HILLCREST HIGH SCHOOL
PHYSICAL SCIENCE
GRADE 12
PAPER 2 - CHEMISTRY

TRIALS 2021

EXAMINER: J. KNOX-WHITEHEAD **TIME: 3 HRS**

TOTAL 150

SECTION A

QUESTION 1: MULTIPLE CHOICE QUESTIONS

1.1 A
1.2 C
1.3 C
1.4 A
1.5 C
1.6 D
1.7 B
1.8 C
1.9 B
1.10 D

10 x2 = [20]

SECTION B

QUESTION 2 / VRAAG 2

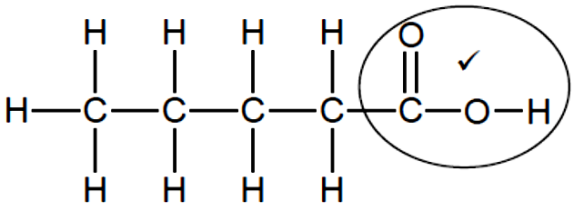
2.1.1 A bond or an atom or a group of atoms ✓that determine(s) the physical and chemical properties of a group of ✓organic compounds.
'n Binding of 'n atoom of 'n groep atome wat die fisiese en chemiese eienskappe van 'n groep organiese verbindings bepaal. (2)

2.1.2 Formyl group/*Formielgroep*✓ (1)

2.1.3 Aldehyde (1)

2.2.1 Same molecular formula, ✓ but different functional groups. ✓
Dieselfde molekulêre formule, maar verskillende funksionele groepe (2)

2.2.2



✓ ✓

Marking criteria / *Nasienriglyne*

- Functional group correct / *Funksionele groep korrek*✓
- Whole structure correct / *Hele struktuur korrek* ✓

(2)

2.2.3 Esterification / *Esterifikasie*✓Accept/*Anvaar:*Condensation/*kondensasie* (1)

2.2.4 Ethanol / *Etanol*✓ (1)

2.2.5 (Concentrated) Sulphuric acid /*(Gekonsentreerde) swawelsuur* / H_2SO_4/catalyst ✓ and / en heat /hitte✓ (2)

2.2.6 The product will have a characteristic smell. / *Die produk sal 'n spesifieke reuk hê.*✓ (1)

2.3.1 The reaction is exothermic / gives off heat / produces energy. (1)

2.3.2

$$n = \frac{m}{M}$$
$$= \frac{34}{44} \checkmark$$
$$n(CO_2) = 0{,}7727 \text{ mol}$$

$$n(C_4H_{10}) = \frac{2}{8} n(CO_2) = 0{,}1932 \text{ mol} \checkmark$$

$$n = \frac{m}{M}$$
$$0{,}1932 = \frac{m}{58} \checkmark$$
$$m(CO_2) = 11{,}2056 \text{ g}$$

$$\% \text{ purity/suiwerheid} = \frac{\text{pure substance/}\textit{suiwer stof}}{\text{impure substance/}\textit{onsuiwer stof}}$$
$$= \frac{11{,}2056}{26} \times 100 \checkmark$$
$$= 43{,}1\ (43{,}098)\% \checkmark$$

(5)

[19]

QUESTION 3

3.1 Boiling point: The **temperature** at which the vapour pressure of a substance equals atmospheric pressure.√√ (2)

3.2 Boiling point increases as number of carbon atoms/chain length/molecular size increases. (1)

3.3 As molecular size/chain length/number of carbons increases, the Van der Waal's London forces increase √, and thus more energy is required to overcome the IMF of a longer chain. √ (2)

3.4.1 Primary. √ The **C attached to the alcohol** group/hydroxyl is attached to only one other C/alkyl group. √ (2)

3.4.2 Higher than (1)

3.4.3

- Butan-1-ol has strong hydrogen bonds✓ in addition to the weak london forces.

  Butan-1-ol het sterk waterstofbindings saam met swak Londonkragte.

- Butane has weak London forces. ✓

  Butaan het swak Londonkragte

- More energy needed to overcome/break the hydrogen bonds/ IMF in butan-1-ol than the London forces in butane. ✓

  Meer energie is nodig om die waterstofbindings te oorkom/te breek/IMK in butan-1-ol te breek/te oorkom as die Londonkragte in butaan.

  OR/*OF*

- Butane has London forces/induced dipole- induced dipole forces/ dispersion forces✓

  Butaan het Londonkragte/geïnduseerde dipool-geïnduseerde dipool krag/dispersiekrag

- Butan-1-ol has strong hydrogen bonds✓ in addition to the weak london forces.

