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Grade 12 Preliminary Examination Memorandum

Paper 2 : Chemistry

Question 1: MCQ (20 MARKS)

1.1 C

1.2 D

1.3 D

1.4 C

1.5 B

1.6 A

1.7 B

1.8 C

1.9 D

1.10 B

(2 x 10= 20)

Question 2: Chemical Bonds (14 MARKS)

2.1.1 Ne(g)

2.1.2 KBr(s)

2.1.3 PH₃(g)

2.1.4 Na(s)

2.1.5 C(s)

2.1.6 HF(g)

(6 x 1= 6 marks)

2.2.1 London Forces **(1)**

2.2.2 As the number of C atoms increase, the solubility decreases (from 4 Cs). **(2)**

2.2.3 Tends to infinity **(2)**

2.2.4

- IMF in alcohol is H-bonding forces
 - Polar O-H end is attached to polar H₂O
 - Similar bond (IMF) strength & energy required, therefore dissolves
 - But longer chains are non-polar (CH₂) are non-polar
 - Have V.W Waals forces, therefore decrease in solubility
- (5)**

Question 3: Energy and Rates (32 MARKS)

3.1.1 Volume of CO₂ (g) produced (or volume of H₂O in cylinder). **(1)**

3.1.2 As the temperature increases, the rate of the CO₂ produced will increase **(2)**

3.1.3 Repeat the experiments (or any suitable measure) **(1)**

3.1.4 Rate of reaction (initial rate) **(2)**

3.1.5 Line dot to dot **(1)** ; line of best fit **(1)**

3.1.6 Gradient Steeper **(1)** and ends in the same place **(1)** as 3.1.5

3.1.7

- As the temperature increases particles have greater E_K .
- Therefore the number of collisions increase.
- More particles have $E_K > E_A \Rightarrow$ effective collisions **(3)**

3.1.8 Halve the size of the tablet **(2)**

3.2.1

$$n = \frac{m}{M} = \frac{5,5}{79,5} = 0,069 \text{ mol}$$

For 1:1 ratio, $n_{\text{CuO}} > n_{\text{H}_2\text{SO}_4}$

Therefore, CuO is in excess

(5)

3.2.2 D **(1)**

3.2.3 A and C as the [] of acid is the same

$$[\text{A}] = \frac{n}{V} = \frac{0,035}{50 \times 10^{-3}} = 0,7 \text{ mol/dm}^3$$

$$[\text{C}] = \frac{n}{V} = \frac{0,021}{30 \times 10^{-3}} = 0,7 \text{ mol/dm}^3 \quad \mathbf{(5)}$$

3.2.4 E **(1)**

3.2.5 C **(1)**

3.2.6 B **(1)**

3.2.7 None of the reactants or products are gases hence pressure does not affect concentration **(2)**

3.2.8 Change in colour **(1)**

Question 4: Chemical Equations (29 MARKS)

4.1.1

$$K_c = \frac{[SO_3]^2}{[SO_2]^2 \times [O_2]} \quad (2)$$

4.1.2

$$[O_2] = \frac{[SO_3]^2}{[SO_2]^2 \times K_c}$$

$$= \frac{(0,072 \div 1,4)^2}{(0,055 \div 1,4)^2 \times 27,9}$$

$$[O_2] = 0,061 \text{ mol.dm}^{-3}$$

$$n(O_2) = c \times V$$

$$= 0,061 \times 1,4$$

$$= 0,086 \text{ mol (allow 0,085 to 0,087)}$$

(5)4.1.3 a) No effect **(1)**b) Effect is increasing in SO_3 (g) **(1)**

- If volume is decreases, pressure increases **(1)**
- L.C.P system will favour the forward reaction due to fewer moles of molecules on RHS to reduce the pressure **(2)**

4.2.1 Dynamic Equation: the rate of the forward reaction is equal to the rate of the reverse reaction on a continual basis **(2)**

4.2.2 See graph **(7)**

4.2.3 $t = 60$ seconds **(1)**

4.2.4 The amount of moles remain constant from 60 seconds for reactants and products. **(2)**

4.2.5 Forward reaction rate $>$ reverse reaction rate **(5)**

4.2.6

- SO_3 goes down **(1)**
- SO_2 and O_2 both go up **(1)**
- 2 curves in proportion (1) OR all 3 curves in proportion **(2)**

Question 5: Acids and bases (23 MARKS)5.1.1 a) Pink ($\frac{1}{2}$)b) Pale pink to colourless ($\frac{1}{2}$)

5.1.2

	1	2	3
Acid	29,5	28,8	39,9
Initial	8,9	7,9	19,5
Rate	20,6	20,9	20,4

(3)**(1 mark for each correct column or row)**5.1.3 Average volume of HCl = 20,5 cm³ **(1)**5.1.4 $n(\text{H}_2\text{SO}_4) = c \times V$

$$= 0,100 \times 20,5 \times 10^{-3} \text{ dm}^3$$

$$= 2,05 \times 10^{-3} \text{ mol OR } 0,00205 \text{ mol } \mathbf{(4)}$$

5.1.5 $n(\text{NH}_3)_{\text{reacted}} = 2 \times 2,05 \times 10^{-3} \text{ mol (ratio)}$

$$= 4,1 \times 10^{-3} \text{ mol}$$

$$(\text{NH}_3) = \frac{n}{V}$$

$$= \frac{4,1 \times 10^{-3}}{25 \times 10^{-3}}$$

$$= 0,164 \text{ mol} \cdot \text{dm}^{-3} \mathbf{(3)}$$

5.1.6 A weak base is a substance that ionizes (dissociates) partially or poorly. **(2)**



- During hydrolysis, OH^- combines with NH_4^+ to form weak base, NH_4OH .
- H_3O^+ combines with SO_4^{2-} to form strong acid.
- Strong acid remains almost fully ionized, while weak base remains poorly dissociated. $[\text{OH}^-]$ decreases.
- L.C.P forward reaction favoured to form OH^- ions which result in excess of H_3O^+ ions.

