



basic education

Department:
Basic Education
REPUBLIC OF SOUTH AFRICA

NATIONAL SENIOR CERTIFICATE

**IBANGA LESHUMI
ELINAMBINI**

INZULULWAZI: IKHEMISTRI (P2)

PREPARATORY 2021

AMANQAKU: 150

IXESHA: 3 iiyure



Eli phepha loviwo linamaphepha ali 16 kunye needatha shithi ezi 4.

Ushicilelo luselugcinweni



Nceda utyhile

IMIQATHANGO/IMIYALELO NOLWAZI

1. Bhala inombolo yakho yovavanyo neziko lokubhalela kwizithuba ezilungele oko KWINCWADI YEEMPENDULO.
2. Eli phepha liqulethe imibuzo ELISHUMI. Phendula YONKE imibuzo kweli phepha KWINCWADI YEEMPENDULO.
3. Phendula umbuzo NGAMNYE kwiphepha ELITSHA KWINCWADI YAKHO YEEMPENDULO.
4. Nambarisha iimpindulo zakho ngokuthe ngqo ngalendlela imibuzo yakho inambarishwe ngayo.
5. Shiya umgca OMNYE phakathi kwemibuzwana umzekelo: UMBUZWANA 2.1 no MBUZWANA 2.2.
6. Uvumelekile ukusebenzisa ikhaltyhuleytha engafakwanga lwazi.
7. Ungazisebenzisa izixhobo zeMathematika ezifanelekileyo.
8. Bonakalisa ZONKE iifomyula nee sabstityushini kwizibalo zakho ZONKE.
9. Shiya impindulo yakho YOKUGQIBELA yamanani kubuncinane bee desimali pleyisi EZIMBINI.
10. Xhasa okanye unike iingxoxwana apho zifuneka khona.
11. Uyacetyiswa ukuba usebenzise IIDATHA SHITHI ezikweli phepha.
12. Bhala ngokucocekileyo nangokucacileyo.

UMBUZO 1: UXUBO-KHETHO MIBUZO

Unikwe iimpindulo ezine ezahlukeneyo kule mibuzo ilandelayo. Khetha impindulo echanekileyo uze ubhale kuphela unobumba (A–D) ecaleni kwenombolo yombuzo (1.1–1.10) KWINCWADI YAKHO YEMPENDULO, umzekelo: 1.11 E.

1.1 Yeyiphi eNYPE eyi ALKHEYINI kwezi zilandelayo?

A C_6H_8

B C_6H_{10}

C C_6H_{12}

D C_6H_{14}

(2)

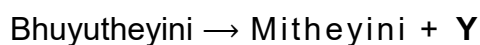
1.2 Ii Esta zifonyishwa nge reaction ephakathi kwe oganikhi khompawundi (organic compounds) ezimbini, u **X** no **Y**, ezikwi fankshinal gruphu ezahlukeneyo.

iifankshinal gruphu zezi khompawundi nazi :

	Ukhompawundi X	Ukhompawundi Y
A	Hydroxyl gruphu	Carboxyl gruphu
B	Hydroxyl gruphu	Carbonyl gruphu
C	Hydroxide ion	Carboxyl gruphu
D	Hydroxide ion	Carbonyl gruphu

(2)

1.3 Xa ibhuyutheyini iphantsi kwamaqondo obushushu (thempritsha) aphezulu no xinzelelo (presha) oluphezulu, le rhiexshini ilandelayo iyenzeka:



Yeyiphi eNYPE kwezi zilandelayo ebonakalisa u **Y**?

A $CHCCH_3$

B CH_2CHCH_3

C $CH_3CH_2CH_3$

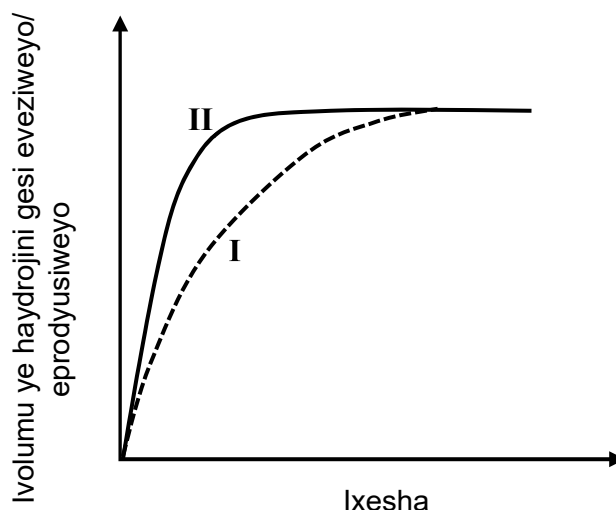
D $CH_3CHCHCH_3$

(2)

- 1.4 Isolushini ye haydroklorikhi asidi, HCl(aq) , ene khonsentreyshini ka $1 \text{ mol} \cdot \text{dm}^{-3}$ yongezwe ku MGUBO OMNINZI (eksesi phawuda) ye magneziyam kwiqondo lobushushu elingu 25°C .

Ukhevu I ongezantsi ubonakalisa ivolumu yehaydrojini gesi evelisiweyo (eprodyusiweyo) kwi rhiexshini.

Ukhevu II ufumaneka kwiikhondishini ezahlukeneneyo kusetyenziswe IVOLUMU ENYE (ENGATSHINTSHWANGA) yesolushini haydroklorik asidi.



