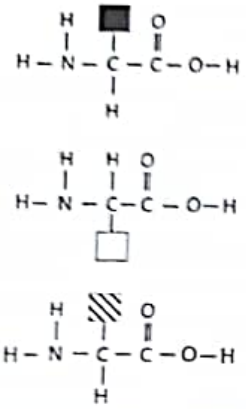
Year:	2022
Exam:	Preliminary Examination
Level/Stream:	4E
Subject:	Chemistry 6092 / 02

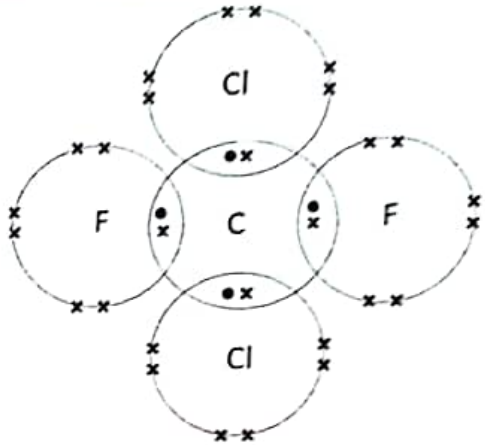
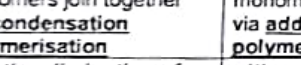
Qn	Answer	Marks	Comments
A1(a)(i)	A and F OR B and E	1	
(a)(ii)	B and D OR C and D Or D and E	1	
(a)(iii)	A and F	1	
(a)(iv)	D	1	
(b)		2	

	true	false
Petroleum is separated by different density into different fractions.		✓
Alkanes used in diesel fuel have a lower boiling point than those used in motor cars.		✓
The fractions used as feedstock for making plastics is extracted from higher up the fractionating column than the fraction used for kerosene(paraffin).	✓	
Each fraction contains a mixture of hydrocarbons.	✓	

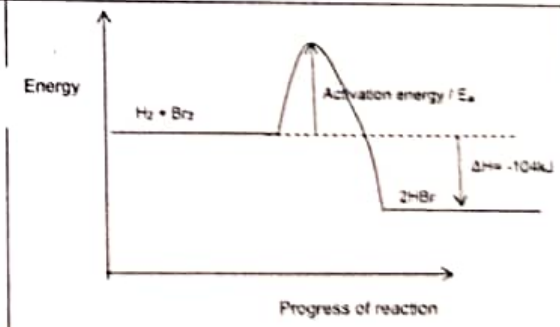
A2(ai)	$C_2H_4 + H_2O \rightarrow C_2H_5OH$	1	
(a)(ii)	To increase the percentage yield of ethanol OR To conserve resources and cut down the cost of starting reactants	1	
(a)(iii)	Oxygen will **oxidise ethanol** to ethanoic acid / Ethanol formed may undergoes **combustion** hence **reducing the yield of ethanol**.	1	
(b)(i)	200°C, 80 atm	1	
(b)(ii)	**Optimum temperature is higher** so that the **reaction** between steam and ethene **is faster**. **Optimum pressure is lower** because **special equipment would be required to maintain the higher pressure** which is **not cost efficient**.	1 1	

Qn	Answer	Marks	Comments
A3(a)	Graphite is made up of **many layers** of carbon atoms covalently bonded **in a hexagonal lattice structure**. The **layers of carbon atoms** are **held loosely** by **weak intermolecular forces of attraction** hence the layers can be easily separated using a sticky tape.	1 1	
(b)	**Each carbon atom** in graphene has **one outer electron** that is **not used to form covalent bonds**. These **electrons can move freely** and **carry electric charges** hence graphene has high electrical conductivity. **Each carbon atom** is **covalently bonded** to **three other carbon atoms**. **A lot of energy** is needed to **break these strong covalent bonds** hence graphene is strong.	1 1 1 1	
(c)	Graphene is transparent as it is **made up of only a single layer of atoms** which is very **thin**.	1	
A4(a)(i)	A strong acid **completely ionized/ dissociates** in aqueous solution/ when dissolved in water while a weak acid **partially ionized/ dissociates** in aqueous solution/ when dissolved in water.	1	
(a)(ii)	Tartaric acid is the weaker acid. **Universal indicator turns orange** in tartaric acid and **red in sulfuric acid** showing that tartaric acid has a **higher pH/ pH of 4-6** while sulfuric acid has a **lower pH/ pH of 1-3.** **Volume of gas collected 10s after reacting with Magnesium is lower with tartaric acid** indicating that the **speed of reaction is slower**. Both tests show that the **concentration of hydrogen ions is lower in tartaric acid** as compared to sulfuric acid.	1 1 1	
(b)	no. of mol of NaOH produced = $\frac{22}{1000}$ x 0.100 = **0.0022 mol** by mol ratio, H_2T : NaOH = **1 : 2** 0.011: 0.0022 Concentration of tartaric acid =0.0011 / $\frac{25}{1000}$ = 0.044 mol/ dm^3	1 1 1	

