education

Department:
Education
REPUBLIC OF SOUTH AFRICA

NATIONAL SENIOR CERTIFICATE

GRADE/*GRAAD* 12

PHYSICAL SCIENCES: CHEMISTRY (P2)
FISIESE WETENSKAPPE: CHEMIE (V2)

MEMORANDUM

NOVEMBER 2008

MARKS/*PUNTE*: 150

This memorandum consists of 18 pages.
Hierdie memorandum bestaan uit 18 bladsye.

Learning Outcomes and Assessment Standards ***Leeruitkomste en Assesseringstandaarde***		
LO 1/*LU 1*	**LO 2/*LU 2***	**LO 3/*LU 3***
AS 12.1.1: Design, plan and conduct a scientific inquiry to collect data systematically with regard to accuracy, reliability and the need to control variables. *Ontwerp, beplan en voer 'n wetenskaplike ondersoek uit om data te versamel ten opsigte van akkuraatheid, betroubaarheid en die kontroleer van veranderlikes.* **AS 12.1.2:** Seek patterns and trends, represent them in different forms, explain the trends, use scientific reasoning to draw and evaluate conclusions, and formulate generalisations. *Soek patrone en tendense, stel dit in verskillende vorms voor, verduidelik tendense, gebruik wetenskaplike beredenering om gevolgtrekkings te maak en te evalueer, en formuleer veralgemenings.* **AS 12.1.3:** Select and use appropriate problem-solving strategies to solve (unseen) problems. *Kies en gebruik geskikte probleemoplossingstrategieë om (ongesiene) probleme op te los.* **AS 12.1.4:** Communicate and defend scientific arguments with clarity and precision. *Kommunikeer en verdedig wetenskaplike argumente duidelik en presies.*	**AS 12.2.1:** Define, discuss and explain prescribed scientific knowledge. *Definieer, bespreek en verduidelik voorgeskrewe wetenskaplike kennis.* **AS 12.2.2** Express and explain prescribed scientific principles, theories, models and laws by indicating the relationship between different facts and concepts in own words. *Verduidelik en druk voorgeskrewe wetenskaplike beginsels, teorieë, modelle en wette uit deur die verwantskap tussen verskillende feite en konsepte in eie woorde aan te dui.* **AS 12.2.3:** Apply scientific knowledge in everyday life contexts. *Pas wetenskaplike kennis in kontekste van die alledaagse lewe toe.*	**AS 12.3.2:** Research case studies and present ethical and moral arguments from different perspectives to indicate the impact (pros and cons) of different scientific and technological applications. *Vors gevallestudies na en lewer etiese en morele argumente uit verskillende perspektiewe om die impak (voordele en nadele) van verskillende wetenskaplike en tegnologiese toepassings aan te dui.* **AS 12.3.3:** Evaluate the impact of scientific and technological research and indicate the contribution to the management, utilisation and development of resources to ensure sustainability continentally and globally. *Evalueer die impak van wetenskaplike en tegnologiese navorsing en dui die bydrae tot bestuur, benutting en ontwikkeling van bronne om volhoubaarheid kontinentaal en globaal te verseker.*

SECTION A/*AFDELING A*

QUESTION 1/*VRAAG 1*

1.1	Endothermic / *Endotermies* ✓	[12.2.3]	(1)
1.2	Dynamic / *Dinamiese*✓		
	(Chemical equilibrium: no marks / *Chemiese ewewig: geen punte*)	[12.2.1]	(1)
1.3	Oxidation / *Oksidasie* ✓	[12.2.1]	(1)
1.4	Membrane (cell) / M*embraan(sel)* ✓ **Accept/*Aanvaar*** Diaphragm (cell) / *Diafragma(sel)* mercury (cell) / *kwik(sel)* chlor alkali (cell) */ chlooralkalie(sel)*	[12.2.1]	(1)
1.5	Functional group / *Funksionele groep*✓	[12.2.1]	(1) **[5]**

