Marking scheme Chemistry Prelims 2022

Paper 1:

1	2	3	4	5	6	7	8	9	10
D	**A**	**C**	**A**	**A**	**B**	**A**	**B**	**C**	**A**
11	12	13	14	15	16	17	18	19	20
A	**B**	**D**	**B**	**C**	**B**	**C**	**D**	**C**	**A**
21	22	23	24	25	26	27	28	29	30
D	**D**	**C**	**A**	**B**	**C**	**D**	**D**	**B**	**B**
31	32	33	34	35	36	37	38	39	40
C	**C**	**B**	**B**	**D**	**D**	**A**	**C**	**D**	**C**

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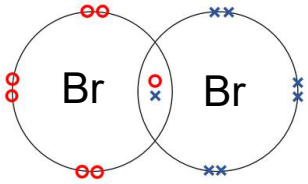
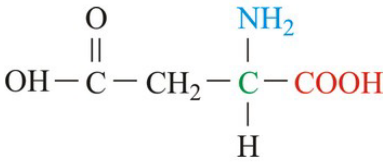
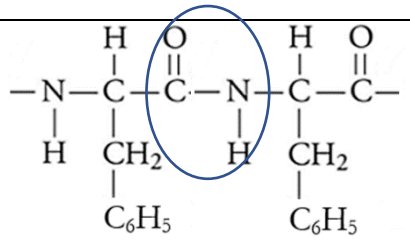
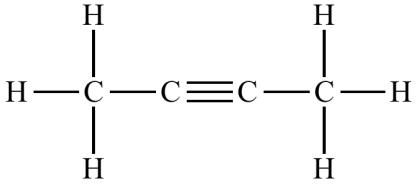
Paper 2:

A1	(a) Fe (b) Pt (c) Zn (d) C (e) C / N (f) K / Ca	1m each
A2(a)	The molecules can <u>roll and glide over one another</u> and can <u>move throughout the liquid</u>. They are <u>arranged closed together</u> in a <u>disorderly arrangement</u>.	1m 1m
A2(b)		1m
A2(c)	Bromine is <u>more reactive</u> than iodine and gains electrons more readily. Hence it will <u>displace</u> iodine from KI to give KBr and I_2. Br_2 (*l*) + 2 I^- (aq) → 2 Br^- (aq) + I_2 (s/aq)	1m 1m 1m
A3(a)	(i) <u>no change</u>/(solution remains pink) (ii) grey solid; forms in green solution	1m 1/2m, 1/2m
A3(b)	CuO + 2 E → E_2O + Cu	1m formulae 1m balanced
A3(c)	Electrolysis	1m
A4(a)	Total amount of energy absorbed during bonding breaking = (413 × 8) + (390 × 6) + (3 × 498) = 7138 kJ Total amount of energy released during bonding forming = (413 × 2) + (891 × 2) + (464 × 12) = 8176 kJ Total amount of energy released is <u>greater</u> than total amount of energy absorbed OR Enthalpy change of energy is <u>negative</u>	 1m 1m 1m
A4(b)	Platinum is a catalyst. It provides an <u>alternative pathway with a lower activation energy</u>. The <u>proportion of particles with sufficient energy to overcome the activation energy increases</u>. As a result, the reacting molecules/ particles (reject ions) collide with each other more often causing the <u>frequency of effective collisions to increase</u> and therefore the rate of reaction.	1m 1m 1m

A4(c)	The reaction is reversible so hydrogen cyanide can decompose back to its reactants as it is formed.	1m
A5(a)	**F**: ammonium sulfate **G**: barium sulfate **L**: calcium carbonate	1m 1m 1m
A5(b)	Blue precipitate formed which dissolves in excess ammonia solution to give a dark blue solution	1m 1m
A6(a)	1. Purple solution turned colourless. 2. Effervescence observed.	1m 1m
A6(b)	The oxidation state of C increases from +3 in $C_2O_4^{2-}$ to +4 in CO_2. $C_2O_4^{2-}$ is oxidised to form CO_2. $C_2O_4^{2-}$ is the reducing agent. OR The oxidation state of Mn decreases from +7 in MnO_4^- to +2 in Mn^{2+}. MnO_4^- is reduced to Mn^{2+}. $C_2O_4^{2-}$ is the reducing agent.	1m 1m
A6(c)	No. of moles of $KMnO_4$ used = 250/1000 x 0.5 = 0.125 mol No. of moles of CO_2 produced = 0.125 x (10/2) = 0.625 mol Volume of CO2 produced = 0.625 x 24 = 15.0 dm^3	1m 1m 1m
A7(a)	(i) electrons (ii) ions	1m 1m
A7(b)	Apparatus A: A1 Apparatus B: B1	1/2m 1/2m
A7(c)	Copper(II) ions (Cu^{2+}) gain electrons more easily than hydrogen ions (H^+) to form copper solid. OR Copper(II) ions (Cu^{2+}) are preferentially discharged to form copper solid. Cu^{2+} (aq) + 2e → Cu (s)	1m 1m
A7(d)	Electrode A2: 4 OH^- (aq) → 2 H_2O (l) + O_2 (g) + 4e Electrode B2: Cu (s) → Cu^{2+} (aq) + 2e	1m 1m
A8(a)	Carboxyl, Amine, Amide, Ester (any two answers)	2m
A8(b)		1m
A8(ci)	Methyl propanoate	1m
A8(cii)	concentrated sulfuric acid	1m
A8(di)	A macromolecule is a very large molecule that is made up of many small molecules.	1m

