HILLCREST HIGH SCHOOL
PHYSICAL SCIENCE
GRADE 11
PAPER 2- Chemistry

JUNE 2022 MEMO

Total: 100

Question 1

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

Question 2

2.1	**OPTION 1**	
	$n = \frac{m}{M}$ ✓ $n = \frac{11,79}{12}$ ✓ $n = 0,9825\ mol$ $n = \frac{m}{M}$ $n = \frac{69,57}{35,5}$ ✓ $n = 1,9597\ mol$ $n = \frac{m}{M}$ $n = \frac{18,64}{19}$ ✓ $n = 0,9811\ mol$	
	$\frac{0,9825}{0,9811} = \frac{1,9597}{0,9811} = \frac{0,9811}{0,9811}$ ✓ Ratio = 1:2:1 Empirical formula-$CC\ell_2F$ Relative formula mass/empirical mass = 12 +2(35,5) + 19 = 102 Ratio = True mass empirical mass 204/102 = 2✓ Molecular formula: $C_2C\ell_4F_2$✓	
	OPTION 2	
	m(C) = $204 \times \frac{11,79}{100}$ ✓= 24,05 g m(Cℓ)= $204 \times \frac{69,57}{100}$ ✓= 141,92 m(F) = $204 \times \frac{18,64}{100}$ ✓= 38,03 g n(C) = $\frac{24,05}{12}$ = 2 mol✓ n(Cℓ) = $\frac{141,92}{35,5}$ = 4 mol✓ n(F) = $\frac{38,03}{19}$ = 2 mol✓ Molecular formula: $C_2C\ell_4F_2$✓	(7)
2.2.1	Limiting reagent is the substance that is completely used up during a chemical reaction ✓✓	(2)

2.2.2	Given: 6Li + N_2 $n(Li) = \frac{m}{M}$ ✓ $n(N_2) = \frac{m}{M}$ $n(Li) = \frac{12,3}{7}$ ✓ $n(N_2) = \frac{33,6}{28}$ ✓ $n(Li) = 1,76\ mol$ $n(N_2) = 1,20\ mol$	
	1,2 mol ÷ 1 x 6 ✓ = 7,2 mol Li ✓ Thus Li is the limiting reagent ✓	(6)
		[15]

Question 3

3.1.1	n = c.V $n(CH_3COOH)$ = (0,5)(0,25) ✓ $n(CH_3COOH)$ =0,13mol	(10)
3.1.2	Reaction 2 n(NaOH) = cv ✓ n(NaOH) = (0,968)(0,025) ✓ n(NaOH) = 0,0242 mol Mole Ratio: CH_3COOH : NaOH 1 : 1 $n(CH_3COOH)$ = 0,0242 mol ✓ Original/*Oorspronlik* (CH_3COOH) $n(CH_3COOH)$ = cv n(reacted) = 0,125-0,0242 ✓ n(reacted) = 0,10 mol	
3.1.3	Reaction 1 Mole Ratio CH_3COOH : $CaCO_3$ 2 : 1 $n(CaCO_3)$ = 0,100/ 2 x 1✓ $n(CaCO_3)$ = 0,050 mol $m(CaCO_3)$ = nM $m(CaCO_3)$ = (0,050)(100) ✓ $m(CaCO_3)$ = 5,00 g % purity = $\frac{5,0}{56} \times 100\%$ ✓ %purity = 8,93%✓	

Question 4 – energy

4.1	Minimum energy required to start a chemical reaction ✓✓	(2)
4.2	Exothermic ✓ The total potential energy of the products is less than the total potential energy of the reactants. ✓ **OR** The heat of the reaction is less than zero/negative.	(2)
4.3	Ea(reverse)= 679.1 ✓+ 184,7 ✓ = 863,8 $kJ \cdot mol^{-1}$ ✓	(3)
4.4	Bond formation = 863,8 $kJ \cdot mol^{-1}$ for 2 HCl molecules Bond energy for EACH HCl = 836,8 ✓ / 2 ✓ = 431,9 $kJ \cdot mol^{-1}$ ✓	(3)
4.5	No effect. ✓ Catalyst only has an effect on the activation energy and no effect on the heat of the reaction ✓	(2)
		[12]