(4)

5.2.1 G (NB quick change in pH units) **(1)**

5.2.2 F **(1)**

5.2.3 H **(1)**

5.2.4 Cresol purple **(2)**

5.2.5 Yellow to red **(1)**

Question 6: Electrochemistry (26 MARKS)

6.1.1 Anode is the half-cell where oxidation occurs. **(2)**

6.1.2 A- chlorine gas **(1)**

B -Sodium Chloride **(1)**

C- Potassium Chloride/nitrate **(1)**

E- Fe^{2+} and Fe^{3+} salts (mixture of salts) **(2)**

6.1.3 Pressure of gs: 1 atm

Temperature: 298 K

Concentration: 1 mol.dm^{-3} **(3)**

6.1.4 Right to left. **(1)**

6.1.5 $E_{\text{cell}} = E_{\text{cathode}} - E_{\text{anode}}$

$= 1,36 - (0,77)$

$= 0,59 \text{ V}$ **(3)**

6.1.6

- If the salt bridge is wider and shorter
 - Internal resistance will decrease because more ions flow and less opposition to charge and shorter distance.
 - Capacity of cell to deliver current will increase (but EMF is constant) **(3)**

6.1.7 $[\text{Cl}^-]$ decreases

- System will counter stress to increase $[\text{Cl}^-]$
- Favour forward reaction
- Increase in EMF of cell **(3)**



(3)

6.2.2 $E_{\text{cell}} = E_{\text{cathode}} - E_{\text{anode}}$

$$= 0,77 \text{ V} - 0,34 \text{ V}$$

$$= 0,43 \text{ V} \quad \mathbf{(3)}$$

6.2.3 Yes **(1)**

Question 7: Electrolysis (20 MARKS)

7.1.1 Electrical to chemical energy. **(2)**



7.1.3 $E^\ominus$ of oxide of H_2O is more negative than Cl^- . H_2O is stronger R.A than Cl^- , therefore will be oxidized before Cl^- . **(2)**

7.1.4 Chlorine ions. **(1)**

7.1.5 a) it is negatively charged to repel negative ions and attract positive ones. **(2)**

b) $(\text{Cl}^- + \text{OH}^- \text{ ions})$ (Chloride + hydroxide ions). **(2)**

7.1.6 NaOH

Soap or other acceptable use **(2)**

$$7.2. I = 4000 \text{ A}$$

$$t = 2,5 \times 60$$

$$= 150 \text{ A}$$

$$V(\text{Cl}_2) @ \text{STP} = ?$$

$$Q = I \times t$$

$$= 4000 \times 150$$

$$= 600000 \text{ C}$$

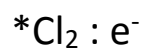


Method 1

$$1 \text{ mol e}^- = 96500 \text{ C}$$

$$n(\text{e}^-) = \frac{600000}{96500}$$

$$= 6,22 \text{ mol of e}^-$$



$$1:2$$

$$n(\text{Cl}_2) = \frac{6,22}{2}$$

$$= 3,11 \text{ mol of Cl}_2$$

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

$$V = n \times V_m$$

$$= 3,11 \times 22,4$$

$$= 69,66 \text{ dm}^3 \text{ of Cl}_2$$

Method 2

$$1e^- = 1,6 \times 10^{-19}$$

$$n(e^-) = \frac{600000 \text{ C}}{1,6 \times 10^{-19}}$$

$$= 3,75 \times 10^{24} e^-$$

$$n = \frac{N}{N_A}$$

$$n = 6,23 \text{ mol}$$

*(same process) **(8)**

Question 8: Organic Chemistry (34 MARKS)

8.1.1. Elimination. **(1)**

8.1.2. Alkanes. **(1)**

8.1.3. $C_3H_8 + Cl_2 \rightarrow C_3H_7Cl + HCl$ **(2)**

8.1.4. $2 C_5H_{10} + 15 O_2 \rightarrow 10 CO_2 + 10 H_2O$ **(4)**

8.1.5. Isomers: same molecular formula but different structural formula. **(2)**

8.1.6. a) See answer sheet

b) Positional isomerism

c) Ethyl Propanoate

R.C Heat + Chem. H_2SO_4 **(10)**

8.2.1.

- The unsaturated double bond will break. **(1)**
- Addition reaction to form single bonds as Br_2 is added on. **(1)**

8.2.2. Addition reaction **(1)**

8.3.1. General formula: $C_nH_{2n}O_2$ **(2)**

8.3.2. Covalent bonds **(1)**

8.3.3. CH_3CO_2H methyl/methanoate **(3)**

8.3.4 Trend: As number of Carbons in carboxylic acid increases, boiling point increases

Reasons:

- Carboxylic acids have IMF of strong H-bond forces.
- As chain increases in length more London forces present.
- Dimer forms between hydroxyl groups, therefore more energy reqd. **(4)**

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