Qn	Answer	Marks	Comments
A5(a)	A polymer is a **macromolecule** formed through the **joining of many small molecules / monomers**	1	
(b)		1 1 1	
(c)	The component amino acids can be identified **from its R_f value** using **chromatography** with a suitable solvent and **locating agent**.	2	
(d)	<table><tr><th>Manufacture of proteins</th><th>Manufacture of poly(ethene)</th></tr><tr><td>monomers join together via condensation polymerisation</td><td>monomers join together via additon polymerisation</td></tr><tr><td>with the elimination of small molecules</td><td>without loss of any small molecules</td></tr><tr><td>Monomers must have 2 different functional groups</td><td>Monomers must have C = C bonds</td></tr></table> *Accept any other possible / reasonable difference(s)*	2	

Qn	Answer	Marks	Comments
A6(a)(i)		2	
(a)(ii)	It is described as substitution reaction because the **hydrogen atoms in methane** is **replaced by halogen atoms**. It is photochemical because it requires **ultraviolet light** to initiate the reaction.	1 1	
(b)		1	
(c)	The OCl particle produced in step 1 reacts with an oxygen atom in step 2 to produce another Cl atom. This Cl atom is then able to start step 1 again. This is a chain reaction.	1 1	
(d)	Ozone **filters out excessive ultraviolet radiation** that could lead to **increased incidence of skin cancer**		
A7(a)	CO is **poisonous/toxic** as it combines with haemoglobin in red blood cells to form carboxyhaemoglobin which **reduces the transport of oxygen to other parts of the body** leading to **headaches / dizziness / breathing difficulties / suffocation / death** SO_2 **irritates the eyes and lungs** and **cause breathing difficulties** OR	2	

Qn	Answer	Marks	Comments
	react with water to form acid rain which corrodes buildings/ harms aquatic life and plants CO_2 is a greenhouse gas that absorbs radiation and leads to global warming		
(b)	The oxidation state of Zn, O, C remains unchanged as +2, −2 and +4 respectively. Both oxidation and reduction has not occurred hence the reaction is not a redox reaction.	1 1	
(c)(i)	• The mixture is heated and vapourises. • Cadmium vapour with the lowest boiling point exits the condenser and distilled over first at 766°C. • After cadmium is collected, Zinc with the second lowest boiling distilled over at 907°C. • Lead and iron with much higher boiling point remains in the distillation flask/ distilled out last. OR • The mixture is heated and vapourises. • Vapours rises up into the fractionating column and begins to cool and condense. • Fractions with a lower boiling points are collected at the top of the fractionating column and fractions with a higher boiling points are collected at the lower sections of the fractionating column. • Zinc is collected at the second lowest section.		
(c)(ii)	Zinc is more reactive than iron hence provides sacrificial protection by corroding in place of iron. OR Zinc is used in galvanization of iron where It acts as a protective barrier for iron against water and oxygen.	1 1 1 1	

Qn	Answer	Marks	Comments
B8(a)	The greater the number of bonds between two atoms, the smaller the bond length. The bond length decreases from 154pm to 120pm when the number of bonds increase from C-C to C≡C. As the bond energy decreases, the bond length increases. As bond energy decreases from 431kJ/mol to 299kJ/mol from H–Cl to H–I, bond length increases from 127pm to 161pm.	2	
(b)	As the number of bonds between two atoms increases, the number of shared electrons increases and the forces of attraction between the shared electrons and nuclei of atoms increases. OR The larger the bond energy, the stronger the covalent bond is and the stronger the forces of attraction between the shared electrons and nuclei of atoms. Hence, the atoms are pulled closer together causing a shorter bond length.	1 1	
(c)(i)	ΔH = Energy absorbed during bond breaking – Energy released during bond forming = (435 + 193) – 2 x 366 = - 104 kJ	1	
(c)(ii)		2	
(d)	Reaction of iodine with hydrogen is slower than the reaction of hydrogen with chlorine because chlorine is more reactive than iodine	1 marking pt	

