basic education

Department:
Basic Education
REPUBLIC OF SOUTH AFRICA

NATIONAL
SENIOR CERTIFICATE
NASIONALE
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GRADE/*GRAAD* 12

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

EXEMPLAR/*MODEL* 2014

MEMORANDUM

MARKS/*PUNTE*: 150

This memorandum consists of 10 pages.
Hierdie memorandum bestaan uit 10 bladsye.

QUESTION 1/*VRAAG 1*

1.1   B ✓✓   (2)

1.2   C ✓✓   (2)

1.3   A ✓✓   (2)

1.4   B ✓✓   (2)

1.5   C ✓✓   (2)

1.6   D ✓✓   (2)

1.7   C ✓✓   (2)

1.8   C ✓✓   (2)

1.9   C ✓✓   (2)

1.10   B ✓✓   (2)
                                                                                                 [20]

QUESTION 2/*VRAAG 2*

2.1

2.1.1   Alkynes / *Alkyne* ✓   (1)

2.1.2   Hydroxyl group / *Hidroksielgroep* ✓   (1)

2.1.3   C ✓   (1)

2.1.4   2-methylpentan-3-one / *2-metielpentan-3-oon* ✓✓   (2)

2.1.5
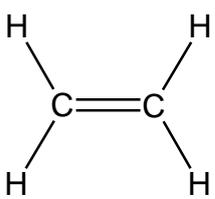
                                                                     (2)

2.1.6 $2C_4H_{10} + 13O_2$ ✓ $\rightarrow 8CO_2 + 10H_2O$ ✓   Bal. ✓   (3)

2.2   Same molecular formula, ✓
           but different positions of the functional group. ✓
           Dieselfde molekulêre formule,
           maar verskillende posisies van die funksionele groep.   (2)

2.3
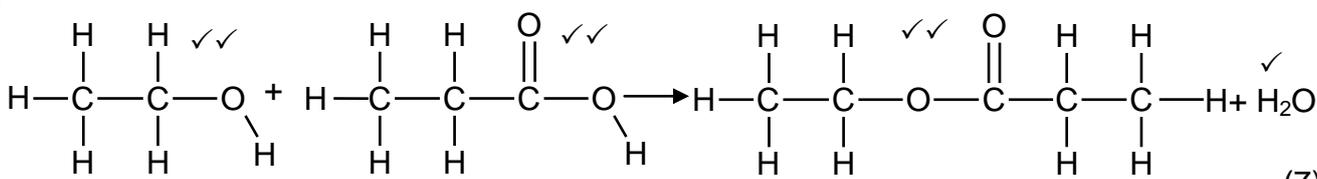
                                                                           (7)
                                                                                 [19]

QUESTION 3/*VRAAG 3*

3.1   Temperature ✓ at which the vapour pressure of the substance equals atmospheric pressure. ✓
Temperatuur waar die dampdruk van die stof gelyk is aan atmosferiese druk.   (2)

3.2

3.2.1   Boiling point increases as the chain length / molecular mass increases. ✓
Kookpunt neem toe soos wat die kettinglengte / molekulêre massa toeneem.

OR/*OF*
Boiling point increases from methane to butane.
Kookpunt neem toe van metaan na butaan.   (1)

3.2.2   • Chain length increases from methane to butane. ✓
Kettinglengte neem toe van metaan na butaan.
• Strength of London forces / induced dipole forces increases from methane to butane. ✓
Sterkte van Londonkragte / geïnduseerde dipoolkragte neem toe van metaan na butaan.
• More energy needed to overcome intermolecular forces in butane than in methane. ✓
Meer energie benodig om intermolekulêre kragte in butaan as in metaan te oorkom.   (3)

3.3   Between molecules of the alkanes are weak London forces or induced dipole forces. / *Tussen molekule van alkane is swak Londonkragte of geïnduseerde dipoolkragte.* ✓
Between alcohol molecules are, in addition to weak London forces or induced dipole forces, also strong hydrogen bonds. / *Tussen alkoholmolekule is sterk waterstofbindings bykomend by tot swak Londonkragte of geïnduseerde dipoolkragte.* ✓   (2)
[8]

QUESTION 4/*VRAAG 4*

4.1 Alkenes / *Alkene* ✓   (1)

4.2
4.2.1 Addition / Hydrohalogenation / Hydrochlorination ✓
*Addisie / Hidrohalogeneging / Hidrochloronering*   (1)

