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UV Chemistry Memo – 2020

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

(20)

- 2.1.1 F, G ✓✓ (-1 for each extra answer) i.e. if candidate writes F,X for this question award 1 mark
- 2.1.2 A,B,D ✓✓✓
- 2.1.3 A ✓
- 2.1.4 E ✓
- 2.1.5 I ✓
- 2.1.6 H ✓
- 2.1.7 C ✓

(10)

- 2.2 - Cl₂ is non-polar ✓
- random e⁻ movement causes fleeting/temp/fluctuating dipole ✓
- temp dipole on one molecule induces dipole on adjacent molecule {if the candidate does not stress adjacent/nearby molecule then don't give this mark} ✓
- oppositely charged dipoles on different molecules attract ✓ producing the IMF. (4)

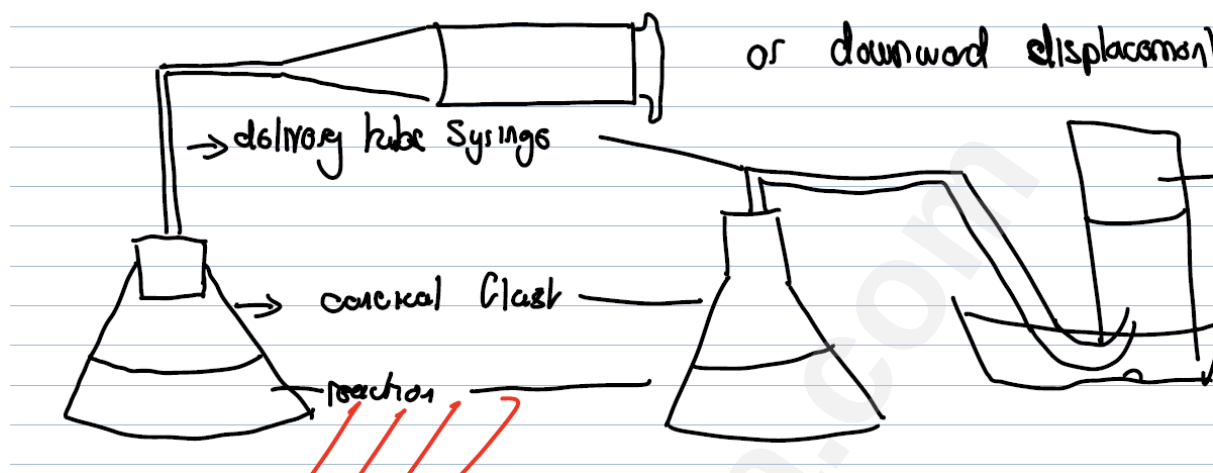
- 2.3.1 butanoic acid (1)

- 2.3.2 butanoic acid has hydrogen bonds between molecules ✓
- O – H present ✓
- propyl methanoate – only exhibits dipole and London
- so stronger hydrogen bonds require more energy to overcome the forces ✓ (4)

- 3.1.1 Yes ✓
- Cu⁰ → Cu⁺² or metal become ion ✓ (or mention oxidation number of Cu or N changing) (2)

3.1.2 change in concentration per unit time of either a reactant or product. $\checkmark\checkmark$ (2)

3.1.3



either gas syringe $\checkmark\checkmark$ with delivery tube $\checkmark$ and reaction vessel $\checkmark$ OR downward displacement apparatus $\checkmark$ with graduated collection vessel $\checkmark$, delivery tube $\checkmark$ and reaction vessel $\checkmark$