Yeyiphi eNYPE kwezi zilandelayo ebonakalisa iikhondishini ezisetyenzisiweyo ukufumana ukhevu II?

	IQONDO LOQHEKEKO (steyithi sedivishini) lwe Mg	IKHONSENTE YSHINI YE ASIDI ($\text{mol} \cdot \text{dm}^{-3}$)	IQONDO LOBUSUSHU (THEMPRITSHA) ($^\circ \text{C}$)
A	Irhibhoni	0,5	25
B	Irhibhoni	2	25
C	Umgubo (iphawuda)	1	20
D	Umgubo (iphawuda)	1	30

(2)

- 1.5 Yeyiphi eNYPE kwezi rhiexshini zilandelayo eyakuthi xa ikwi ekhwilibriyam ibene YILDI ephezulu xa IVOLUMU yekhonteyina yonyusiwe kwiqondo lobushushu lingatshintshi?

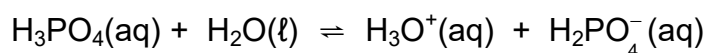
- A $\text{N}_2\text{O}_4(\text{g}) \rightleftharpoons 2\text{NO}_2(\text{g})$
 B $\text{H}_2(\text{g}) + \text{I}_2(\text{g}) \rightleftharpoons 2\text{HI}(\text{g})$
 C $\text{N}_2(\text{g}) + 3\text{H}_2(\text{g}) \rightleftharpoons 2\text{NH}_3(\text{g})$
 D $2\text{SO}_2(\text{g}) + \text{O}_2(\text{g}) \rightleftharpoons 2\text{SO}_3(\text{g})$

(2)

1.6 SESIPHI isiqwengana kwezi zilandeyo ESINYANISILEYO nge EKZOTHEMIKHI rhiexshini?

- A I eneji eninzi iyangeniswa kunokuba ikhululwa.
- B I eneji eninzi iyakhululwa kunokuba ingeniswa.
- C Ihithi (ΔH) ye rhiexshin iphozithivi.
- D I eneji yee prowudakthi inkulu kune eneji yee rhiecten (2)

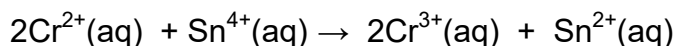
1.7 Qwalasela le ikhweyshini ingezantsi.



Yeyiphi eNYPE kwezi zilandelayo esisibini (pair) sekhonjugeythi-bheysi?

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

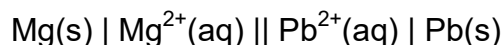
1.8 Qwalasela le ikhweyshini ibhalansiweyo ingezantsi:



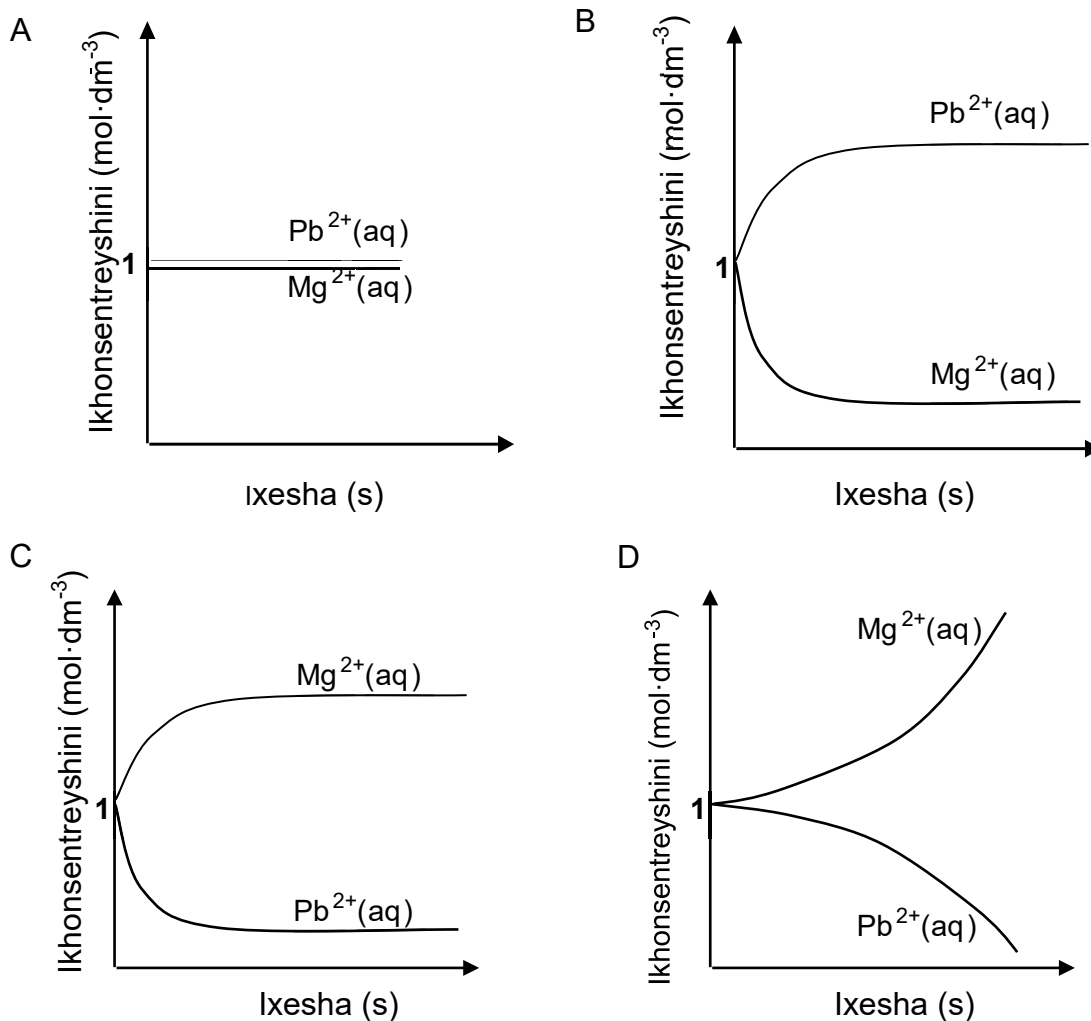
I OXIDISING AGENT yi:

- 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 I elektrokhemikhali seli isetwe kwiistandadi khondishini. Iseli noteyshini yeseli inikiwe ngezantsi.



Iseli ikonekthwe kwi sekethi. Yeyiphi eNVE kwezi grafu zilandelayo ENGCONO kunazo zonke ukubonakalisa iikhonseyntreyshini zee elektrolaythi emva kwexesha elide?



- 1.10 Iingxowa ezimbini ezingama 50 kg, zinee fethelayiza (imigquba) uR no S ngokulandelelana kwazo, zileybhelwe ngoluhlobo lulandelayo:
 Fethelayiza (umgquba) **R**: 3 : 1 : 5 (20)
 Fethelayiza (umgquba) **S**: 1 : 2 : 6 (20)
 Khetha ifethelayiza/iifethelayiza (umgquba/imigquba) eyiyeyona ikulungeleyo ukukhulisa amagqabi kunye neengcambu ngokusempilweini.

	UKUKHULA KWAMAGQABI	UKUKHULA KWENGCAMBU
A	R	R
B	S	R
C	R	S
D	S	S

(2)
[20]



UMBUZO 2 (Qala kwiphepha elitsha.)

Oonobumba **A** ukuya ku **E** kwitheybhile engezantsi babonisa ii oganikhi khompawundi ezintlanu.

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 Bhala phantsi UNOBUMBA obanakalisa IKHOMPAWUNDI NGANYE kwezi zilandelayo:

2.1.1 Ikhethowni (1)

2.1.2 Ihydrokhabhoni (1)

2.1.3 I alkini (1)

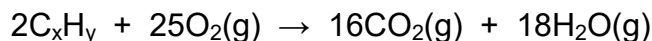
2.2 Bhala phantsi:

2.2.1 Igama lika khompawundi **A** ngokwe IUPAC (3)

2.2.2 ISTRUCTURAL FOMYULA sika khompawundi **D** (2)

2.2.3 Igama ngokwe IUPAC le STRAIGHT FUNCTIONAL ISOMER ka khompawundi **C** (2)

2.3 Ukhompawundi **B** yikhompawundi enetsheyina elenza le rhiexshin ilandelayo e ekzothemikhi:



2.3.1 Ngaphandle kokuba ekzothemikhi, loluphi uhlobo lwerhiexshin olubonakaliswe ngasentla? (1)

2.3.2 Fumana IMOLETYHULA FOMYULA ka khompawundi **B**. (2)

Le rhiexshin ingentla yenzeka kwi khonteyina evaliweyo phantsi kwegondo lobushushu (thempritsha) elingatshintshiyo elingaphezulu kuno 100 °C kunye ne presha engatshintshiyo.

2.3.3 Bala IVOLUMU IYONKE ye gesi eyenzekileyo kwi khonteyina xa u 50 cm³ we C_xH_y erhiexktha ngokupheleleyo ne oksijini. (3)

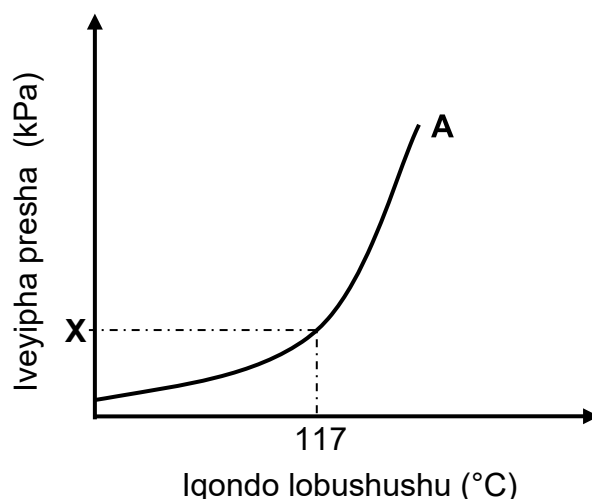
[16]

UMBUZO 3 (Qala kwiphepha elitsha.)

likhompawundi **A**, **B** no **C** zisetyenzisiwe ukuphanda nzulu ifektha ephembelela amaqondo okubila (boiling point) ee oganikhi khompawundi. Iziphumo zophando-nzulu zinikiwe kule theybhile ingezantsi.