QUESTION 2/*VRAAG 2*

2.1	D ✓	[12.2.1]	(1)
2.2	F ✓	[12.2.1]	(1)
2.3	J ✓	[12.2.1]	(1)
2.4	A ✓	[12.2.1]	(1)
2.5	I ✓	[12.2.1]	(1) **[5]**

QUESTION 3/*VRAAG 3*

3.1 True / *Waar* ✓✓ [12.2.1] (2)

3.2 True / *Waar* ✓✓ [12.1.2] (2)

3.3 False / *Onwaar* ✓
[A][B] > [C][D]✓

OR/*OF*
[C][D] < [A][B]

OR/OF
… K_c > 1, … [12.2.3] (2)

3.4 True / *Waar* ✓✓ [12.2.3] (2)

3.5 False / *Onwaar* ✓
… an increase in the rate of the reaction ✓/*… 'n verhoging in reaksietempo*
OR/*OF*
… an increase in the rate of production of products /*… 'n verhoging in die tempo waarteen produkte vorm*
OR/OF
… higher concentration per second/ … hoër konsentrasie per sekonde
OR/OF
Pt decreases the activation energy */ Pt verlaag die aktiveringsenergie* [12.2.3]
OR/OF
Does not ensure a high concentration of products */ Verseker nie 'n hoë konsentrasie van produkte nie* (2)
[10]

QUESTION 4/*VRAAG 4*

4.1 B ✓✓✓ [12.2.3] (3)

4.2 D ✓✓✓ [12.2.2] (3)

4.3 C ✓✓✓ [12.2.2] (3)

4.4 C ✓✓✓ [12.1.2] (3)

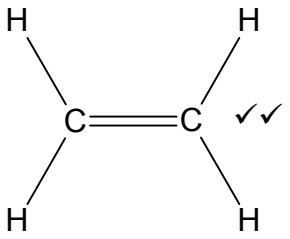
4.5 D ✓✓✓ [12.1.2] (3)
[15]

TOTAL SECTION A: 35
***TOTAAL AFDELING A:* 35**

SECTION B/*AFDELING B*

QUESTION 5/*VRAAG 5*

5.1



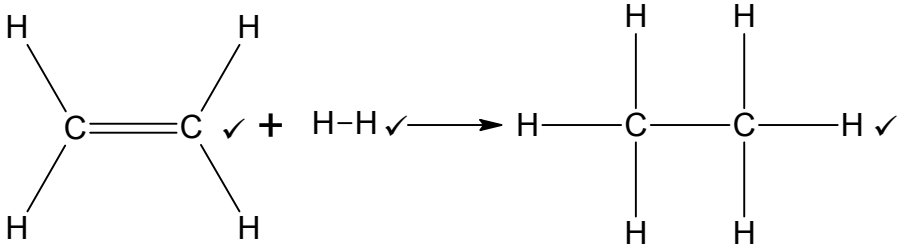
✓✓ [12.2.3] (2)

5.2 The ethene liberated by the banana ages the cabbage and lettuce.✓ ✓
Die eteen wat deur die piesang vrygestel is, verouder die kool en die blaarslaai. [12.3.2] (2)

5.3 C_nH_{2n} ✓ [12.2.1] (1)

5.4 A: substitution (halogenation/bromination) / *substitusie (halogenering / brominering)*✓
B: addition (hydrogenation) / *addisie (hidrogenering)*✓
D: addition (hydration) / *addisie (hidrasie/hidrering)* ✓
H: substitution/ *substitusie* ✓ [12.1.2] (4)

5.5



[12.2.3] (3)

5.6 HBr ✓✓
(Hydrogen bromide – one mark / *Waterstofbromied – een punt*) [12.1.2] (2)

5.7.1 *E: concentrated / gekonsentreerd* ✓
G: dilute / verdund ✓

OR/*OF*
Base is more concentrated in reaction E than in reaction G or base is less concentrated in reaction G than in reaction E ✓✓
Basis is meer gekonsentreerd in reaksie E as in reaksie G of basis is minder gekonsentreerd in reaksie G as in reaksie E

OR/OF
Base in reaction E is dissolved in ethanol (no water added) ✓✓
Basis in reaksie E is in etanol opgelos (geen water nie) [12.1.2] [12.2.3] (2)

5.7.2 Dehydrohalogenation/*Dehidrohalogenering* ✓ [12.1.2] (1)

[17]

QUESTION 6/*VRAAG 6*

6.1.1 **Investigative question / *Ondersoekende vraag*:**
Which one of the <u>two compounds (X and Y)</u> is <u>saturated / unsaturated</u>? ✓✓
Watter een van die verbindings (X en Y) is versadig / onversadig?

