

MEMO:

Q1.1 D 1.2 B 1.3 C 1.4 A 1.5 C
 1.6 C 1.7 A 1.8 B 1.9 D 1.10 A [20]

Q2.1.1 Cl₂ ✓ 2.1.2 NH₃ ✓ 2.1.3 P₂O₅ ✓ 2.1.4 Fe ✓ 2.1.5 HBr ✓ 2.1.6 MgI₂ ✓ (6)

2.2.1 gas ✓ 2.2.2 induced dipole/induced dipole/London/Dispersion ✓ (2)

2.2.3 increase, bonds get stronger ✓ (1)

2.2.4 Noble gases and halogens both have- London/Dispersion/Ind. Dipole/Ind. Dipole ✓

Halogens have higher melting and boiling points; since the molecules increase in size ✓

the halogens become liquids and solids at room temperature. ✓ (3)

[12]

Q3.1 Activation energy is defined as *the minimum energy required to start a chemical reaction.* ✓✓ (2)

3.2 $2\text{SO}_3 \rightarrow 2\text{SO}_2 + \text{O}_2$ ✓✓ -1 FOR EACH MISTAKE (2)

3.3 Molecules must be correctly aligned ✓/ molecules must contain the minimum amount of activation E. ✓ (2)

3.4 Reaction rate is the change in concentration per unit time ✓ of either a reactant or product. ✓ (2)

3.5 Pressure /temperature/a catalyst any 2 ✓✓ (2)

3.6 Experiment 2 ✓ greater surface area means more collisions between reacting particles. ✓ (2)

3.7 Crush it, etc. ✓ (1)

3.8 Volume of acid/ temperature/concentration of acid any 2 ✓✓ (2)

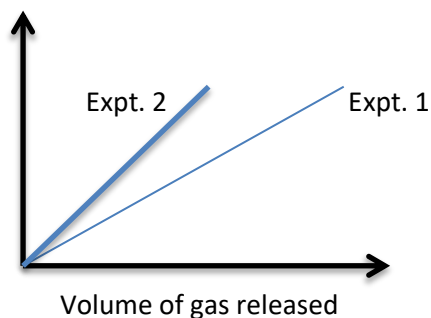
3.9 Volume of gas released ✓ (1)

3.10 Same volume of tablet in the same acid, which means products volume are the same. ✓✓ (2)

Law of conservation of mass

3.11

Surface area

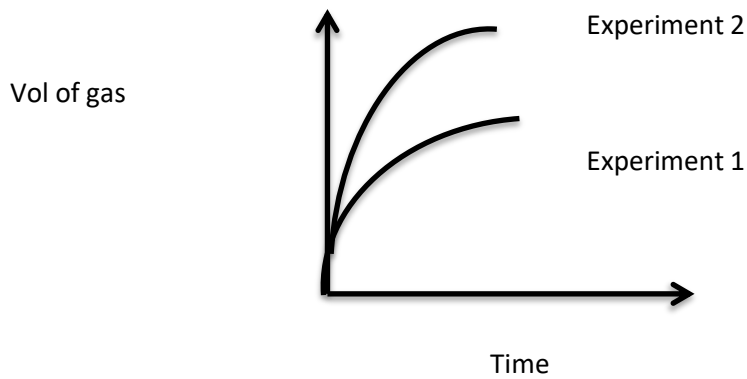


1 mark for labels ✓

1 mark for different gradient lines ✓

(2)

OR



3.12 Experiment 2 was faster. (1)

[21]

Q4.1.1 "When an external stress (change in pressure, temperature or concentration) is applied to a system in chemical equilibrium, the equilibrium point will change in such a way as to counteract the stress" (3)

4.1.2 Dynamic means the reverse and forward reaction are taking place even though changes are not visible, and equilibrium means that the observable properties like concentration remain constant. (2)

4.2.1 Decreases (1)

4.2.2 Decreases (1)

4.3 Stress: Increase in pressure

Le Chatelier says an increase in pressure favours the reaction which has less moles of gas in order to reduce the pressure, therefore the forward reaction is favoured to reduce the pressure.

As a result the concentration of CO will be reduced. (3)

4.4 Increase in volume As a result of an increase in volume there is a decrease in concentration as volume is inversely proportional to concentration. Le Chatelier states that it opposes the stress therefore in this case all three concentrations of the gases will decrease in concentration. Also when volume increases pressure decreases and as pressure decreases so Le Chatelier states that the side with less moles of gas will decrease accordingly.

(4)

4.5.1 Exothermic (1)

4.5.2 Stress is an increase in temperature. Le Chatelier states that when temperature is increased the reaction which causes a decrease in temperature (endothermic) will be favoured. At Disturbance C we see the concentration of Cl₂ and CO increasing and COCl₂ decreasing, hence the reverse reaction was favoured, thus making the reverse reaction endothermic.

