education

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NATIONAL SENIOR CERTIFICATE
NASIONALE SENIOR SERTIFIKAAT

GRADE 12/*GRAAD 12*

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

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MARKING GUIDELINES/NASIENRIGLYNE

MARKS/*PUNTE*: 150

These marking guidelines consist of 12 pages and 3 pages with the cognitive grid.

Hierdie nasienriglyne bestaan uit 14 bladsye en 3 bladsye met die kognitiewe tabel.

040400D

QUESTION 1/*VRAAG 1*

1.1 B (2)

1.2 D (2)

1.3 B (2)

1.4 D (2)

1.5 A (2)

1.6 B (2)

1.7 D (2)

1.8 C (2)

1.9 B (2)

1.10 A (2)

[20]

QUESTION 2/*QUESTION 2*

2.1 Molecules with the same molecular formulae, but different structural formulae. ✓✓
Molekule met dieselfde molekulêre formule, maar verskillende struktuurformules. (2)

2.2

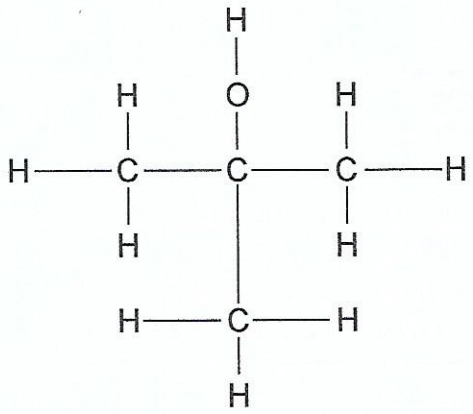
2.2.1 A ✓ (1)
2.2.2 D ✓ (1)
2.2.3 B ✓✓ (2)

2.3

2.3.1 Esterification/*Esterifikasie* ✓ (1)

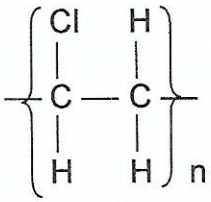
2.3.2 Acts as a catalyst/a substance that speeds up the rate of the reaction/dehydrating agent. ✓
Tree op as 'n katalisator/'n stof wat die tempo van 'n reaksie verhoog/dehidrateermiddel (1)

2.3.3



✓✓ (2)

2.4



✓✓ (2)

[12]

QUESTION 3/*VRAAG 3*

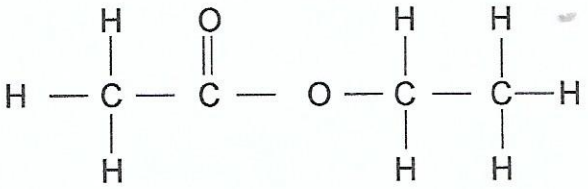
3.1 The temperature at which the vapour pressure of a substance equals atmospheric/external pressure. ✓✓
Die temperatuur waar die dampdruk van die stof gelyk is aan die atmosferiese/eksterne druk (2)

3.2 A ✓
Lowest boiling point/Shortest chain length✓
Laagste kookpunt/ Kortste kettinglengte (2)

3.3

3.3.1 Ethyl ethanoate. ✓✓ /*Etieletanoaat* (2)

3.3.2



✓✓ (2)

3.4

Marking guidelines/*nasienriglyne*
- BOTH have hydrogen bonding✓ /*BEIDE het waterstofbinding*
- Compare number of sites for hydrogen bonding✓ /*Vergelyk aantal plekke vir waterstofbinding*
- Compare strength of IMFs✓ /*Vergelyk sterkte van IMKs*
- Compare energy required✓ /*Vergelyk energie benodig*

- Both compounds/**C** and **D** have (in addition to London forces and dipole-dipole forces) hydrogen bonding. ✓
*Beide verbindings/**C** en **D** het (in addisie tot Londonkragte en dipool-dipoolkragte) waterstofbinding*
- Compound **C**/Ethanol/alcohol has one site for hydrogen bonding and compound **D**/Ethanoic acid/ carboxylic acid has two/more sites for hydrogen bonding. ✓
*Verbinding **C**/etanol /alkohol het een plek vir waterstofbinding en verbinding **D**/etanoësuur/karboksielsuur het twee/meer plekke vir waterstofbinding.*
- Intermolecular forces in compound **D**/Ethanoic acid/ carboxylic acid are stronger than intermolecular forces in compound **C**/Ethanol/alcohol. ✓
*Intermolekulêre kragte in verbinding **D**/etanoësuur /karboksielsuur is sterker as die intermolekulêre kragte in verbinding **C**/etanol/alkohol.*

OR/OF

Intermolecular forces in compound **C**/Ethanol/alcohol are weaker than intermolecular forces in compound **D**/Ethanoic acid/ carboxylic acid.
*Intermolekulêre kragte in verbinding **C**/etanol/alkohol is swakker as die intermolekulêre kragte in verbinding **D**/etanoësuur/karboksielsuur*