OR/OF
Is X <u>saturated</u>?
Is X versadig?

No marks if an aim or hypothesis is stated / Geen punte as stelling of hipotese gegee word [12.1.1] (2)

TEST FOR SATURATION USING BROMINE/IODINE
TOETS VIR VERSADIGING DEUR VAN BROOM/JODIUM GEBRUIK TE MAAK

6.1.2 **Apparatus and chemicals/*Apparaat en chemikalieë*:**
Bromine water(solution) / Br_2 or iodine (solution) / I_2 ✓
Broomwater(oplossing)/ Br_2 of jodium / I_2(oplossing)
Test tubes / suitable containers /measuring cylinder / dropper✓
Proefbuise/geskikte houers/maatsilinder/drupper [12.1.1] (2)

6.1.3 **Safety precautions/*Veiligheidsmaatreëls*:**
- <u>Protective clothing</u> : Use gloves / Avoid contact with skin/ goggles *Gebruik handskoene/ vermy kontak met die vel / veiligheidsbrille* ✓
- Work in fume cupboard /mask(well ventilated room /outside) / Do not inhale✓ *Werk in 'n dampkas/masker (goed geventileerde vertrek/werk buitekant) /Moenie inasem nie*
- No open flames*/Geen oop vlamme nie* [12.1.1] (2)

6.1.4 **Procedure / *Prosedure* (4 marks):**
- Add bromine water / iodine solution (iodine)✓
- to each of compounds X and Y in the test tubes ✓
- Compare / note /record/ observe ✓the (rate of) colour change ✓ (decolourisation) for the two compounds.

- *Voeg broomwater/jodiumplossing (jodium)*
- *by elk van verbindings X en Y in die proefbuise*
- *Vergelyk / noteer/ skryf neer die (tempo van) kleurverandering (ontkleuring) vir die twee verbindings.* [12.1.1] (4)

BOILING POINT METHOD / KOOKPUNT METODE

6.1.2 **Apparatus and chemicals/*Apparaat en chemikalieë*:**
Any two / *Enige twee*
Water bath/*Waterbad* ✓
Heat source */ Bron van hitte* ✓
Retort stand /*Retortstaander/Kolfstaander*
Thermometer / *Termometer* [12.1.1] (2)

6.1.3 **Safety precautions/*Veiligheidsmaatreëls*:**
Any two / *Enige twee*

- Protective clothing : Use gloves / Avoid contact with skin/ goggles *Gebruik handskoene/ vermy kontak met die vel / veiligheidsbrille* ✓
- Work in fume cupboard /mask(well ventilated room /outside) / Do not inhale✓ *Werk in 'n dampkas/masker (goed geventileerde vertrek/werk buitekant) /Moenie inasem nie*
- No open flames / *Geen oop vlamme*

[12.1.1] (2)

6.1.4 **Procedure / *Prosedure* (4 marks):**

- Set up the apparatus with the thermometer in the waterbath ✓
  Stel die apparaat op met die termometer in die waterbad
- Place the test tubes containing the liquids in the water bath ✓
  Plaas die proefbuise wat die vloeistowwe bevat in die waterbad
- Heat waterbath gently until the each liquid boils✓
  Verhit die waterbad versigtig totdat elke vloeistof kook
- Record/compare the temperature at which the solutions boil✓
  Vergelyk/teken die temperatuur waarteen elke vloeistof kook op

[12.1.1] (4)

6.2 **SATURATION TEST / TOETS VIR VERSADIGING**

The solution that shows a rapid colour change is unsaturated. ✓✓ /*Die oplossing wat 'n kleurverandering toon, is onversadigd.*

