Admiralty Secondary School
Marking Scheme
4E Pure Chemistry
PRELIMINARY EXAMINATION 2024

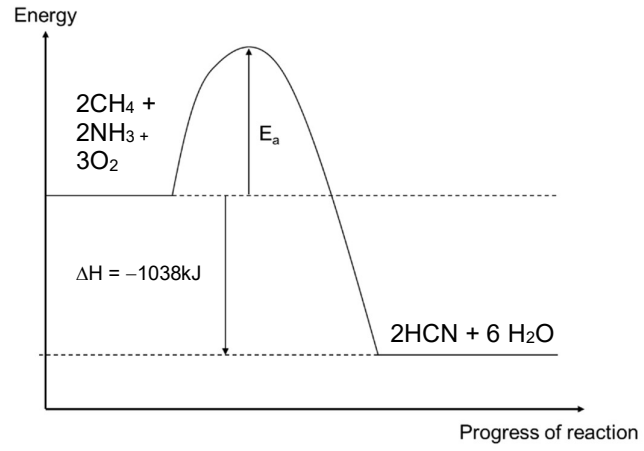
PAPER 2 SECTION A [70 marks]

1(a)	Substance B B is made up of carbon atoms which are joined together in layers of hexagonal rings. Only 3 out of the 4 valence electrons of each carbon atom are used to form these hexagonal rings. There is one valence electron that is delocalised between the layers to conduct electricity. Hence, it can acts as an electrode.	[1] [1] [1]	KU Accept: mobile electrons
(b)	Substance C C is made up of simple molecules which has very weak intermolecular forces of attraction between molecules. Hence, little energy is needed to overcome it and its melting point is low. Hence, it is the only liquid at room temperature.	[1] [1] [1]	KU
(c)	Substance B B is made up of carbon atoms which are joined together in layers of hexagonal rings. There are weak intermolecular forces of attractions between each layer. Little energy is required to slide one layer over the other. Hence, it can be used as a lubricant.	[1] [1] [1]	KU

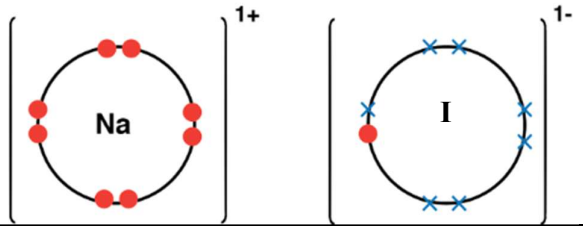
2(a)	The oxygen in air may oxidise/rust iron.	[1]	HISP
(b)	The iron wool is a catalyst.	[1]	KU
(c)	The ammonia gas produced is less than $50cm^3$ <or a value less than $50cm^3$> This is due to mole ratio. However, the reaction will not be complete as it is a reversible reaction.	[1] [1] [1]	HISP
(d)	Advantage: Higher pressure leads to higher yield/ faster reaction. Disadvantage: Maintaining high pressure incurs a large cost/ more energy required.	[1] [1]	KU

3(a)	Zinc nitrate	[1]	[A] any souble zinc salt HISP
(b)	$Zn(NO_3)_2$ (aq) + H_2SO_3(aq) → $ZnSO_3$ (s) + $2HNO_3$ (aq)	[2]	[1] – balanced equation with correct chemical formula

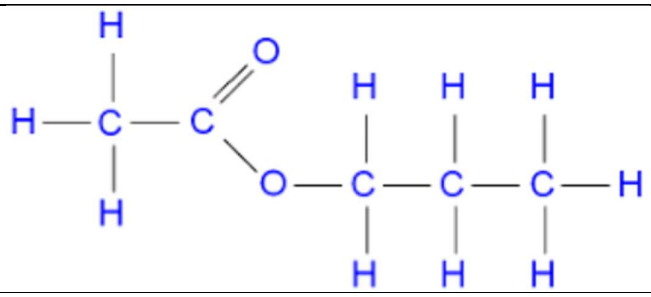
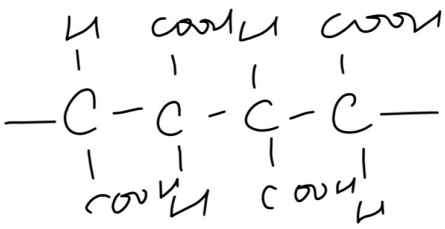
			[1] – correct state symbols ECF from 3(a) but only give [1] for balanced equation with chemical formula HISP
(c)	Add <u>excess zinc nitrate</u> to $10cm^3$ of $0.10mol/dm^3$ of sulfurous acid. <u>Filter the precipitate</u> using filter paper and filter funnel. <u>Wash the precipitate with distilled water</u>. Dry it between 2 sheets of filter papers.	[2]	3 points –[2] 2 points – [1] 1/0 point – [0] KU
(d)	Zinc sulfate cannot be prepared using the same method as zinc sulfate is soluble in water.	[1]	HISP