- More energy is needed to overcome/break intermolecular forces in compound **D**/Ethanoic acid/ carboxylic acid than in compound **C**/ Ethanol/alcohol. ✓
*Meer energie word benodig om die intermolekulêre kragte in verbinding **D** /etanoësuur /karboksielsuur te breek/oorkom as in verbinding **C**/etanol /alkohol*

OR/OF

Less energy is needed to overcome/break intermolecular forces in compound **C**/Ethanol/alcohol than in compound **D**/Ethanoic acid/ carboxylic acid.
*Minder energie word benodig om die intermolekulêre kragte in verbinding **C**/etanol /alcohol te breek/oorkom as in verbinding* **D**/Ethanoic acid/ carboxylic acid.

(4)
[12]

QUESTION 4/*VRAAG 4*

4.1

4.1.1 Addition ✓ /*Addisie* (1)

4.1.2 $2C_2H_6 + 7O_2 \rightarrow 4CO_2 + 6H_2O$

Notes/*Nota's*
• Reactants /*Reaktante*✓ Products/*Produkte* ✓ Balancing/*Balansering* ✓
• Ignore/*ignoreer* ⇌ and phases/*en fases*
• Marking rule/*Nasienreël* 6.3.10

(3)

4.2

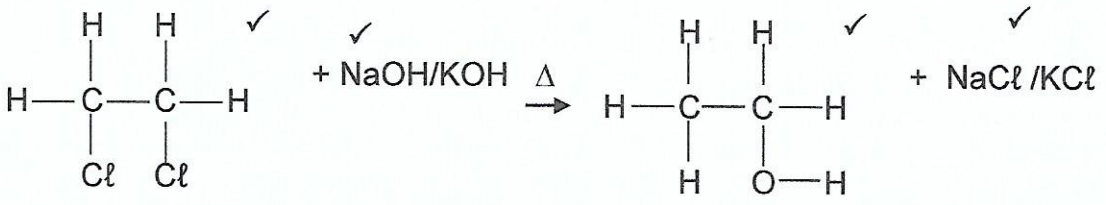
4.2.1 1,2-dichloroethane✓✓ /*1,2-dichloroetaan* (2)

4.2.2 Halogenation/Chlorination ✓ /*Halogenering/Chlorinering* (1)

4.3

4.3.1 Hydrolysis ✓ /*Hidrolise* (1)

4.3.2



(4)

4.4

4.4.1 Hydration ✓ /*Hidrasie* (1)

4.4.2 - ANY ONE /*ENIGE EEN*
- Excess water ✓ /*Oormaat water*
- Concentrated H_2SO_4 /*Gekonsentreerde* H_2SO_4 (1)

[14]

QUESTION 5/*VRAAG 5*

5.1 The influence/the effect of a catalyst ✓ /*Invoed/effek van katalisator* (1)

5.2 L✓ (1)

5.3 No-catalyst✓✓/*Geen katalisator* (2)

5.4 Change in concentration of products/ reactants✓ per (unit) time✓
Verandering in konsentrasie van produkte/reaktante per tydseenheid (2)
OR/OF
Change in amount/number of moles/volume/mass of products or reactants per (unit) time
Verandering in die hoeveelheid/aantal mol/volume/massa van produkte/reaktante per tydseenheid

5.5 Average rate $= -\frac{\Delta [H_2O_2]}{\Delta t}$

$= -\frac{0.0131-0,020}{400-(0)}$ ✓ ✓

$= 1,73 \times 10^{-5}\ mol{\cdot}dm^{-3}\ s^{-1}$✓ (3)

5.6

MARK ALLOCATION/*PUNTETOEKENNING*

- $c = \frac{n}{V}$ or/*of* $c = \frac{m}{MV}$ or/*of* $n = \frac{m}{M}$ ✓
- Substitute/*vervang* (0,0200 – 0,0106) and/en 50×10^3 ✓
- $n(O_2) = ½(H_2O_2)$ ✓
- Using/*gebruik* M = 32 in m = Mn or/*of* n = cMV or/*of* ratio calculation/*verhouding berekening* ✓
- Answer/*antwoord:* $7,52 \times 10^{-3}$ g/ 0,008 g/ 0,01 g ✓

