



eduresourceza.com



ST. MARY'S DSG KLOOF

Physical Sciences
Paper 2
MEMO

GRADE 12
Trials 2016

Time: 3 hours
Marks: 200

Examiners: T. Kirsten and G. Main
Moderator: K. Bolton

QUESTION 1 - MULTIPLE CHOICE

1. C ✓✓
2. C ✓✓
3. D ✓✓
4. C ✓✓
5. A ✓✓
6. D ✓✓
7. D ✓✓
8. B ✓✓
9. A ✓✓
10. D ✓✓

10 x 2 = [20]

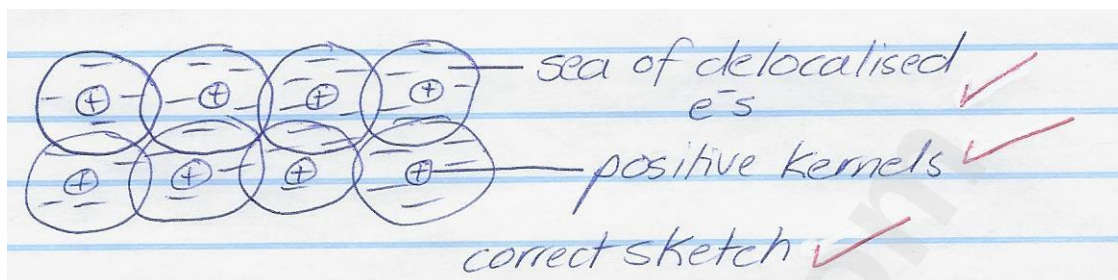
QUESTION 2 - CHEMICAL BONDING

- 2.1.1 A measure of the tendency of an atom to attract ✓ a bonding pair of electrons ✓. (2)
- 2.1.2.1 non - polar ✓ / pure covalent ✓ (2,1 - 2,1 = 0) (2)
- 2.1.2.2 polar ✓ covalent ✓ (4 - 2,1 = 1,9) (2)
- 2.2.1 A weak force of attraction ✓ between molecules or between atoms of noble gases. ✓ (2)
- 2.2.2.1 London forces ✓ (or dispersion forces) (1)

2.2.2.2 Hydrogen bonding ✓ (1)

2.3.1 Metallic ✓ (1)

2.3.2



2.3.3 Due to the electrons leaving ✓ the atoms and drifting in a sea of delocalised e^- s (as they are so loosely bound), they can easily ✓ carry the current through the copper. (3)

[16]

QUESTION 3 - ENERGY CHANGE AND REACTION RATES

3.1.1 Temperature ✓ (1)

3.1.2 Volume of gas released ✓ (1)

3.2 Exp 4 has a larger ✓ mass of impure CaCO_3 $\therefore$ there are more particles ✓ for the HCl to collide with. The more collisions there are, the more effective collisions ✓ there will be and the faster the rate will be. (3)

- 3.2
- 1 - C ✓ ✓
 - 2 - D
 - 3 - B
 - 4 - A

1 and 2 have same mass and temp but 2's concentration is less than 1 $\therefore$ will take longer ✓ to produce the same volume of CO_2 .

1 and 3 have same mass and concentration but 3 has higher temp $\therefore$ steeper gradient ✓ in the beginning as it will produce same volume of CO_2 faster.

1 and 4, same concentration but 4 has greater mass and higher temp $\therefore$ will produce more CO_2 ✓ and faster. ✓

(6)

[11]

