PHYSICAL CONSTANTS/TAFOLE YA 1: DIFISIKALE 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 molar 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: DIFOMULARA

$n = \frac{m}{M}$ or/kapa $n = \frac{N}{N_A}$ or/kapa $n = \frac{V}{V_m}$	$c = \frac{n}{V}$ or/kapa $c = \frac{m}{MV}$ $\frac{c_a V_a}{c_b V_b} = \frac{n_a}{n_b}$	$\text{pH} = -\log[\text{H}_3\text{O}^+]$ $K_w = [\text{H}_3\text{O}^+][\text{OH}^-] = 1 \times 10^{-14} \text{ at /ho } 298\text{K}$
$E^\theta_{\text{cell}} = E^\theta_{\text{cathode}} - E^\theta_{\text{anode}} / E^\theta_{\text{sele}} = E^\theta_{\text{kafode}} - E^\theta_{\text{anote}}$ $E^\theta_{\text{cell}} = E^\theta_{\text{reduction}} - E^\theta_{\text{oxidation}} / E^\theta_{\text{sele}} = E^\theta_{\text{retakeshene}} - E^\theta_{\text{okeseteishene}}$ $E^\theta_{\text{cell}} = E^\theta_{\text{oxidising agent}} - E^\theta_{\text{reducing agent}} / E^\theta_{\text{sele}} = E^\theta_{\text{kemedi e okesetaesang}} - E^\theta_{\text{kemedi e rejusang}}$		
$q = I\Delta t$ $n = \frac{Q}{e}$ or/of $n = \frac{Q}{q_e}$		

TABLE 3: THE PERIODIC TABLE OF ELEMENTS/TAFOLE YA 3: TAFOLE YA PHERIOTIKI YA DIELEMENTE

1 (I)	2 (II)	3	4	5	6	7	8	9	10	11	12	13 (III)	14 (IV)	15 (V)	16 (VI)	17 (VII)	18 (VIII)
KEY/ SESUPO																	
Nomoro ya atomiki/ Atomic number																	
1 H 1																	2 He 4
3 Li 7	4 Be 9																
11 Na 23	12 Mg 24																
19 K 39	20 Ca 40	21 Sc 45	22 Ti 48	23 V 51	24 Cr 52	25 Mn 55	26 Fe 56	27 Co 59	28 Ni 59	29 Cu 63,5	30 Zn 65	31 Ga 70	32 Ge 73	33 As 75	34 Se 79	35 Br 80	36 Kr 84
37 Rb 86	38 Sr 88	39 Y 89	40 Zr 91	41 Nb 92	42 Mo 96	43 Tc 98	44 Ru 101	45 Rh 103	46 Pd 106	47 Ag 108	48 Cd 112	49 In 115	50 Sn 119	51 Sb 122	52 Te 128	53 I 127	54 Xe 131
55 Cs 133	56 Ba 137	57 La 139	72 Hf 179	73 Ta 181	74 W 184	75 Re 186	76 Os 190	77 Ir 192	78 Pt 195	79 Au 197	80 Hg 201	81 Tl 204	82 Pb 207	83 Bi 209	84 Po 210	85 At 210	86 Rn
87 Fr 223	88 Ra 226	89 Ac															
			58 Ce 140	59 Pr 141	60 Nd 144	61 Pm	62 Sm 150	63 Eu 152	64 Gd 157	65 Tb 159	66 Dy 163	67 Ho 165	68 Er 167	69 Tm 169	70 Yb 173	71 Lu 175	
			90 Th 232	91 Pa	92 U 238	93 Np	94 Pu	95 Am	96 Cm	97 Bk	98 Cf	99 Es	100 Fm	101 Md	102 No	103 Lr	

Eleketeroniketifiti
ElectronegativityLetshwao
SymbolBoima ba aporokosimeiti reletifo athomiki/
Approximate relative atomic mass

TABLE 4A: STANDARD REDUCTION POTENTIALS
TAFOLE 4A: RETAHESHENE POTENSHIALE E LEKANTSWENG

Half-reactions/Hafo-reekeshene			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/Kgoneho ya okesetaeseng e eketsehang

