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)

SEPTEMBER 2017

MEMORANDUM

MARKS/*PUNTE*: 150

This memorandum consists of 12 pages.
Hierdie memorandum bestaan uit 12 bladsye.

QUESTION 1/*VRAAG 1*

1.1 C ✓✓ (2)

1.2 C ✓✓ (2)

1.3 B✓✓ (2)

1.4 D✓✓ (2)

1.5 D✓✓ (2)

1.6 A ✓✓ (2)

1.7 B ✓✓ (2)

1.8 B ✓✓ (2)

1.9 C ✓✓ (2)

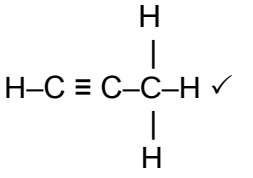
1.10 D ✓✓ (2)
[20]

QUESTION 2/*VRAAG 2*

2.1.1 2,3-dimethyl✓pent-2-ene✓ (2,3-dimethyl-2-pentene) //
2,3-dimetiel✓pent-2-een✓ (2,3-dimetiel-2-penteen) (2)

2.1.2 3-bromo-4-ethyl✓hexane✓ //
3-bromo-4-etiel✓heksaan✓ / 3-broom-4-etiel✓heksaan ✓ (2)

2.1.3

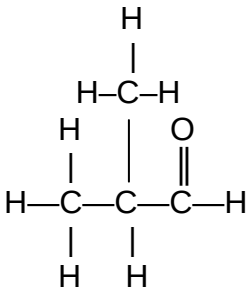


(0 if functional group correct, but structure incorrect.)
(0 as die funksionele groep korrek is maar die struktuur verkeerd is.) (1)

2.2 Isomer are organic compounds/molecules with the same molecular formula✓ but different structural formulas.✓//
Isomere is organiese verbindings/molekules met dieselfde molekulêre formule✓ maar verskillende struktuurformules✓ (2)

2.3 B✓ / (hexanoic acid) ✓ //
B✓ / (*heksanoësuur)✓* (1)

2.4



Notes/*Aantekeninge*
Functional group: ✓
Whole structure correct: ✓

Funksionele groep: ✓
Hele struktuur korrek: ✓

(2)

Notes/*Aantekeninge*:
- Condensed or semi structural formula:/*Gekondenseerde of semistruktuurformule*: ½
- All bonds shown, one or more H atoms omitted: Max. ½
  Alle bindings aangetoon, een of meer H-atome uitgelaat: Maks. ½
- Wrong number of bonds e.g. C atoms not forming 4 bonds: 0/2
  Verkeerde aantal bindings bv. C-atome vorm nie 4 bindings nie: 0/2

[10]

QUESTION 3/*VRAAG 3*

3.1 It is the temperature✓ where the vapour pressure equals the pressure of the (surrounding) atmosphere ✓//
Dit is die temperatuur✓ waar die dampdruk gelyk is aan die (omliggende) atmosferiese druk ✓ (2)

3.2.1 Different homologous series ✓/ type of bonds/ functional groups.
Verskillende homoloë reekse✓/ soort verbindings/ funksionele groepe (1)

3.2.2 Boiling points✓ //
Kookpunte✓ (1)

3.2.3 Molecular mass✓ //
Molekulêre massa✓ (1)

3.3 A has hydrogen bonds ✓ //
A het waterstofbindings✓ (1)

3.4 There is hydrogen bonding (and London forces) in the alcohol / B✓
but dipole-dipole force (and London forces) in the ester / C. ✓
Hydrogen bonds are stronger than dipole-dipole forces.✓
More energy is needed to overcome the stronger intermolecular forces ✓ in the alcohol / B and therefore the boiling point is higher.
OR There are dipole-dipole forces between the ester molecules ✓
and hydrogen bonding between the alcohol molecules. ✓
Dipole-dipole forces are weaker than hydrogen bonding. ✓
Less energy needed to overcome the intermolecular forces between the molecules of the ester✓ therefore boiling point of ester is lower.

