basic education

Department:
Basic Education
REPUBLIC OF SOUTH AFRICA

NATIONAL SENIOR CERTIFICATE/ *NASIONALE SENIOR SERTIFIKAAT*

GRADE/*GRAAD* 12

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

NOVEMBER 2017

MARKING GUIDELINES/*NASIENRIGLYNE*

MARKS/*PUNTE*: 150

These marking guidelines consist of 11 pages.
Hierdie nasienriglyne bestaan uit 11 bladsye.

QUESTION/*VRAAG 1*

1.1 D ✓✓ (2)

1.2 B ✓✓ (2)

1.3 C ✓✓ (2)

1.4 A ✓✓ (2)

1.5 C ✓✓ (2)

1.6 C ✓✓ (2)

1.7 C ✓✓ (2)

1.8 A ✓✓ (2)

1.9 B ✓✓ (2)

1.10 B ✓✓ (2)

[20]

QUESTION/*VRAAG 2*

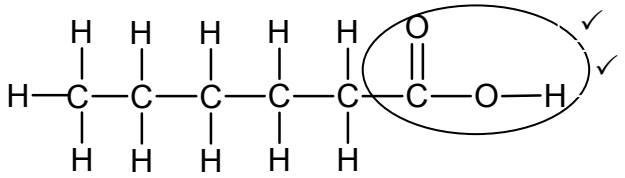
2.1

2.1.1 Esters ✓ (1)

2.1.2 Ethyl ✓ butanoate ✓/*Etielbutanoaat* (2)

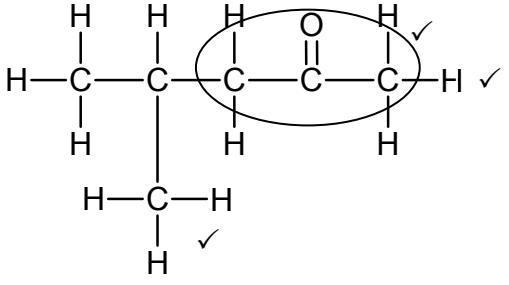
2.1.3 Butanoic acid/*Butanoësuur* ✓ (1)

2.1.4



✓ ✓ (2)

2.2



✓ ✓ ✓ (3)

2.3
2.3.1 C_nH_{2n-2} ✓ (1)

2.3.2 5-ethyl-2,6-dimethylhept-3-yne/5-ethyl-2,6-dimethyl-3-heptyne
5-etiel-2,6-dimetielhept-3-yn/5-etiel-2,6-dimetiel-3-heptyn (3)
[13]

QUESTION/*VRAAG 3*

3.1 **ANY ONE/*ENIGE EEN*:**
- They have ONLY single bonds. ✓
  Hulle het SLEGS enkelbindings.
- They have single bonds between C atoms.
  Hulle het enkelbindings tussen C-atome.
- They have no double OR triple bonds OR multiple bonds.
  Hulle het geen dubbel- OF trippelbindings OF meervoudige bindings nie.
- They contain the maximum number of H atoms bonded to C atoms.
  Hulle bevat die maksimum getal H-atome gebind aan C-atome.
- Each C atom is bonded to four other atoms.
  Elke C-atoom is gebind aan vier ander atome. (1)

3.2 The pressure exerted by a vapour in equilibrium with its liquid ✓ in a closed system. ✓
Die druk uitgeoefen deur 'n damp in ewewig met sy vloeistof in 'n geslote sisteem.
(2)

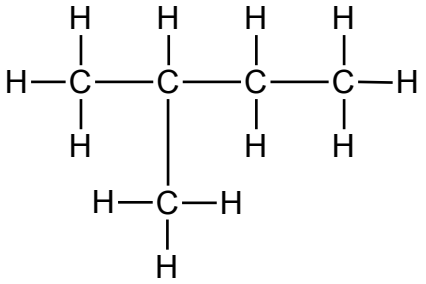
3.3
3.3.1 Increases/*Verhoog* ✓ (1)

3.3.2 Q ✓
It is the temperature where the graph intercepts the dotted line. ✓
Dit is die temperatuur waar die grafiek die stippellyn sny.