  Butan-1-ol het sterk waterstofbindings saam met swak Londonkragte.

- Less energy needed to overcome/break the London forces/ IMF in butane than the hydrogen bonds in butan-1-ol. ✓

  Minder energie is nodig om die Londonkragte te oorkom/te breek/IMK in butaan te oorkom/te breek as die waterstofbindings in butan-1-ol.

(3)

[11]

QUESTION 4

4.1.1 Substitution/halogenation✓ (1)

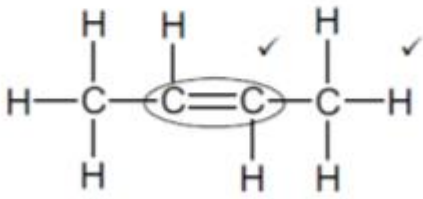
4.1.2 Substitution/Hydrolysis✓ (1)

4.1.3 Addition/Hydrogenation✓ (1)

4.2.1 Concentrated strong base ✓ heated under reflux ✓ (2)

4.2.2 2-Bromo✓butane✓/*2-broombutaan/2-bromobutaan* (2)

4.2.3



Marking criteria / *Nasienriglyne*
- Functional group on second carbon/*funksionele groep op tweede koolstof* ✓
- Whole structure correct / *Hele struktuur korrek* ✓

(2)

4.2.4 Unsaturated √, alkene has double bonds between carbons. √ (2)

4.3.1 Hydration / *Hidrasie / Hidratering* ✓ (1)

4.3.2 H_2SO_4/Sulphuric acid/*Swawelsuur* H_3PO_4/Phosphoric acid/*fosforsuur* ✓ (1)

4.4 NaBr/HBr✓ (1)

4.4.2 alcohols (1)

[15]

QUESTION 5

5.1 Exothermic (1)

5.2 NO/gas escapes✓ OR it is not a closed system
NO/ gas ontsnap OF dit is nie 'n geslote sisteem nie (1)

5.3 $\text{Rate/tempo} = -\frac{\Delta m}{\Delta t}$

$= -\frac{6,3-0✓}{0-105✓} = 0,06\ g{\cdot}s^{-1}$ ✓

(accept/*aanvaar* $-0,06\ g{\cdot}s^{-1}$) (3)

5.4 Reaction is completed/all Cu(reactant) is used up✓(NOT equilibrium)
(1)

5.5 Temperature increased/heat is given off /exothermic reaction✓
Accept: HNO_3 removes CuO from Cu surface/ cleans copper surface
(1)

5.6 Concentration of HNO_3 decreased/ reactants are being used up✓
(1)

5.7 The number of particles has decreased✓ Thus fewer/less effective collisions occur per second✓
(2)

5.8 NO: $n = \frac{m}{M} = \frac{6,3}{30}$ ✓ $= 0,21$ mol (Accept / Aanvaar 6,2 - 6,4)

$n_{Cu} : n_{NO}$

1 : 4 $\therefore \frac{0,21}{4}$ ✓ $= 0,052$ mol (Using ratio / toepassing van verhouding)

method mark, only if mole ratio shown

Cu: $m = nM = 0,052 \times 63,5$✓ $= 3,30$ g ✓
(4)

5.9 Increase the concentration of HNO_3✓
Increase the temperature of the solution✓
Use Cu powder / smaller pieces of Cu/increase the surface area of Cu ✓
(3)

[17]

QUESTION 6

6.1.1 Le Chatelier's principle – When the equilibrium in a closed system is disturbed, the system will re-instate a new equilibrium by favouring the reaction that will oppose the disturbance. √√ (2)

6.1.2 No / *Nee* ✓

Equilibrium is not reached yet / *Ewewig is nog nie bereik nie*. ✓ (2)

6.1.3
- Concentration of O_2 decreased ✓
- The reverse reaction was favoured. ✓
- The amount/concentration of reactants increased/ The amount/concentration of products decreased. ✓

(3)

6.1.4 Exothermic ✓

A decrease in temperature favours the exothermic reaction ✓, the forward reaction was favoured OR [H_2O] and [NO] increased. ✓

(3)

6.2.1 **CALCULATIONS USING NUMBER OF MOLES / *BEREKENINGE WAT ANTALE MOLE GEBRUIK***

Marking criteria / Nasienriglyne

- Use ratio/*gebruik verhouding* 1:1:1
- Multiply and/or Divide by 2 dm^3.
- Correct Kc expression/ *Korrekte Kc uitdrukking*
- Substitution of consentration into Kc expression /*Vervanging van konsentrasie in Kc uitdrukking*
- Final answer / *Finale antwoord*. 0,357