Daar is waterstofbindings (en Londonkragte) in die alkohol / B✓maar dipool-dipoolkragte (en Londonkragte) tussen die estermolekules / C✓.
Waterstofbindings is sterker as dipool-dipoolkragte✓.
Meer energie word dus benodig om die sterker intermolekulêre kragte ✓ in alkoho l/ B te oorkom en daarom is die kookpunt hoër.
Die teenoorgestelde verduideliking vir die laer kookpunt van esters teenoor die alkohol is ook aanvaarbaar. (4)

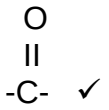
3.5.1 *Chain isomerism✓ //*
Kettingisomere✓ (1)

3.5.2 *Higher than✓ //*
Hoër as✓ (1)
[12]

QUESTION 4/*VRAAG 4*

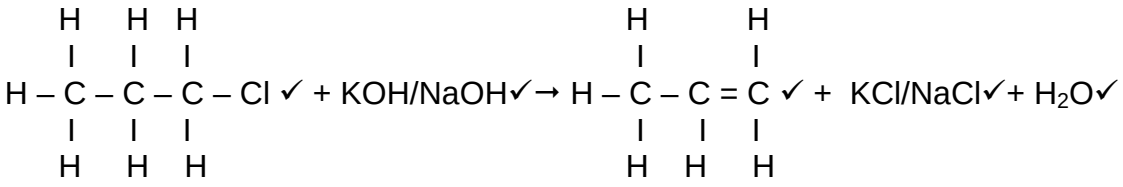
4.1.1 *A functional group is a bond or atom or a group of atoms✓ which determines the chemical properties of a group of (organic) compounds✓// 'n Funksionele groep is 'n binding of 'n atoom of groep atome✓ wat die (fisiese en) chemiese eienskappe van 'n groep (organiese) verbindings bepaal.✓* (2)

4.1.2



(1)

4.2.1



(5)

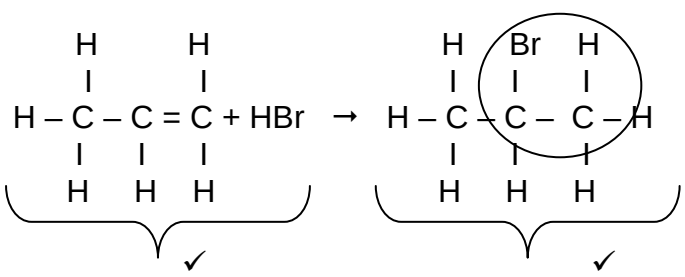
4.2.2 Elimination✓(dehydrohalogenation) //
Eliminasie✓ (dehidrohalogenering) (1)

4.2.3 Concentrated strong base (dissolved in ethanol)✓ and (strong) heating✓//
Gekonsentreerde sterk basis (opgelos in etanol)✓ en (sterk) verhitting✓ (2)

4.2.4 Propan-1-ol / 1-propanol✓ (1)

4.2.5 Primary alcohol ✓//
primêre alkohol ✓ (1)

4.2.6



(Hydrogen and bromine at the correct carbon atoms //
waterstof en broom op die korrekte koolstowwe)

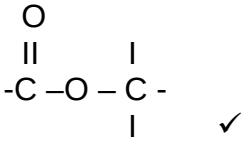
(2)

4.2.7 Addition reaction✓ // hydrohalogenation✓
addisiereaksie✓// hidrohalogenering / hidrohalogenasie✓ (1)

4.2.8 A pleasant smell will form✓//
'n aangename reuk sal vorm✓. (1)

4.2.9 Esters✓ (1)

4.2.10

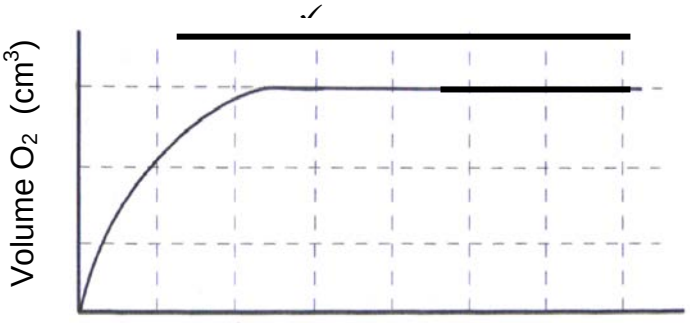


(1)
[19]

QUESTION 5/*VRAAG 5*

5.1 A catalyst is a chemical substance which increases the rate of a reaction ✓without undergoing a permanent change itself ✓//
'n Katalisator is 'n chemiese stof wat die tempo van 'n chemiese reaksie verhoog ✓sonder om self 'n permanente verandering te ondergaan. ✓
OR/*OF*
A catalyst increases the rate of a reaction by providing an alternative route ✓with lower activation energy.✓ //
'n Katalisator verhoog die tempo van 'n reaksie deur 'n alternatiewe roete✓ van laer aktiveringsenergie ✓te verskaf. (2)

5.2.1



Line A: smaller gradient, same volume ✓
Lyn A: kleiner gradiënt, dieselfde volume ✓ (1)