Question 5 – rates of reaction

5.1 5.1.1 Endothermic / *Endotermies* ✓ (1)

5.1.2 $\Delta H = E_{products} - E_{reactants}$ / $\Delta H = E_{produkte} - E_{reaktante}$
$\Delta H = 420 - 0$
$\Delta H = 420\ kJ \cdot mol^{-1}$ ✓ ✓
If learner only writes the correct answer with unit – allocate 2 marks
No unit – only one mark
Slegs korrekte antwoord met eenheid – gee 2 punte
Geen eenheid – slegs een punt (2)

5.1.3 $E_{A\ reverse} = 60\ (kJ \cdot mol^{-1})$/ $E_{A\ terugwaarts} = 60\ (kJ \cdot mol^{-1})$ ✓ (1)

5.2 5.2.1 The change in concentration of reactants or products per unit time / *Die verandering in konsentrasie van reaktante of produkte per eenheid tyd* ✓✓ (2 or 0) (2)

5.2.2 The number of particles with sufficient energy for effective collisions. Or with enough energy for effective collisions / *Die hoeveelheid deeltjies met genoegsame energie vir effektiewe botsings. Of met voldoende energie vir effektiewe botsings.* ✓ (1)

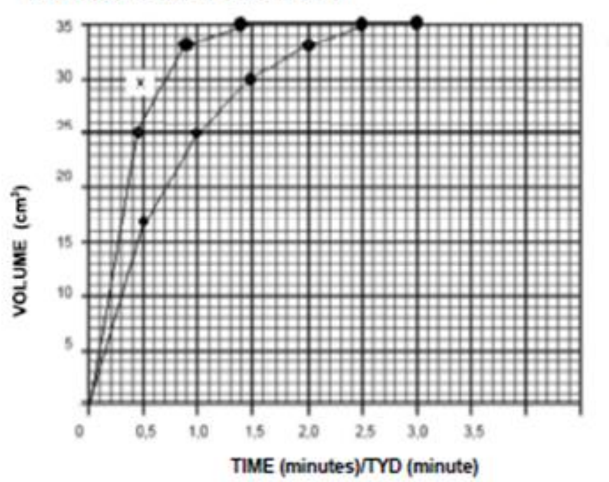
5.2.3 Sample S / *Monster S* ✓ (1)

5.2.4
- When the temperature is increased the particles gain kinetic energy. ✓
- More particles will have sufficient energy/the number of effective collisions will increase. ✓
- More particles will therefore have energy greater than the activation energy, so the area under the graph to the right of line T increases. ✓

(3)

5.3 5.3.1

GRAPH INDICATING THE RELATIONSHIP BETWEEN THE VOLUME OF $H_{2(g)}$ PRODUCED PER UNIT TIME/*GRAFIEK WAT DIE VERHOUDING AANDUI TUSSEN DIE VOLUME $H_{2(g)}$ GEPRODUSEER PER EENHEIDSTYD*



ON GRAPH PAPER/*OP DIE GRAFIEKPAPIER*
✓ All points correctly plotted/*Alle punte korrek geplot*
✓ Points connected into correct shape/*Punte verbind en die vorm reg* (2)

5.3.2 The reaction rate is decreasing because the reactants decrease.
The reaction rate is decreasing because the gradient of the graph is decreasing.
The reaction has run to completion. The reactant has been used up. ✓
(any one) (1)

5.3.3 ON GRAPH PAPER/*OP DIE GRAFIEKPAPIER*
✓ Steeper gradient / Steiler gradiënt
✓ Reach completion earlier / Bereik gouer voltooiing (2)

5.3.4] $Mg + 2HCl \rightarrow H_2$

Mg	2 HCl	H_2
	$1,4303 \times 10^{-3} \div 1 \times 2$ ✓m	$n = V/V_m$
	$= 2,8606 \times 10^{-3}$ mol	$= \frac{0,035}{24,47}$ ✓
	$V = \frac{n}{c}$	$= 0,00143 / 1,4303 \times 10^{-3}$ mol
	$= \frac{2,8606 \times 10^{-3}}{0,25}$ ✓m	
	$= 0,01 / 1,14 \times 10^{-2}$ dm^3 ✓A	(4)