IKHOMPAWUNDI		IQONDO LOKUBILA (BOILING POINT) (°C)
A	Butan-1-ol	117
B	Butan-2-ol	100
C	2-methylpropan-2-ol	82

- 3.1 Ingaba luphando olungenamkhethe olu? Khetha ku EWE no HAYI. (1)
- 3.2 Nika isizathu sempendulo oyinike ku MBUZO 3.1. (1)
- 3.3 Chaza ngokupheleleyo umahluko kumaqondo okubila kakhompawundi **B** no **C**. (3)
- 3.4 Chaza eli gama lithi *positional isomer*. (2)
- 3.5 Ukusuka kukhompawundi **A**, **B** no **C**, khetha unobumba/oonobumba ababonakalisa ikhompawundi NGANYE yezi zilandelayo:
- 3.5.1 lipozishinal ayzoma (1)
- 3.5.2 I theshiyari alkhohol
Nika isizathu sempendulo yakho. (2)
- 3.6 Le grafu ingezantsi ibonakalisa unxibelelwano phakathi kwe veypha presha ne qondo lobushushu (thempitsha) lika khompawundi **A** (butan-1-ol).



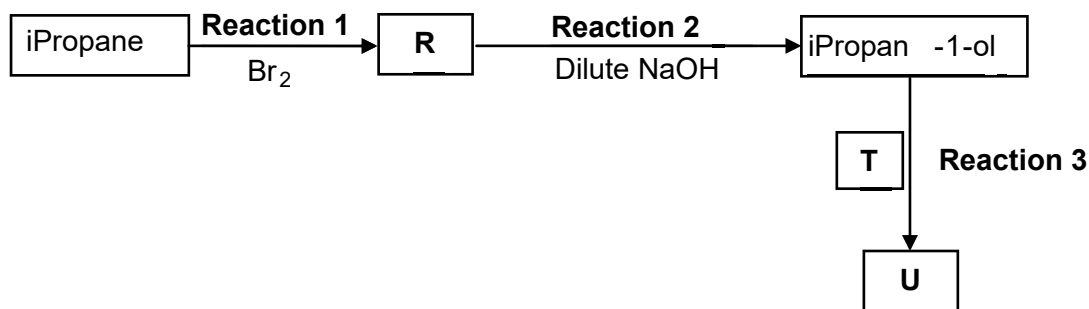
- 3.6.1 Bhala phantsi ubungakanani buka **X**. (1)
- 3.6.2 Zoba kwakhona le grafu ingentla KWINCWADI YEMPENDULO. Kwi seti enye ye eksis, zoba ikhevu kakhompawundi **C** eyakufunyanwa. Lebelisha ngokucacileyo iikhevu **A** no **C**. Bonakalisa ngokucacileyo iqondo lokubila elihambelana no khompawundi **C** kwi grafu. (2)

[13]

UMBUZO 4 (Qala kwiphepha elitsha.)

- 4.1 Umzobo oqukuqelayo (flowu dayagram) ongezantsi ubonakalisa iintlobo zee oganikhi reactions kusetyenziswa u propane njenge sithako (starting reactant) sokuqala. U **R**, u**T** kunye no **U** babonakalisa iintlobo ezohlukeneyo zee oganikhi khompawundi.

U khompawundi **T** yi KHABHOKZILIKHI ASIDI yena u**U** yi FUNCTIONAL AYZOMA ka pentanowikh asidi.



Bhala phantsi IGAMA lohlobo lwe reaction ebonakaliswa ngu:

4.1.1 Reaction 1 (1)

4.1.2 Reaction 2 (1)

Qwalasela **reaction 1** no **reaction 2**.

4.1.3 Bhala phantsi igama lika khompawundi **R** ngokwe IUPAC. (2)

U Reaction 3 wenzeka xa kufakwe ikhathalisti nobushushu.

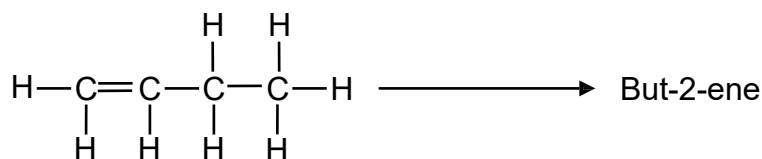
Bhala phantsi:

4.1.4 IGAMA okanye IFOMYULA ye khathalisti (1)

4.1.5 Igama lika khompawundi **T** ngokwe IUPAC (2)

4.1.6 ISTRUCTURAL FOMYULA sika khompawundi **U** (2)

- 4.2 Igcisa lase labholatri lifuna ukwenza I bhuyuthi-2-ini lisebenzisa I bhuyuthi -1-ini njenge sithako (rhieyijenti) sokuqala njengoko kubonakalisiwe ngezantsi.



La machiza (khemikhali) alandelayo akhona elabhoratri:

iH ₂ SO ₄ engangxengwanga	iH ₂ O	iNaOH engangxengwanga
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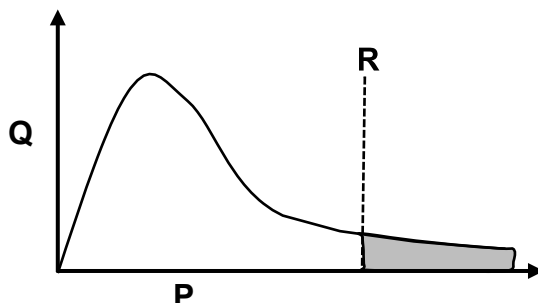
Khetha amachiza afunekayo ukuyila olu lungiselelo lungentla kolu ludwe lunikwe ngentla.

