



**HILLCREST HIGH SCHOOL**  
**PHYSICAL SCIENCE**  
**GRADE 11**  
**PAPER 2- Chemistry**



**NOVEMBER 2023 MEMO**

**TIME: 2 HRS**

**Total 100**

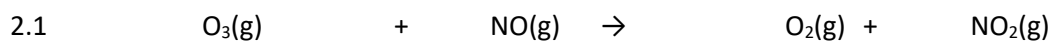
**Section A**

**Question 1**

- 1.1 A  
1.2 C  
1.3 A  
1.4 C  
1.5 D

**[10]**

**Question 2**



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

$$= \frac{0,74}{3(16)} \checkmark$$

$$= 0,015 \text{ mol} \checkmark$$

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

$$= \frac{0,67}{14+16} \checkmark$$

$$= 0,022 \text{ mol} \checkmark$$

Need:  $n = 0,022 \div 1 \times 1 \checkmark$

$$= 0,022 \text{ mol}$$

$O_3$  is limiting reagent  $\checkmark$

(7)

2.2

$$n_{NO_2} = 0,015 \div 1 \times 1 \checkmark$$
$$= 0,015 \text{ mol}$$

$$V = n \times V_0 \checkmark$$

$$= (0,015) \times 22,4 = 0,34 \text{ dm}^3 \text{ (accept 0,336)}$$

(4)

## Question 3

3.1 A catalyst provides an alternative pathway with lower activation energy ✓ which means more particles have sufficient (kinetic) energy to react, ✓ so rate of reaction increases. (2)

3.2.1 reaction is complete/reactants used up/no more products formed/  
mass of H<sub>2</sub>O (formed)/ mass of H<sub>2</sub>O is 202 g/  
mass (or amount) of H<sub>2</sub>O (or solution) remains constant. ✓ (1)

3.2.2 Gas product escapes ✓ (1)

3.2.3 5-15 s ✓ (1)

3.2.4 Steepest gradient ✓ (1)

3.2.5 Avg rate =  $\Delta m / \Delta t$   

$$= \frac{202 - 211,6}{70 - 0}$$

$$= (-) 0,14 \text{ g.s}^{-1}$$
 (3)

3.3.1 Change in concentration of reactants or products per unit time. ✓✓ (2)

3.3.2 Increasing the temperature would increase the amount of kinetic energy ✓ that the particles have. This would result in more collisions, so more effective collisions per unit time, ✓ INCREASING the rate of the reaction. ✓ (3)

[14]

## Question 4

4.1 An acid is a substance that produces hydrogen ions (H<sup>+</sup>)/hydronium ions (H<sub>3</sub>O<sup>+</sup>) when it dissolves in water. ✓ ✓ (2)

4.2.1 X ✓ (1)

4.2.2

$$\text{HNO}_3 + \text{NH}_3 \rightleftharpoons \text{NH}_4^+ + \text{NO}_3^-$$

Acid 1                      base 1 ✓  
                                     Base 2    acid 2 ✓ (2)

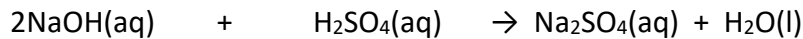
4.3.1 A *strong base* dissociates completely in water to form a high concentration of OH<sup>-</sup> ions. ✓✓ (2)

4.3.2 Greater than (1)

4.3.3  $n = C \times V$  ✓  
 $= 0,10 \times 0,012$  ✓  
 $= 0,0012 \text{ mol}$  ✓ (3)

$$4.3.4 \quad \text{pOH} = -\log [\text{OH}^-] = 14 - 12.56 \checkmark = 1,44$$

$$[\text{OH}^-] = [\text{NaOH}] = 0,0363 \text{ mol.dm}^{-3} \checkmark \dots \text{concentration after mixing}$$



$$n = 0,0012 \text{ mol}$$

n (reacted)

$$= 0,0012 \underline{\div 1 \times 2} \checkmark$$

$$= 0,0024 \text{ mol}$$

n (left over) = C x V

$$= 0,0363 \times 0,037 \checkmark$$

$$= 0,001343 \text{ mol}$$

$$\text{Total n (NaOH)} = 0,0024 + 0,001343 \checkmark = 0,003743 \text{ mol}$$

Mass X = n x M

$$= 0,003743 \times 40 \checkmark$$

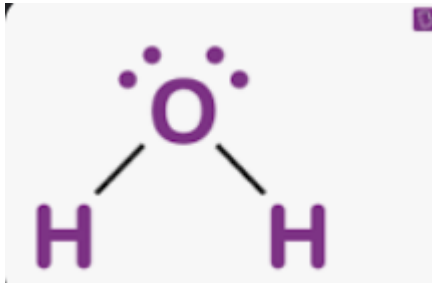
$$= 0,15 \text{ g} \checkmark$$

(7)