OR/OF

The solution that shows no or a slow rate of colour change (no reaction takes place) is saturated. ✓✓ / *Die oplossing wat geen of stadige tempo van kleurverandering toon (geen reaksie vind plaas), is versadigd.*

BOILING POINT METHOD

The compound which has the higher boiling point is saturated✓✓/ *Die verbinding met die hoogste kookpunt is versadig*

OR/OF

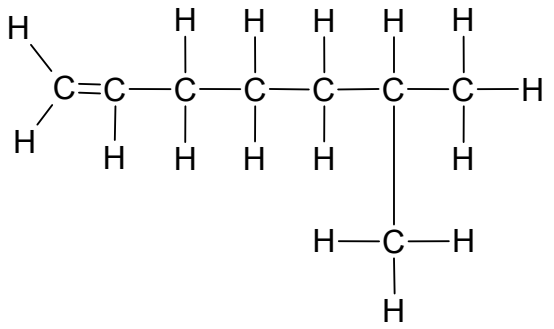
The compound with the lower boiling point is unsaturated ✓✓ / *Die verbinding met die laer kookpunt is onversadig* [12.1.2] (2)

6.3 Any one/*Enigeen*
1-pentene / pent-1-ene / *1-penteen / pent-1-een*✓✓
OR/OF
2-pentene / pent-2-ene / *2-penteen* / *pent-2- een*
OR/OF
3-methyl-1-butene / 3-methylbut-1-ene
3-metiel-1-buteen/3-metielbut-1-een
OR/*OF*
2-methyl-1-butene / 2-methylbut-1-ene
2-metiel-1-buteen /2-metielbut-1-een
OR/*OF*
2-methyl-2-butene / 2-methylbut-2-ene
2-metiel-2-buteen/2-metielbut-2-een [12.2.3] (2)
[14]

QUESTION 7/*VRAAG 7*

7.1 Butanoic acid/*Butanoësuur* ✓ [12.2.1] (1)

7.2



✓✓

[12.2.3] (2)

7.3 Amides / *amiede* ✓ [12.2.3] (1)

7.4 1-propanol / propan-1-ol / ethylmethylether ✓✓
1-propanol / propan-1-ol /etielmetieleter [12.2.3] (2)

7.5 Amines are (weak) bases, ✓ lemon juice is an acid and therefore a neutralisation reaction ✓takes place to mask the smell (odour).
Amiene is (swak) basisse, suurlemoensap is suur en daarom sal 'n neutralisasiereaksie plaasvind om die reuk te verminder.

OR/OF
The base (amine) ✓ neutralises the acid ✓./*Die basis (amien) neutraliseer die suur*. [12.3.2] (2)
[8]

QUESTION 8/*VRAAG 8*

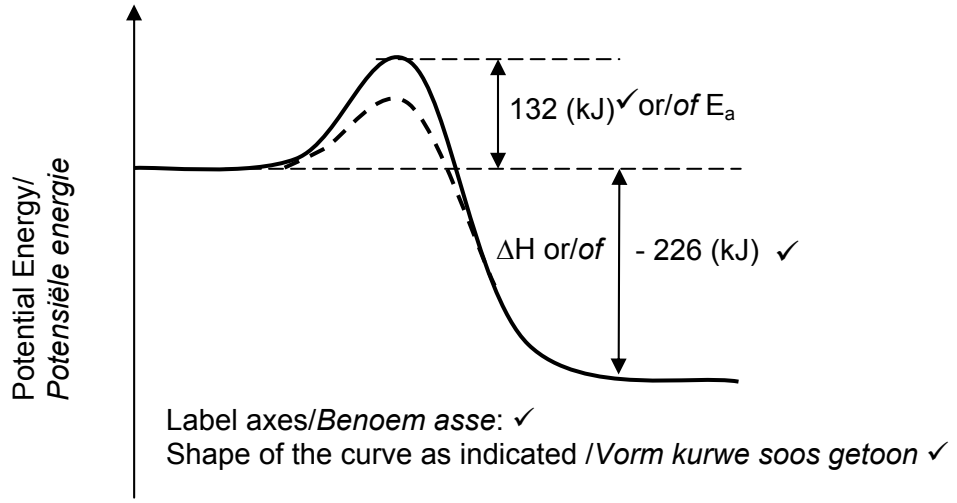
8.1.1 Sufficient kinetic energy (molecules move fast enough) of molecules A and B for the collisions ✓
Molecules A and B must be correctly orientated✓