QUESTION 4 - EQUILIBRIUM

- 4.1.1 A reaction in which the forward and reverse reactions ✓ continue to take place simultaneously, at the same rate. ✓ (2)
- 4.1.2 A change in any of the factors that determine equilibrium conditions ✓ of a system will cause the system to change ✓ in such a manner as to reduce or counteract ✓ the effect of the change. (3)
- 4.1.3 No. ✓ The reaction has not ✓ reached equilibrium yet. (2)
- 4.1.4 Stress - oxygen ✓ was removed from the system. The reverse reaction was then favoured to make more ✓ O_2 and more NH_3 . So $[NH_3]$ increased. NO and H_2O was used up to make NH_3 and O_2 so $[NO]$ ✓ and $[H_2O]$ ✓ decreases. (4)
- 4.1.5.1 Exothermic ✓
- 4.1.5.2 The concentrations of the reactants, NH_3 and O_2 decreased ✓ and the [] of the products NO and H_2O increased ✓ ∴ the forward reaction was favoured. ✓ If temperature was decreased, equilibrium would shift to make more heat ✓ ∴ if forward reaction was favoured, the forward reaction must be exo. (4)
- 4.2.1 Reverse ✓ (1)
- 4.2.2 From 0 - 20s the rate of the reversed reaction ✓ increased from 20 - 30s equilibrium had been ✓ reached so graph is horizontal. ✓ (3)
- 4.2.3 Increase in temperature ✓
The rate of the fwd and reverse reactions both increase immediately, then because the forward reaction is endothermic ✓ it shifts the equilibrium to the right to use up the heat ✓. i.e. the forward reaction is favoured ✓ and then the rate of the forward reaction decreases with time. (4)
- 4.2.4 Increase ✓ (1)
- 4.2.5.1 Forward ✓ (1)
- 4.2.5.2 Not affect ✓ (1)
- 4.2.6 Addition of a catalyst ✓ (1)

[28]

QUESTION 5 - ACIDS AND BASES

5.1.1 Diprotic ✓ (1)

5.1.2 H_2O ✓ $(\text{COO})_2^{2-}$ ✓ (2)

5.1.3 $\text{H}(\text{COO})_2^-$ ✓
In reaction 1 it is acting as a base, and in reaction 2 it is acting as an acid. ✓ (2)

5.1.4 $c = \frac{m}{MV}$
 $\therefore m = cMV$ ✓
 $= 0,2 \times 90 \times 0,25$ ✓
 $= 4,5 \text{ g}$ ✓ (4)

5.2.1 A strong acid ionises almost completely ✓ in an aqueous solution, whereas a weak acid only ionises partially ✓
strong - HY ✓
weak = $\text{HZ} / \text{H}_2\text{X}$ ✓ (4)

5.2.2 HY ✓ the lowest pH means the highest $[\text{H}_3\text{O}^+]$ ✓. As HY has a very high K_a , it means it ionises (to form H_3O^+ ions) almost completely ✓ $\therefore$ high $[\text{H}_3\text{O}^+]$. (3)

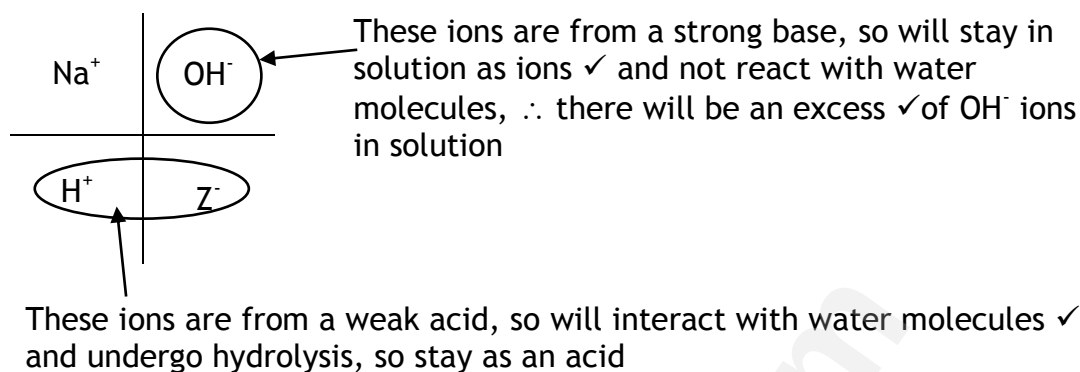
5.2.3 HZ ✓ - Very low K_a value, which means it has not ionised much, ✓ $\therefore$ not many free ions to carry a current ✓ (3)