[18]

## Question 5

5.1



(2)

5.2 NH<sub>3</sub> / ammonia

(1)

5.3.1 polar  $\checkmark$

(1)

5.3.2 non-polar  $\checkmark$

(1)

5.3.3 non-polar  $\checkmark$

(1)

5.4 Each bond between C and O is polar  $\checkmark$  because the electronegativity difference between C and O is  $(3,5 - 2,5 =) 1,0 \checkmark$ . However, the molecule has (linear shape) which is symmetrical  $\checkmark$ , and therefore the charge is evenly distributed and so the molecule is non-polar.

(3)

[9]

## Question 6

6.1 Boyle's law ✓ (1)

6.2  $P_1V_1 = P_2V_2$

$$98 \times 140 \checkmark = P_2 \times \underline{80/100} \times 140 \checkmark$$

$$P_2 = 122,5 \text{ kPa} \checkmark \quad (3)$$

6.3  $2 \text{NaN}_3(\text{s}) \rightarrow 2 \text{Na}(\text{s}) + 3 \text{N}_2(\text{g})$

$$m = 178,95 \text{ g}$$

$$n = m/M$$

$$= 178,95/28 \checkmark$$

$$= 6,391 \text{ mol}$$

$$\% \text{ Purity} = (\text{actual m} / \text{theor m}) \times 100$$

$$95 / 100 = 170 / \text{theor m} \checkmark$$

$$\text{Theor m} = 178,95 \text{ g}$$

Need:  $n = 6,391 \div 3 \times 2 \checkmark$

$$= 4,26 \text{ mol}$$

$$m = n \times M$$

$$= 4,26 \times 65 \checkmark$$

$$= 276,95 \text{ g} \checkmark \text{ (or } 276,90 \text{ g depending on rounding)} \quad (5)$$

[9]

## Question 7

7.1 +3 ✓ (1)

7.2 iron / Fe ✓ (1)

7.3  $\text{Fe} \rightarrow \text{Fe}^{3+} + 3\text{e}^- \checkmark \checkmark$  (ignore phase symbols) (2)

[4]

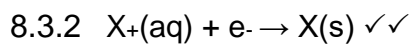
## Question 8

8.1 chemical to electrical energy ✓ (1)

8.2 Temperature: 25 °C/298 K. ✓  
Concentration of electrolytes: 1 mol.dm<sup>-3</sup>. ✓ (2)

8.3.1 ✓ ✓ ✓

$\text{Pt}(\text{s}) / \text{Fe}^{2+}(\text{aq})(1 \text{ mol.dm}^{-3}), \text{Fe}^{3+}(\text{aq})(1 \text{ mol.dm}^{-3}) // \text{X}^+(\text{aq})(1 \text{ mol.dm}^{-3}) / \text{X}(\text{s})$  (3)



(2)

8.4

$$E_{\text{cell}}^{\theta} = E_{\text{reduction}}^{\theta} - E_{\text{oxidation}}^{\theta} \quad \checkmark$$

$$0,03 \checkmark = E_{\text{reduction}}^{\theta} - (0,77) \quad \checkmark$$

$$E_{\text{reduction}}^{\theta} = 0,80V$$

X is Ag ✓

(4)

[12]

### Question 9

9.1 A substance of which the aqueous solution contains ions OR  
A substance that dissolves in water to give a solution that conducts electricity. (2)

9.2 copper nitrate / copper sulfate (1)

9.3 P (1)

9.4  $\text{Cu}^{2+}(\text{aq}) + 2\text{e}^{-} \rightarrow \text{Cu}(\text{s})$  ✓✓ (2)

9.5  $n(\text{e}) = N_0/N_A$  ✓  
 $= 8,5 \times 10^{22} / 6,02 \times 10^{23}$  ✓

$= 0,1412 \text{ mol}$

$n(\text{Cu}) = 0,1412 \div 2$  ✓

$= 0,07060 \text{ mol}$

$m(\text{Cu}) = n \times M$

$= 0,07060 \times 63,5$  ✓

$= 4,48 \text{ g}$  ✓

(5)

9.6 **OPTION 1**

$\text{Cu}^{2+}$  ions is a stronger oxidising agent than  $\text{Zn}^{2+}$  ions ✓  $\text{Cu}^{2+}$  will be reduced to Cu. ✓

**OPTION 2**

(2)

$\text{Zn}^{2+}$  ions are a weaker oxidising agent than  $\text{Cu}^{2+}$  ions ✓  $\text{Zn}^{2+}$  will therefore not be reduced to Zn. ✓

[13]

**Total 100**