Voldoende kinetiese energie (molekule beweeg vinnig genoeg) van molekule A en B vir die botsings
Korrekte oriëntasie van die molekule A en B. [12.2.1] (2)

8.1.2 Increase in temperature means:
More molecules move fast enough or have sufficient $E_{k.}$ ✓
There are more effective collisions. ✓

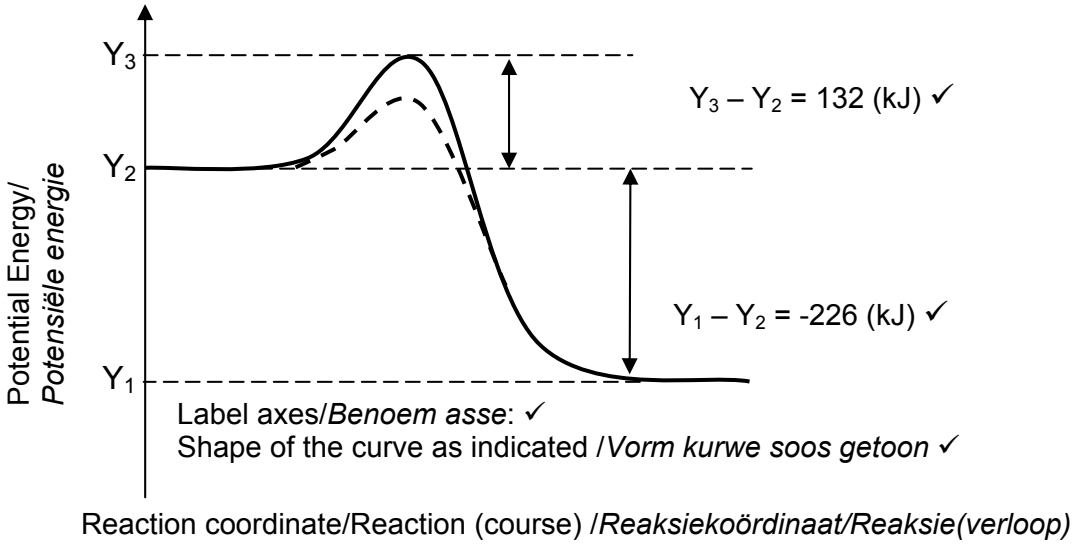
Toename in temperatuur beteken:
Meer molekule beweeg vinnig genoeg of het genoeg E_k. ✓
Daar is meer effektiewe botsings. ✓ [12.2.2] (2)

8.2.1



If graph is endothermic ……only one mark for labelling of axes (1/4)
As grafiek endotermies is …. slegs een punt vir benoeming van asse (1/4)

Any values of Y_1, Y_2 and Y_3 that gives the correct answer
Enige waardes van Y_1, Y_2 en Y_3 wat die korrekte antwoorde gee



[12.1.2] (4)

8.2.2 See broken curve on graph ✓
Verwys na gebroke kromme op grafiek [12.1.2] (1)
[9]

QUESTION 9/*VRAAG 9*

9.1 Any two/*Enige twee*:

Positive impact/ *Positiewe impak:*
The process has led to/ Die proses het gelei tot :
- Creation of jobs / *Werkverskaffing*

Production of / *Produksie van* :
- Fertilisers to ensure enough food production /*Kunsmis om voldoende voedselproduksie te verseker*
- Plastics used to make containers, etc. /*Plastiek wat gebruik word om houers te maak, ens.*
- Coolants used in air conditioners, etc./*Koelmiddels gebruik in lugreëling, ens.*
- Cleaning agents for household use etc. / *Skoonmaakmiddels vir huishoudelike gebruik, ens.*
- Explosives used in mining industry, etc. / Plofstowwe vir gebruik in mynwese, ens.
- Medicines to improve health /Medisyne om gesondheid te verbeter