(4)

4.6
$$K_c = \frac{[\text{COCl}_2]}{[\text{CO}][\text{Cl}_2]} = \frac{[0.8]}{[1.7][0.7]} = 0.67$$
 (3)

4.7 K_c value is low therefore the yield of COCl_2 will be low **✓**/ OR Low yield as concentration of products is lower than the concentration of the reactants thus reaction is incomplete. **✓** (2)

4.8 Temperature change (1)

[25]

5.1. Protolytic reactions **✓** (1)

5.2 Diprotic- $\text{H}_2\text{SO}_4, \text{H}_2\text{SO}_3, \text{H}_2\text{CO}_3$ **✓** Triprotic- H_3PO_4 **✓** (2)

5.3 Sodium carbonate is a strong base therefore the cations of the strong base do not undergo hydrolysis. **✓**

However, the anion does as shown in the second equation. **✓** Water undergoes hydrolysis and form the ions shown in the first equation. **✓** Therefore there is an excess of OH^- ions, hence a basic solution. **✓** (4)

OR

CO_3^{2-} is the conjugate base of a weak acid $\text{HCO}_3^- (\text{H}_2\text{CO}_3)$ **✓**. It is able to remove H^+ from a water molecule therefore creating an excess of OH^- ions. **✓** The solution is basic. **✓** (4)

5.4.1 $[\text{NH}_3] = 0,1 \text{ mol} \cdot \text{dm}^{-3}$ and $[\text{OH}^-] = 0,001 \text{ mol} \cdot \text{dm}^{-3}$ **✓** therefore NH_3 forms ions to a limited extent **✓** or

$\text{NH}_4\text{OH}/\text{NH}_3$ only partially ionizes hence weak base. **✓** or only partially ionizes. (3)

5.4.2 **$\text{NH}_4\text{OH}(\text{aq}) + \text{HCl}(\text{aq}) \rightarrow \text{NH}_4\text{Cl}(\text{aq}) + \text{H}_2\text{O}(\text{l})$**

$v = 20 \text{ cm}^3$

$v = 22 \text{ cm}^3$

HCl:

$$n = cV \quad \mathbf{v} = 0,062 \times 22 \times 10^{-3} \mathbf{v}$$

$$= 1,364 \times 10^{-3} \text{ mol. } \mathbf{v}$$

Ratio is 1:1

therefore $1,364 \times 10^{-3} \text{ mol}$ therefore $c = n/V = 1,364 \times 10^{-3} / 20 \times 10^{-3} \mathbf{v}$

$$C = 0.0682 \text{ mol} \cdot \text{dm}^{-3} \quad \mathbf{v} \quad (5)$$

5.5.1 *Neutralization is the point where an acid and base have reacted so neither is in excess.* **✓** (1)

5.5.2 Acid $n = CV = 0.5 \times 0.024 \mathbf{v} = 0.012 \text{ mol} \mathbf{v}$

Mole ratio 1:2 therefore 0.012:0.024 mol of base **✓**

$$C = n/V = 0.024 / 0.02 \quad \mathbf{v} = 1.2 \text{ mol} \cdot \text{dm}^{-3} \quad \mathbf{v} \quad (5)$$

5.5.3 $m = n \times MV = 0.024 \times 40 \mathbf{v} = 0.96 \text{ g} \mathbf{v}$ (3)

5.6.1 CONC acid : contains a large number of moles of acid solute **✓** per volume of solution **✓** (2)

5.6.2 $A \mathbf{✓}$: $\text{pH} \propto (1 / [\text{H}_3\text{O}^+]) \mathbf{✓}$ therefore the weak acid which ionises to a lesser extent **✓** results in higher pH (3)

5.6.3 C and B **✓** : strong acids undergoes almost complete ionisation so [product] is high **✓** (equilibrium lies to the right) , resulting in larger K_c value (2)

5.6.4 $C \checkmark$: conductivity \propto [ion] \checkmark (2)

5.7 sulfuric acid \checkmark and ammonium(ammonia/hydroxide/oxide/ carbonate/ chloride/nitrate) \checkmark (2)

[35]

6.1 298K \checkmark and conc. of 1mol.dm⁻³. \checkmark (2)

6.2 There is a build up of cations and anions within the cells \checkmark and the salt bridge allows the ions to move from one cell to another to maintain cell neutrality. \checkmark (2)

6.3 Mg to Ag \checkmark (1)

6.4 Magnesium electrode \checkmark (1)

6.5 $Mg(s) / Mg^{2+}(aq) \checkmark // \checkmark Ag^+(aq) / Ag(s) \checkmark$ (3)

6.6 $Mg(s) + 2 Ag^+(aq) \rightarrow Mg^{2+}(aq) + 2Ag(s) \checkmark \checkmark \checkmark$ -1 for no phase indicators -1 for any other mistake (3)

6.7 Increase \checkmark , if you increase the concentration of Ag^+ ions, it will favour the forward reaction which will increase the positive charge at the cathode, \checkmark thus the emf of the cell will increase. \checkmark (3)

6.8 It will become zero. \checkmark (1)

6.9.1 $Ag: n = m/M = 2.7/108 \checkmark = 0.025mol. \checkmark$

Mole ratio 2: 1 Ag:Mg therefore 0.025: 0.0125 \checkmark

Mg: $m = n \times M = 0.0125 \times 24 \checkmark = 0.3g \checkmark$

therefore mass of Mg electrode is 12,15 – 0.3 = 11.85g. \checkmark (6)

