METHODIST GIRLS' SCHOOL
SEC 4 CHEMISTRY PRELIM EXAM 2024

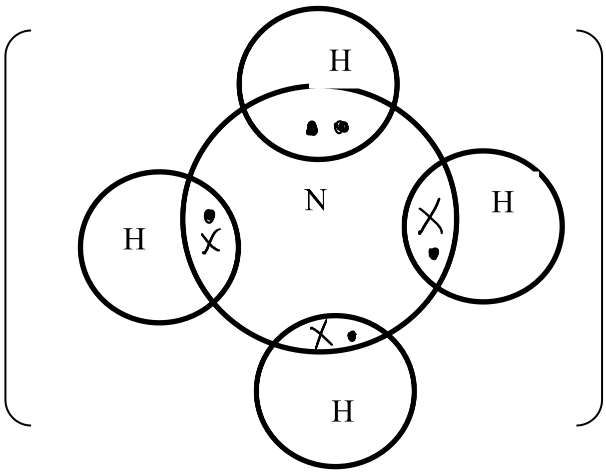
Answer Scheme
Section A

A1 **(a)(i)** F 1

(a)(ii) A 1

(a)(iii) E 1

(b)



+

Key:

x : electron of hydrogen

• : electron of nitrogen

2

A2 **(a)(i)** Carbon dioxide / CO_2 1

(a)(ii) Redox reaction or reduction 1

(a)(iii) $CuO + C \rightarrow Cu + CO_2$ 1

(b)(i) At mass 0g, there is no theoretical yield of copper 1
or
If no copper carbonate is used, no copper is made Or No reaction

(b)(ii) 80g 1

The theoretical yield is directly proportional to the mass of copper at the start / the graph has a positive gradient or; 1
linearly related or;
as mass of copper(II) carbonate doubles, mass of copper doubles so at 40g, the starting mass of copper will be 80g. or;
when the yield is 20g, the mass of $CuCO_3$ is 40g. hence by proportion, when the yield is 40g the mass of $CuCO_3$ is 80g.

(b)(iii) Tick (✓) **two** boxes. 2

She did not use enough copper carbonate.	☐
She did not dry the copper at the end.	✓
She did not heat the copper oxide for long enough.	☐
Her copper contains solid impurities.	✓

(c) Students need to calculate out the % yield of both Nina and Kai and make a comparison.

Kai's % yield is higher than that of Nina's, so he has extracted more copper than Nina. 1

% yield for Kai = 4.8/5 x 100% = 96%

% yield for Nina = 18 / 26 x 100% = 69.2% 1

A3 **(a)** Cathode: Mg^{2+} (l) + 2 e^- → Mg (l) 2

Anode: 2 Cl^- (l) → Cl_2 (g) + 2e^-

State symbols not required

(b) To prevent molten magnesium from (coming into contact and hence) reacting with oxygen in the air 1

(c) Magnesium chloride has a very high melting point.

Lowering its melting point will reduce energy cost / less energy needed./ lower cost of electricity 1

(d) Fe (s) → Fe^{2+} (l) + 2 e^- 1
or
Fe (s) → Fe^{3+} (l) + 3 e^-

The iron will react with the chlorine evolved to form iron(II)/ iron(III) chloride 1
OR
The iron anode, being a reactive anode, will be oxidized and shrink in size / become smaller / dissolve into the molten electrolyte, and no bubbles
will be formed.