OPTION 1/*OPSIE 1*

$c = \frac{n}{V}$ ✓

$(0{,}0200 - 0{,}0106) = \frac{n}{50 \times 10^{-3}}$ ✓

$n(O_2) = 1/2\ n(H_2O_2) = 1/2(4{,}7 \times 10^{-4})$ ✓

$= 2{,}35 \times 10^{-4}$ mol

$n = \frac{m}{M}$

$2{,}35 \times 10^{-4} = m/32$ ✓

$m = 7{,}52 \times 10^{-3}$ g ✓

OPTION 2/*OPSIE 2*

$\Delta c\ [H_2O_2] = 0{,}0200 - 0{,}0106$

$= 0{,}094$

$\Delta c(O_2) = 1/2(H_2O_2)$

$=1/2(0{,}0094)$ ✓

$=0{,}0047$ ✓

$C = \frac{m}{MV}$ ✓

$\Delta m(O_2) = cMV$

$= (0{,}0047)(32)$ ✓ (50×10^{-3})

$= 7{,}52 \times 10 - 3$ g

$= 0{,}008$ g

$= 0.01$ g✓ (5)

[14]

QUESTION 6/*VRAAG 6*

6.1 The stage in a chemical reaction when the rate of the forward reaction is equals to the rate of the reverse reaction. ✓✓
Stadium in 'n chemiese reaksie waar die tempo van die voorwaartse reaksie gelyk is aan die tempo van die terugwaartse reaksie.

OR/OF

The stage in a chemical reaction when the concentration of reactants and products remain constant.
Stadium in 'n chemiese reaksie waar die konsentrasie van reaktante en produkte konstant bly. (2)

6.2 STAY THE SAME. ✓ *BLY DIESELFDE*
At equilibruim there are equal number of moles of gaseous reactants and products. ✓✓
By ewewig is daar gelyke aantal mol gasagtige reaktante en produkte. (3)

6.3

6.3.1 A very small amount of NO(g) is formed. ✓✓
'n Baie klein hoeveelheid NO(g) is gevorm. (2)

6.3.2

	$N_2(g)$	$O_2(g)$	$2NO(g)$
Initial moles/*Aanvangsmol*	7	2	0
Moles reacted/*mol gereageer*	0,2	0,2	0,4 ✓
Moles at equilibrium/*mol by ewewig*	6,8 ✓		0,4✓
Equilibrium concentration/ *Ewewigskonsentrasie* (mol·dm^{-3})	3,4	0,9	0,2

Divide by 2/*deel met 2*)✓

$$K_c = \frac{[NO]^2}{[N_2][O_2]} \checkmark$$

$$= \frac{0,04}{(3.4)(0.9)} \checkmark$$

$$= 0,013 \checkmark$$

(8)

OPTION 2/*OPSIE 2*

	N_2	O_2	2NO
Initial concentration *Aanvangskonsentrasie* ($mol \cdot dm^{-3}$)	$\frac{7}{2} = 3,5$	$\frac{2}{2} = 1$✓	0
Change/*verandering* ($mol \cdot dm^{-3}$)	0,1✓	0,1	$\frac{0,4}{2} = 0.2$✓
Equilibrium concentration /*konsentrasie by ewewig* ($mol \cdot dm^{-3}$)	3,4	0,9	0,2 ✓

$$K_C = \frac{[NO]^2}{[N_2][O_2]}$$✓

$$= \frac{[0,2]^2}{(3,4)(0,9)}$$✓

$$= \frac{0,04}{3,06}$$✓

$$= 0,013$$✓

6.3.3

- When the system is heated, Kc increased✓, which implies that more NO(g) was formed. ✓
  Met toename in temperatuur het die K_c verhoog, wat impliseer dat meer NO(g) gevorm het.
- The forward reaction is favoured. ✓
  Die voorwaartse reaksie is bevoordeel.
- Increase in temperature favours the reaction which absorbs energy✓ / endothermic reaction.
  Verhoging in temperatuur bevoordeel die reaksie wat energie absorbeer / endotermiese reaksie. (4)

[19]

QUESTION 7/*VRAAG 7*

7.1

7.1.1 An acid that ionises completely in water. ✓✓
'n Suur wat volledig ioniseer in water. (2)

7.1.2

OPTION 1/*OPSIE 1*	**OPTION 2/*OPSIE 2***
$pH = - \log [H_3O^+]$ ✓ $3 = - \log [H_3O^+]$ ✓ $[H_3O^+] = 0,001 \text{ mol·dm}^{-3}$ ✓ (3)	$pH + pOH = 14$ $3 + pOH = 14$ $pOH = - \log [OH^-]$ $11 = - \log [OH^-]$ $[OH^-] = 1 \times 10^{-11}$ $Kw = [H_3O^+] [OH^-] = 14$ $[H_3O^+] = 0,001 \text{ mol·dm}^{-3}$

7.1.3 No /*Nee* (1)

7.1.4 The concentration of the hydrogen ions in the HX solution is lower than✓ that of HCℓ of the same concentration . ✓
Die konsentrasie van die waterstofione in die HX oplossing is laer as die van HCℓ met dieselfde konsentrasie. (2)
OR/OF
The pH of HX is higher than that of HCℓ of the same concentration
Die Ph van HX is hoër as die van HCℓ met dieselfde konsentrasie