4(a)	Correct calculation for the total amount of energy absorbed during bonding breaking [i.e. (413 × 8) + (390 × 6) + (3 × 498) = 7138 kJ] Correct calculation for the total amount of energy released during bonding forming [i.e. (413 × 2) + (891 × 2) + (464 × 12) = 8176 kJ] Enthalpy change of reaction = -8176+7138 = -1038 kJ	[1] [1] [1]	HISP No units/incorrect units -1 marks
(b)	The energy absorbed for bond breaking is lesser than the energy released for bond forming. Hence, enthalpy change is negative.	[1] [1]	KU
(c)		[3]	[1] - correct shape of graph [1] - correct labelling of reactant and product [1] - correct labelling of enthalpy change and activation energy KU

(d)	• Platinum is a catalyst. It provides an alternative pathway with a lower activation energy. • The proportion of particles with sufficient energy to overcome the activation energy increases. • Powdered platinum has a smaller particles size / larger surface area. This provides more sites for the reacting particles to be adsorbed onto. As a result, the reacting molecules/ particles (reject ions) collide with each other more often • leading to an increased in frequency of effective collisions and therefore the rate of reaction.	[3]	[3] - 4 points [2] - 3 points [1] - 2 points KU

5(a)	When starch is added to iodine, a dark blue colour is obtained. This dark blue colour acts as an indicator to the titration so that end point can be observed accurately when the colour change from dark blue to colourless.	[1]	HISP [R] inaccuracy in answers like the analyte turns from colourless to blue with I^-
(b)	No. of moles of thiosulfate = 0.12/1000X11 $=1.32X10^{-3}$ mol $S_2O_3^{2-}:I_2$ 2:1 No. of moles of iodine = $1.32X10^{-3}$ /2 $= 6.6\ X10^{-4}$ mol Concentration of iodine = $6.6\ X10^{-4}/25$ x1000 $= 0.0264$ mol/dm^3	[1] [1] [1]	KU ECF given to step 2 and 3 if step 1 is correct.
(c)		[2]	[1] – correct cation [1] – correct anion KU

6(ai)	W: Ethane X: Glucose Y: Carbon dioxide	[1] [1] [1]	KU
(aii)	Z	[1]	KU

			
(b)(i)	Addition reaction	[1]	KU
(ii)	Oxidation	[1]	KU
(c)	Steam phosphoric acid, 300 °C, 60 atm	[1] [1]	KU Reject water
(d)	Add $KMnO_4$, H_2SO_4 and heat. Purple $KMnO_4$ will decolorise with ethanol but not ethanoic acid. OR Add Mg ribbon. Effervescence will be observed that extinguished burning split with a pop sound for ethanoic acid but not ethanol. Hydrogen gas evolved. OR Add $MgCO_3$. Effervescence will be observed that gives white precipitate when bubbled into limewater for ethanoic acid but not ethanol. Carbon dioxide produced. OR Add universal indicator. Ethanol will given green/yellow colour while ethanoic acid will give orange colour.	[1] [1] [1] [1] [1] [1]	HISP Or any suitable metals or metal carbonates
(e)		[1]	HISP

7(a)(i)	$2Cl^- \rightarrow Cl_2 + 2e$ The chloride ions are preferentially discharged at the anode to produce chlorine gas (green yellow gas).	[1] [1]	HISP
(ii)	Zinc chloride solution	[1]	HISP
(iii)	Electrode R: $4OH^- \rightarrow O_2 + 2H_2O + 4e$ Electrode S: $2H^+ + 2e \rightarrow H_2$	[1] [1]	HISP
(iv)	No. of moles of H_2 gas = 9.6/24 = 0.4 mol H_2: O_2: e 2: 1: 4 No. of moles of O_2 gas = 0.2 mol Mass of O_2 gas = 0.2X(16X2) = 6.4g	[1] [1] [1]	HISP
(v)	Pink solid will be deposited on electrode S/ cathode.	[1]	HISP
(b)	$Zn \rightarrow Zn^{2+} + 2e$ As Zn oxidises, it gives out 2 electrons. Hence, the electrons flow from zinc case to manganese dioxide.	[1] [1]	HISP