4.2.2
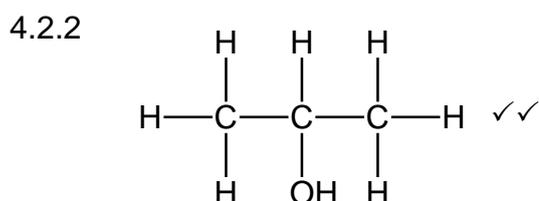
Propan-2-ol ✓   (3)

4.2.3 Elimination / Dehydration ✓
Eliminasie / Dehidrasie   (1)

4.2.4 Catalyst / *Katalisator* ✓   (1)

4.3
4.3.1 Sodium hydroxide / Potassium hydroxide ✓
Natriumhidroksied / Kaliumhidroksied   (1)

4.3.2 Dissolve base in ethanol. / Concentrated (strong) base) ✓
Heat strongly. ✓

Los basis op in etanol. / Gekonsentreerde (sterk) basis
Verhit sterk.   (2)

4.3.3

(5)
[15]
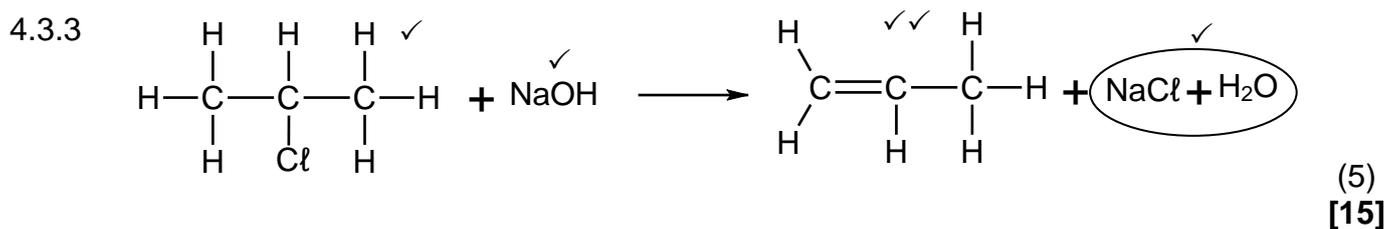
QUESTION 5/*VRAAG 5*

5.1   Hydrochloric acid / HCℓ / *Soutsuur* ✓   (1)

5.2   Hydrogen gas escapes from the flask. ✓
        Waterstofgas ontsnap uit die fles.   (1)

5.3

Criteria for graph P: / *Riglyne vir grafiek P:*	
Shape as shown. / *Vorm soos aangetoon.*	✓
Graph parallel to x-axis after a certain time to indicate constant non-zero mass of zinc. *Grafiek parallel aan x-as na 'n sekere tyd om konstante nie-nul massa van sink aan te dui.*	✓

        (2)
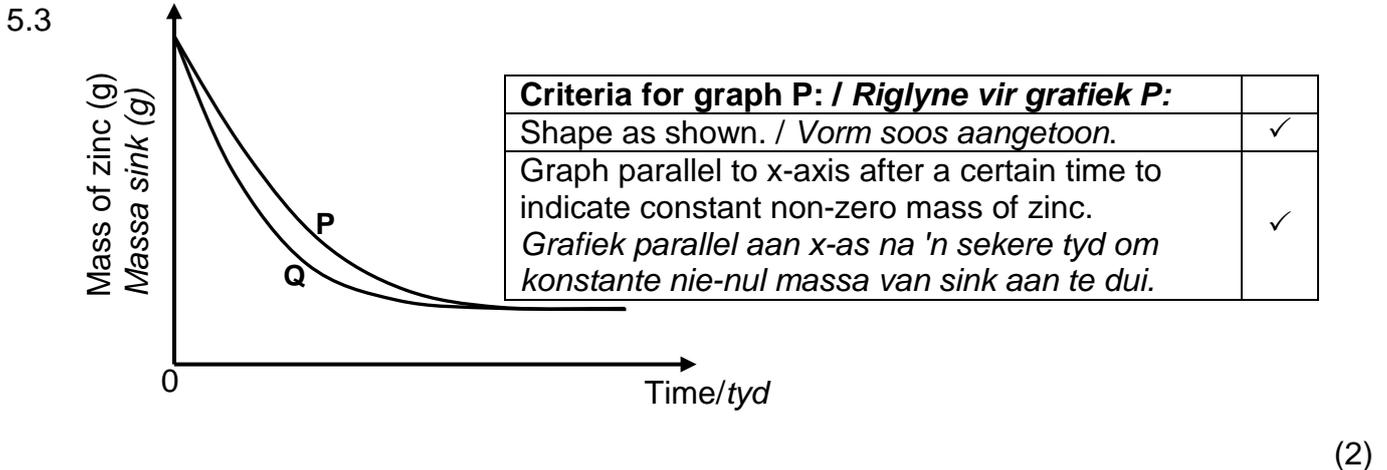
5.4
Criteria for graph Q / *Riglyne vir grafiek Q*:	
Steeper gradient than Graph **P**. / *Steiler gradiënt as Grafiek **P**.*	
Joins parallel section of Graph **P** after a shorter time. *Verbind met die parallelle deel van Grafiek **P** na 'n korter tyd.*	✓

