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QUESTION 1

20 MARKS

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

QUESTION 2

11 MARKS

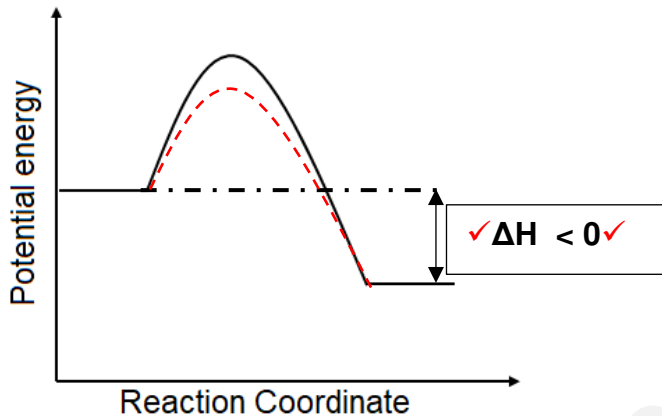
- 2.1 A bond which occurs between atoms within molecules. ✓✓ (2)
- 2.2 Non-polar / Pure covalent bond between O-atoms. ✓
Equal sharing of electrons ✓
Polar covalent bond between O and H atoms. ✓
Unequal sharing of electrons ✓ (4)
- 2.3 Hydrogen bonds ✓ (1)
- 2.4 Hydrogen peroxide a greater electron cloud density for stronger London dispersion forces. (✓)
OR
Hydrogen peroxide has a much greater dipole moment than water therefore greater dipole-dipole attraction contributes to the increased boiling point. (✓)
Water makes four hydrogen bonds, but only with four other water molecules where hydrogen peroxide makes two hydrogen bonds between the same molecules, ✓✓
therefore, requires more energy to overcome these forces. ✓ (4)

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QUESTION 3 – ENERGY & RATES OF REACTIONS 22 MARKS

3.1.1 The change in concentration per unit time ✓ of either a reactant or product ✓ (2)

3.1.2a (2)



3.1.2b Lower curve ✓, as seen above.
Starting at reactants and ending a products ✓ (2)

3.1.3 Concentration of H_2O_2 ✓✓ (2)

3.1.4 The reaction rate of experiment 3 would be higher ✓
As particle would have a higher average kinetic energy ✓
Therefore more collisions per unit time ✓
Therefore more effective collisions per unit time. ✓ (-1 for no time) (4)

3.1.6a D ✓✓

3.1.6b B ✓✓

3.1.6c A ✓✓ (6)

3.2.1 $n = m/M$

(ozone)

$$n = 4000 / 3(16) \quad \checkmark$$

$$n = 83,33 \text{ mol}$$

(water)

$$n = 1150 / 18 \quad \checkmark$$

$$n = 63,89 \text{ mol}$$

$$1:1 \quad \checkmark$$

63,89 mol of water is available ✓, 83,33 mol is need to react with all the ozone, therefore water is limiting ✓ (L2) (5)

3.2.2 $\text{H}_2\text{O} : \text{O}_2$ Downloaded from eduresourceza.com

1 : 2

63,89 : 127,78 ✓

$V = nV_m$

$V = 127,78 (25) \checkmark$

$V = 3194,44 \text{ dm}^3 \checkmark$

(3)

QUESTION 4 – CHEMICAL EQUILIBRIUM

26 MARKS

4.1.1 TURNS BLUE ✓✓ (2)

4.1.2 REVERSE ✓✓ (2)

4.1.3 Stress – Decrease concentration of ALL ions ✓

Response – Favour the reverse reaction ✓

Reason – There are more ions in the reactants ✓, thereby increasing the concentration of ions

Answer – The purple solution will go pink ✓ (4)

4.2.1 3 Minutes ✓

At equilibrium, the forward and reverse reaction rate are equal ✓ and the concentration of O₂ and SO₃ are constant. ✓ (3)

4.2.2 Sketch begins at the origin ✓

Curves till 3 minutes ✓

Levels off at 0,3 mole ✓ (3)

4.2.3a A closed system (in chemistry) as one in which mass is conserved inside the system ✓ but energy can enter or leave the system freely. ✓

(2)

4.2.3b

R	2SO ₃	2SO ₂	O ₂	R	2SO ₃	2SO ₂	O ₂
I	0,4	0	0	I	0,1	0,3	0,15
C	-0,33	+0,33	+0,165	C	-0,03 ✓	+0,03	+0,015
E	0,07	0,33	0,165	E	0,07	0,33 ✓	0,165 ✓

$$K_c = \frac{0,33^2 \times 0,165}{0,07^2} = 3,67 \quad (6)$$

4.2.3c (The equilibrium concentration of SO₃ decreases ✓)

The forward reaction was therefore favoured ✓

The forward reaction is endothermic ✓

T₂ is therefore the higher temperature ✓ (4)