A8(dii)		1m 1m circle linkage
B9(a)	Coagulation <u>increases size of particles</u>, allow it to be <u>trapped by the filters/cannot pass through</u> the pores. Coagulation <u>increases mass of particles</u>, hence is <u>heavier and settles to the bottom</u> of the tank for removal.	1m 1m
B9(b)	Filtration removes <u>undissolved, insoluble</u> particles while BAC removes <u>dissolved, soluble</u> particles. Filtration separates by <u>size</u>, while BAC specifically <u>attracts organic compounds</u> and not other compounds.	1m 1m
B9(c)	Calcium oxide is a basic oxide that can neutralise acids in water to increase pH.	1m
B9(d)	Error 1: <u>quote</u> any <u>2 ions</u> in Table B9.4 which will form precipitate; state they will <u>form precipitate / insoluble salt</u> OR Error 2: <u>Precipitate of lead(II) hydroxide and aluminium hydroxide</u> will react away / <u>dissolve in excess</u> (sodium) hydroxide solution	1m 1m OR 1m 1m
B9(e)	one spot for copper(II) at 4.1 cm one spot for iron(III) at 2.4 cm (-1m for no labelling)	1m 1m
B9(f)	No. The components would have <u>different solubilities</u> in a different solvent, hence the <u>R_f values would be different</u>, resulting in a different chromatogram.	1m 1/2m 1/2m
B10(a)	They have the same functional group <u>carbon-carbon triple bond; C≡C</u> They have the same general formula <u>C_nH_{2n-2}</u>. The two members differ by a <u>$-CH_2$</u> unit.	1m each (Any two)
B10(bi)	Any value within the range of 36-43.	1m
B10(bii)	As the <u>molecular sizes increase</u>, there are <u>more intermolecular forces of attraction</u> to overcome. <u>More energy</u> is required to overcomes these forces of attraction during boiling.	1m 1m
B10(ci)		1m
B10(cii)	<u>Isomers</u>. OR They have the <u>same molecular formula but different structural formulae</u>.	1m

B10(d)	$2\ C_4H_6 + 11\ O_2 \rightarrow 8\ CO_2 + 6\ H_2O$	2m
B11E (a)	$CuCO_3 \rightarrow CuO + CO_2$	1m
B11E (b)	Down Group II, the reactivity of the metal increases. The more reactive the metal, the greater the thermal stability of the metal carbonate, hence the temperature for decomposition of the metal carbonate increases.	1m 1m 1m
B11E (ci)	When sulfuric acid is added to $CaCO_3$, insoluble $CaSO_4$, CO_2 and water is produced. The CO_2 produced gives the effervescence. The insoluble $CaSO_4$ formed forms a protective layer over the $CaCO_3$, preventing further reaction.	 1m 1m
B11E (cii)	No of moles of sulfuric acid = 0.200 x 25/1000 = 0.00500 mol No of moles of $MgCO_3$ = 1/ [24 + 12 + (16 x3)] = 0.0119 mol Mole ratio H_2SO_4 : $MgCO_3$ is 1:1 0.005 mol of H_2SO_4 requires 0.005 mol of $MgCO_3$ but there is 0.0119 mol, hence $MgCO_3$ is in excess. Since there is excess $MgCO_3$, there should be solid $MgCO_3$ left behind and not disappear.	1m 1m 1m for explanation 1m for observation
B11O (ai)	Gas syringe	1m
B11O (aii)	Insert a lighted splint into the gas. The gas will extinguish the lighted splint with a pop sound.	1m 1m
B11O (aiii)	Observation 1 – sulfuric acid is strong acid and hence ionises completely to produce a higher concentration of H^+ ions. Observation 2 – Citric acid is a tribasic acid while sulfuric acid is dibasic. The number of mole of H^+ ions produced is greater with citric acid.	1m 1m
B11O (bi)	Ionic AND Covalent	1m
B11O (bii)	It is formed when the hydrogen ion in citric acid is replaced by the potassium ion.	1m
B11O (biii)	Heat the solution until it is saturated and allow it to cool for crystals to form. Filter to collect crystals as residue. Wash the crystals with a little cold deionised water and dry by pressing between sheets of filter paper.	1m 1m 1m