	$PC\ell_5$	$PC\ell_3$	$C\ell_2$
Initial quantity (mol) Aanvangshoeveelheid (mol)	2,4	0	0
Change (mol) *Verandering (mol)*	-1,0	+1,0	+1,0
Quantity at equilibrium (mol)/ *Hoeveelheid by ewewig (mol)*	1,4	1,0	1,0
Equilibrium concentration ($mol \cdot dm^{-3}$) Ewewigskonsentrasie ($mol \cdot dm^{-3}$)	0,7	0,5	0,5

Ratio ✓

Mutiply/divide by 2 ✓

$$Kc = \frac{[PC\ell_3][\ C\ell_2]}{[PC\ell_5]} \quad \checkmark$$

$$= \frac{(0,5)(0,5)}{(0,7)} \checkmark$$

$$= 0,357 \checkmark$$

No Kc expression, correct substitution / *Geen Kc uitdrukking, korrekte substitusie:* Max. / *Maks* $^4/_5$

Wrong Kc expression / *Verkeerde Kc uitdrukking*: Max./*Maks.* $^2/_5$

(5)

6.2.1 **CALCULATIONS USING CONCENTRATION / *BEREKENINGE WAT KONSENTRASIE GEBRUIK***

(4)

Marking criteria / Nasienriglyne

- Use ratio/*gebruik verhouding* 1:1:1
- Divide by 2 dm^3 on $PC\ell_3$
- Correct Kc expression/ *Korrekte Kc uitdrukking*
- Substitution of consentration into Kc expression /*Vervanging van konsentrasie in Kc uitdrukking*
- Final answer / *Finale antwoord.* 0,357

	$PC\ell_5$	$PC\ell_3$	$C\ell_2$
Initial concentration ($mol \cdot dm^{-3}$) *Aanvanklike konsentrasie ($mol \cdot dm^{-3}$)*	1,2	0	0
Change ($mol \cdot dm^{-3}$) *Verandering ($mol \cdot dm^{-3}$)*	-0,5	+0,5	+0,5
Equilibrium concentration ($mol \cdot dm^{-3}$) *Ewewigskonsentrasie ($mol \cdot dm^{-3}$)*	0,7	0,5	0,5

Ratio ✓

Divide by 2 ✓

$$Kc = \frac{[PC\ell_3][\ C\ell_2]}{[PC\ell_5]} \quad \checkmark$$

$= \frac{(0,5)(0,5)}{(0,7)}$ ✓

=0,357✓

No Kc expression, correct substitution / *Geen Kc uitdrukking, korrekte substitusie:* Max. / *Maks* $^4/_5$

Wrong Kc expression / *Verkeerde Kc uitdrukking*: Max./*Maks.* $^2/_5$

6.2.2 **OPTION 1**

$n = \frac{m}{M}$ ✓

$2,4 ✓ = \frac{m}{(208,5)}$ ✓

m = 500,4g ✓

Marking criteria / Nasienriglyne

- Formula / *Formule*
- substitution / *invervanging* 2,4 in n
- substitution / *invervanging* 208,5 in M
- final answer /*finale antwoord* 500,4g

(4)

OPTION 2

$c = \frac{m}{MV}$ ✓

$1,2 ✓ = \frac{m}{(208,5)(2)}$ ✓

m = 500,4g ✓

Marking criteria / Nasienriglyne

- Formula / *Formule*
- substitution / *invervanging* 1,2 in c
- substitution / *invervanging* 208,5 in M
- final answer /*finale antwoord* 500,4g

(4)

[19]

QUESTION 7

7.1

7.1.1 **Acid-base reaction/neutralisation/protolysis ✓**

Suur-basis reaksie/ neutralisasie/protoliese ✓ **(1)**

7.1.2 **Barium hydroxide ✓**
Bariumhidroksied **(1)**

7.1.3 **X- Burette ✓** ***Buret*** **(1)**

7.1.4.1 End point is the point at which the indicator√ changes colour√ . (2)

7.1.4.2 Yellow √ solution changes to orange/golden yellow √
(If they say precipitate forms – give one mark for this; if they just say yellow, no marks as final colour observed is orange) (2)