A4 **(a)** Propanone: In experiment 1 and 2, increases (rate)/doubling concentration doubles rate 1

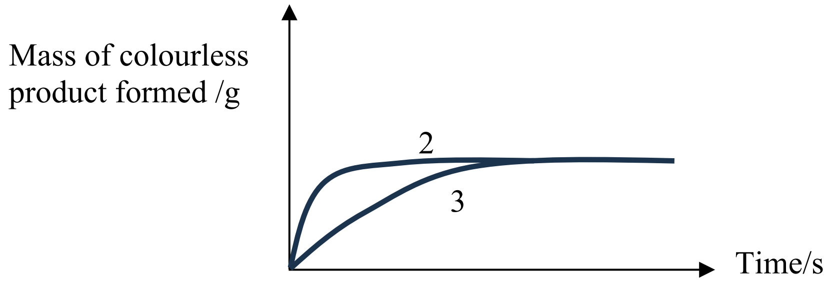
iodine: In experiment 2 and 3, no effect (on rate) 1

Must state the experiments

(b) particles move faster/particles have more energy / KE 1

more particles have (energy greater than) the activation energy/sufficient energy to overcome the energy barrier and leads to higher frequency of effective collisions 1

(c) 1



(d) 2

isotope	number of electrons	number of neutrons
Iodine–127	53	74
Iodine–130	54	77

A5 **(a)(i)** The reverse reaction is favoured ; preferred , 1

backward and forward reaction is different.
many molecules formed and few ions or partially ionised

(a)(ii) It produces hydroxide ions in water 1

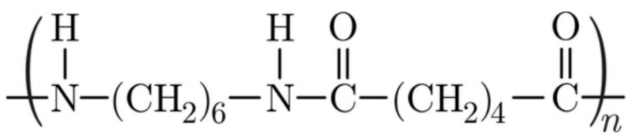
(b) less than 12 more than 7 1

smaller concentration of hydroxide ions or partially dissociated 1

(c)(i) $CH_3NH_2 + HCl \rightarrow CH_3NH_3Cl$ 1
methylammonium chloride 1

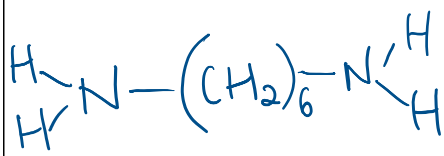
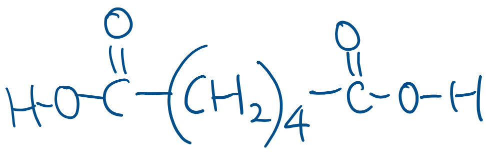
(c)(ii) $Fe^{3+} + 3OH^{-} \rightarrow Fe(OH)_3$ 1

A6	**(a)(i)**	Diesel and petrol are mixtures of hydrocarbons / contains different hydrocarbons but bio-ethanol is made up of only one compound	1
	(a)(ii)	Yeast, absence of oxygen and temperature of 35-40^{o}C 3 conditions – 2m 2 conditions – 1m 1 condition – 0m	2
	(a)(iii)	Bioethanol comes from plants which is a sustainable /renewable resource / infinite resource while petrol comes from crude oil/ fossil fuels which is non-renewable resource / finite	1
	(a)(iv)	Molar mass of C_2H_5OH = 46g/mol	
		Enthalpy change of combustion in kJ/mol = -30.5 x 46 = 1403 kJ/mol	1
	(b)	LPG consists of smaller molecules than diesel with smaller surface area, allow smaller chains	1
		LPG has weaker intermolecular forces of attraction than diesel	1
		less energy is required to break/overcome the weak intermolecular forces of attraction between the molecules in LPG	1
		assume answer refers to LPG if no reference **allow** LPG has smaller chains **ignore** all references to few carbon atoms in LPG / is a short chain hydrocarbon unless there is a direct comparison with petrol **allow** weaker forces.	
A7	**(a)(i)**	Depolymerisation is a process in which polymers are broken down into their monomers.	1

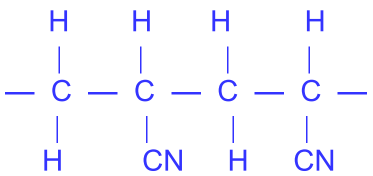


Nylon 66

(a)(ii) 2

Simpler molecules formed	Structural Formula
Hexamethylendiamine	
Adipic acid	

(b)(i) 2



1 mark for 2 repeat units
1 mark for both the side bonds present

(b)(ii) Addition polymerisation results in a single product formed, the polymer, while condensation polymerisation results in the formation of a polymer and small molecules eg. water. 2