5.2.4.1 $K_a = \frac{[\text{H}^+]^2[\text{X}^-]}{\text{H}_2\text{X}}$ ✓✓ (2)

5.2.4.2 $2,8 \times 10^{-3} \checkmark = \frac{x^3 \checkmark}{0,2 \checkmark}$
 $x^3 = 2,8 \times 10^{-3} \times 0,2$
 $\therefore [x] = 0,082 \text{ mol. dm}^{-3}$ ✓ (4)

5.2.5.1 $\text{HZ} + \text{NaOH} \rightarrow \text{NaZ} \checkmark + \text{H}_2\text{O} \checkmark$ (2)

5.2.5.2 $\frac{n_a}{n_b} = \frac{C_a V_a}{C_b V_b}$ ✓
 $\frac{1}{1} = \frac{C_a \cdot 25}{0,1 \times 32,4}$ ✓
 $C_a = \frac{0,1 \times 32,4}{25}$
 $= 0,13 \text{ mol. dm}^{-3}$ ✓ (3)



∴ due to the fact that there is an excess of OH⁻ ions in solution, ✓ it will have a pH GREATER THAN 7. ✓ (5)

[35]

QUESTION 6 - GALVANIC CELL

6.1 P ✓ [Magnesium is a stronger reducing agent than iron, so will be oxidised.]
Electrode P is - , ∴ is the source of e⁻s from this oxidation. ✓ (2)

6.2 Mg/Mg²⁺ (aq; / mol.dm⁻³, 25° C // Fe³⁺ (aq; /mol.dm⁻³; 25°C)/Fe ✓ ✓ ✓ (3)

6.3.1 A substance which accepts electrons ✓✓ (2)

6.3.2 Fe³⁺ / Fe(NO₃)₃ ✓✓ (2)

6.4 E° cell = E° cathode - E° anode
= -0,04 ✓ - (-2,37) ✓
= +2,33 V ✓ (3)

6.5.1 Remains the same ✓

6.5.2 Decreases ✓ (2)

6.6.1 $n = \frac{m}{M} = \frac{1,12}{56} ✓$
 $= 0,02 \text{ mol } ✓$ (2)

6.6.2 $3\text{Mg} + 2\text{Fe}^{3+} \rightarrow 3\text{Mg}^{2+} + 2\text{Fe}$
Mol ratio Mg : Fe
3 : 2 ✓
x : 0,02
∴ 0,03 mol ✓
 $m = n \times M$
 $= 0,03 \times 24 ✓$
 $= 0,72 \text{ g } ✓$ (4)

[20]