Increasing reducing ability/Kgoneho ya rejusing e eketsehang

TABLE 4B: STANDARD REDUCTION POTENTIALS
TAFOLE YA 4B: RETAKESHENE POTENSHIALE E LEKANTSWENG

Half-reactions/Hafo-reekeshene			E^θ (V)
$\text{Li}^+ + \text{e}^-$	\rightleftharpoons	Li	-3,05
$\text{K}^+ + \text{e}^-$	\rightleftharpoons	K	-2,93
$\text{Cs}^+ + \text{e}^-$	\rightleftharpoons	Cs	-2,92
$\text{Ba}^{2+} + 2\text{e}^-$	\rightleftharpoons	Ba	-2,90
$\text{Sr}^{2+} + 2\text{e}^-$	\rightleftharpoons	Sr	-2,89
$\text{Ca}^{2+} + 2\text{e}^-$	\rightleftharpoons	Ca	-2,87
$\text{Na}^+ + \text{e}^-$	\rightleftharpoons	Na	-2,71
$\text{Mg}^{2+} + 2\text{e}^-$	\rightleftharpoons	Mg	-2,36
$\text{Al}^{3+} + 3\text{e}^-$	\rightleftharpoons	Al	-1,66
$\text{Mn}^{2+} + 2\text{e}^-$	\rightleftharpoons	Mn	-1,18
$\text{Cr}^{2+} + 2\text{e}^-$	\rightleftharpoons	Cr	-0,91
$2\text{H}_2\text{O} + 2\text{e}^-$	\rightleftharpoons	$\text{H}_2(\text{g}) + 2\text{OH}^-$	-0,83
$\text{Zn}^{2+} + 2\text{e}^-$	\rightleftharpoons	Zn	-0,76
$\text{Cr}^{3+} + 3\text{e}^-$	\rightleftharpoons	Cr	-0,74
$\text{Fe}^{2+} + 2\text{e}^-$	\rightleftharpoons	Fe	-0,44
$\text{Cr}^{3+} + \text{e}^-$	\rightleftharpoons	Cr^{2+}	-0,41
$\text{Cd}^{2+} + 2\text{e}^-$	\rightleftharpoons	Cd	-0,40
$\text{Co}^{2+} + 2\text{e}^-$	\rightleftharpoons	Co	-0,28
$\text{Ni}^{2+} + 2\text{e}^-$	\rightleftharpoons	Ni	-0,27
$\text{Sn}^{2+} + 2\text{e}^-$	\rightleftharpoons	Sn	-0,14
$\text{Pb}^{2+} + 2\text{e}^-$	\rightleftharpoons	Pb	-0,13
$\text{Fe}^{3+} + 3\text{e}^-$	\rightleftharpoons	Fe	-0,06
$2\text{H}^+ + 2\text{e}^-$	\rightleftharpoons	$\text{H}_2(\text{g})$	0,00
$\text{S} + 2\text{H}^+ + 2\text{e}^-$	\rightleftharpoons	$\text{H}_2\text{S}(\text{g})$	+0,14
$\text{Sn}^{4+} + 2\text{e}^-$	\rightleftharpoons	Sn^{2+}	+0,15
$\text{Cu}^{2+} + \text{e}^-$	\rightleftharpoons	Cu^+	+0,16
$\text{SO}_4^{2-} + 4\text{H}^+ + 2\text{e}^-$	\rightleftharpoons	$\text{SO}_2(\text{g}) + 2\text{H}_2\text{O}$	+0,17
$\text{Cu}^{2+} + 2\text{e}^-$	\rightleftharpoons	Cu	+0,34
$2\text{H}_2\text{O} + \text{O}_2 + 4\text{e}^-$	\rightleftharpoons	4OH^-	+0,40
$\text{SO}_2 + 4\text{H}^+ + 4\text{e}^-$	\rightleftharpoons	$\text{S} + 2\text{H}_2\text{O}$	+0,45
$\text{Cu}^+ + \text{e}^-$	\rightleftharpoons	Cu	+0,52
$\text{I}_2 + 2\text{e}^-$	\rightleftharpoons	2I^-	+0,54
$\text{O}_2(\text{g}) + 2\text{H}^+ + 2\text{e}^-$	\rightleftharpoons	H_2O_2	+0,68
$\text{Fe}^{3+} + \text{e}^-$	\rightleftharpoons	Fe^{2+}	+0,77
$\text{NO}_3^- + 2\text{H}^+ + \text{e}^-$	\rightleftharpoons	$\text{NO}_2(\text{g}) + \text{H}_2\text{O}$	+0,80
$\text{Ag}^+ + \text{e}^-$	\rightleftharpoons	Ag	+0,80
$\text{Hg}^{2+} + 2\text{e}^-$	\rightleftharpoons	$\text{Hg}(\ell)$	+0,85
$\text{NO}_3^- + 4\text{H}^+ + 3\text{e}^-$	\rightleftharpoons	$\text{NO}(\text{g}) + 2\text{H}_2\text{O}$	+0,96
$\text{Br}_2(\ell) + 2\text{e}^-$	\rightleftharpoons	2Br^-	+1,07
$\text{Pt}^{2+} + 2\text{e}^-$	\rightleftharpoons	Pt	+1,20
$\text{MnO}_2 + 4\text{H}^+ + 2\text{e}^-$	\rightleftharpoons	$\text{Mn}^{2+} + 2\text{H}_2\text{O}$	+1,23
$\text{O}_2(\text{g}) + 4\text{H}^+ + 4\text{e}^-$	\rightleftharpoons	$2\text{H}_2\text{O}$	+1,23
$\text{Cr}_2\text{O}_7^{2-} + 14\text{H}^+ + 6\text{e}^-$	\rightleftharpoons	$2\text{Cr}^{3+} + 7\text{H}_2\text{O}$	+1,33
$\text{Cl}_2(\text{g}) + 2\text{e}^-$	\rightleftharpoons	2Cl^-	+1,36
$\text{MnO}_4^- + 8\text{H}^+ + 5\text{e}^-$	\rightleftharpoons	$\text{Mn}^{2+} + 4\text{H}_2\text{O}$	+1,51
$\text{H}_2\text{O}_2 + 2\text{H}^+ + 2\text{e}^-$	\rightleftharpoons	$2\text{H}_2\text{O}$	+1,77
$\text{Co}^{3+} + \text{e}^-$	\rightleftharpoons	Co^{2+}	+1,81
$\text{F}_2(\text{g}) + 2\text{e}^-$	\rightleftharpoons	2F^-	+2,87

Increasing oxidising ability/Kgoneho ya okeetaeseng e keketsehang

Increasing reducing ability/Kgoneho ya rejusing e eketsehang