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*

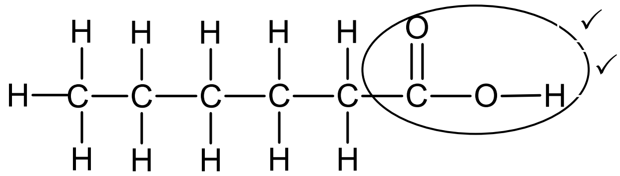
2.1

2.1.1 Esters ✓ (1)

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

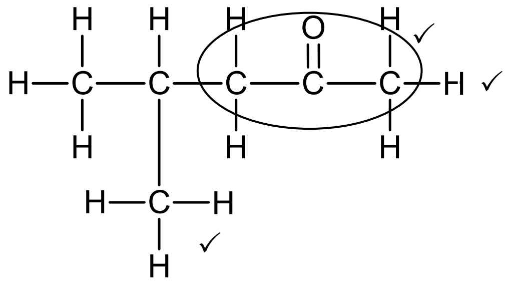
2.1.3 Butanoic acid/*Butanoësuur* ✓ (1)

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)

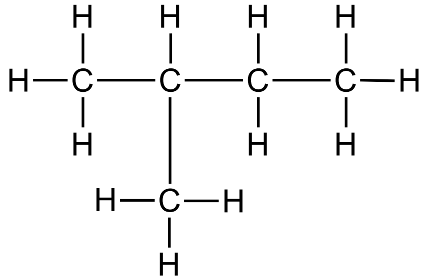
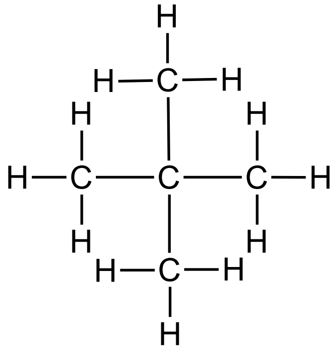
3.3.2 Q ✓
It is the temperature where the graph intercepts the dotted line. ✓
Dit is die temperatuur waar die grafiek die stippellyn sny.

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)

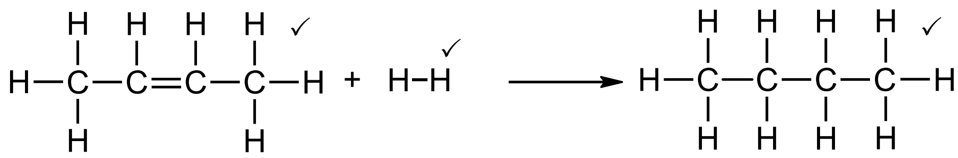
4.3

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-✓bromobutane ✓/*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

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

$= \frac{n}{V}$

$= \frac{0,04}{2}$ ✓

$= 0,02 \text{ mol·dm}^{-3}$

$K_c = \frac{[CO][Br_2]}{[COBr_2]}$ ✓

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

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

6.2.2

OPTION 1/*OPSIE 1*	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 % decomposed $= \frac{0,04}{0,044}$ ✓ $\times 100$ $= 90,46\%$ ✓ Range/*Gebied*: 90,46 – 90,9%	$n(COBr_2)_{eq/ewewig} = cV$ $= 2,11 \times 10^{-3} \times 2$ ✓ $= 4,22 \times 10^{-3}$ 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 ✓ $= -\log[H_3O^+]$ $[H_3O^+] = 1 \times 10^{-6}$ mol·dm^{-3} $[H_3O^+][OH^-] = 10^{-14}$ ✓ $[OH^-] = 1 \times 10^{-8}$ mol·dm^{-3} ✓	$pH + pOH = 14$ ✓ 6 ✓+ $pOH = 14$ $pOH = -\log[OH^-]$ ✓ $8 = -\log[OH^-]$ $[OH^-] = 1 \times 10^{-8}$ 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 $c(HC\ell)_{dilute/verdun} = \frac{n}{V}$ $= \frac{5,47 \times 10^{-3}}{0,05}$ ✓ $= 0,1094$ mol·dm^{-3} $cV(HC\ell)_{dilute/verdun} = cV(HC\ell)_{conc/gekons}$ $0,1094 \times 500$ ✓ $= (HC\ell)_{conc/gekons} \times 5$ ✓ $\therefore c(HC\ell)_{conc/gekons} = 10,94$ 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*: $\underline{1\ mol{\cdot}dm^{-3}}$ ✓
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 <u>Catalytic oxidation of ammonia</u> ✓
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

<u>OPTION 1/*OPSIE 1*</u>	**<u>OPTION 2/*OPSIE 2*</u>**
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