3.1.4 scale > $\frac{1}{2}$ page $\checkmark$

Correct shape $\checkmark$

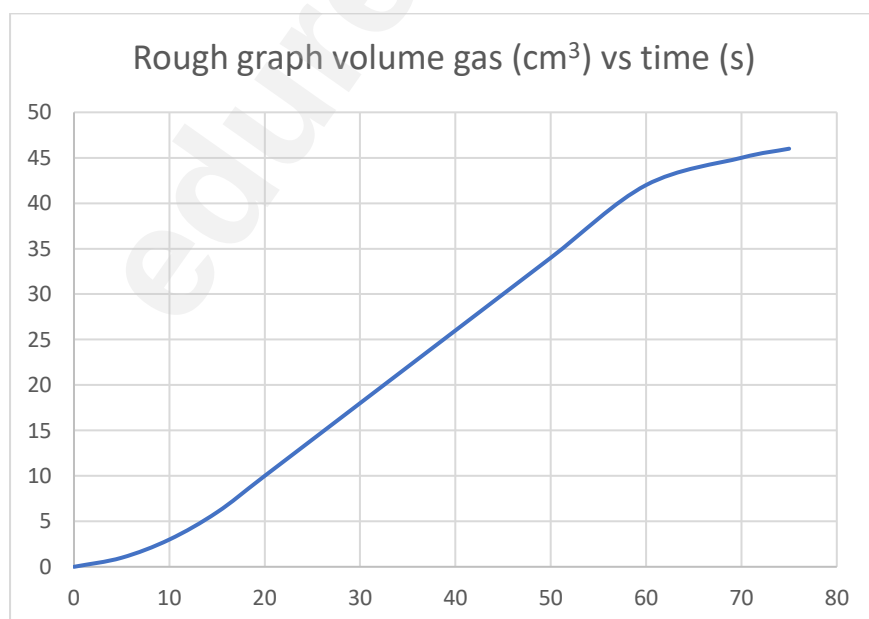
Suitable heading $\checkmark$

Labelled axes with units $\checkmark$

LOBF (curve)

Check 1 plotted point correct $\checkmark$

(6)



3.1.5 Reaction rate = $\Delta \text{volume} / \Delta t$ (implied) = $6 \text{ cm}^3 / 15 \text{ s} = 0,4 \text{ cm}^3/\text{s}$ (3)

3.1.6 Temperature is increasing ΔT , reaction is exothermic (3)

OR surface area increasing ΔA as initial solid is pitting (getting imperfections from reaction)

3.1.7 30-50 s (2)

4.1 closed system with reversible reaction

rate forward = rate reverse (2)

4.2.1 LCP = when an external stress (change in pressure, temperature or concentration) is applied to a system in dynamic chemical equilibrium

The equilibrium point will change in such a way as to counter the stress. (2)

4.2.2 Stress : inc conc chloride ions

Response : reduce chloride ion concentration

Explanation: forward reaction removes chloride ions therefore forward favoured

Observation colour goes more blue (maroon $\rightarrow$ blue) (3)

4.3.1 exothermic (1)

4.3.2 Stress : Inc temp. OR Response: decrease temp

Explanation : system favours reaction that reduces temp

Reverse is endothermic therefore (reverse favoured) (3)

4.4.1

	$\text{Co}(\text{H}_2\text{O})_6^{2+}$	$+ 4 \text{ Cl}^-$	CoCl_4^{2-}	$+ 6 \text{ H}_2\text{O}$
Ratio (R)	1	4	1	6
Initial moles (I)	0,300	1,000	0	0
Change (C)	$- 5 \times 10^{-3}$ (0,005)	$- 2 \times 10^{-2}$ (0,02)	$+ 5 \times 10^{-3}$ (0,005) ✓	$+ 3,0 \times 10^2$ (0,030)
Equil Moles (E)	0,295 ✓	0,98 ✓	5×10^{-3}	$+ 3,0 \times 10^2$ (0,030)
conc (c)	$0,295/0,5$ $= 0,59$	$0,98/0,5 = 1,96$ ✓	$5 \times 10^{-3} / 0,5 = 1$ $\times 10^{-2} = 0,01$	$3,0 \times 10^2 / 0,5 =$ 0,06 ✓
Kc	Sub into given formula = $5,35 \times 10^{-11}$ ✓	If they subbed into formula without water: Allocate 1 out of 2 marks		