        (1)

5.5   At a higher temperature:
        • More molecules have sufficient kinetic energy / kinetic energy equal to or greater than the activation energy. ✓
        • More effective collisions per unit time / second. ✓
        By 'n hoër temperatuur:
        • *Meer molekule het voldoende kinetiese energie / kinetiese energie gelyk aan of groter as die aktiveringsenergie.*
        • *Meer effektiewe botsings per eenheidstyd / sekond.* ✓

        (2)

5.6 $c(HCℓ) = \dfrac{n}{V}$ ✓

        $\therefore 0,2 = \dfrac{n}{0,1}$ ✓

        $\therefore n(HCℓ) = 0,02$ mol

        $n(Zn) = ½n(HCℓ) = 0,01$ mol ✓

        m(Zn reacted / *gereageer*) = nM ✓
                              = (0,01)(65) ✓
                              = 0,65 g
        Mass of Zn initially in flask / *Massa Zn aanvanklik in fles*:
        0,65 + 0,12 = 0,77 g ✓   (6)

        [13]

QUESTION 6/*VRAAG 6*

6.1 The stage in a chemical reaction when the <u>rate of forward reaction equals the rate of reverse reaction</u>. ✓✓
Die stadium in 'n chemiese reaksie wanneer die <u>tempo van die voorwaartse reaksie gelyk is aan die tempo van die terugwaarste reaksie</u>. ✓✓ (2)

6.2
6.2.1 Higher than / *Hoër as* ✓ (1)

6.2.2 Equal to / *Gelyk aan* ✓ (1)

6.3
6.3.1 NO_2(g) added / *bygevoeg* ✓ (1)

6.3.2 Decrease in pressure / *Afname in druk* ✓ (1)

6.4 Increases ✓
An increase in temperature favours the endothermic reaction. ✓
The forward reaction is endothermic. / The forward reaction is favoured. ✓
Verhoog
'n Toename in temperatuur bevoordeel die endotermiese reaksie.
Die voorwaartse reaksie is endotermies. / Die voorwaartse reaksie word bevoordeel. (3)

6.5

	N_2O_4	NO_2	
Initial quantity (mol) *Aanvangshoeveelheid (mol)*	0,92	0	
Change (mol) *Verandering (mol)*	0,19 ✓	0,38	ratio ✓ *verhouding*
Quantity at equilibrium (mol)/ *Hoeveelheid by ewewig (mol)*	0,73	0,38 ✓	
Equilibrium concentration (mol·dm^{-3}) *Ewewigskonsentrasie (mol·dm^{-3})*	$\frac{0,73}{2} = 0,37$	$\frac{0,38}{2} = 0,19$	

$$K_C = \frac{[NO_2]^2}{[N_2O_4]} \checkmark$$

$$= \frac{(0,19)^2}{(0,37)} \checkmark$$

$$= 9,76 \times 10^{-2} \checkmark$$

Divide by / *gedeel deur* 2 ✓

No K_C expression, correct substitution /
Geen K_c-uitdrukking, korrekte substitusie:
Max. / *Maks.* $^6/_7$

Wrong K_C expression / *Verkeerde K_c-uitdrukking*: Max. / M*aks.* $^4/_7$

(7)
[16]

QUESTION 7/*VRAAG 7*

7.1 An acid forms hydronium ions / H_3O^+ ions when it dissolves in water. ✓
'*n Suur vorm hidroniumione / H_3O^+-ione wanneer dit in water oplos.* (2)

7.2 Incompletely / partially ionised ✓
Onvolledig / gedeeltelik geioniseer (1)

7.3 Solution of known concentration. / *Oplossing van bekende konsentrasie.* ✓ (1)

7.4 Burette / *Buret* ✓
Pipette / *Pipet* ✓ (2)

7.5
7.5.1

OPTION 1/*OPSIE 1*	**OPTION 2/*OPSIE 2***
$K_w = [H_3O^+][OH^-]$	$pOH = -\log[OH^-]$ ✓
$\therefore 1 \times 10^{-14} = [H_3O^+](0,5)$ ✓	$= -\log(0,5)$ ✓
$\therefore [H_3O^+] = 2 \times 10^{-14}$ mol·dm^{-3}	$= 0,3$
$pH = -\log[H_3O^+]$ ✓	$pH = 14 - pOH$ ✓
$= -\log (2 \times 10^{-14})$ ✓	$= 14 - 0,3$
$= 13,7$ ✓	$= 13,7$ ✓