8(a)	The use of gas has increased from 1% to 40% from 1990 to 2012. OR The use of coal has decreased from 67% to 32% from 1990 to 2012.	[1]	HISP
(b)	As gas has <u>air:fuel ratio of 14: 1</u> which produces <u>lesser carbon monoxide and unburnt hydrocarbon</u>/less pollutants are released to the environment. There are less negative impact on the environment which are <u>carbon monoxide binds irreversibility to haemoglobin of a person and prevents oxygen intake/unburnt hydrocarbon causes respiratory issues.</u> OR (Generic, not linked to (a)) When <u>air:fuel increases from 16:1 to 24: 1</u>, the <u>carbon monoxide produced remained low but unburnt hydrocarbon increased drastically.</u> An increase in <u>unburnt hydrocarbon causes respiratory issues</u>.	[1] [1] [1] [1] [1]	HISP Cannot award total [3] if no link to (a)
(c)	The percentage of carbon dioxide in the atmosphere is generally directly related to the average temperature at the Earth surface/ The higher the percentage of carbon dioxide in the atmosphere, the higher the average temperature at the Earth surface.	[1]	HISP

(d) (i)	Fractional distillation	[1]	KU
(ii)	Oxygen and argon Their boiling points are too close together and tends to vapourise almost together.	[1] [1]	HISP
(iii)	They have <u>stable/full noble gas configuration</u> hence cannot gain, lose or share electrons	[1]	KU

PAPER 2 SECTION B [10 marks]

9(a)	The cations are +1 charge and the anions are -1 charge. The electrons are gained or lost to achieve stable noble gas configuration.	[1] [1]	[1m] How to get +1, -1 HISP
(b)	290 328	[1]	KU
(c)(i)	The melting point decreases as the sum of the ionic radius increases.	[1]	HISP
(c)(ii)	As the ionic radius increases, the electrostatic attractions between cations and anions decreases. Hence, the energy needed to overcome the electrostatic forces between cations and anions decreases and the melting point decreases.	[1] [1]	KU
(d)(i)	Reactivity decreases down Group 17. Chlorine is more reactive than bromine. Hence $CuCl_2$ will be produced at a faster rate.	[1]	HISP
(ii)	$2Br^- + Cl_2 \rightarrow 2Cl^- + Br_2$ Chlorine is more reactive than bromine. Hence, it will displace bromine and form $CuCl_2$. A reddish solution will be observed.	[1] [1] [1]	HISP

10(a)(i)	The element undergoes reduction and oxidation according to the position on the Periodic Table as it reflects the number of valence electrons each element has. The element will gain or lose electrons (oxidize or reduce) to achieve noble gas configuration. It is not linked to the size of the atoms as there are elements of similar sizes (e.g. Al, Si, P) may be oxidized or reduced. OR regardless of sizes, noble gas are neither oxidized or reduced.	[1] [1]	HISP
(ii)	The bigger the atomic radius, the greater is the reactivity of the halogen.	[1]	KU
(b)(i)	Metal W is likely to be sodium.	[1]	HISP
(ii)	• Metal W will give out effervescence • and reacts violently with a flame. • The metal will skid on the surface of the water. Any 1 observation will be given 1 mark	[2]	KU

(c)(iii)	Metal Z is calcium as it is the 2nd most reactive metal as it displaces 2 metals from its nitrate solutions. Metal Y is magnesium as it is the 3rd most reactive metal as it displace 1 metal from its nitrate solution. Metal X is aluminium as it is the least reactive metal as it does not displace any metal from its nitrate. Correct identities [1] Correct explanation [1]	[3]	[1m] show knowledge that more reactive metal displaces less reactive metal [1m] compare the number of metal displaced [1m] identity of the metal HISP
(iv)	$Mg(NO_3)_2$ (aq) + Ca(s) → Mg(s) + $Ca(NO_3)_2$ (aq) OR $Y(NO_3)_2$ (aq) + Z(s) → Y(s) + $Z(NO_3)_2$ (aq)	[1]	No need state symbols HISP