If they read it as 1000 mole				
	$\text{Co}(\text{H}_2\text{O})_6^{2+}$	$+ 4 \text{Cl}^-$	CoCl_4^{2-}	$+ 6 \text{H}_2\text{O}$
Ratio (R)	1	4	1	6
Initial moles (I)	0,300	1000	0	0
Change (C)	$- 5 \times 10^{-3}$ (0,005)	$- 2 \times 10^{-2}$ (0,02)	$+ 5 \times 10^{-3}$ (0,005) v	$+ 3,0 \times 10^2$ (0,030)
Equil Moles (E)	0,295 v	$1000 - 0,02 =$ 999,98 v	5×10^{-3}	$+ 3,0 \times 10^2$ (0,030)
conc (c)	$0,295/0,5$ $= 0,59$	$999,98/0,5 =$ 1999,96 v	$5 \times 10^{-3} / 0,5 = 1$ $\times 10^{-2} = 0,01$	$3,0 \times 10^2 / 0,5 =$ 0,06 v
Kc	Sub into given formula = $4,94 \times 10^{-23}$ v v	If they subbed into formula without water: $1,05 \times 10^{-15}$ Allocate 1 out of 2 marks		

(7)

4.4.2 System is at a different temperature. v

(1)

4.4.3 Usually water is the solvent v and its concentration is constant v i.e. water being used or formed is assumed too little to affect its concentration

OR ethanol is the solvent v so $[\text{H}_2\text{O}]$ is changing v

(2)

- 5.1.1 $n = c \cdot v = 0,2 \times (0,5) = 0,1 \text{ mol } v$
 $m \text{ LiOH} = 0,1 \times 24 v(\text{correct molar mass}) = 2,4 \text{ g } v$ (4)
- 5.1.2 11-14 (strong base) v (1)
- 5.2.1 proton acceptor $v v$ (2)
- 5.2.2 (almost) completely v dissociates v (2)
- 5.2.3 large volume solvent to amount solute $v v$ (or small ratio solute to solvent) (2)
- 5.2.4 Yes v - lots of free ions $v v$ (3)
- 5.3 $\text{H}_2\text{SO}_4 + 2 \text{LiOH} \rightarrow \text{Li}_2\text{SO}_4 + 2 \text{H}_2\text{O}$ v formula Li_2SO_4 water v balancing LHS and RHS v (3)
- 5.4.1 $\text{CH}_3\text{COOH} (\ell) + \text{H}_2\text{O} (\ell) \rightleftharpoons \text{CH}_3\text{COO}^- (\text{aq}) + \text{H}_3\text{O}^+ (\text{aq})$
 phases v $\text{CH}_3\text{COO}^- v \text{H}_3\text{O}^+ v$ (3)
- 5.4.2 substance that can act as either an acid or a base $v v$ (2)
- 5.4.3 $\text{H}_2\text{O} v$ (1)
- 5.4.4 CH_3COOH acid $\rightleftharpoons \text{CH}_3\text{COO}^-$ base pair v correct acid/base identified in pair v
 H_2O base $\rightleftharpoons \text{H}_3\text{O}^+$ acid v correct acid/base identified in pair v (4)
- 5.4.5 Low v ethanoic acid is a weak acid v (or HCl strong acid) therefore lower ion concentration (2)
- 5.5.1 $n (\text{HCl}) \text{ added} = c \cdot v = 0,12 \cdot 2 v = 0,240 \text{ mol } v$ (2)
- 5.5.2 $n (\text{NaOH}) = c \cdot v = 1,00 \times (44,10/1000v) = 0,044 \text{ mol NaOH } v$
 $\therefore n (\text{HCl}) \text{ that reacted} = 0,240 \text{ c/o} - 0,044 v = 0,196 \text{ mol } v$ (3)
- 5.5.3 $n (\text{MgCO}_3) = 0,196 / 2 v (\text{mol ratio}) = 0,098 \text{ mol}$
 $m (\text{MgCO}_3) \text{ pure} = 8,23 \text{ g } v$
 $\% \text{ purity } \text{MgCO}_3 = 8,23 / 10 \times 100 v = 82,3 \% v$
 $\therefore$ yes manufacturer's claim is valid v (for these 2 tablets) (5)

