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PHYSICAL SCIENCES: PAPER 2

MEMO

Question 1

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

Question 2

- 2.1 Lower / Smaller ✓
- 2.2 The higher the concentration ✓ (of HCl) the faster the rate of the reaction ✓
- 2.3 Fair test OR Mg the controlled variable OR Mg is constant OR to ensure there is only one variable. ✓✓
- 2.4.1 60 cm³ ✓
- 2.4.2 42 cm³ ✓
- 2.5 Experiment 1. ✓ The gradient is steeper. ✓
- 2.6 Same amount of magnesium was used in both experiments. ✓✓
- 2.7 The rate of reaction increases with concentration ✓✓
- 2.8.1 Remains the same ✓
- 2.8.2 Increase ✓

Question 3

- 3.1 Dynamic chemical equilibrium is when the forward and reverse reactions continue to take place simultaneously at the same RATE. ✓✓
- OR
- Dynamic chemical equilibrium is when the RATE of the forward reaction is equal to the RATE of the reverse reaction.
- 3.2 $2CO \rightarrow 2C + O_2$ ✓✓
- 3.3 Concentration of CO increases. ✓✓
- 3.4.1 A measure of the extent of a reaction, generally measured by comparing the amount of product against the amount of product that is possible. ✓✓

3.4.2 Stress: Increase pressure ✓

Response: Favour reverse reaction ✓

Reason: The reaction that produces the least mole gas will be favoured to relieve the stress. ✓

Yield of CO: Decreases. ✓

3.5.1 Forward ✓

3.5.2 EXOTHERMIC ✓

Stress: Decrease in temperature.

Response: Reverse reaction rate decreases more than forward reaction rate, therefore forward reaction favoured. ✓

Reason: Forward reaction releases extra heat (exothermic) in order to relieve the stress. ✓

3.6 A catalyst was added ✓

3.7 No change in the number of moles of oxygen. ✓ The rate at which the number of moles of oxygen is produced increases. ✓

$$3.8.1 \quad v = \frac{n}{c} = \frac{3}{1,2} = 2,5 \text{ dm}^3 \text{ ✓}$$

$$3.8.2 \quad K_c = \frac{[CO]^2}{[O_2]} \text{ ✓}$$

3.8.3

	C	O ₂	CO
Ratio	2	1	2
Initial		9	0
Change		-1,5 ✓	3
Equilibrium		7,5 ✓	3
Conc		3 ✓	1,2

$$K_c = \frac{[CO]^2}{[O_2]} = \frac{(1,2)^2}{3} = 0,48 \text{ ✓}$$

Question 4

- 4.1 An acid is a proton donor ✓✓
- 4.2 Hydronium ion ✓
- 4.3 H_2SO_3 (acid) & HSO_3^- (base) ✓
 H_3O^+ (base) & H_2O (acid) ✓
- 4.4 An amphoteric (or amphiprotic) substance as a substance that can act as either an acid or a base. ✓✓
- 4.5.1 a weak acid as an acid that only ionises partially in an aqueous solution. ✓✓
- 4.5.2 weak acid + strong base ✓ $\rightarrow$ basic salt ✓ / pH above 7 at equivalence point
 thus phenolphthalein. ✓
- 4.6.1 A standard solution as a solution of known concentration ✓✓
- 4.6.2 $m = cMV$ ✓ = $(0,2)(106)(0,3)$ ✓ = $6,36 \text{ g}$ ✓
- 4.6.3 concentration ✓ of H_3O^+ ✓
- 4.6.4 $\text{H}_2\text{SO}_4 + \text{Na}_2\text{CO}_3 \rightarrow \text{Na}_2\text{SO}_4$ ✓ + H_2O ✓ + CO_2 ✓
- 4.6.5 $n = cv = (0,2) \left(\frac{15}{1000} \right)$ ✓ = $0,003$
- $$c = \frac{n}{v} = \frac{0,003 \text{ m}}{0,02} = 0,15 \text{ mol. dm}^{-3}$$
- ✓

Question 5

5.1 Oxidation is the loss of electrons. ✓✓

5.2 Metal X ✓

The anode is the electrode at which oxidation takes place. ✓ During oxidation of a metal, the atoms become ions which dissolve into solution and the anode therefore corrodes ✓

5.3 $E_{cell}^0 = E_{cathode}^0 - E_{anode}^0$ ✓

$$1,52 = -0,14 - E_{anode}^0 \quad E_{anode}^0 = -1,66 \quad X = \text{Aluminium} \quad \checkmark$$

5.4 $2Al + 3Sn^{2+} \rightleftharpoons 2Al^{3+} + 3Sn$ ✓ **Balancing** ✓

5.5 Al ✓

5.6 The salt bridge maintains electrical/ionic neutrality in the cell ✓ by allowing

Cations to move from the oxidation half-cell to the reduction half-cell ✓

Anions to move from the reduction half-cell to the oxidation half-cell ✓

Question 6

6.1.1 A homogenous mixture ✓ of solute and solvent. ✓

6.1.2 Water ✓

6.2.1a) a transfer of electrons ✓ and subsequent electrostatic attraction. ✓

6.2.1b) splitting of an ionic compound ✓ into its ions. ✓

6.2.2 The sodium chloride solid dissociates into its ions in the brine solution. ✓ The ions are mobile and can move in an electric field to enable conduction of charge ✓

