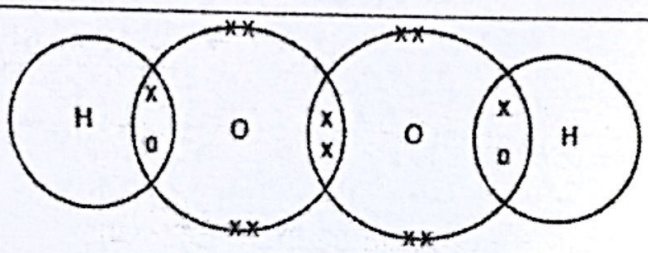
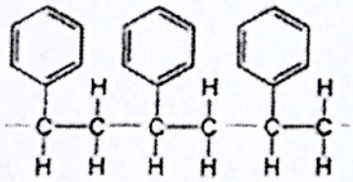
2021 Sec 4Exp Pure Chemistry Paper 1 MS

Paper 1 (MCQ) 40 marks

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

2021 Sec 4Exp Pure Chemistry Paper 2 MS

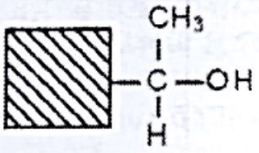
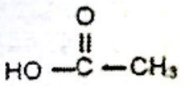
Qn	Solutions	MS
A1(a)	(i) R and T (ii) Q (iii) Q, R and V (iv) S and V	Both to score 1m 1m All to score 1m Both to score 1m
A1(b)	$PbSiO_3$	1m
		Total: 5m
A2(a)		Correct number of electrons shared – 1m Correct number of valence electrons in all atoms – 1m Accept if all electrons shown
A2(b)	• In liquid state, hydrogen peroxide has a <u>simple molecular structure / exist as simple molecules / discrete molecules / neutral molecules</u>; hence • there are <u>no free mobile ions and electrons;</u> in this structure to carry charges and conduct electricity.	1m 1m
A2(d)	(i) ^{16}O, ^{17}O and ^{18}O all have <u>8 electrons and 8 protons</u> showing that they are <u>atoms of the same element</u>; ^{16}O, ^{17}O and ^{18}O each has <u>different number of neutrons, 8, 9, 10 respectively</u>, which shows they are have <u>different number of neutrons</u>; (ii) ^{16}O, ^{17}O and ^{18}O <u>all have 6 valence electrons</u> and hence the three isotopes have the same chemical reactions. *Ignore reference made using 8 electrons, answer should be precise to making reference to the number of valence electrons.*	1m 1m 1m
A2(e)	[3x2] + [18 x 2] = <u>42</u>	1m
		Total: 8m
A3(a)	• Zinc <u>does not exhibit variable oxidation states</u> like other transition elements / <u>has only one (fixed) oxidation state</u> of +2 in its compounds; • Zinc <u>does not formed coloured compounds</u> / <u>do not form coloured solutions</u> when dissolved in water; • Zinc has <u>low melting and boiling points</u> / the <u>lowest melting and boiling points amongst the transition elements</u>; Reject: Zinc has low density Ignore: its elements and/or compounds are not catalysts	1m 1m 1m (any two)
A3(b)	(i) reagent 1: <u>zinc / zinc oxide / zinc hydroxide / zinc carbonate</u>	1m for reagents

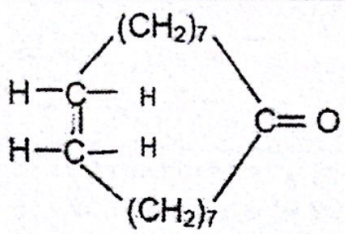
	reagent 2: <u>sulfuric acid</u> **Filter** the mixture. **Heat** filtrate till **saturation**. **Cool** to allow **crystals** to form. (ii) reagent 1: <u>aqueous zinc nitrate/chloride (must have aq/sol)</u> reagent 2: <u>aqueous sodium carbonate (or any other Group I carbonate solution)</u> **Filter** the mixture. Obtain **residue**. Dry residue with filter papers.	1m for brief description 1m for reagents 1m for brief description
A3(c)	• The <u>**height of the precipitate formed remained unchanged on adding dilute nitric acid**</u>, indicating that the precipitate formed is due to formation of silver chloride and <u>**carbonate ions are not present**</u>. • Hence, the anion present in solution P is <u>**chloride ion / Cl^-**</u>	1m to eliminate carbonate ions 1m
		Total: 8m
A4(a)	Amide linkage	1m
A4(b)	Carboxyl group/-COOH	1m
A4(c)	Monomer: styrene 	1m 1m
A4(d)	Polypropene/poly(propene)/polypropylene	1m
A4(e)	• Addition polymers are formed from <u>**(unsaturated) monomers containing carbon-carbon double bonds**</u> while condensation polymers are formed from <u>**monomers containing two different functional groups / carboxyl and hydroxyl groups or carboxyl and amine groups**</u>. • In addition polymerisation, <u>**no molecules are lost/ no other substances formed**</u> when monomers join/bond together / <u>**only the polymer is formed**</u> during the formation of addition polymers while in condensation polymerisation, <u>**small molecules (usually water molecules) are lost**</u> / the <u>**polymer together with water or small molecules are formed**</u>; • The <u>**empirical formula of the addition polymer**</u> is the <u>**same as its monomer**</u> while the <u>**empirical formula of condensation polymer is not the same as its monomer**</u>; • Addition polymers <u>**contain long chains of carbon-carbon atoms / do not contain amide or ester linkages**</u> while <u>**condensation polymers contain amide or ester linkages**</u>;	1m for each difference clearly described for both types of polymerisation Max 2 differences stated
A4(f)	Mr of each repeat unit of Q = 42	