Ngebakala NGALINYE lokulungisela, bhala i ikhweyshini ebhalansayo, usebenzisa IZITRAKTSHARAL FOMYULA zazo zonke ii oganikhi khompawundi. Bonakalisa onke amachiza afunekayo kwibakala ngalinye.

(6)
[15]

UMBUZO 5 (Qala kwiphepha elitsha.)

- 5.1 Phonononga le distribuyushini khevu ka Maxwell-Boltzmann ingezantsi eyenzelwe irhiekshin ethile.



U **P** no **Q** zileyibheli ze eksisi. Yintoni le kwantithi imelwe ngu:

5.1.1 **P** (1)

5.1.2 **Q** (1)

- 5.2 Umgca u **R** ubonakalisa eyona enejini incinane efunekayo ukuze irhiekshin yenzeke.

5.2.1 Bhala phantsi igama lesi siqwengana sikrwelelwe umgca ngaphantsi. (1)

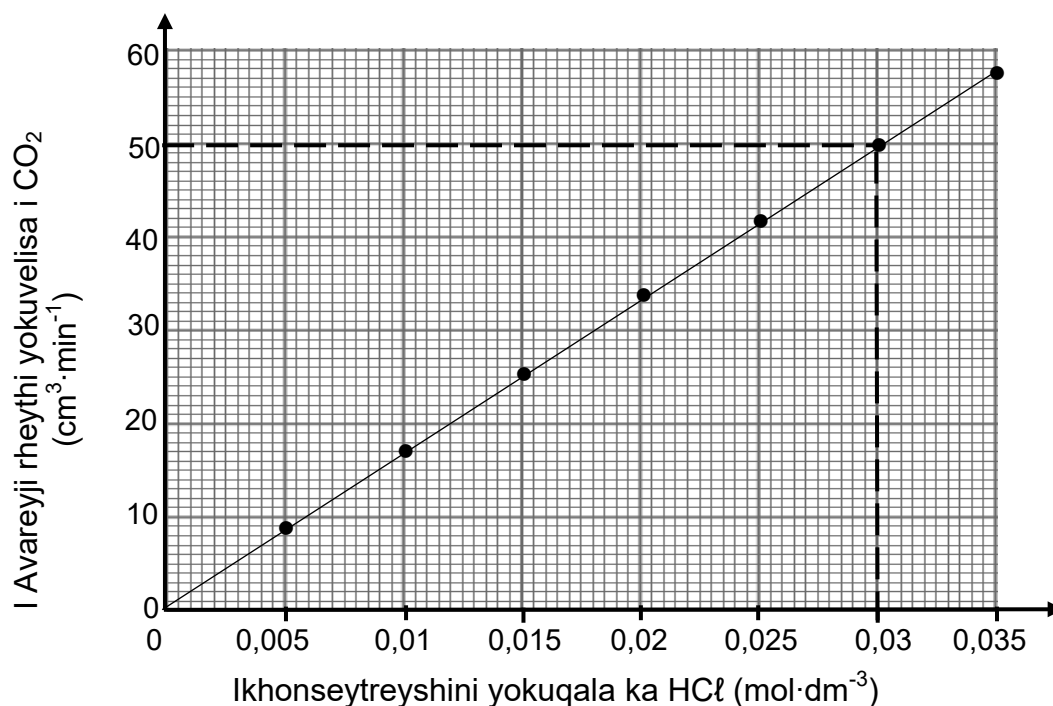
5.2.2 Ingaba iyakuchaphazeleka njani le eriya irhixiziweyo kwigrafu xa kongezwe ikhathalisti? Khetha ku IYENYUKA, IYEHLA okanye IHLALA INJALO. (1)

- 5.3 Sebenzisa ikholishin thiyori ukucacisa ukuba ikhathalisti iyichaphazela njani irheyithi ye rhiekshin. (4)

- 5.4 Irhiekshin pakathi ko MGUBO we khalsiyam khabhoneyithi ne $\text{CaCO}_3(\text{s})$, ne haydroklorikhi asidi EGQITHISILEYO, $\text{HCl}(\text{aq})$, isetyenzisiwe ukuphanda nzulu nge rhiexshin rheyithi ku 25°C . I ikhweyishin ebhalansayo yale rhiexshin ithi:



Ii eksperiment eziliqela zenziwe kusetyenziswa imesi enye ye khalsiyam khabhoneyithi ENGACOCKKANGA kunye nee khonseyntreyshini zokuqala ezohlukeneyo ze hayidroklrikhi asidi engxengiweyo. Igrafu engezantsi ibonakalisa iziphumo ezifunyenweyo. Thatha ngokuba izingcolisi azirhiexkthi.



Ngolu phando, bhala phantsi i:

5.4.1 Ivaryebli ekhontrolweyo (1)

5.4.2 Isigqibo (conclusion) (2)

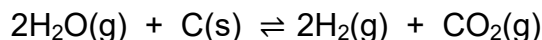
I $\text{CaCO}_3(\text{s})$ kwi 6 g ye sampula engacocokanga irhiexktha ngokupheleleyo ne $0,03 \text{ mol} \cdot \text{dm}^{-3} \text{ HCl}(\text{aq})$ kwimizuzu engama 26.