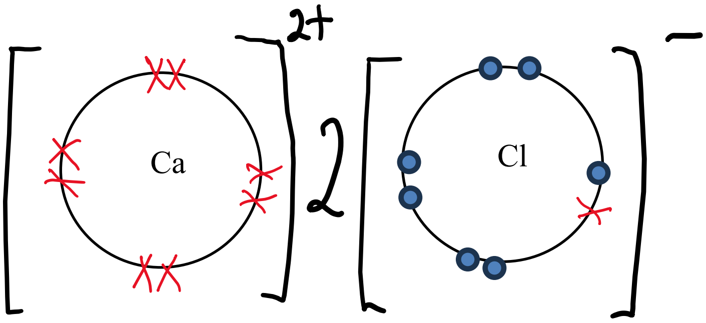
The monomers for addition polymerisation must be unsaturated alkenes with carbon to carbon double bonds while the monomers for condensation polymerisation can be saturated.

Condensation polymerisation forms 2 types of linkages. They are ester linkages from reactions between hydroxyl and carboxyl groups or amide linkages from amine and carboxyl groups. Addition polymerisation forms long carbon chains without ester or amide linkages.

In addition polymerisation, only one type of functional group, carbon to carbon double bonds, are required in the monomers. In condensation polymerisation, two types of functional groups, amine and carboxyl groups or hydroxyl and carboxyl groups, are required in the monomers.

8(a)	W (respiration) – organic compounds in both plants and animals to CO_2 in the atmosphere X (photosynthesis) – CO_2 in atmosphere to organic compounds in plants only	1 1
8(b)	Z (combustion) – coal and petroleum to CO_2 in the atmosphere	1
8(c)(i)	Petroleum	1
8(c)(ii)	Decomposition of plants and animals that died and buried in the ground millions of years ago.	1
8(d)	Carbon dioxide is slightly soluble in water to form carbonic acid. or CO_2 from atmosphere dissolves in water in the ocean/sea/river to form carbonate ions	 1
8(e)	Burning of hydrogen produces only water, does not increase or decrease atmospheric cycle. $2H_2 + O_2 \rightarrow 2H_2O$	1 1
	Total	8

9(a)	(i) Silica gel Adsorption – weak van der waals'/ intermolecular forces of attraction between surface atoms of silicon dioxide/ silica gel and water molecules (ii) Calcium chloride Absorption – weak forces of attraction between ions of calcium chloride and water molecules when it becomes hydrated crystals (iii) Ionic bonds in calcium chloride broken when it dissolves in the moisture	1 1 1
9(b)	Moles of $CaCl_2$ = (32.5 – 20) ÷ (40 + 71) = 0.11261 Moles of water = (36.5 – 32.5) ÷ (2+16) = 0.22222 Mole ratio of $CaCl_2$ to H_2O = 0.11261 : 0.2222 = 1:2 Formula is $CaCl_2.2H_2O$ mole ratio calculation/ working 1m Mole ratio 1m and Formula 1m	3
9(c)	Mass of 1 mole of SiO_2 = 32 + 32 = 64g Mass of water removed by SiO_2 = 0.4 x 64 = 25.6 g Mass of 1 mole of $CaCl_2$ = 40 + 71 = 111 g	1

	Mass of water removed by 1 mole $CaCl_2$ = 3 x 111 = 333 g	1
9(d)		2
9(e)(i)	Evaporation to dryness	1
9(e)(ii)	Boiling point of water is 100 ^{0}C, lower than that of calcium chloride / calcium chloride is stable on heating. OR Hydrated calcium chloride <u>decomposes on heating</u> to form <u>anhydrous calcium chloride and water vapour</u>.	1
	Total	12