(4)

7.5.2 n(NaOH) = cV ✓
$= (0,5)(0,04)$ ✓
$= 0,02$ mol

n(CH_3COOH) = n(NaOH) = 0,02 mol ✓

m(CH_3COOH) = nM ✓
$= (0,02)(60)$ ✓
$= 1,2$ g

% mass of / *massa van* $CH_3COOH = \dfrac{1,2}{20} \times 100$ ✓ $= 6\%$ ✓

(7)

7.6 $CH_3COO^-(aq) + H_2O(\ell)$ ✓ $\rightarrow CH_3COOH(aq) + OH^-(aq)$ ✓   Bal. ✓ (3)

[20]

QUESTION 8/*VRAAG 8*

8.1 1 mol·dm^{-3} ✓ (1)

8.2 Iodine is not a conductor. / *Jodium is nie 'n geleier nie.* ✓ (1)

8.3 Graphite is a conductor. / *Grafiet is 'n geleier.*✓
Graphite is inert. / *Grafiet is onaktief/traag.* ✓ (2)

8.4
8.4.1 Permanganate ion / *Permanganaat-ioon* ✓ (1)

8.4.2 $2MnO_4^-(aq) + 16H^+(aq) + 10I^-(aq)$ ✓$\rightarrow 2Mn^{2+}(aq) + 5I_2(s) + 8H_2O(\ell)$ ✓ bal.
✓ (3)

8.4.3 $C(s) \mid I^-(aq) \mid I_2(s) \parallel H^+(aq), MnO_4^-(aq), Mn^{2+}(aq) \mid C(s)$ (3)

8.5 $E^o_{cell} = E^o_{cathode} - E^o_{anode}$ ✓
$= 1,51$ ✓ $- 0,54$ ✓
$E^o_{cell} = 0,97$ V ✓ (4)

8.6 Decreases / *Verlaag* ✓ (1)
[16]

QUESTION 9/*VRAAG 9*

9.1 A solution that conducts electricity through the movement of ions. ✓✓
'n Oplossing wat elektrisiteit gelei deur die beweging van ione. (2)

9.2 Bracelet / *Armband* ✓ (1)

9.3
9.3.1 Chromium / *Chroom* ✓ (1)

9.3.2 $Cr^{3+}(aq) + 3e^- \rightarrow Cr(s)$ ✓✓ (2)

9.4
$n(Cr) = \dfrac{m}{M}$ ✓

$= \dfrac{0,86}{52}$ ✓

$= 0,0165$ mol

n(electrons / *elektrone*) = 3n(Cr) ✓ $= 4,96 \times 10^{-2}$ mol

$n = \dfrac{N}{N_A}$ ✓

$4,96 \times 10^{-2} = \dfrac{N}{6,02 \times 10^{23}}$

$\therefore N = 2,99 \times 10^{22}$✓ (6)
[12]

QUESTION 10/*VRAAG 10*

10.1   Contact process / *Kontakproses* ✓   (1)

10.2   Sulphur dioxide / SO_2 / S*waweldioksied* ✓   (1)

10.3
10.3.1   Vanadium pentoxide / Vanadium(V) oxide / V_2O_5 ✓
          Vanadiumpentoksied / Vanadium(V)oksied / V_2O_5   (1)

10.3.2 $2SO_2(g) + O_2$ ✓ $\rightleftharpoons 2SO_3$ ✓   Bal. ✓   (3)

10.4
10.4.1   Oleum / Pyrosulphuric acid / $H_2S_2O_7$ ✓
          Oleum / Piroswawelsuur / $H_2S_2O_7$ (1)

10.4.2   Reaction is highly exothermic and forms a mist. ✓
          Die reaksie is hoog eksotermies en vorm 'n mis.   (1)

10.5   Ammonium sulphate / $(NH_4)_2SO_4$ ✓
        Ammoniumsulfaat / $(NH_4)_2SO_4$ (1)

10.6   Eutrophication leads to the destruction of aquatic life / dead zones. ✓
        This results in less income due to selling of food / recreation areas. ✓
        Eutrofikasie lei tot die afbreek van waterlewe / dooie sones.
        Dit het minder inkomste deur die verkoop van voedsel / ontspanningsareas tot
        gevolg.   (2)

                                                                                   [11]

                        GRAND TOTAL/*GROOTTOTAAL*:   150