5.4.3 Sebenzisa ulwazi olukwi grafu ukubala ipesenteyiji phiyurithi ye calcium carbamate. Thatha ngokuba imowula gesi volumu ku 25°C ngu $24\,000 \text{ cm}^3$.

(6)
[17]

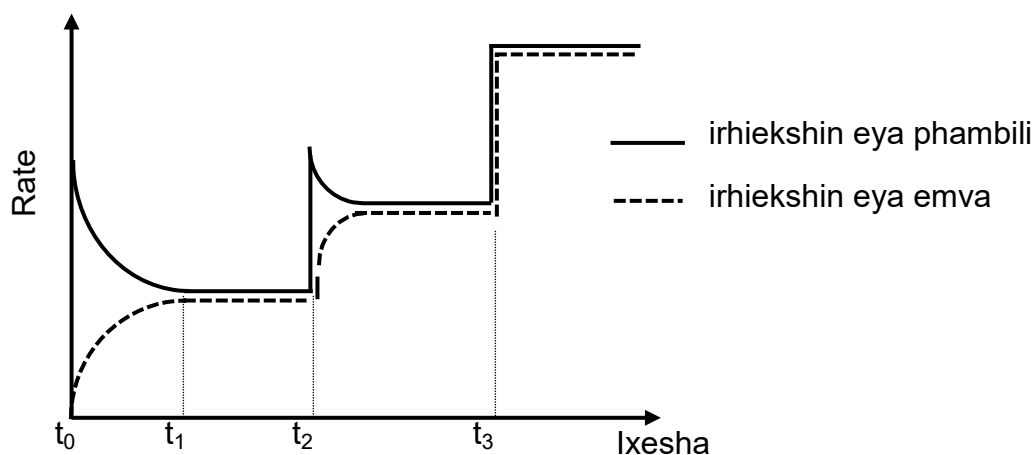
UMBUZO 6 (Qala kwiphepha elitsha.)

Umophu, $\text{H}_2\text{O(g)}$, urhiektha ne khabhon, C(s) eshushu , ku $1\,000\,^\circ\text{C}$ ngokwale ikhweyishin ibhalansayo:



Ekuqaleni, u 36 g womophu nomyinge othile we khabhon babekwe kwi khonteyna engu $2\,\text{dm}^3$ evingciweyo baze bavunyelwa ukuba barhiekthe. Kwi ekhwilibriyam kufunyaniswe okokuba umyinge we khabon utshintshe ngo 0,225 mol.

- 6.1 Chaza igama u*dynamic equilibrium*. (2)
- 6.2 Bala I ekhwilibriyam khonstenti, K_c , yereaction ku $1\,000\,^\circ\text{C}$. (8)
- 6.3 Igrafu ibonisa ukuba zitshintsha njani irheyithi yerhiekshin eya phambili neya emva ngokuhamba kwexesha. (2)



- 6.3.1 Nika isizathu sokuba kutheni irheyithi ye rhiexshini eya phambili incipha phakathi ko t_0 no t_1 . (1)
- 6.3.2 Kwenziwe oluphi utshintsho kumxube okwi equilibrium ku t_3 ? (1)
- Kwixesha elingu t_2 , Iqondo lobushushu le sistimu lonyusiwe.
- 6.3.3 Ingaba irhiekshin eya phambili I EXOTHERMIC okanye I ENDOTHERMIC? (1)
- 6.3.4 Ngokubhekisele kumgaqo ka Le Chatelier cacisa impedulo KUMBUZO 6.3.3. (2)

[15]

UMBUZO 7 (Qala kwiphepha elitsha.)

Ibhikha ezimbini, u **A** no **B**, baqulethe iibheyisi ezi strongo.

Ubhikha **A**: 500 cm^3 ye barium hydroxide, $\text{Ba}(\text{OH})_2(\text{aq})$ ene khonseyntreyshini engaziwayo engu **X**

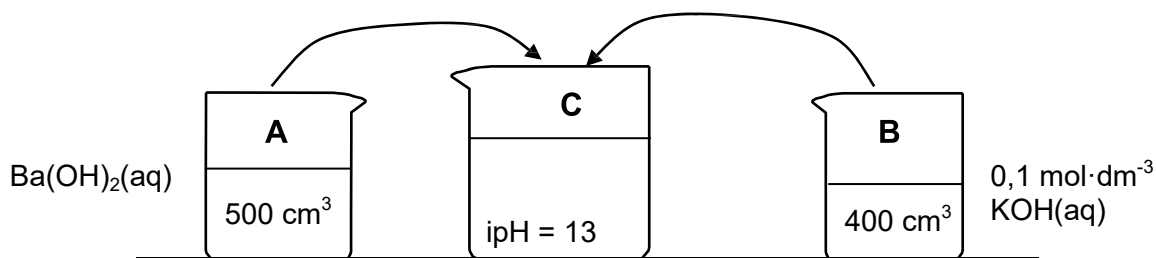
Ubhikha **B**: 400 cm^3 ye potassium hydroxide, $\text{KOH}(\text{aq})$ enekhonsentreyshini engu $0,1\text{ mol}\cdot\text{dm}^{-3}$

7.1 Chaza ibase ngokwe thiyori ka Arrhenius. (2)

7.2 Bala inombolo yee mowuli zehydroksayidi ayoni (OH^-) kubhikha **B**. (2)

7.3 Okuqulethwe kwi bhikha(beaker) **A** no **B** kudityaniswe konke kubhikha **C**. Isolushin ku bhikha **C** ine pH engu 13.