Any two/*Enige twee*:

Negative impact/*Negatiewe impak:*
- Preparation of explosives – life risk / *Bereiding van plofstowwe - lewensrisiko*
- Air Pollution: increased amounts of nitrogen oxides is a health risk / Lugbesoedeling : toenemende hoeveelhede stikstofoksiede is 'n gesondheidsrisiko
- Water pollution e.g. excessive nitrates in water can cause blue baby syndrome/ Warebe*soedeling bv.oormaat nitrate in water kan bloubabasindroom veroorsaak*
- Eutrophication and its consequences e.g. dead zones/ *Eutrofisering en gevolge daarvan bv. dooie sones*

[12.3.2] (4)

9.2 (The system) is in equilibrium / amounts or concentration remains constant (the same) ✓ /(*Die sisteem) is in ewewig* / *hoeveelhede of konsentrasie bly konstant (dieselfde)*

[12.1.2] (1)

9.3 (The amount of ammonia) was increased / concentration was increased/ ammonia was added ✓ /(*Die hoeveelheid ammoniak) is vermeerder.*

[12.1.2] (1)

9.4 When the concentration of NH_3 is increased, the <u>reverse reaction is favoured</u> ✓ because this reaction <u>decreases the excess NH_3</u> ✓.
The result is <u>an increase in the concentration of H_2 and N_2</u> / <u>until a new equilibrium is established</u> ✓

Wanneer die konsentrasie van NH_3 verhoog word, word die terugwaartse reaksie bevoordeel omdat hierdie reaksie die oormaat NH_3 verminder. Die gevolg is dat die konsentrasie van H_2 en N_2 toeneem./totdat 'n nuwe ewewig bereik word.

[12.1.2] (3)

9.5

	N_2	H_2	NH_3
Molar ratio/*Molverhouding*	1	3	2
Initial quantity mol/ *Aanvangshoeveelheid*	1,5	2	0
Change (mol)/ *Verandering (mol)*	- 0,5✓	- 1,5✓	+ 1
Quantity at equilibrium (mol)/ *Hoeveelheid by ewewig (mol)*	1✓	0,5✓	1
Concentration ($mol \cdot dm^{-3}$) *Konsentrasie ($mol \cdot dm^{-3}$)*	2	1	2

✓(divide by/*deel deur* 0,5)

+

$$K_c = \frac{[NH_3]^2}{[N_2][H_2]^3} \checkmark = \frac{(2)^2}{(2)(1)^3} \checkmark = 2 \checkmark$$

OR/OF

Calculations using concentrations / *Berekeninge deur gebruik van konsentrasie*

	N_2	H_2	NH_3
Molar ratio/*Molverhouding*	1	3	2
Initial concentration ($mol \cdot dm^{-3}$) *Aanvangskonsentrasie ($mol \cdot dm^{-3}$)*	3	4 ✓	0
Change in concentration ($mol \cdot dm^{-3}$) *Verandering in konsentrasie* ($mol \cdot dm^{-3}$)	- 1✓	- 3✓	+ 2
Equilibirum concentration ($mol \cdot dm^{-3}$) *Ewewigskonsentrasie ($mol \cdot dm^{-3}$)*	2✓	1✓	2

+

$$K_c = \frac{[NH_3]^2}{[N_2][H_2]^3} \checkmark = \frac{(2)^2}{(2)(1)^3} \checkmark = 2 \checkmark$$

[12.1.3] (8)

9.6.1 K_c decreases/*neem af/verminder* ✓ [12.2.3] (1)

9.6.2 When the temperature is increased the reverse (endothermic) reaction is favoured✓, resulting in a lower concentration of products✓ (and a higher concentration of reactants)/denominator increases and numerator decreases

Wanneer die temperatuur styg, word die terugwaartse (endotermiese) reaksie bevoordeel✓,wat tot 'n laer konsentrasie van produkte✓ (en 'n hoër konsentrasie reaktanse) /noemer vermeerder en teller verminder . [12.1.4] (2)
[20]

QUESTION 10/*VRAAG 10*

10.1.1 $Fe \rightarrow Fe^{2+} + 2e^-$ ✓✓ [12.2.3] (2)