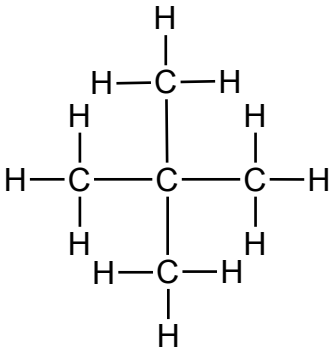
OR/*OF*
It is the temperature where the vapour pressure of compound **Q** equals atmospheric pressure/is equal to 760 mmHg.
*Dit is die temperatuur waar die dampdruk van verbinding **Q** gelyk is aan atmosferiese druk/gelyk is aan 760 mmHg.* (2)

3.3.3 S ✓
- At a given temperature, **S** has the lowest vapour pressure/highest boiling point. ✓
  *By 'n gegewe temperatuur het **S** die laagste dampdruk/hoogste kookpunt.*
- Strongest intermolecular forces/London forces/dispersion forces/induced dipole forces. ✓
  Sterkste intermolekulêre kragte/London-kragte/dispersiekragte/ geïnduseerde dipoolkragte.
- Highest energy needed to overcome/break the intermolecular forces. ✓
  Hoogste energie benodig om intermolekulêre kragte te oorkom/breek. (4)

3.4

3.4.1  ✓✓

OR/*OF*



2-methylbutane ✓
2-metielbutaan

2,2-dimethylpropane✓
2,2-dimetielpropaan

(3)

3.4.2 Higher than/*Hoër as* ✓ (1)

[14]

QUESTION/*VRAAG 4*

4.1 Secondary/*Sekondêre* ✓
The C atom bonded to the –OH group is bonded to TWO other C atoms. ✓
Die C-atoom gebind aan die –OH-groep is aan TWEE ander C-atome gebind. (2)

4.2

4.2.1 Dehydration ✓
Dehidrasie/dehidratering (1)

4.2.2 Hydration ✓
Hidrasie/hidratering (1)

4.2.3 Dehydrohalogenation/dehydrobromination ✓
Dehidrohalogenasie/dehidrohalogenering/dehidrobrominasie/dehidrobrominering (1)

4.3

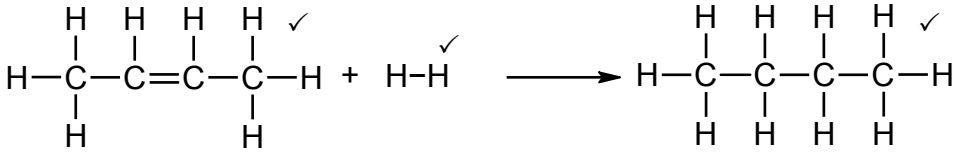
4.3.1 Substitution/Hydrolysis ✓
Substitusie/Hidrolise (1)

4.3.2
- Dilute base/sodium hydroxide/NaOH ✓
  Verdunde basis/natriumhidroksied/NaOH
- Moderate temperature/(mild) heat ✓
  Matige temperatuur/(matige) hitte (2)

4.3.3 2-✓<u>bromobutane</u> ✓/*2-bromobutaan* (2)

4.4 NaOH/KOH ✓ (1)

4.5



(3)

4.6 Butane/*Butaan* (1)

[15]

QUESTION/*VRAAG 5*

5.1 **ANY ONE/*ENIGE EEN*:**

- Change in concentration of products/reactants per (unit) time. ✓✓
  Verandering in konsentrasie van produkte/reaktanse per (eenheid) tyd.

- Rate of change in concentration.
  Tempo van verandering in konsentrasie.

- Change in amount/number of moles/volume/mass of products or reactants per (unit) time.
  Verandering in hoeveelheid/getal mol/volume/massa van produkte of reaktanse per (eenheid) tyd.

- Amount/number of moles/volume/mass of products formed or reactants used per (unit) time.
  Hoeveelheid/getal mol/volume/massa van produkte gevorm of reaktanse gebruik per (eenheid) tyd. (2)

5.2

Marking criteria/*Nasienriglyne:*	
Dependent and independent variables correctly identified. *Afhanklike en onafhanklike veranderlikes korrek geïdentifiseer.*	✓
Ask a question about the relationship between the independent and dependent variables./*Vra* 'n *vraag oor die verwantskap tussen die afhanklike en onafhanklike veranderlikes.*	✓

Examples/*Voorbeelde*:

- What is the relationship between concentration and reaction rate?
  Wat is die verwantskap tussen konsentrasie en reaksietempo?
- How does the reaction rate change when the concentration changes/increases/decreases?
  Hoe sal die reaksietempo verander wanneer die konsentrasie verander/ verhoog/verlaag? (2)