QUESTION 7 - ELECTROLYSIS

- 7.1.1 $2\text{O}^{2-} \rightarrow \text{O}_2 + 4\text{e}^-$ ✓✓ (2)
- 7.1.2 $\text{Al}^{3+} + 3\text{e}^- \rightarrow \text{Al}$ ✓✓ (2)
- 7.1.3 It reduces its melting point ✓ and $\therefore$ saves on energy costs. ✓ (2)
- 7.1.4 The oxygen gas ✓ produced at the anode reacts with the carbon ✓ which the anode is made of. (2)
- 7.1.5 The dissolving process takes place at 1000°C /at a higher temperature ✓ than the melting point of aluminium. ✓ (2)
- 7.1.6.1 $n = \frac{m}{M} = \frac{14,9}{27} \checkmark = 0,55 \text{ mol } \checkmark$ (2)
- 7.1.6.2 Mol ratio $\text{Al} : \text{e}^-$
 $1 : 3 \checkmark$
 $\therefore 3 \times 0,55 = 1,65 \text{ mol } \checkmark$ (2)
- 7.1.6.3 $N_{\text{e}^-} = n \times N_A$
 $= 1,65 \times 6,02 \times 10^{23} \checkmark$
 $= 9,93 \times 10^{23} \text{ e}^- \checkmark$ (2)
- 7.1.6.4 $9,93 \times 10^{23} \text{ e}^- \times 1,6 \times 10^{-19} \checkmark$
 $= 158\,880 \text{ C} \checkmark$ (2)
- 7.1.6.5 $Q = It \checkmark \therefore t = \frac{Q}{I} = \frac{158\,880}{10} \checkmark$
 $= 15\,888 \text{ s (or 4,41 hours) } \checkmark$ (3)
- 7.2.1 Electrical ✓ $\rightarrow$ Chemical ✓ (2)
- 7.2.2 brine ✓ (1)
- 7.2.3 Allows for the exchange of positive ions ✓ (Na^+) from anode compartment to cathode compartment ✓. (2)
- 7.2.4 The diaphragm cell produced NaOH which was of a very low % purity (or concentration) ✓. The membrane cell produces a better quality/purer ✓ NaOH. Diaphragm cell used a lot of energy, $\therefore$ was very costly ✓, whereas the membrane cell uses significantly less E ✓ $\therefore$ cheaper to run. (4)
- 7.2.5 Cl_2 ✓ (1)
- 7.2.6 $2\text{H}_2\text{O} + 2\text{e}^- \rightarrow 2\text{OH}^- + \text{H}_2$ ✓✓ (2)
- 7.2.3 Water is a stronger oxidizing agent ✓ than Na^+ , (or Na^+ is a weaker oxidizing agent) $\therefore$ will have a greater tendency to be reduced ✓ / will be selectively discharged. (NB NOT accepting anything about reducing agents, as there is no oxidation at the cathode) (3)

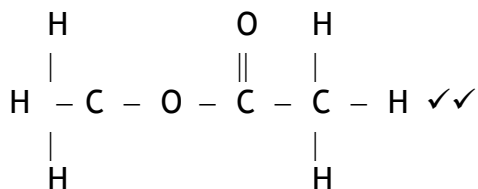
[36]

QUESTION 8 - ORGANIC CHEMISTRY

8.1 A series of similar compounds which have the same functional ✓ group and have the same general ✓ formula, in which each member differs from the previous one by a single CH_2 ✓ unit. (3)

8.2 Alkanes ✓ (1)

8.3



(2)

8.4 Methanol ✓ and ethanoic ✓ acid (2)

8.5 OH^- / hydroxyl group ✓ (1)

8.6 X ✓ (1)

8.7.1 $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{OH} \rightarrow \text{CH}_3\text{CH}_2\text{CHCH}_2 + \text{H}_2\text{O}$ ✓ ✓ ✓ (3)

8.7.2 but – 1 ✓ – ene ✓ (2)

8.7.3 Elimination ✓ (1)

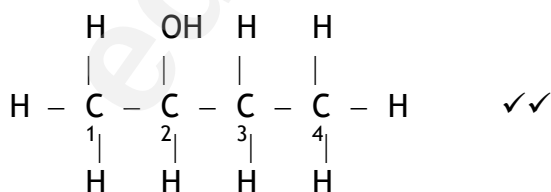
8.8 $\text{C}_3\text{H}_{12} + 8\text{O}_2 \checkmark \rightarrow 5\text{CO}_2 \checkmark + 6\text{H}_2\text{O} \checkmark$ ✓ bal (4)

8.9.1 Compounds having the same molecular formula ✓ but different ✓ structural ✓ formulae. (2)

8.9.2 Pentane ✓ ✓ (2)

8.9.3 Propanoic acid ✓ ✓ (2)

8.9.4 (butan-2-ol)



(2)

8.10 X has a low boiling point due to weak ✓ London ✓ forces between the molecules.

Y has a higher boiling point than X as esters have dipole -dipole ✓ van der Waals forces which are stronger than ✓ London forces $\therefore$ more energy required to overcome them.

Z has the highest boiling point as it has strong ✓ hydrogen bonds✓ between molecules which require the most energy in order to overcome.

(6)

[34]

eduresourceza.com