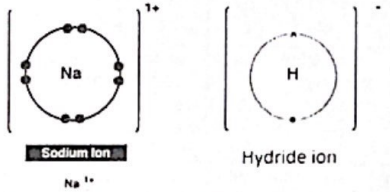
Sec 4 Pure Chem Mock Paper Set 5 Ans

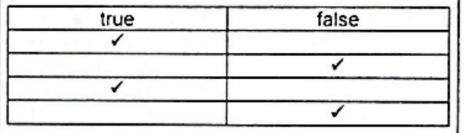
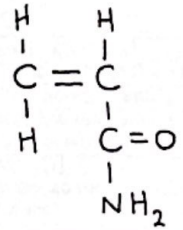
4E CHEMISTRY PRELIMINARY EXAMINATION 2019

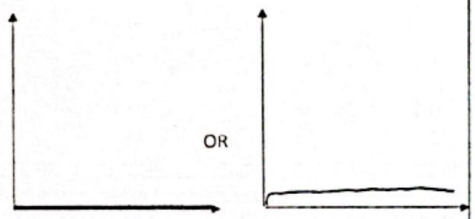
MARK SCHEME

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

Paper 2, Section A: [50marks]

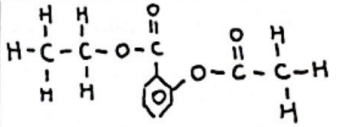
Question number	Suggested answer	Allocated mark
A1a	B and D	2
A1b	A	1
A1c	E	1
A1d	C	1
A1ei	Add aq ammonia. [1] A blue precipitate should form that dissolves in excess to give a dark blue solution [1] OR Add aq NaOH. [1] a blue precipitate should form that is insoluble in excess [1] OR Add dilute nitric acid followed by barium nitrate solution [1] A white precipitate should form [1]	2
A1eii	Exothermic reaction 1 mark for correct diagram 1 mark for activation energy and enthalpy change 1 mark for correct labelling of reactants and products chemical formula	3
A1f	 1 mark for correct diagram and symbols, 1 mark for key. 0 mark if diagram is wrong.	2
A2a	B [1] it has very poor electrical conductivity/very low melting and boiling points of -210 °C and -196°C/no reaction with water (Accept any 2) [2] OR	3

	C [1] it has very poor electrical conductivity [1] and no reaction with water [1]	
A2bi	F [1]. High melting and boiling points of 1535°C and 3000°C/high density of 7900 kg/m^3/forms coloured compounds like reddish brown solid/has good electrical conductivity (Accept any 2). [2]	3
A2bii	Metals have giant metallic lattice structure [1] with a lattice of positive ions surrounded by a sea of delocalized, mobile, negatively-charged valence electrons that can move and carry charge [1] while non-metals have a small and simple molecular structure [1] with weak intermolecular forces of attraction between molecules and strong covalent bonds between atoms. There are no mobile electrons or ions that can move and carry charge. [1]	4
A2c	 Any two correct earns 1 mark.	2
A3a	$C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6H_2O$ 1m for correct chemical formula 1m for balancing	2
A3b	Respiration, decay, bacterial decomposition and combustion of fuels take place which produces carbon dioxide. Photosynthesis and ocean uptake takes in carbon dioxide. [1] The rate of production of carbon dioxide is equal to the rate of removal of carbon dioxide in the atmosphere, thus keeping the carbon dioxide level constant. OWTTE [1]	2
A3ci	diol	1
A3cii		1
A3d		1
A4a	Vol of carbon dioxide produced = 24 cm^3	2

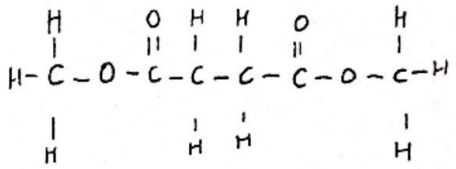
	No. of moles of CO_2 = no. of moles of barium carbonate = 24 / 24 000 = 0.001 mol [1] Mass of barium carbonate = 0.001 x (137+12+16+16+16) = 0.197 g [1] Final ans must be to 3 s. f.	
A4b	Horizontal line at origin OR slight increase with steeper gradient before quickly becoming horizontal  	1
A4c	An insoluble layer of barium sulfate will form around the barium carbonate particles, preventing further reaction between the acid and barium carbonate	1
A4di	$24cm^3$	1
A4dii	Ethanoic acid is a weak acid so will dissociate partially to give a lower concentration of hydrogen ions [1]. This leads to fewer particles per unit volume, leading to lower probability of collisions, lower frequency of collisions, successful collisions and effective collisions, and hence, a lower rate of reaction. [1]	2
A4e	Heat until saturated. Leave to cool and crystallise. [1] Filter out the crystals. Press dry between sheets of filter paper. [1] Ignore 'rinse crystals with a little distilled water'.	2
A5a	butane [1]	1
A5b	Different bonds are broken in propene and cyclopropane. Propene has 1 C = C bond, 1 C – C bond to be broken while cyclopropane has 3 C – C bonds to be broken. [1]	1
A5c	No. of moles of propane = 1 / (12 x 3 + 8) = 0.022727 mol [1] Enthalpy change of combustion = 0.022727 x (-2220) = -50.5 kJ [1]	2
A5d	Enthalpy change increases as number of carbon atoms increase as can be seen from propane with 3 carbon atoms increase to butane with 4 carbon atoms, the magnitude of enthalpy change of combustion also increases from 2220 kJ/mol to 2877 kJ/mol. [1] As number of carbon atoms	2

	increase, more carbon dioxide and water is formed, so more energy is given out to form more bonds. [1]	
A6a	$N_2 + 3\ H_2 \rightleftharpoons 2\ NH_3$ Must have reversible arrow.	1
A6b	450°C, 200-250 atm, finely divided iron catalyst	1
A6c	945 + 3 x – 6 (391) = - 93 [1] X = 436 kJ/mol [1]	2