5.2.2 Line B: More products✓ higher rate✓ / steeper gradient, greater volume.
Lyn B: Meer produkte ✓hoër tempo ✓/ steiler gradiënt, groter volume (2)

5.3 1 g✓ (1)

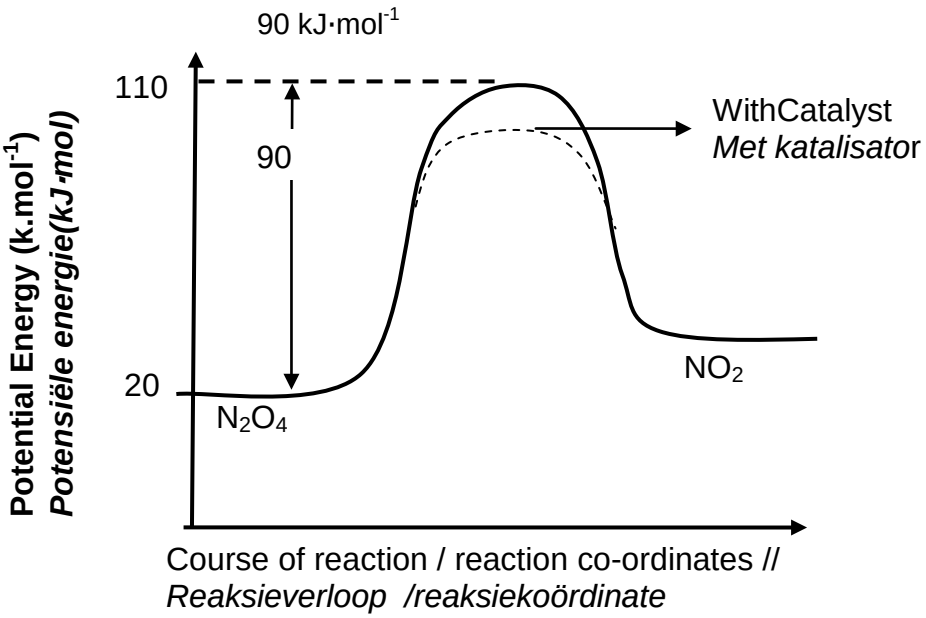
5.4 Reaction rate is the change in the concentration of the reactants or products✓ per unit time. ✓/ amount of products formed or reactants used up per unit time //
Reaksietempo is die verandering in die konsentrasie van die reaktante of produkte ✓per tydseenheid ✓/ hoeveelheid reaktante verbruik of produkte gevorm per tydseenheid. (2)

5.5 The minimum kinetic energy /activation energy is lowered✓therefore there are more effective collisions per unit time ✓//
D*ie minimum kinetiese energie /aktiveringsenergie te word verlaag. ✓ en dus is daar meer effektiewe botsings per tydseenheid✓* (2)

[10]

QUESTION 6/*VRAAG 6*

6.1.1



1 mark each: shape of graph, both 20 and 110 correctly indicated, activation energy correctly indicated (Teaching note: x-axis label NOT time)
1 punt elk: vorm van grafiek , 20 en 110 korrek aangedui, aktiveringsenergie korrek aangedui. (3)

6.1.2 See dotted line on graph.✓ // *Sien stippellyn op grafiek.✓* (1)

6.1.3 Forward✓//
Voorwaarts ✓ (1)

6.1.4 (The temperature increases) According to Le Chatelier's principle, the reaction that will lower the temperature of the reaction is favoured,✓ thus the endothermic reaction✓. The forward reaction is endothermic ✓ and therefore the forward reaction will be favoured.
(Die temperatuur neem toe.) Volgens Le Chatelier se Beginsel sal die sisteem die reaksie bevoordeel wat die temperatuur van die reaksie verlaag, ✓d.w.s. die endotermiese reaksie. ✓
Die voorwaartse reaksie is endotermies ✓en dus word die voorwaartse reaksie bevoordeel (3)

6.2 Exothermic✓
When temperature decreases, Kc decreases,
reverse reaction is favoured ✓
When temperature decreases, exothermic reaction is favoured, ✓
therefore the revere reaction is exothermic. //
Eksotermies ✓
As temperatuur afneem verminder Kc, die terugwaartse reaksie word bevoordeel.✓
As temperatuur verlaag word die eksotermiese reaksie bevoordeel✓
dus is die terugwaartse reaksie eksotermies. (3)