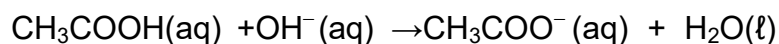
Thatha ngokuba iivolumu ziyadibaniseka kwaye lqondo lobushushu le solushini ngu $25\text{ }^\circ\text{C}$.



7.3.1 Bala ikhonseyntreyshini, u **X**, ye $\text{Ba}(\text{OH})_2$ kubhikha **A**. (8)

Isolushini ku bhikha **C** ithayitreythwe nge ethanowikhi asidi. Kufunyaniswe ukuba i 15 cm^3 ye solushini inyutralayza u 30 cm^3 we asidi.

i ikhweyshin ye reaction ebhalansiweyo ithi:



7.3.2 Ingaba i ethanoic acid, $\text{CH}_3\text{COOH}(\text{aq})$, yi acid e WEAK okanye ESTRONG?

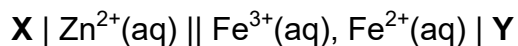
Nika isizathu sempendulo yakho. (2)

7.3.3 Bala ikhonseyntreyshini ye ethanoic acid. (4)

[18]

UMBUZO 8 (Qala kwiphepha elitsha.)

Igalvanikhi seli kwiimeko eziqingqiweyo (kwiistandadi khondishini) ibonakaliswa ngale seli noteyshini ingezantsi. U **X** no **Y** zii elektrowudi ezingaziwayo.



8.1 Bhala phantsi IGAMA okanye IFOMYULA ka:

8.1.1 Elektrowudi **X** (1)

8.1.2 Elektrowudi **Y** (1)

8.1.3 oksidayzing eyijent (1)

8.2 Bhala phantsi:

8.2.1 Umsebenzi UBEMNYE ka elektrowudi **Y** (1)

8.2.2 Ihafu yerhiekshini eyenzeka ku elektrowudi **Y** (2)

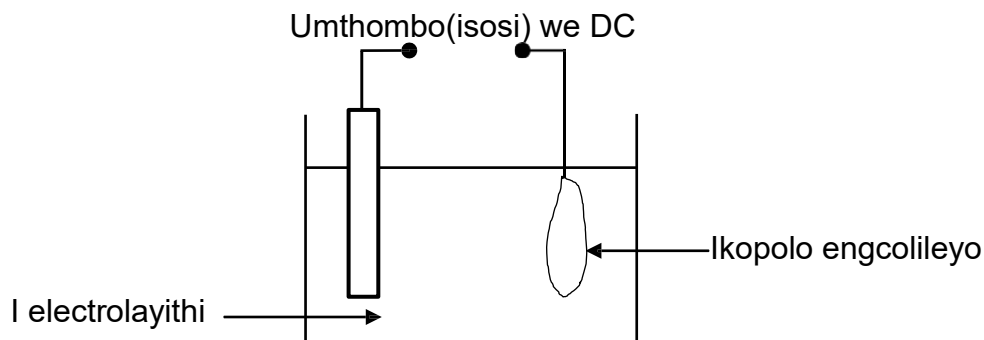
8.2.3 Inethi (epheleleyo) ikhweyshini yeseli rhiekshini eyenzeka kule seli. (3)

8.3 Bala i emf yokuqala yale seli. (4)

8.4 Ingaba i emf yokuqala iyakuchaphazeleka njani xa ikhonseytreysin ye ayoni zika ayon (III) itshintshwe yangu $0,6 \text{ mol} \cdot \text{dm}^{-3}$? Khetha ku IYENYUKA, IYEHLA okanye IHLALA INJALO. (1)
[14]

UMBUZO 9 (Qala kwiphepha elitsha.)

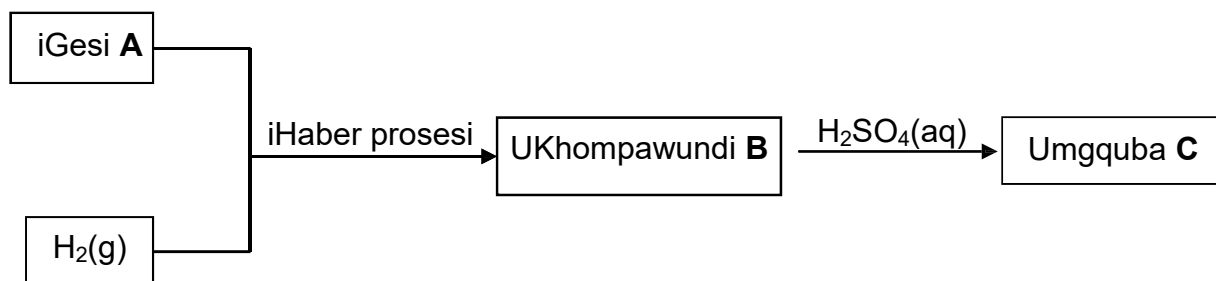
Lo mzobo ushwankathelweyo ungezantsi ubonisa I elektrokhemikhali seli esentyenziselwe ukucoca ikopolo. Ikopolo engacocekanga iqulethe imiyinge emincinci ye silivere (Ag) kunye ne zinki (Zn) njenge zingcolisi ekuphela kwazo.