7.1.5.1 $[OH^-] = 2 \times 0,1$ √ $= 0,2\ mol.dm^{-3}$

$pOH = -\log 0,2$ √ $= 0,699…$

$pH = 14 – 0,699…$√ $= 13,3$ √ (4)

or

[OH-] = 0,1 x 2 √= 0,2mol.dm-3 *it is dibasic

[H3O+][OH-] = 1 x 10-14

[H3O+][0,2] √= 1 x 10-14

[H3O+] = 1 x 10-13

pH = -log[h3O+]

pH = -log(1 x 10-13) √m

= 13,3 √

7.1.5.2 Marking guidelines/*Nasienriglyne*

- Any formulae/*Enige formule:* ✓
- Division by Volume ✓/ *deel deur volume*
- Use mole ratio ✓ *gebruik molverhouding*
- Use M = 233 g·mol^{-1} in m = nM ✓
- Answer = 1,165 g ✓

OPTION 1: *OPSIE 1*

$$\frac{c_a V_a}{c_b V_b} = \frac{n_a}{n_b}$$

$$\frac{c_a(30)}{(0,1)(50)} = \frac{1}{1}$$

$$c_a = 0,167 mol \cdot dm^{-3}$$

$$c = \frac{n}{V}$$

$$0,167 = \frac{n}{0,03}$$

$$n = 0,005\ mol$$

OPTION 2: *OPSIE 2*

$$c = \frac{n}{V}$$

$$0,1 = \frac{n}{0,05}$$

$$0,005\ mol$$

÷1 x1

$n(BaSO_4) = n(Ba(OH)_2)$
$= 0,005$ mol

m = n x M
= (0,005)(233)
= 1,165 g

(5)

7.2

7.2.1 $NH_4^+(aq) + H_2O(\ell) \rightarrow NH_3 + H_3O^+$ (2)

7.2.2 $CH_3CHOO^-(aq) + H_2O(\ell) \rightarrow CH_3COOH + OH^-$ (2)

[20]

QUESTION 8

8.1 chemical energy to electrical energy (1)

8.2 Salt bridge √
To complete the circuit / to maintain electrical neutrality √ (2)

8.3 standard hydrogen electrode (accept hydrogen but not H_2 – asked for NAME) (1)

8.4 It can conduct electricity √

It is unreactive √ (2)

8.5 $Mg\ (s)\ |\ Mg^{2+}\ (aq)$ ✓ ||✓ $Pt_{(s)}/I_{2(g)(1\ atm)}\ /I^-_{(aq)(1mol.dm\text{-}3)}$ ✓ (3)

8.6 $E^{\theta}_{cell} = E^{\theta}_{cathode} - E^{\theta}_{anode}$ ✓

$E^0_{sel} = E^0_{katode} - E^0_{anode}$

$E^{\theta}_{cell/sel} = 0,54$✓ - (-2,36)✓

$E^{\theta}_{cel/sel} = 2,90$ V✓

E^{θ}_{cell} is less than 3 V so the bulb will not glow to its maximum brightness. ✓

Last mark consistent accuracy with Ecell answer

(5)

8.7 The bulb will switch off/it will no longer glow at all.✓ (1)

[15]

QUESTION 9

9.1 A ✓ **(1)**

9.2 $Cu^{2+}_{(aq)} + 2e^- \rightarrow Cu_{(s)}$ ✓✓ **(2)**

9.3.1 m (impurities) = 8,5 g in 1 hour

n (Cu deposited) = 0,25 mol in 7200 s (2 hours)

n (Cu deposited in 1 hour) = 0,25 / 2 √ = 0,125 mol

m (Cu) = n x M

= 0,125 x 63,5 √

= 7,9375 g

Total ore mass lost in 1 hour = 7,9375 + 8,5 √ = 16,4375 g

% Purity = (pure / total) x 100

= (7,9375 / 16,4375) x 100 √

= 48,29% √ (5)

9.3.2 Pt and Ag are both weaker reducing agents ✓(than copper) and will not be oxidised. ✓
Pt en Ag is beide swakker reduseermiddels (as koper) en sal nie geoksideer word nie.

OR/*OF*
Cu is a stronger reducing agent (than Pt and Ag) ✓
and will be oxidised. ✓/ *Cu is 'n sterker reduseermiddel (as Pt en Ag) en sal geoksideer word.*

[12.2.3] (2)

9.3.3 Platinum and silver are valuable / expensive metals. (1)

9.4.1 **Electrolyte is a solution/liquid/dissolved substance that conducts electricity through the movement of ions (2 or 0)**

An electrolyte is a substance of which the aqueous solution contains ions / a substance that dissolves in water to give a solution that conducts electricity. √√ **(new definition)** **(2)**

9.4.2 **The rate of oxidation is equal to the rate of reduction.** ✓

Die tempo waarteen oksidasie plaasvind is gelyk aan die tempo van reduksie. ✓ **(1)**

[14]