10.1.2 Oxygen / *Suurstof* ✓ [12.2.3] (1)

10.1.3 $E^\circ_{cell/sel} = E^\circ_{oxidising\ agent/oksideermiddel} - E^\circ_{reducing\ agent/reduseermiddel}$ ✓
$= 0,4$ ✓ $- (-0,44)$ ✓
$= 0,84$ V ✓

OR/*OF*

✓ $Fe \rightarrow Fe^{2+} + 2e^-$ $E^\circ = +0,44$ ✓
$2H_2O + O_2 + 4e^- \rightarrow 4OH^-$ $E^\circ = +0,40$ ✓
$E^\circ = +0,84$ V ✓

Because E°_{cell} is positive✓, the reaction is spontaneous
Omdat E°_{sel} positief is, is die reaksie spontaan. [12.2.3] (5)

10.2.1 Mg is a stronger reducing agent (than Fe) ✓ / and will be oxidised (and not Fe)✓ / *Mg is 'n sterker reduseermiddel as Fe en sal geoksideer word (en nie Fe nie)*

OR/OF
Mg loses electrons more easily✓ than Fe and becomes oxidised✓
Mg verloor makliker as Fe elektrone en word geoksideer

OR/*OF*
Fe is a weaker reducing agent (than Mg) ✓and will not be oxidised ✓
Fe is 'n swakker reduseermiddel (as Mg) en sal nie geoksideer word nie.

OR/*OF*
Fe will not lose its electrons easily compared to Mg✓and will not be oxidised✓ / *Fe sal nie elektrone maklik verloor in vergelyking met Mg nie, en word dus nie geoksideer nie.* [12.2.3] (2)

10.2.2 Electrolytes in the soil ✓✓/ Salts dissolved ✓ in the moist soil ✓
Sout opgelos in die klammigheid van die grond/elektroliete in die grond [12.2.3 (2)

10.2.3 Mg is oxidised/becomes corroded /used up ✓
Mg is geoksideer/weggevreet /opgebruik [12.2.3] (1)

10.2.4 $Mg \rightarrow Mg^{2+} + 2e^{-}$ ✓✓ [12.2.3] (2)

10.2.5 Any two/*Enige twee*:
- Paint/*Verf* ✓
- Electroplating/*Elektroplatering* ✓
- Oil or waterproofing/*Olie of waterdigting*
- Galvanising/*Galvanisering*
- Plastic coating / *Plastiese bedekking* [12.3.3] (2)

10.2.6 <u>Advantages/V*oordele:*</u>
Any one/E*nigeen*
- Plastic is cheaper / *Plastiek is goedkoper* ✓
- Does not rust / *Roes nie*

<u>Disadvantage/N*adeel:*</u>
Any one/E*nigeen*
- Not degradable / *Nie afbreekbaar nie* ✓
- Not as strong as iron/*Nie so sterk soos yster nie* (2)

[12.3.3] **[19]**

QUESTION 11/*VRAAG 11*

11.1 Electrical energy ✓to chemical energy✓
Elektriese energie na chemiese energie

Only electrical or chemical energy: no marks
Slegs elektries of chemiese energie: geen punte [12.2.1] (2)

11.2 negative / *negatief* ✓ [12.2.3] (1)

11.3 $A\ell^{3+} + 3e^- \rightarrow A\ell$ ✓✓ [12.2.3] (2)

11.4 Carbon will burn in/react with O_2 because of the high temperature ✓✓
to form CO_2 / *Koolstof verbrand in/reageer met O_2 a.g.v. die hoë temperatuur om CO_2 te vorm*

OR/*OF*

$C(s) + O_2(g) \rightarrow CO_2(g)$

OR/*OF*

The carbon is oxidised according to the following half-reaction:
Die koolstof is oksideer as gevolg van die volgende halfreaksie:
$C(s) + 2O^{2-}(g) \rightarrow CO_2(g) + 4\ e^-$ [12.2.3] (2)