7.2

7.2.1 A substance that can react as an acid or a base in a chemical reaction. ✓ ✓
'n Stof wat beide as 'n suur en 'n basis kan optree in 'n chemiese reaksie (2)

7.2.2 HSO_3^- ✓ (1)

7.2.3 Sulphite ion ✓ *Sulfietioon* (1)

7.3

7.3.1 $c (H_2SO_4) = \frac{n}{V}$ ✓

$0,2 = \frac{n}{0,1}$ ✓

$n = 0,02 \text{ mol}$✓ (3)

7.3.2 $n\ [Mg(OH)_2] = cV$
$= (0,2) \times (0,02)$ ✓
$= 0,004$ mol

$n(H_2SO_4$ in excess/*oormaat*$) = 0,004$ mol ✓ (mol ratio)

$n(H_2SO_4)$ reacts with/*reageer met* $Na_2CO_3 = 0,02 - 0,004$✓
$= 0,016$ mol

$n(Na_2CO_3) = n(H_2SO_4) = 0,016$ mol✓ (mol ratio)

$m(Na_2CO_3) = nM$
$= 0,016 \times 106$✓
$= 1,696$g

Mass of impurity/*massa onsuiwerheid* $= 5 - 1,696$✓
$= 3,304$g ✓ (7)
[22]

QUESTION 8/*VRAAG 8*

8.1 The substance/ species which gains electrons. ✓✓
Stof wat elektrone bykry. (2)

8.2 **B/** Ag^+ ✓
Silver ions (Ag^+) has a stronger oxidising ability than cobalt (Co)✓, and silver ions (Ag^+) will be reduced to silver ✓.
Silwer ione (Ag^+) het 'n sterker oksideervermoë as kobalt (Co), en silwer (Ag^+) sal gereduseer word na silwer (3)

8.3 $Co(s) \rightarrow Co^{2+} + 2e^-$
$2Ag^+ + 2e^- \rightarrow 2Ag(s)$
$Co(s) + 2Ag^+ \rightleftharpoons Co^{2+} + 2Ag(s)$✓✓ (bal)✓ (3)

8.4 $E^{\ominus}_{cell} = E^{\ominus}_{cathode/katode} - E^{\ominus}_{anode}$ ✓
$E^{\ominus}_{sel} = E^{\ominus}_{katode/katode} - E^{\ominus}_{anode}$
$= +0,80$ ✓ $- (-0,28)$ ✓
$= 1,08$ V✓

Accept any other correct formula from the data sheet.
Aanvaar enige ander korrekte formule vanaf gegewensblad.

$E^{\ominus}_{cell/sel} < 1,5$ V, thus the bulb will not glow or light up/ *gloeilamp sal nie brand.*✓ (5)
[13]

QUESTION 9/*VRAAG 9*

9.1 Electrical energy is converted to chemical energy. ✓✓
Elektriese energie word omgeskakel in chemiese energie. (2)

9.2 Cathode/katode ✓ (1)

9.3.1 Cryolite/*kriolliet* ✓ (Na_3AlF_6) ✓ (2)

9.3.2 $Al_2O_3(.2H_2O)$ ✓✓ (2)

9.4 Carbon in the electrodes reacts with O_2 gas produced, forming CO_2 ✓ carbon is used up✓ causing electrodes to disintegrate/corrode away.
Koolstof in die elektrodes reageer met O_2 gas wat vorm en vorm CO_2/ Koolstof word opgebruik wat veroorsaak dat elektrodes disintegreer/ weggevreet word (2)
[9]

QUESTION 10/*VRAAG 10*

10.1

10.1.1 Combustion (process) ✓ *Verbrandings(proses)* (1)

10.1.2 $4NH_3 + 5O_2$ ✓→ $4NO + 6H_2O$ ✓ bal ✓ (3)

10.2

10.2.1 Neutralisation (Acid-Base) ✓ *Ineutralisasie (Suur-basis)* (1)

10.2.2 $HNO_3 + NH_3$ ✓→ NH_4NO_3 ✓ bal ✓ (3)

10.3

10.3.1 Haber ✓ (1)

10.3.2 Fe/iron/*yster* ✓ (1)

10.4

10.4.1 The ratio of nitrogen, phosphorus and potassium in the fertiliser✓ ✓*IDie verhouding stikstof, suurstof fosfor en kalium in die kunsmis*. (2)

10.4.2 Pure fertiliser/*Suiwer kunsmis* = $\frac{10 \text{ kg} \times 23}{100}$ ✓ ✓
= 2,3 kg ✓ (3)
[15]

TOTAL/*TOTAAL*: 150