6.3.1 CALCULATIONS USING NUMBER OF MOLES
BEREKENINGE WAT AANTAL MOL GEBRUIK

Option 1 / *Opsie 1:*

n(H_2O) at equilibrium / *by ewewig* = 0,2 mol (given)

n(H_2O) formed / *gevorm* = n(CO) formed/*gevorm* = 0,2 (mol)
n(H_2) reacted = (0,2 mol): n(CO_2) reacted = (0,2 mol) ✓

At equilibrium / *By ewewig*:
n(H_2) = (x – 0,2)/(x – change / *verandering*)
n(CO_2) = 0,1 (mol)/(0,3 – change / *verandering*) ✓
n(H_2O) = n(CO) = 0,2 (mol) ✓

Equilibrium concentration / *Ewewigskonsentrasies:*

$$c(H_2) = \frac{n}{V} = \frac{x-0,2}{10}$$
$$c(CO_2) = \frac{n}{V} = \frac{0,1}{10}$$
$$c(H_2O) = \frac{n}{V} = \frac{0,2}{10}$$
$$c(CO) = \frac{n}{V} = \frac{0,2}{10}$$
✓

$$K_c = \frac{[CO][H_2O]}{[H_2][CO_2]} \checkmark \quad \therefore \frac{(0,02)(0,02)\checkmark}{\left(\frac{x-0,2}{10}\right)(0,01)\checkmark} = 4 \checkmark$$

∴x = 0,3 ∴ n(H_2) = 0,3 mol ✓

Option 2/*Opsie 2*

	H_2	CO_2	H_2O	CO
Initial quantity (mol) *Aanvangshoeveelheid (mol)*	x	0,3	0	0
Change (mol) *Verandering (mol)*	-0,2	-0,2	+0,2	+0,2
Quantity at equilibrium (mol)/ *Hoeveelheid by ewewig(mol)*	x-0,2	0,1 ✓	0,2	0,2 ✓
Equilibrium concentration (mol·dm^{-3}) *Ewewigskonsentrasie (mol·dm^{-3})*	$\frac{x-0,2}{10}$	0,01	0,02	0,02

ratio✓

÷ 10✓

$K_c = \frac{[CO][H_2O]}{[H_2][CO_2]}$ ✓ $\therefore \frac{(0,02)(0,02)✓}{\left(\frac{x-0,2}{10}\right)(0,01)✓}$ = 4 ✓

∴x = 0,3 ∴ n(H_2) = 0,3 mol ✓

CALCULATIONS USING CONCENTRATION
BEREKENINGE WAT KONSENTRASIE GEBRUIK

	H_2	CO_2	H_2O	CO
Initial concentration (mol·dm^{-3}) *Aanvangskonsentrasie (mol·dm^{-3})*	$\frac{x}{10}$	0,03	0	0
Change in concentration (mol·dm^{-3}) *Verandering in konsentrasie (mol·dm^{-3})*	0,02	0,02	0,02	0,02
Equilibrium concentration (mol·dm^{-3}) *Ewewigskonsentrasie (mol·dm^{-3})*	$\frac{x}{10}$ -0,02	0,01 ✓	0,02	0,02 ✓

÷10✓

ratio✓

$K_c = \frac{[CO][H_2O]}{[H_2][CO_2]}$ ✓ $\therefore \frac{(0,02)(0,02)✓}{\left(\frac{x-0,2}{10}\right)(0,01)✓}$ = 4 ✓

∴x = 0,3 ∴ n(H_2) = 0,3 mol ✓ (9)

6.3.2 Remains the same ✓//
Bly dieselfde ✓ (1)

[21]

QUESTION 7/*VRAAG 7*

7.1.1 An acid is a proton donor ✓
a base is a proton acceptor ✓//
'n Suur is 'n protonskenker ✓
'n basis is 'n protononttvanger ✓ (2)

7.1.2 Ampholyte /amphiprotic substance ✓//
Amfoliet /amfiprotiese stof ✓ (1)

7.1.3 B ✓✓ (2)

7.1.4 HCO_3^- ✓ (1)

7.1.5 It can donate two protons ✓//
dit kan twee protone skenk ✓ (1)

7.2.1 $M(CaCO_3) = 40 + 12 + 3(16) = 100\ g\cdot mol^{-1}$

$n = \frac{m}{M}$ ✓ $= \frac{0,8}{100}$ ✓ = 0,008 mol ✓ $CaCO_3$ has reacted //
$CaCO_3$ het gereageer

2 mol HCl reacts with// *reageer met* 1 mol $CaCO_3$ ✓

∴ 2(0,008) = 0,016 mol ✓ HCl reacted with // *reageer met* 1 mol $CaCO_3$ (5)