Qn	Answer	Marks	Comments
	Reaction of iodine with hydrogen is **exothermic** and the reaction of hydrogen with chlorine is **endothermic** because the **energy absorbed for bond breaking is less than the energy released from bond forming when chlorine reacts with hydrogen**/ the energy absorbed for bond breaking is more than the energy released from bond forming when iodine reacts with hydrogen Reaction of iodine with hydrogen is **reversible** and the reaction of hydrogen with chlorine is not/ Reaction of iodine with hydrogen produced a halide which decomposes at high temperature while reaction of chlorine produced a halide that does not decompose at high temperature. because **hydrogen iodide is thermally less stable** as compared to hydrogen chloride hence it breaks down easily to form hydrogen and iodine.	*1 marking pt* *1 marking pt* *1 marking pt* *1 marking pt*	
(e)	91 pm (accept 87 to 107pm)	1	
B9(a)	Any three: • In the 'plum pudding' model, there are no neutral charge particles/ neutrons but present idea of the atom has. • In 'plum pudding' model, electrons are spread out randomly in the sphere but electrons are arranged in electron shells in the present idea of the atom. • In 'plum pudding' model, there is no nucleus in the centre of the atom but present idea of the atom has. • In 'plum pudding' model, the positive charges /protons are not contained in the centre of the atom /in the nucleus but present idea of the atom is. • (Accept any other plausible answers)	3	
(b)	• **x** is negatively charged as it is attracted to the positive plate. • **z** is positively charged as it is attracted to the negative plate. • **y** is electrically neutral (no charge) as it move straight/ is not attracted to any of the plates. • **x** is much lighter than **z** as **x** deflects more to the positive plate than **z** to the negative plate.	2 1	

Qn	Answer	Marks	Comments
(c)	For the atom with a proton number 11 to form an ion, it has to **lose 1 electron** to **achieve an electronic configuration of a noble gas**. However, the model drawn show a **loss of 1 proton** instead of electron.	1 1	
Either B10(a)	The experiment involving zinc and sulfuric acid only **acts as a control** and **comparison between the time taken can be used to determine the effectiveness of the catalyst**.	1	
(b)	Temperature affects the rate of reaction. **Increased temperature** causes **particles to gain more kinetic energy** and **collide more frequently**. When particles gained energy, the **number of particles with energy equal or higher than the activation energy also increase**. hence causing the **frequency of effective collisions to increase** and **rate of reaction to increase.**	1 1 1	
(c)	Similarities: Both experiments showed that the **use of copper as a catalyst increase the speed of reaction**. This is because **copper provides the reaction with an alternative pathway where the activation energy required is lower / Copper is less reactive than zinc** hence **rate of zinc corrosion** due to acid **increased** A **brown solid remained at the end of the reaction** for both experiments. This is because **copper**, as a catalyst, **remains chemically unchanged in a chemical reaction / Copper** being **unreactive does not react with acid.** Difference: The use of copper powder in experiment 4 **increases the rate more than when copper is used as lumps** in experiment 5. This is because as powder has a **higher contact area** than lumps **with the reactants**.	1 1 1 1	
(d)	**Zinc is more reactive than copper** hence **zinc displaced copper from copper(II) sulfate.**	1 1	

Qn	Answer	Marks	Comments
	to form **copper which is a brown solid** and **zinc sulfate which is a colourless solution**		
Or B10(a)	$Cu(s) \rightarrow Cu^{2+}(aq) + 2e$	1	
(b)	As the **current double from 2.0A to 4.0 A**, the **mass of copper formed** also **double from 0.12g to 0.24g**.	1	
	As the **time taken for electrolysis double from 180s to 360s**, the **mass of copper formed** also **double from 0.12g to 0.24g**.	1	
	As more current passes through and more time allowed for electrolysis to occur, there are **more electrons flowing through the circuit** hence **more copper (II) ions** will **gain electrons/ discharged / reduced**.	1	
(c)	Mass of copper deposited at cathode = 1.44 – 1.20 = 0.24g		
	No. of mols of copper deposited = No. of mols of copper that was oxidized at anode Hence, mass of copper deposited at cathode = mass of copper oxidized at anode	1	
	Mass of anode after electrolysis = 1.45 – 0.24g = 1.21g	1	
(d)	At the anode: When carbon electrodes are used, there will be **no decrease in mass** in the anode as **carbon is an inert electrode and does not participate in electrolysis**.	1	
	When copper electrodes are used, **copper anode decreased in mass** due to **copper being oxidized to form copper ions**.	1	
	Electrolyte: When carbon electrode are used, **blue aqueous copper(II) sulfate will turn colourless** because copper ions are discharged at the cathode causing **a decrease in concentration of copper ions**.	1	
	When copper electrodes are used, **blue aqueous copper(II) sulfate remains colourless**. There is no change in concentration of copper ions because **copper ions discharged/ reduced at the cathode is replenished by the oxidation of copper at the anode**	1	