5.3 Q ✓

- Smaller gradient./Less steep. ✓
  Kleiner gradiënt./Minder steil.
- Reaction **I** has the lowest HCℓ concentration and will take longer to reach completion/for the maximum volume of gas to be formed. ✓
  Reaksie **I** *het die laagste* HCℓ-konsentrasie en *neem langer om voltooi te word/die maksimum volume gas te vorm.* (3)

5.4

OPTION 1/*OPSIE 1*

Ave rate/*Gem. tempo* = $\frac{\Delta V}{\Delta t}$

$15 = \frac{\Delta V}{30 - 0}$ ✓

$V(H_2)_{produced/berei} = 450\ cm^3$

$n(H_2)_{produced/berei} = \frac{V}{V_m}$

$= \frac{450}{24\ 000}$ ✓

$= 0,0188$ mol

$n(Zn) = n(H_2) = 0,0188$ mol ✓

$n(Zn)_{used/gebruik} = \frac{m}{M}$

$\therefore 0,0188 = \frac{m}{65}$ ✓

$\therefore m(Zn) = 1,22$ g ✓

OPTION 2/*OPSIE 2*

Ave rate/*Gem. tempo* = $\frac{15}{24\ 000}$ ✓

$= 6,25 \times 10^{-4}\ mol \cdot s^{-1}$

$V(H_2)_{produced/berei} = 6,25 \times 30$ ✓

$= 0,0188$ mol

$n(Zn) = n(H_2) = 0,0188$ mol ✓

$n(Zn)_{used} = \frac{m}{M}$

$0,0188 = \frac{m}{65}$ ✓

$\therefore m(Zn) = 1,22$ g ✓

OPTION 3/*OPSIE 3*

Ave rate/*Gem. tempo* = $\frac{\Delta V}{\Delta t}$

$15 = \frac{\Delta V}{30 - 0}$ ✓

$V(H_2)_{produced/berei} = 450\ cm^3$

65 g ✓ Zn …… 24 000 cm^3 ✓

x g Zn ……450 cm^3 ✓

x = 1,22 g ✓

(5)

5.5

5.5.1 Equal to/*Gelyk aan* ✓ (1)

5.5.2 Equal to/*Gelyk aan* ✓ (1)

5.6

- At higher temperature the <u>average kinetic energy of particles is higher</u>. ✓
  By hoër temperatuur is die <u>gemiddelde kinetiese energie van deeltjies hoër</u>.
- <u>More molecules gain sufficient/enough kinetic energy</u> **OR** more molecules have kinetic energy equal to or greater than the activation energy. ✓
  *<u>Meer molekule het voldoende/genoeg kinetiese energie</u> **OF** meer molekule het kinetiese energie gelyk aan of groter as die aktiveringsenergie.*
- <u>More effective collisions per unit time</u>./Frequency of effective collisions increases. ✓
  <u>Meer effektiewe botsings per eenheidtyd</u>./Frekwensie van effektiewe botsings neem toe.

(3)

[17]

QUESTION/*VRAAG 6*

6.1 The stage in a chemical reaction when the rate of forward reaction equals the rate of reverse reaction. ✓✓
Die stadium in 'n chemiese reaksie wanneer 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 concentrations of reactants and products remain constant. ✓✓
Die stadium in 'n chemiese reaksie wanneer die konsentrasies van reaktanse en produkte konstant bly. (2)

6.2

6.2.1 **OPTION 1/*OPSIE 1***

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

$= \frac{1,12}{28}$ ✓

$= 0,04$ mol

	$COBr_2$	CO	Br_2
Initial quantity (mol) *Aanvangshoeveelheid (mol)*		0	0
Change (mol) *Verandering (mol)*	0,04	0,04	0,04
Quantity at equilibrium (mol)/ *Hoeveelheid by ewewig (mol)*		0,04	0,04 ✓
Equilibrium concentration/ *Ewewigskonsentrasie* ($mol \cdot dm^{-3}$)		0,02	0,02