- 9.1 Chaza igama elingu *elektrolisis*. (2)
- 9.2 Bhala phantsi IGAMA okanye IFOMYULA yee ayoni EZIMBINI ezipozithivi ezikhoyo kwi electrolyayithi. (2)
- 9.3 Bhala phantsi I hafu yerhiekshin eyenzeka kwi khathowudi. (2)
- 9.4 Sebenzisa itheybhile yee Standadi Rhidakshini Potenshiyali ucacise ukuba kutheni ikopolo ecociweyo INGAZUKUQULATHA zinki. (3)
- 9.5 Bala imesi ephezulu kunazo zonke ka Cu eyenzekileyo ukuba iimowuli eziyi 0,6 zee elektroni zidlulisiwe(transferiwe). (3)
- [12]**

UMBUZO 10 (Qala kwiphepha elitsha.)

- 10.1 Umzobo oqukuqelayo (iflowu dayagram) ubonakalisa iprosesi ezichaphazelekayo ekuvelisweni komgquba (fethelayiza) **C**.



Bhala phantsi IGAMA okanye IFOMYULA:

10.1.1 kaGesi **A** (1)

10.1.2 yekhathalisti esetyenziswe kwi Haber prosesi (1)

10.1.3 kakhompawundi **B** (1)

Bhala phantsi:

10.1.4 Igama le prosesi esetyenzisiweyo ukuvelisa igesi **A** (1)

10.1.5 I ikhweyshin ebhalansayo yokuvelisa umgquba **C** (3)

- 10.2 Ingxowa engama 40 kg yomgquba iqulethe i65% yefila. Imesi yeenyutriyenti engxoweni ibonakaliswe kwitheybhile engezantsi.

NUTRIENTS	MASS (kg)
iNitrogen	x
Phosphorus	2x
iPotassium	5

Bala i NPK rheysho yomgquba.

(3)
[10]

EWONKE: 150

IDATHA YE NZULULWAZI
IBANGA LE 12
IPHEPHA 2 (IKHEMISTRI)

TABLE 1: PHYSICAL CONSTANTS//THEYBHILE 1: I KHONSTENTI EZIFIZIKHALI

NAME//IGAMA	SYMBOL//ISIMBOLI	VALUE//IVELU
Standard pressure <i>IStandadi presha(ipresha ekwibakala elifanayo)</i>	p^θ	$1,013 \times 10^5 \text{ Pa}$
Molar gas volume at STP <i>Imola gesi volumu eku STP</i>	V_m	$22,4 \text{ dm}^3 \cdot \text{mol}^{-1}$
Standard temperature <i>iStandadi tempritsha(lqondo lobushushu elikwibakala elifanayo)</i>	T^θ	273 K
Charge on electron <i>Itshaji ye elektroni</i>	e	$-1,6 \times 10^{-19} \text{ C}$
Avogadro's constant <i>Ikhonstenti ka Avogadro</i>	N_A	$6,02 \times 10^{23} \text{ mol}^{-1}$

TABLE 2: FORMULAE//THEYBHILE 2: I I FOMYULA

$n = \frac{m}{M}$	$n = \frac{N}{N_A}$
$c = \frac{n}{V}$ or/of $c = \frac{m}{MV}$	$n = \frac{V}{V_m}$
$\frac{c_a v_a}{c_b v_b} = \frac{n_a}{n_b}$	$\text{pH} = -\log[\text{H}_3\text{O}^+]$
$K_w = [\text{H}_3\text{O}^+][\text{OH}^-] = 1 \times 10^{-14} \text{ at/by } 298 \text{ K}$	
$E^\theta_{\text{cell}} = E^\theta_{\text{cathode}} - E^\theta_{\text{anode}} \quad / E^\theta_{\text{seli}} = E^\theta_{\text{khathowudi}} - E^\theta_{\text{anowudi}}$ or/okanye $E^\theta_{\text{cell}} = E^\theta_{\text{reduction}} - E^\theta_{\text{oxidation}} \quad / E^\theta_{\text{seli}} = E^\theta_{\text{redakshini}} - E^\theta_{\text{oksideyshini}}$ or/okanye $E^\theta_{\text{cell}} = E^\theta_{\text{oxidisingagent}} - E^\theta_{\text{reducingagent}} \quad / E^\theta_{\text{seli}} = E^\theta_{\text{I oksidayizingi eyijenti}} - E^\theta_{\text{iredyusingi eyijent}}$	

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
(I)	(II)							Atoomgetal				(III)	(IV)	(V)	(VI)	(VII)	(VIII)
KEY / SI FI / TEI																	

[illegible]

TABLE 4A: STANDARD REDUCTION POTENTIALS
ITHEYBHILE 4A: YE STANDADI REDAKSHINI

Half-reactions/iiHafu rhiekshini	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/Ukwenyuka kwe oksidayizingi abhithi

Increasing reducing ability/Toenemende reduserende vermoë

TABLE 4B: STANDARD REDUCTION POTENTIALS
TABEL 4B: STANDAARD-REDUKSIEPOTENSIALE

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

Increasing oxidising ability/Ukunyuka kwe oksidayizingi

Increasing reducing ability/Toenemende reduserende vermoë