Paper 2, Section B: [30marks]

Question number	Suggested answer	Allocated mark
B7a	Substance A is ethanol as there is a significant dip at wavenumber of approximately 3500 cm^{-1} indicating presence of O-H bond [1] and at 1100 cm^{-1}, indicating the presence of C-O bond. [1] Substance B is dimethyl ether as there is a significant dip at wavenumber of 1100 cm^{-1}, indicating the strong presence of more C-O bonds [1] and also at 2900 cm^{-1}, indicating more C-H bonds. [1] OWTTE	4
B7b		1
B7c	Solubility decreases [1], boiling point increases [1]	2
B7d	C_2H_4 (g) + H_2O (g) → C_2H_5OH (l) [1] 300°C, 60 atmospheres, phosphoric (V) acid [1]	2
B7e	Fermentation of glucose	1
B8a	Magnesium / anode / negative electrode reacts with dilute sulfuric acid to give hydrogen gas [1] and hydrogen gas was produced at the copper / cathode / positive electrode since hydrogen ions accept electrons/hydrogen ions are preferentially discharged to give hydrogen gas. [1]	1
B8b	W X Z Y [1] A positive voltmeter reading indicates that metal rod 1 would be more reactive than metal rod 2. The larger the magnitude, the further apart they are in the reactivity series. [1] In experiment 1, Y is more reactive than W, given that the magnitude of voltmeter reading is 2 V. In experiment 2, Z is more reactive than X. In experiment 3, Z is more reactive than W and W is further below in reactivity series than X since the	3

	magnitude of the voltmeter reading is 1.10 V, more than 0.32 V in experiment 2. [1] 1 m for basis of reasoning, 1 m for quoting data in explaining	
B8ci	Concentration increases [1] hydrogen ions and hydroxide ions are preferentially discharged so water is leaving the solution, leaving behind sodium and chloride ions. [1]	2
B8cii	Cathode: copper Anode: chlorine gas [1]	1
	Copper (II) ions are preferentially discharged to form copper as copper is lower than hydrogen in the reactivity series. [1] chloride ions are preferentially discharged at the anode as chloride ions are in higher concentration than hydroxide ions. [1]	2
EITHER	***(Marker's comment:*** -	
B9a	Sulfur dioxide irritates eyes and lungs/causes breathing difficulties [1] and can dissolve in rainwater to form acid rain which can damage agricultural crops, metal structures, buildings and harm aquatic life. [1]	2
B9b	Pass the waste gases through an aqueous suspension of calcium carbonate (or oxide) / wet calcium carbonate (or oxide). [1] $SO_2 + CaCO_3 \rightarrow CaSO_3 + CO_2$ [1] OR $CaO + SO_2 \rightarrow CaSO_3$ Optional: Calcium sulfite is further oxidized to calcium sulfate in atmospheric oxygen. $2CaSO_3 + O_2 \rightarrow CaSO_4$	2
B9c	$ZnO + C \rightarrow Zn + CO$ OR $2ZnO + C \rightarrow 2Zn + CO_2$ OR $ZnO + CO \rightarrow Zn + CO_2$	1
B9d	Zinc oxide. [1] It oxidised carbon to form carbon monoxide / carbon dioxide while itself is reduced to form zinc by losing oxygen. / It oxidised carbon monoxide to carbon dioxide while itself is reduced to form zinc by losing oxygen. [1]	2
B9e	The blast furnace is at very high temperatures and zinc, having a lower boiling point than iron, will exist as a gas/vapour which needs to be condensed into a liquid. [1]	1
B9f	Calcium silicate / molten slag	1
B9g	Amphoteric	1
OR	***(Marker's comment: This question was less popular.)***	

B9a	Add acidified aqueous potassium dichromate (VI) /potassium manganate (VII). [1] 2,3-dihydroxybutanedioic acid will turn acidified potassium dichromate (VI) from orange to green / potassium manganate (VII) from Purple to colourless [1] while potassium dichromate (VI) will remain orange / potassium manganate (VII) will remain purple in the presence of butanedioic acid. [1]	3
B9b	H – O – H [1]  [1]	2
B9c	It will have a low melting point, as it is a covalent compound with small and simple molecular structure, [1] with weak intermolecular forces of attraction between molecules which require little heat energy to overcome.[1]	2
B9d	Concentration of salt = 0.45 mol/dm^3 Volume present is = 25 + 25 cm^3 = 50 cm^3 No. of moles of salt = 0.45 x (50/1000) = 0.0225 mol [1] No. of moles of NaOH = 0.0225 x 2 = 0.045 mol Concentration = 0.045 / (25/1000) = 1.80 mol/dm^3 [1] Final ans must be to 3 s.f.	3