Divide by 2 ✓
Deel deur 2

$K_c = \frac{[CO][Br_2]}{[COBr_2]}$ ✓

$0,19$ ✓ $= \frac{(0,02)^2}{[COBr_2]}$ ✓

$[COBr_2] = 2,11 \times 10^{-3}$ $mol \cdot dm^{-3}$ ✓

OPTION 2/*OPSIE 2*

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

$= \frac{1,2}{28}$ ✓

$= 0,04$ mol

$n(CO)_{formed/gevorm} = n(Br_2)_{formed/gevorm}$ ✓

$= 0,04$ mol

$c(CO)_{eq/ewe} = c(Br_2)_{eq/ewe}$

$= \frac{n}{V}$

$= \frac{0,04}{2}$ ✓

$= 0,02$ mol·dm^{-3}

$K_c = \frac{[CO][Br_2]}{[COBr_2]}$ ✓

$0,19$ ✓ $= \frac{(0,2)^2}{[COBr_2]}$ ✓

$[COBr_2] = 2,11 \times 10^{-3}$ mol·dm^{-3} ✓ (7)

6.2.2

OPTION 1/*OPSIE 1*

$n(COBr_2)_{eq/ewewig} = cV$

$= 2,11 \times 10^{-3} \times 2$ ✓

$= 4,22 \times 10^{-3}$ mol

$n(COBr_2)_{initial/begin}$

$= 0,04 + 4,22 \times 10^{-3}$ ✓

$= 0,044$ mol

% decomposed $= \frac{0,04}{0,044}$ ✓ $\times 100$

$= 90,46\%$ ✓

Range/*Gebied*: 90,46 – 90,9%

OPTION 2/*OPSIE 2*

$n(COBr_2)_{eq/ewewig} = cV$

$= 2,11 \times 10^{-3} \times 2$ ✓

$= 4,22 \times 10^{-3}$ mol

$n(COBr_2)_{initial/begin}$

$= 0,04 + 4,22 \times 10^{-3}$ ✓

$= 0,044$ mol

$m(COBr_2)_{initial/begin} = nM$

$= 0,044 \times 188$

$= 8,27$ g

$m(COBr_2)_{reacted/reageer} = 0,04 \times 188$

$= 7,52$ g

% decomposed/*ontbind* $= \frac{7,52}{8,27}$ ✓ $\times 100$

$= 90,9\%$ ✓ (4)

6.3 $K_c < 0,19$ (1)

6.4 Decreases/*Verminder* ✓

A decreases in pressure favours the reaction that produces the larger number of moles of gas./*'n Afname in druk bevoordeel die reaksie wat die groter aantal mol gas lewer.* ✓

The forward reaction will be favoured./*Die voorwaartse reaksie sal bevoordeel word.* ✓ (3)

[17]

QUESTION/*VRAAG 7*

7.1
7.1.1 Weak/*Swak* ✓
Dissociates/Ionises incompletely (in water) ✓
Dissosieer/Ioniseer onvolledig (in water) (2)

7.1.2 NH_4^+ ✓ (1)

7.1.3 H_2O/water **OR/*OF*** NH_3 ✓ (1)

7.2
7.2.1 Acidic/*Suur* ✓
pH < 7 ✓ (2)

7.2.2

OPTION 1/*OPSIE 1*	**OPTION 2/*OPSIE 2***
pH = -log[H_3O^+] ✓ 6 ✓ = -log[H_3O^+] [H_3O^+] = 1×10^{-6} mol·dm^{-3} [H_3O^+][OH^-] = 10^{-14} ✓ [OH^-] = 1×10^{-8} mol·dm^{-3} ✓	pH + pOH = 14 ✓ 6 ✓+ pOH = 14 pOH = -log[OH^-] ✓ 8 = -log[OH^-] [OH^-] = 1×10^{-8} mol·dm^{-3} ✓

(4)

7.3

OPTION 1/*OPSIE 1*	**OPTION 2/*OPSIE 2***
$n(Na_2CO_3) = \frac{m}{M}$ ✓ $= \frac{0,29}{106}$ ✓ = $2,74 \times 10^{-3}$ mol ↓ $n(HC\ell) = 2n(Na_2CO_3)$ ✓ = $5,47 \times 10^{-3}$ mol ↓ $c(HC\ell)_{dilute/verdun} = \frac{n}{V}$ $= \frac{5,47x10^{-3}}{0,05}$ ✓ = 0,1094 mol·dm^{-3} ↓ $cV(HC\ell)_{dilute/verdun} = cV(HC\ell)_{conc/gekons}$ 0,1094 × 500 ✓ = $(HC\ell)_{conc/gekons} \times 5$ ✓ $\therefore c(HC\ell)_{conc/gekons}$ = 10,94 mol·dm^{-3} ✓	$n(Na_2CO_3) = \frac{m}{M}$ ✓ $= \frac{0,29}{106}$ ✓ = $2,74 \times 10^{-3}$ mol ↓ $n(HC\ell) = 2n(Na_2CO_3)$ ✓ = $5,47 \times 10^{-3}$ mol ↓ In 50 cm^3: $n(HC\ell) = 5,47 \times 10^{-3}$ mol In 500 cm^3: $n(HC\ell) = \frac{500}{50}$ ✓ $(5,47 \times 10^{-3})$ ✓ = 0,547 mol ↓ $c(HC\ell)_{conc/gekons} = 0,547 \times \frac{1000}{5}$ ✓ = 10,94 mol·dm^{-3} ✓