Or

Mg	2 HCl	H_2
$n = m/M$	0,4583 mol $\div 1 \times 2$ ✓m	
$= 11/24$ ✓	= 0,9167 mol	
= 0,4583 mol	$V = n/c$	
	$= \frac{0,9167}{0,25}$ ✓m	$= 3,67$ dm^3 ✓A

Question 6 – acids and bases

6.1 Weak acid ✓ It ionises incompletely/does not ionise completely in water✓ (to form a low concentration of H_3O^+)/ (2)

careful, $[H_3O^+] \neq 2[H_2CO_3]$ since carbonic acid is weak

6.2 $n = cV$ ✓
$= 0{,}012 \times 0{,}5$ ✓
$n = 0.006$ mol ✓ 6×10^{-3} mol / 0,01 mol (3)

6.3.1 $n_{(NaOH)} = cV$✓
$n_{(NaOH)} = 0{,}25 \times 0{,}75$✓
$= 0.1875$ mol / $1{,}88 \times 10^{-1}$ / 0,19 mol (3)

$n(OH^-) = n(NaOH)$ ✓ This is equal, since NaOH is strong & monobasic.
$= 0{,}19$ mol

6.3.2]

H_2CO_3 + / H_3O^+	NaOH → / OH^-
Given: 0,006 mol	0,1875 mol

Needed:

$0,1875 \text{ mol} \div 1 \times 1$
$= 0,1875 \text{ mol}$

∴ Limiting

$0,006 \text{ mol} \div 1 \times 1$ ✓ m ratio
$= 0,006 \text{ mol}$

∴ Excess

Excess mol $= 0,1875 - 0,006$ ✓ CA 6.2 + 6.3.1
$= 0,1815 \text{ mol}$

$C_{excess\ base} = \frac{n}{V}$

$= \frac{0,1815}{[0,5 + 0,75]}$ ✓ m ($V_1 + V_2$)

$= 0,1452 \text{ mol.dm}^{-3}$

$[OH^-] = [NaOH]$
$= 0,1452 \text{ mol.dm}^{-3}$

✓ Formula
$[OH^-][H_3O^+] = 1 \times 10^{-14}$ ✓ CA
$(0,1452)[H_3O^+] = 1 \times 10^{-14}$
$[H_3O^+] = 6,8871 \times 10^{-14}$

$pH = -\log[H_3O^+]$ ✓ subst A
$= -\log(6,8871 \times 10^{-14})$
$= 13,16$ ✓ CA

$pOH = -\log[OH^-]$ ✓ Formula
$= -\log(0,1452)$ ✓
$= 0,8380$

$pH + pOH = 14$
$pH + 0,8380 = 14$ ✓ subst A
$pH = 13,16$ ✓ CA

(7)

Or

6.3.2) H_2CO_3 + NaOH →

	H_2CO_3	NaOH
Given:	0,01 mol	0,19 mol
		$0,01 \div 1 \times 1$ ✓m ratio
		= 0,01 mol
		∴ Excess

Excess mol = 0,19 − 0,01 ✓CA 6.2 + 6.3.1
= 0,18 mol

C(excess base) = $\frac{n}{V}$

$= \frac{0,18}{[0,5 + 0,75]}$ ✓m ($V_1 + V_2$)

$= 0,144\ mol \cdot dm^{-3}$

$[H_3O^+][OH^-] = 1 \times 10^{-14}$ ✓
$[H_3O^+][0,144] = 1 \times 10^{-14}$ ✓
$[H_3O^+] = 6,944 \times 10^{-14}$

pH = −log $[H_3O^+]$ ✓subs
= −log $[6,944 \times 10^{-14}]$
= 13,16 ✓

pOH = −log $[OH^-]$ ✓
= −log (0,144) ✓
= 0,8416

pH + pOH = 14
pH + 0,8416 = 14 ✓
pH = 13,16 ✓

Question 7 – galvanic

7.1 Temperature: 298 K (25 °C) ✓
Concentration of electrolyte (2)

7.2 B ✓ (1)

7.3 $Ba(s) \rightarrow Ba^{2+}(aq) + 2e^-$ ✓✓ double arrow – penalise by one mark. (2)