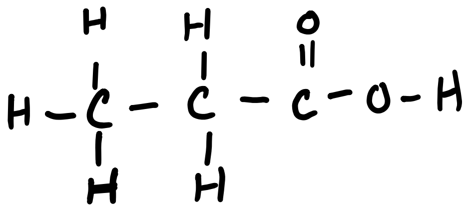
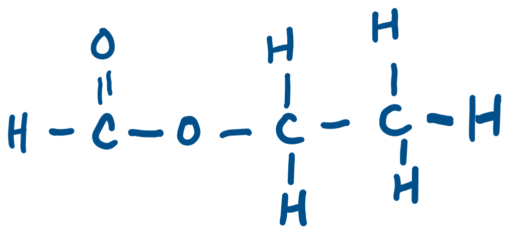
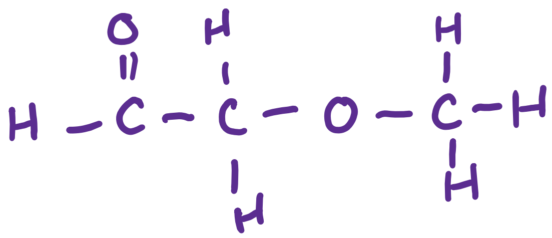
Section B

Either

<table>
<tr><td>10(a)</td><td>Colourless
Pale green</td><td>1</td></tr>
<tr><td>10(b)</td><td>The relative atomic mass of transition metals are higher than those of metals in Group II.</td><td>1</td></tr>
<tr><td>10(c)</td><td>It has variable oxidation state/ Transition metals or their compounds can act as catalyst.</td><td>1</td></tr>
<tr><td>10(d)(i)</td><td>The more reactive the metal, the more negative the standard electrode potential.</td><td>1</td></tr>
<tr><td>10(d)(ii)</td><td>It measures the ease that metals lose valence electrons/ reducing power of metals.</td><td>1</td></tr>
<tr><td>10(d)(iii)</td><td>Copper loses valence electrons least easily hence it has positive standard electrode potential while the other metals have negative standard electrode potential.</td><td>1</td></tr>
<tr><td>10(d)(iv)</td><td>
<table>
<tr><td></td><td>$FeCl_2$ (aq)</td><td>$CuCl_2$ (aq)</td></tr>
<tr><td>Mn</td><td>Green solution turned pink. A grey solid deposited [1]</td><td>Blue solution turned pink. A reddish brown solid formed. [1]</td></tr>
</table>

Since manganese displaces iron(II) ions and copper(II) ions from their aqueous salt, manganese is more reactive than iron and copper. [1]
$Mn + Fe^{2+} \rightarrow Mn^{2+} + Fe$
$Mn + Cu^{2+} \rightarrow Mn^{2+} + Cu$</td><td>4</td></tr>
<tr><td></td><td></td><td></td></tr>
<tr><td></td><td>Total</td><td>10</td></tr>
</table>

OR

10(a)	The reddish-brown aqueous bromine turns colourless in compounds A and B only. Addition reaction takes place / bromine atoms can be added onto the carbon atoms with the double bonds. $C_3H_6 + Br_2 \rightarrow C_3H_6Br_2$ $CH_2CHCOOH + Br_2 \rightarrow CH_2BrCHBrCOOH$	1 1 1 1
10(b)	  	1

10(c)	Percentage composition of C = (3×12)/(3×12+6+2×16) ×100%= 36/74 ×100%=48.65 Percentage composition of H = 6/(3×12+6+2×16) ×100%= 6/74 ×100%=8.108 Percentage composition of O = 100 – 48.65 – 8.108 = 43.24	 1 1
10(d)	They have the same molecular formula.	1
10(e)	Ethanoic acid and methanol. Warm with concentrated sulfuric acid as catalyst.	1 1
	Total	10