(7)
[17]

QUESTION/*VRAAG 8*

8.
8.1.1 Voltmeter/Multimeter ✓ (1)

8.1.2 Anode ✓ (1)

8.1.3 $3Ag^{+}(aq) + A\ell(s)$ ✓ → $3Ag(s) + A\ell^{3+}(aq)$ ✓ Bal. ✓ (3)

8.1.4

OPTION1/*OPSIE 1*

$E^{\theta}_{cell} = E^{\theta}_{reduction} - E^{\theta}_{oxidation}$ ✓
= +0,80 ✓- (- 1,66) ✓
= 2,46 V ✓

OPTION 2/*OPSIE 2*

$Ag^{+}(aq) + e^{-} \rightarrow Ag(s)$ 0,80 V ✓
$A\ell(s) \rightarrow A\ell^{3+}(aq) + 3e^{-}$ 1,66 V ✓
$3Ag^{+}(aq) + A\ell(s) \rightarrow 3Ag(s) + A\ell^{3+}(aq)$ 2,46 V ✓

(4)

8.2

8.2.1 Platinum/Pt/Carbon/C/*Koolstof* ✓ (1)

8.2.2 **ANY TWO/*ENIGE TWEE*:**
Concentration/*Konsentrasie*: 1 mol·dm^{-3} ✓
Temperature/*Temperatuur*: 25 °C/298 K ✓
Pressure/*Druk:* 101,3 kPa/1,01 x 10^{5} Pa/1 atm (2)

8.2.3 Zinc/Zn/*sink* ✓ (1)

8.2.4 PQ ✓ (1)
[14]

QUESTION/*VRAAG 9*

9.1 DC ✓ (1)

9.2 Cathode/*Katode* ✓
$Cu^{2+}(aq) + 2e^{-} \rightarrow Cu$ ✓✓

9.3 Cu^{2+} is a stronger oxidising agent ✓ than Zn^{2+} ions ✓ and therefore Zn^{2+} ions will not be reduced (to Zn). ✓
Cu^{2+} is 'n sterker oksideermiddel as Zn^{2+}-ione en dus sal Zn^{2+}-ione nie gereduseer word nie (na Zn). (3)

9.4

9.4.1 (Chlorine) gas/bubbles is/are formed. ✓
(Chloor)gas/borrels vorm. (1)

9.4.2 Decreases/*Verlaag* ✓ (1)
[9]

QUESTION 10/*VRAAG 10*

10.1

10.1.1 Ammonia/*Ammoniak* ✓ (1)

10.1.2 NO_2 ✓ (1)

10.1.3 Catalytic oxidation of ammonia ✓
Katalitiese oksidasie van ammoniak (1)

10.1.4 Platinum/Pt ✓ (1)

10.1.5 Ostwald (process)/*Ostwald(proses)*✓ (1)

10.1.6 Haber (process)/*Haber(proses)*✓ (1)

10.1.7 $NH_3 + HNO_3$ ✓ $\rightarrow NH_4NO_3$ ✓ Bal. ✓ (3)

10.2

10.2.1

OPTION 1/*OPSIE 1*	**OPTION 2/*OPSIE 2***
N : P : K 10 : 5 : 15 m(fertiliser/*kunsmis*) = $\frac{30}{100}$ x 15 = 4,5 kg m(P) = $\frac{5}{30}$ x 4,5 ✓ = 0,75 kg ✓	m(fertiliser/*kunsmis*) = $\frac{5}{100}$ x 15 ✓ = 0,75 kg ✓

(2)

10.2.2 %fertiliser/*kunsmis* = 10 + 5 + 15 = 30%
%filler/*bindstof* = 100 – 30 = 70%
$m_{(filler/bindstof)} = \frac{70}{100}$ ✓ x 15 ✓
= 10,5 kg ✓ (3)

[14]

TOTAL/*TOTAAL*: 150