6.2.3 $m = cMV = (6)(23 + 35,5)(500) = 175\,500\text{ g}$

$$m(\text{impure}) = \frac{175\,500}{0,93} = 188\,709,68\text{ g}$$

6.3.1 X ✓

6.3.2 $2\text{Cl}^- \rightarrow \text{Cl}_2 + 2\text{e}^-$ ✓ ✓

6.3.3 Oxidation ✓

6.4 They will react to form hydrochloric acid ✓

6.5.1 Electrode at which reduction takes place. ✓ ✓

6.5.2 Mercury ✓

6.5.3 $2\text{H}_2\text{O} + 2\text{e}^- \rightarrow \text{H}_2 + 2\text{OH}^-$ ✓

6.6 Toxicity of the mercury released as vapors and in contaminated brine; ✓
high energy consumption of the mercury cell makes it costly; ✓

6.7 $c = \frac{m}{Mv} = \frac{50}{(40)\left(\frac{100}{1000}\right)} = 12,5\text{ mol}\cdot\text{dm}^{-3}$ ✓

6.8.1 $2\text{NaCl} + 2\text{H}_2\text{O} \rightarrow 2\text{NaOH} + \text{Cl}_2 + \text{H}_2$ ✓

6.8.2 $n = cv = (6)(500); = 3000\text{ mols}$

$n(\text{H}_2) = 1500\text{ mols};$ ✓

$V = nV_m = (1500)(22,4); = 33\,600\text{ dm}^3 = 33,6\text{ m}^3;$ ✓

$\% \text{ Yield} = \frac{25}{33,6} \times 100; = 74,4\%;$ ✓

Question 7

7.1.1 Hydroxyl; ✓

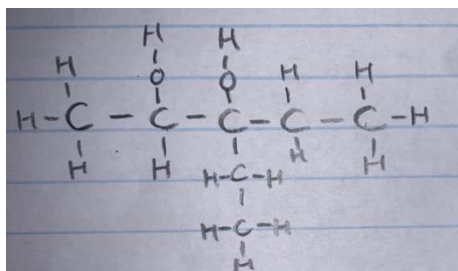
7.1.2 Carboxyl; ✓

7.2.1 4,4-dimethylhexan-1-ol ✓

7.2.2 1,3-difluoro-2-methylbutane ✓

7.2.3 hexa-2,4-diene ✓

7.3



✓ 5C chain; ✓ diol position; ✓ ethyl substituent position

7.4 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 ✓

7.5 Alkene ✓✓

7.6.1 Alkene ✓

7.6.2 Alcohol ✓

7.7.1 Substitution ✓✓

7.7.2 $\text{CH}_3\text{CH}_2\text{Cl}$ ✓ + NaOH (aq) ✓ $\rightarrow$ $\text{CH}_3\text{CH}_2\text{OH}$ + NaCl ✓

7.8.1 Organic substances are volatile and flammable ✓

7.8.2. Ethyl ✓ methanoate ✓

Question 8

- 8.1 a bond which occurs ✓ between atoms within molecules ✓
- 8.2 X ✓ ✓
- 8.3 Cl has a larger electronegativity value than C ✓ indicating a polar covalent bond ✓
- 8.4 Polar molecules have opposite ends of their molecules that carry opposite partial charges ✓
There will be an electrostatic force of attraction between the oppositely charged ends of adjacent molecules ✓
- 8.5 London ✓ and dipole dipole ✓
- 8.6 Compound A has London forces which are weaker IMFs than the predominant dipole-dipole forces present in compound B ✓
(OR due to the larger molar mass of the CH_3Cl molecule, there will be more electrons and thus the temporary dipoles that are setup will lead to stronger London forces)
Thus, more energy is required to overcome the stronger IMF in compound B and the boiling point will be higher. ✓
- 8.7 Butane ✓ ✓
- 8.8.1 compounds having the same molecular formula ✓ but different structural formulae ✓
- 8.8.2 Chain isomers ✓
- 8.8.3 Compound D and E are alkanes and both have London forces between their molecules. ✓
D is the straight chain isomer and will thus have a larger surface area over which London forces can be setup which leads to more London forces and hence stronger IMFs in D than E ✓
The stronger IMFs in D require more energy to overcome to phase change and thus ✓
the boiling point of D will be higher than that of E/E will be lower than that of D ✓
- 8.9 F has one hydroxyl group and thus has one site for hydrogen bonding to occur over ✓
whereas G has a carboxyl group and thus has 2 sites for hydrogen bonding to occur over ✓
G thus requiring more energy to overcome the stronger IMFs than F, and G will thus have a higher boiling point than F ✓

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