11.5 Carbon burns away/used up/oxidised / loses e^- (and needs to be replenished)✓✓
Koolstof brand weg/opgebruik/geoksideer/ verloor e^-(en moet aangevul word) [12.2.3] (2)

11.6 Any two: ✓✓

Ecological Impact

- Loss of landscape due to the size of the chemical plant needed
- Disposal of red mud (iron(III) oxide formed during extraction of aluminium oxide from bauxite) into lagoons causing them to become unsightly

Environmental Impact

- Carbon dioxide from the burning of the anodes contributes to the (enhanced) greenhouse effect (air pollution /global warming)
- Carbon monoxide is poisonous
- fluorine (and fluorine compounds) lost from the cryolite during the electrolysis process is poisonous
- Alkali of red mud dams can drain into soil and contaminate groundwater
- Pollution caused by power generation (for electrolytic process) using coal-fired plants leads to acid rain/enhanced (greenhouse effect)
- Noise pollution

Enige twee: ✓✓

Ekologiese impak

- *Groot gebied vir chemiese aanleg benodig - verlies aan landskap*
- *Wegdoening van rooi modder (yster(III)oksied gevorm tydens die ekstraksie van aluminiumoksied vanaf bauxiet) ontsier strandmere*

Omgewingsimpak

- *Koolstofdioksied uit die verbranding van die anode dra by tot die kweekhuiseffek (lugbesoedeling / aardverwarming)*
- *Koolstofmonoksied is giftig*
- *fluoor (en fluoorprodukte); verlies van krioliet gedurende die elektrolise – proses is giftig*
- *Alkalieë van rooi modderdamme kan in grond sypel en grondwater kontamineer*
- *Besoedeling veroorsaak deur kragopwekking d.m.v. steenkoolaanlegte dra by tot suurreën/kweekhuiseffek*
- *Klankbesoedeling*

[12.3.3] (2)

[11]

QUESTION 12/*VRAAG 12*

12.1 Nitrogen-rich (and phosphorous) nutrients (fertilisers) get into water✓
This causes rapid growth of algae (algal bloom). ✓
Depletion of oxygen: ✓when algae die, their decomposition by bacteria removes oxygen from water
Living organisms die ✓

Stikstofryke (en fosforryke) voedingstowwe (kunsmisstowwe) beland in water
Veroorsaak vinnige groei van alge (alge-opbloeiing).
Uitputting van suurstof: Die bakteriese ontbinding van dooie alge verwyder suurstof vanuit water
Lewende organismes sterf. [12.3.3] (4)

12.2 Any two/*Enige twee*: ✓✓
- Over-application of fertilisers / *Ooraanwending van kunsmisstowwe*
- Emissions from vehicles / *Emissies deur voertuie*
- Factory emissions / *Emissies deur fabrieke*
- Sewage; waste disposal systems / *Riool; afvalverwyderingstelsels*
- Stock farming / *Veeboerdery* [12.3.3] (2)

12.3.1 Catalytic oxidation of ammonia/*Katalitiese oksidasie van ammoniak* ✓ [12.3.3] (1)

12.3.2 $4NH_3 + 5O_2$ ✓→ $4NO + 6H_2O$ ✓ (✓bal) [12.3.3] (3)

12.3.3 NO_2 ✓✓ [12.3.3] (2)

12.3.4 $NH_3 + HNO_3$ ✓ → NH_4NO_3 ✓ (✓bal)
OR/OF
$NH_3 + HNO_3$ ✓ → $NH_4^+ + NO_3^-$ ✓ (✓bal) [12.3.3] (3)

12.4 Any two ✓✓
- Control (reduce) the use of fertilisers / Use organic fertilisers / compost
- Control (reduce) waste disposal
- Control vehicle and factory emissions, etc.

Enige twee
- *Kontroleer (verminder) die gebruik van kunsmisstowwe/ Gebruik organiese kunsmisstowwe / kompos*
- *Kontroleer (verminder) afvalwegdoening*
- *Kontroleer voertuig- en fabriekemissies* [12.3.3] (2)

[17]

TOTAL SECTION B:/*TOTAAL AFDELING B*: 115
GRAND TOTAL:/*GROOTTOTAAL*: 150