	Total no of repeat unit = 84000/42 = 2000 Total no of C atoms = 2000(3) = 6000	1m **Total: 8m**
A5(a)	• $E_2 - E_1$: enthalpy change/ ΔH • $E_3 - E_1$: activation energy for backward reaction ($C + D \rightarrow A + B$) • $E_3 - E_2$: activation energy for forward reaction. ($A + B \rightarrow C + D$)	1m 1m 1m
A5(b)	• The forward reaction is **exothermic**; • as the **energy level of the reactants is higher than the energy level of the products**; Reject: • *energy of reactants to products decreases* • *energy of A & B to C & D decreases* • *energy of bond breaking is lower than energy of bond forming*	1m 1m
A5(c)	(i) $H_2SO_4 + 2KOH \rightarrow K_2SO_4 + 2H_2O$ (ii) $nH_2SO_4 = 1 \times (500/1000) = 0.5$ mol $nKOH = 2 \times (200/1000) = 0.4$ mol KOH is limiting reactant. $KOH:H_2O = 1 : 1$ $nH_2O = 0.4$ mol heat produced = $57 \times 0.4 = 22.8$ kJ	1m 1m 1m 1m
		Total: 9m
A6(a)	(i) Oxides of nitrogen are produced due at **high temperature due to the reaction between nitrogen and oxygen** in the engine; CO is produced by **incomplete combustion of carbon-comtaining fuel** in the engine; (ii) Dissolve in rainwater to form acid rain / formation of petrochemical smog / depletion of earth's ozone layer (any one)	1m 1m 1m
A6(b)	(i) $2CO\ (g) + 2NO\ (g) \rightarrow 2CO_2\ (g) + N_2\ (g)$ (ii) CO is oxidised by gaining oxygen to form CO_2. NO is reduced by losing oxygen to form N_2. Hence it is a redox reaction. Accept: using oxidation number to explain	1m 1m
		Total: 5m
A7(a)	$2HCl + Zn \rightarrow ZnCl_2 + H_2$	1m
A7(b)	• Experiment B: 100 cm^3, 0.5 mol/dm^3	1m

	accept any answer with lower conc but same moles of acid (0.05 mol) • Experiment C: 100 cm^3, 0.25 mol/dm^3 *accept any answer with lower conc and half the moles of acid compared to Expt B (0.025 mol)*	1m
A7(c)	(i) Experiment R By comparing **expt P and R** using the **same concentration and volume of hydrochloric acid**, the **time taken to collect 10 cm^3 of gas for expt R is shorter compared to P**, indicating that the variable changed is temperature, where the temperature is higher for expt R since the time taken is shorter. (ii) At higher temperature, the reactant particles **gain energy, move faster and collide more often** with each other / At higher temperature, more particles possess energy equal or higher than the activation energy. Therefore **frequency of effective collisions between reacting particles is increased** and **speed of reaction is increased**.	1m 1m 3 points – 2m 1-2 points – 1m
		Total: 7m
B8(a)	• The equivalence points **do not always conicide with neutral pH;** • **In titration 2, equivalence point is pH 8** / From the titration graphs, the **pH at the equivalence points depends on the strength of the acid and base;**	1m 1m for reasoning
B8(b)	$HCl (aq) + NaOH(aq) \rightarrow NaCl (aq) + H_2O (l)$ Let the concentration of HCl and NaOH be y mol/dm^3. (mentioned in qns that conc of both acids and bases have the same concentration) From graph, at the equivalence point, volume of NaOH = 25.0 cm^3 No. of moles of NaOH = 25 / 1000 * y = 0.025y mol 1 mole of NaOH reacts with 1 mole of HCl No. of moles of HCl = 0.025y mol Volume of HCl = 0.025y / y = 0.025 dm^3 = 25 cm^3	 1m 1m