7.4 $Ba(s) \mid Ba^{2+}(aq)$ ✓ $(1 mol.dm^{-3}) \| $ ✓ $Cu^{2+}(aq)\ (1 mol.dm^{-3}) \mid Cu\ (s)$ ✓

(3)

7.5 $E^{\theta}_{cell} = E^{\theta}_{cathode/katode} - E^{\theta}_{anode/anode}$ ✓ (no abbreviations in formula allowed)
= 0,34 ✓ – (-2,90) ✓
= 3,24 V ✓ (4)

7.6 $Ba + Cu^{+2} \rightarrow Ba^{+2} + Cu$

You need to start with the Cu^{+2} (limiting reagent) & then work towards the Ba^{+2}

n = c.v ✓
n = 1 (0,04) ✓
$n = 0.04\ mol\ Cu^{+2}$

0,04 mol /2 x 2 = 0,02

m = n .M
m = 0,04 x ✓ 137 ✓ m mark only if mol ratio shown
m = 5,48 g ✓

Question 8 – electrolytic

8.1.1	A substance of which the aqueous solution contains ions. OR: a substance that dissolves in water to give a solution that conducts electricity. ✓✓	(2)
8.1.2	Cathode ✓	(1)
8.1.3	$Cu^{2+} + 2e^- \rightarrow Cu$ ✓✓	(2)
8.2	Positive✓	(1)
8.3.1	It will sink to the bottom of the cell. ✓	(1)
8.3.2	It will be oxidised/it will go into solution. ✓	(1)
8.4	Cu^{2+} Is a stronger oxidising agent than Zn^{2+} ✓and therefore the Zn^{2+} will not be reduced (will stay in solution). ✓	(2)

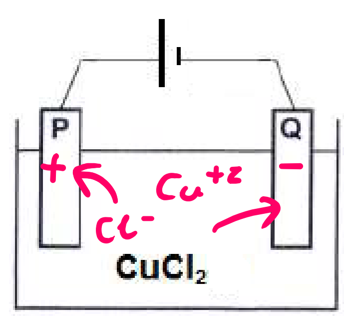
8.5

$$m(Cu) = nM$$
$$= (3{,}75 \times 10^{-2})(63{,}5) \checkmark$$
$$= 2{,}38 \text{ g} \checkmark$$

$$\%Cu = \frac{m(Cu)_{pure}}{m(Cu)_{impure}} \times 100$$
$$= \frac{2{,}38}{4} \times 100 \checkmark$$
$$= 59{,}53\% \checkmark$$

(4)

From 8.6 the cell now looks like this



8.6	Gan bubbles✓	(1)
8.7	It will change from “bright blue” to pale blue/colourless. ✓✓	(2)

[17]

Question 9 – IMF

9.1
A group of two or more atoms covalently bonded and it functions as a unit. ✓✓

(2)

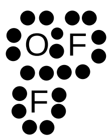
9.2.1
Tetrahedral ✓

(1)

9.2.2
Trigonal pyramidal ✓

(1)

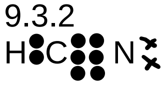
9.3.1



✓✓

(2)

9.3.2



✓✓

(2)

9.4
The nitrogen (N) atom in NH_3 contains a lone pair electrons.
No lone pair in $CCℓ_4$. ✓
Nitrogen (N) atom in NH_3 can donate its lone pair into the vacant orbital of H^+ ✓

(2)

9.5 Polar. ✓ • Sulphur atoms more electronegative than the hydrogen atom ✓ • The molecular shape is bent and assymetrical ✓ • Distribution of charge is assymetrical. ✓ (4)		
		[14]

Question 10 -IMF with BP

10.1	The temperature at which the vapour pressure of a liquid is equal to the external (atmospheric) pressure. ✓✓	(2)
10.2	• Group 4 hydrogen hydrides have London forces ✓ • Hydrogen halides have dipole-dipole forces ✓ • The dipole-dipole forces are stronger than the London/dispersion/induced-dipole forces ✓ • More energy will be required to weaken the IMF and change the phase for the hydrogen halides✓	(4)
10.4	HF has <u>hydrogen bonds</u> ✓✓	(2)
		[8]