7.2.2 Initial // *Aanvanklik*: moles HCl: n = cV ✓ = 0,5 x 0,06 ✓= 0,03 mol ✓

HCl left // *oor* = 0,03 – 0,016 = 0,014 mol ✓

(HCl is a strong acid and ionises completely thus $n(H^+) = 0,014$ mol //
HCl is *'n sterk suur en ioniseer volledig∴ mol $H^+ = 0,014$ mol*)

$c = \frac{n}{V} = \frac{0,014}{0,06}$ ✓= 0,23 $mol\cdot dm^{-3}$ ✓

pH = - log $[H^+]$ ✓ = - log (0,23) ✓= 0,64 ✓ (9)
[21]

QUESTION 8/*VRAAG 8*

8.1 ✓ ✓ ✓
Ni / Ni^{2+} (1mol·dm^{-3}) // Cu^{2+} / Cu (1mol·dm^{-3}) (3)

8.2 negative✓//
negatief✓ (1)

8.3 Cu✓/ copper // (1)
koper

8.4 $E^{\theta}_{cell} = E^{\theta}_{cathode} - E^{\theta}_{anode}$✓
E^{θ}_{cell}= 0,34 ✓ – (-0,27) ✓= 0,61 V ✓
E^{θ}_{cell} > 0,5 V.✓ the bulb should light up ✓ //
die gloeilamp behoort te brand ✓ (6)
[11]

QUESTION 9/*VRAAG 9*

9.1 Y ✓ (1)

9.2 Hydrogen gas (accept bubbles/gas)✓//
Waterstofgas (aanvaar borrels / gas)✓ (1)

9.3 $2H_2O + 2e^- \rightarrow H_2 + 2OH^-$ ✓✓

Marking criteria // *Nasienriglyne*	
$2H_2O + 2e^- \rightleftharpoons H_2 + 2OH^-$ (1/2)	$2H_2O + 2e^- \leftarrow H_2 + 2OH^-$ (2/2)
$H_2 + 2OH^- \rightleftharpoons 2H_2O + 2e^-$ (0/2)	$H_2 + 2OH^- \rightarrow 2H_2O + 2e^-$ (0/2)

(2)

9.4 Cathode ✓//
Katode ✓ (1)

9.5 *Y to / na X* ✓ (1)

9.6 Chloride ions ✓ //
chloriedione ✓ (1)

9.7 $2H_2O + 2NaCl$ ✓ $\rightarrow H_2 + 2NaOH + Cl_2$ ✓ Bal ✓

Except / *aanvaar* $2H_2O + 2Cl^-$ ✓ $\rightarrow H_2 + 2OH^- + Cl_2$ ✓ Bal ✓ (3)

[10]

QUESTION 10/*VRAAG 10*

10.1.1 Mass ratio of N:K:P is 3:2:1 ✓//
Massaverhoudingsamestelling van N:P:K is 3:2:1 ✓ (1)

10.1.2 Percentage of fertiliser (N,P and K) present ✓//
persentasie kunsmis (N, P en K) teenwoordig.✓ (1)

10.2.1 % N = $\frac{3}{6}$ ✓x 28 ✓ = 14 % ✓ (3)

10.2.2

OPTION 1/OPSIE 1	**OPTION 2/OPSIE 2**
22% of 20 kg = 4,4 kg $\frac{4}{9}$ ✓x 4,4 ✓ = 1,96 kg ✓	$\frac{4}{9}$ ✓ x 22 ✓ = 9,78 % 9,78 % x 4,4 = 1,96 kg ✓
OPTION 3/OPSIE 3 22% of 20 kg = 4,4 kg 44,44%✓of 4,4 ✓ = 1,96 kg ✓	

(3)

10.3 $2\ NH_3 + H_2SO_4$ ✓→ $(NH_4)_2SO_4$ ✓ (Bal)✓ (ignore / *ignoreer* ⇆) (3)

10.4 *C*ontact process ✓//
Kontakproses ✓ (1)

10.5 Necessary for root development ✓//
Nodig vir ontwikkeling van wortels, ✓ (1)

10.6 Eutrofication✓//
Eutrofikasie ✓ (1)

10.7 An excess of fertilizer washed into/landed up in the pond, causing increased algae growth✓ //
'n Oormaat van die kunsmis kon in die visdam beland het en algegroei aangehelp het. ✓ (1)

10.8 Fishes die, may cause illness(any relevant result)✓
//*Omgewing begin stink en kan siektes veroorsaak.(Enige geldige gevolg wat op mense van toepassing is)*✓ (1)

[16]

TOTAL/TOTAAL: 150