QUESTION 5 – ACIDS

25 MARKS

5.1 A reaction of an ion ✓ (from a salt) with water ✓ (2)

5.2 $\text{C}_{17}\text{H}_{35}\text{COO}^- + \text{H}_2\text{O} \rightarrow \text{C}_{17}\text{H}_{35}\text{COOH} + \text{OH}^-$ ✓✓ (5)

5.3 $n = m/M$ ✓

$$n = 145 / 606$$

$$n = 0,24 \text{ mol} \quad (0,23927) \quad \checkmark$$

Scum : Soap

1 : 2

0.24 : 0.48 (Soap available) : ✓

$$m = nM$$

$$m = 0.48 \times (306) \quad \checkmark$$

$$m = 146.44 \text{ g} \quad \checkmark$$

$$\% \text{ composition} = 146.44 / 600 \times 100$$

$$= 24,41\% \quad \checkmark$$

(6)

5.1.4 The amount of solute per unit volume of solution ✓✓ (2)

5.1.5 $c = n/V$ ✓

$$c = 0.198 / 0.5 \quad \checkmark$$

$$c = 0,4 \text{ mol.dm}^{-3} \text{ calcium chloride} \quad \checkmark \quad (3)$$

5.1.6 CaCl_2 : Soap

1 : 2

$$0,198 : 0,396 \quad \checkmark$$

$$0,4489 - 0,396 = 0,0825 \text{ mol unreacted} \quad \checkmark$$

$$c = 0,0825 / 0.5$$

$$c = 0,165 \text{ mol.dm}^{-3} \quad \checkmark$$



$$0,165 : 0,165 \quad (\checkmark)$$

$$[\text{OH}^-][\text{H}_3\text{O}^+] = 1 \times 10^{-14} \quad \checkmark(\checkmark)$$

$$(0,165)[\text{H}_3\text{O}^+] = 1 \times 10^{-14} \quad \checkmark$$

$$[\text{H}_3\text{O}^+] = 6,06 \times 10^{-14} \text{ mol.dm}^{-3} \quad \checkmark \quad (7)$$

QUESTION 6 Downloaded from eduresourceza.com **19 MARKS**

6.1.1 the splitting of an ionic compound into its ions ✓✓ (2)

6.1.2 $\text{Mg}(\text{OH})_2 \rightleftharpoons \text{Mg}^{2+} + 2\text{OH}^-$ ✓✓ (3)

6.1.3 **Both** are ionic compounds held in the solid state by **electrostatic forces**. ✓

Na^+ has a charge of +1 while Mg^{2+} has a charge of +2, therefore the electrostatic **forces in magnesium hydroxide are stronger**. ✓

More energy is required to **overcome the electrostatic forces** in magnesium hydroxide ✓✓

Magnesium hydroxide is **less soluble/dissociates to a lesser extent**. ✓ (4)

6.2.1 $\text{Na}_2\text{CO}_3(\text{s}) + 2\text{HCl} \rightarrow 2\text{NaCl} + \text{H}_2\text{O} + \text{CO}_2$ ✓✓ (4)

6.2.2a DECREASE ✓✓ (2)

6.2.2b INCREASE ✓✓ (2)

6.2.3 congo red ✓✓ (2)

QUESTION 7 Downloaded from eduresourceza.com **20 MARKS**

- 7.1 A substance that can conduct electricity by forming free ions✓ when molten or dissolved in solution.✓ (2)
- 7.2 $\text{Mg}(\text{NO}_3)_2$ ✓ or any soluble Mg salt (1)
- 7.3 Platinum✓ (1)
- 7.4 $\text{Pt} \mid \text{H}_2 (1 \text{ ATM}) \mid \text{H}^+ (1 \text{ mol.dm}^{-3}) \parallel \text{Mg}^{2+} (1 \text{ mol.dm}^{-3}) \mid \text{Mg} @ 25^\circ\text{C}$ (5)
Phase barriers and salt bridge✓
Conditions✓
Hydrogen first with Pt✓
Correct direction of "electron flow" ✓✓
- 7.5 In cell 2 Mg is connected to the positive terminal of the voltmeter✓ and is oxidizing as it is the stronger reducing agent✓ as SHE is always connected as the anode, hence to the negative terminal of the voltmeter. ✓ (3)
- 7.6.1 $\text{Cu}^{2+} + 2\text{e}^- \rightarrow \text{Cu}$ ✓✓ (AON) (2)
- 7.6.2 The blue solution will turn pale✓
The Cu electrode will thicken OR a red/brown deposit will form on the electrode✓ (2)
- 7.6.3 Cu^{2+} are being removed from the half-cell✓
Cations from the salt bridge enter the half-cell✓ (2)
- 7.6.4 INCREASE✓✓ (2)