6.9.2 $n = m/M = 2.7 / 108 = 0.025mol. \checkmark$

$Q = n \times F = 0.025 \times 96500C = 2412.5C \checkmark$

$I = Q/t = 2412.5/(30 \times 60) \checkmark = 1.34 A \checkmark$ (4)

[26]

7.1 Anode \checkmark (1)

7.2 $2Br^-(aq) \rightarrow Br_2(l) + 2e^- \checkmark \checkmark$ (2)

7.3 $2H_2O + 2e^- \rightarrow H_2 + 2OH^- \checkmark \checkmark$ (2)

7.4 Bromine forms therefore a brown discolouration at the electrode. \checkmark

[did not accept mass of electrode decreasing] (1)

7.5 $2Br^-(aq) + 2H_2O(l) \rightarrow Br_2(l) + H_2(g) + 2OH^-(aq)$ -1 for incorrect balancing

-1 for any other mistake/s **vvv** (3)

(No carrying over from 7.2 or 7.3)

7.6.1 A = cathode **v** B = anode **v** (2)

7.6.2 Gold Cyanide/sulphite/chloride/nitrate/sulphate anion/s possibilities **vv** (2)

7.6.3 Gold ions **v** (1)

7.6.4 Electrical to Chemical **vv** (1)

7.7.1 Chlorine/Hydrogen and sodium hydroxide **vvv** (3)

7.7.2 Mercury cell - **v** because of the health issues associated with mercury **v**

Diaphragm cell **v**– because of asbestosis health concerns with the asbestos membrane **v** (4)

[23]

8.1 A: elimination / dehydration **✓**

B: combustion / oxidation **✓**

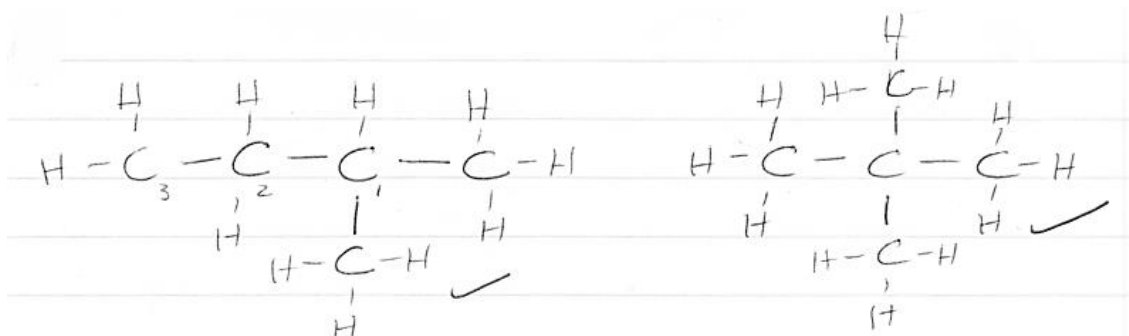
C: hydrohalogenation / addition **✓**

D: esterification **✓** (4)

8.2 $C_5H_{12} + 8O_2 \rightarrow 5CO_2 + 6H_2O$ **✓✓** (2)

8.3.1 Compounds with the same molecular formula **✓** but different structural formula **✓** (2)

8.3.2



2 **✓** methyl butane **✓** 2,2 **✓** dimethyl propane **✓** (6)

8.4.1

$$C_5H_{12} = \frac{m}{M} = \frac{108}{(60+12)} \quad \checkmark$$

$$= 1,5 \checkmark$$

Mol ratio: $C_5H_{12} : CO_2$ $m_{CO_2} = n \times M$

$$2 : 10 \quad (1:5) = 7,5 \times 44 \checkmark$$

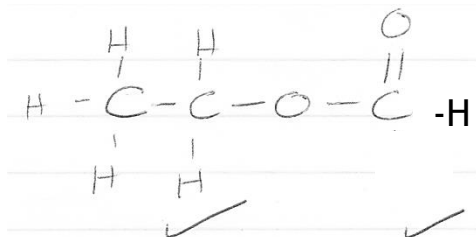
$$1,5 : 7,5 \checkmark = 330g \checkmark$$

(5)

8.4.2 Carbon monoxide \checkmark

(1)

8.4.3



ethyl \checkmark methanoate \checkmark

(4)

8.5.1 Butane \checkmark and butene \checkmark

(2)

8.5.2 Butene – alkene \checkmark

Butanol – alcohol \checkmark

(2)

8.6.1 Butane (saturated) has more bonds \checkmark than butene (unsaturated). This means more temporary dipoles \checkmark set up in butene, and more v.d Waals \checkmark forces, therefore more energy required to break them, therefore higher B.P \checkmark (can also accept answers which talk about surface area of butane smaller than butane which leads to less vd waals forces, hence.....)

(4)

8.7.1 propane -1,2,3 – triol $\checkmark\checkmark$



(3)

8.7.2 Tertiary alcohol \checkmark

It is determined by the number of carbon atoms bonded to the carbon atom \checkmark that is bonded to the hydroxyl group. \checkmark

(3)

[38]

[200 marks]