- 6.1 electrode at which oxidation occurs ✓✓ (2/0) (2)
- 6.2 substance that donates electrons ✓✓ (2/0) (2)
- 6.3 25°C ✓ 1 mol/dm³ concentration ✓ 1 atmosphere pressure ✓ (3)
- 6.4.1 $\text{Cu} \rightarrow \text{Cu}^{+2} + 2 \text{e}^-$ ✓✓ ✓✓ -1 if double arrows used (6.4.1 – 6.4.3) (2)
- 6.4.2 $\text{Cl}_2 + 2 \text{e}^- \rightarrow 2 \text{Cl}^-$ ✓✓ (2)
- 6.4.3 $\text{Cu} + \text{Cl}_2 \rightarrow \text{Cu}^{2+} + 2 \text{Cl}^-$ ✓✓ (2)
- 6.5 $E^\circ_{\text{cell}} = E^\circ_{\text{cat}} - E^\circ_{\text{an}} = 1,36 - (0,34) \text{ V} = 1,02 \text{ V}$ (3)
- 6.6.1 Decrease ✓✓ (2)
- 6.6.2 Decrease ✓✓ (2)
- 6.6.3 No effect (2)
- 6.7.1 decrease mass ✓ (1)
- 6.7.2 solution becomes darker ✓ blue (more intense colour) (1)
- 6.8 No ✓, the product is a gas ✓ which escapes ✓ and doesn't coat the inert Pt electrode (3)
- 7.1 cathode ✓ reduction ✓ of Cr^{3+} takes place to Cr (s) ✓ (3)
- 7.2 $\text{Cr}^{3+} + 3 \text{e}^- \rightarrow \text{Cr}$ ✓✓ (2)
- 7.3 A – chromium metal ✓ anode
B – Cr^{3+} ions ✓ (2)
- 7.4 The cell will initially work ✓, but eventually the $[\text{Cr}^{3+}]$ will decrease ✓ to the level where (the water will be reduced at the cathode and no Cr metal will plate.) ✓ (3)
- 7.5 $q = I \cdot t = 1 (20 \times 60) = 1200 \text{ C}$ ✓
 $n(\text{e}^-) = 1200 / 96500 = 0,0124 \text{ mol}$ ✓
 $n(\text{Cr}) = 0.0124 / 3 = 0,0042 \text{ mol}$ ✓
mass Cr deposited = $0,0042 \times 52 \text{ V} = 0,21 \text{ g}$ ✓ (5)
- 7.6 Cr^{3+} is more reactive than water ✓ (stronger oxidising agent than water ✓) and so will form Cr metal and plates while Mg^{2+} is a weaker oxidising agent and so water will react and gain electron rather than Mg^{2+} and so Mg metal doesn't form. ✓
The answer must include comparison between Cr^{3+} and water and Mg^{2+} and water to get full credit (3)

- 8.1.1 compound containing hydrogen and carbon only (0/2) (2)
- 8.1.2 atom or group of atoms that form the centre of chemical activity of the molecule. 2/0 (2)
- 8.1.3 Compounds having the same molecular formula but different structural formula. 2/0 (2)
- 8.2.1 carboxyl group ✓ (1)
- 8.2.2 hydroxyl group ✓ (1)
- 8.3.1 pent-1-ene ✓✓ (asked to name the positional isomer of pent-2-ene)
Position of C=C changes on molecule ✓ (3)
- 8.3.2 $2 \text{C}_5\text{H}_{10} + 15 \text{O}_2 \rightarrow 10 \text{CO}_2 + 10 \text{H}_2\text{O}$
✓✓ balanced ✓ H_2O and CO_2 ✓ C_5H_{10} (4)
- 8.4.1 addition ✓ not hydrohalogenation (2)
- 8.4.2 hydrohalogenation ✓ (2)
- 8.5.1 substitution ✓ (1)
- 8.5.2 4,4-dimethylpentan-1-ol ✓ correct numbering ✓ (3)
- 8.5.3 alkene ✓ (if more specific molecule given then also ✓) (1)
- 8.5.4 elimination (1)
- 8.6 d, alcohol ✓
Exhibits hydrogen bonding ✓
e exhibits dipole-dipole ✓
more energy required to overcome hydrogen bonding. ✓ (4)
- 8.7.1 elimination ✓ (1)
- 8.7.2 either $\text{CH}_2\text{CHCH}_2\text{CH}_2\text{CH}_3$ OR $\text{CH}_3\text{CHCHCH}_2\text{CH}_3$ ✓✓ (3 or 0) (3)
- 8.7.3 dehydrating agent or catalyst ✓ (1)