QUESTION 8 – ELECTROLYTIC CELLS

19 MARKS

- 8.1.1 A concentrated ✓ aqueous solution ✓ of sodium chloride ✓ (3)
- 8.1.2 B (2)
- 8.1.3a $2\text{H}_2\text{O} + 2\text{e}^- \rightarrow \text{H}_2(\text{g}) + 2\text{OH}^-$ ✓ ✓ (2)
- 8.1.3b The nature of the mercury cathode ✓ adjusts the electrode potentials of the Na ions and water ✓, so that the reduction of Na^+ is now more likely than that of water (2)
- 8.1.4a Hydrogen ✓ (no symbols), rocket fuel ✓ (2)
- 8.1.4b The purity in the mercury cell will be higher ✓ as the hydroxide ion cannot migrate to the anode ✓ (as amalgam is poured into a separate vessel.) (2)
- 8.2.1 The loss ✓ of electrons ✓ (2)
- 8.2.2 The voltage of the cell is increased slowly. ✓
Zn to oxidise and dissolve into the electrolyte. ✓
The voltage is kept constant when the copper atoms start to oxidise and dissolve. ✓
Ag will drop to the bottom of the vessel. ✓ (4)

9.1 These molecules contain carbon atoms ✓ (and none of them are the exceptions -carbon dioxide, carbon monoxide, diamond, graphite, carbonates, bicarbonates, carbides and cyanides) (1)

9.2.1 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 CH₂ unit. ✓ (2)

9.2.2 carboxylic acid(s) ✓ (1)

9.2.3
$$\begin{array}{c} \text{O} \\ \parallel \\ \text{R}-\text{C}-\text{O}-\text{R} \end{array}$$
 ✓ (1)

9.2.4 C_nH_{2n+2} ✓ (1)

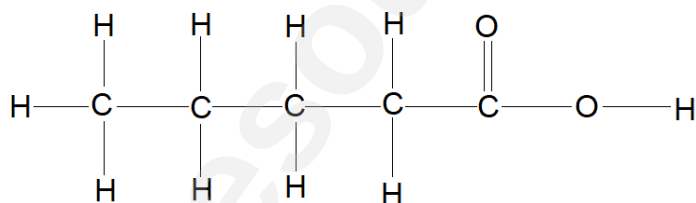
9.3 Compound A, C D ✓ (must have all to get mark) (1)

9.4 Compound B & D ✓ (must have both to get mark) (1)

9.5 penta ✓ -1,3-di ✓ ene ✓ (3)

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

9.6.2 Most common functional isomer should be: pentanoic acid



Any molecule drawn using **structural formulae** with molecular formula C₅H₁₀O₂ ✓, that is **NOT an ester**. ✓ (2)

9.6.3 Chain isomerism ✓ (1)

9.7 Compound A

- Both molecules are of similar length and surface area
- the most significant IMF's in compound A (ester) are dipole-dipole forces ✓
- the only IMF's compound B (alkene) are London forces ✓
- Dipole-dipole forces are stronger than London forces resulting in stronger net force ✓ between Compound A molecules.
- More energy is required ✓ to overcome stronger net force resulting in a higher boiling point. (4)

9.8.1 compound C (1)

9.8.2 $\text{CH}_3\text{CH}_2\text{CH}_2(\text{OH})$ ✓✓
(subtract 1 mark if condensed structural formula is not used) (2)

9.8.3 Esterification OR condensation ✓ (1)

9.9.1 addition reaction ✓ (1)

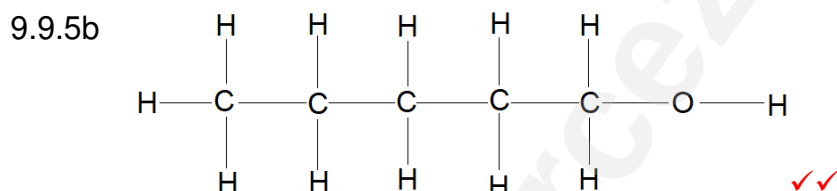
9.9.2 (free-radical) halogenation ✓ (1)

9.9.3 dissolved in organic solvent ✓
Pt, Pd OR Ni (catalyst) present ✓ (2)

9.9.4 $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_3$ ✓ + $\text{Cl}_2 \rightarrow \text{CH}_2\text{ClCH}_2\text{CH}_2\text{CH}_2\text{CH}_3$ ✓ + HCl ✓

Allow chlorine substituent on any carbon atom in haloalkane
(subtract 1 mark if condensed structural formula is not used) (3)

9.9.5a sodium hydroxide OR potassium hydroxide ✓
[must be the name of the reactant NOT the formula] (1)



- Must be marked in conjunction with 8.9.4 the hydroxyl group
must replace the chlorine substituent in the chloroalkane. (2)