B8(c)	(i) The <u>**end-point of methyl orange does not coincide with the equivalence point**</u> of the reaction between ethanoic acid and sodium hydroxide and <u>**thus will not show a colour change**</u> / The pH change of the reaction between ethanoic acid and sodium hydroxide is between pH 7 and pH 12 and the end-point of methyl orange is at pH 4 and thus methyl orange <u>**will remain yellow**</u> at equivalence point of the reaction. (ii) Phenolphthalein	1m 1m
B8(d)	• From the graph in titration , <u>**hydrochloric acid has a pH value of about 1, indicating that it is a strong acid;**</u> • From the graph in titration 2/3, <u>**ethanoic acid has a pH value of about 3/ 4, indicating that it is a weak acid;**</u>	1m 1m
B8(e)	(i) $H_2PO_4^- \rightleftharpoons H^+ + HPO_4^{2-}$ (ii) Na_2HPO_4	1m 1m
		Total: 10m
B9(a)	A: positive terminal B: negative terminal	Both to score 1m
B9(b)	Electrode P: $Ag\,(s) \rightarrow Ag^+\,(aq) + e$ Electrode Q: $Ag^+\,(aq) + e \rightarrow Ag\,(s)$ Penalise 1m if no state symbols written	1m 1m
B9(c)	The Universal Indicator turns <u>**blue / violet / purple**</u>; During the electrolysis, the <u>**H^+ ions and Cl^- ions are discharged**</u> at the cathode and anode respectively, leaving behind aqueous <u>**sodium hydroxide / hydroxide ions**</u>, which is a <u>**strong alkali**</u>, and hence Universal Indicator turns blue / violet.	1m 1m
B9(d)	Electrode S (cathode): $2H^+(aq) + 2e \rightarrow H_2\,(g)$ Electrode R (anode): $2Cl^-\,(aq) \rightarrow Cl_2\,(g) + 2e$ For the <u>**same number / moles of electrons**</u> transferred, the ratio / volume of hydrogen gas produced is the same as the volume of chlorine gas produced.	1m for equations showing same ratio of the gases 1m
B9(e)	No of moles of Ag deposited at Q = 0.270 / 108 = 0.0025 mol Ag : e = 1 : 1 → No of moles of e transferred to R = 0.0025 mol Cl_2 : e = 1 : 2 → No of moles of Cl_2 gas produced = 0.0025 / 2 = 0.00125 mol Vol of Cl_2 gas produced at R = 0.00125 x 24 = <u>**0.0300 dm³ / 30.0 cm³**</u>	1m 1m 1m
		Total: 10m
Either		

B10(a)(i)	(a) no change/solution remains pink; (b) grey solid; forms in green solution;	1m 1m, 1m
B10(a)(ii)	Solution remains blue OR no observable/visible change; Silver is less reactive than copper, hence unable to displace copper from copper (II) sulfate.	1m 1m
B10(b)	(i) Mass of carbonate / moles of carbonate / Flame intensity / size of carbonate/ duration of heating / temperature of surroundings; Ignore "amount of carbonate" (vague) (ii) calcium carbonate; (iii) 27 cm^3; (iv) The faster the rate of decomposition of the metal carbonates, the higher the metal is in Group II; Hence, calcium is above strontium, which is above barium; in the Periodic Table.	1m 1m 1m 1m 1m
OR		
B10(a)	(i) It has the ester functional group; accept: ester linkage (ii) Alcohol  Carboxylic acid 	1m 1m 1m
B10(b)	Add acidified potassium manganate(VII) to both solutions; If purple solution turns colourless, the sample is middle note / 2-phenylethanol; If purple solution remains purple, the sample is top note / styrallyl acetate;	1m for correct choice of reagent 1m for correct observations 1m for correct observations
B10(c)	(i) It has a carbon-carbon double bond;	1m 1m

	(ii) 	
	(iii) 1 mol of end note reacts with 1 mol of iodine. No. of mole of end note = 100/250 = 0.4 mol; No of mole of iodine = 0.4 mol Mass of iodine = 0.4 x 2 x 127 =101.6 g; rej: missing unit	1m 1m
		Total: 10m