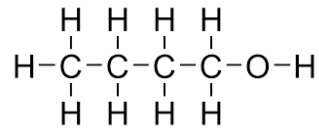
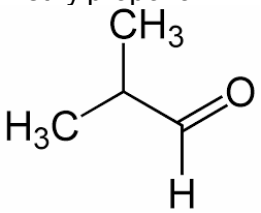
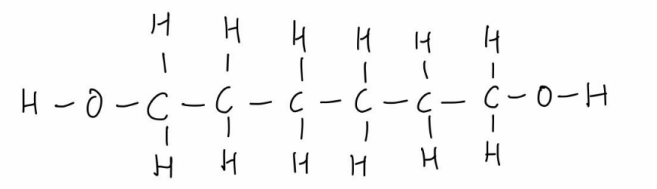
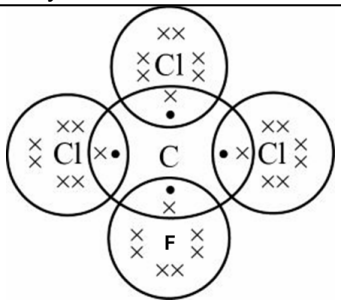
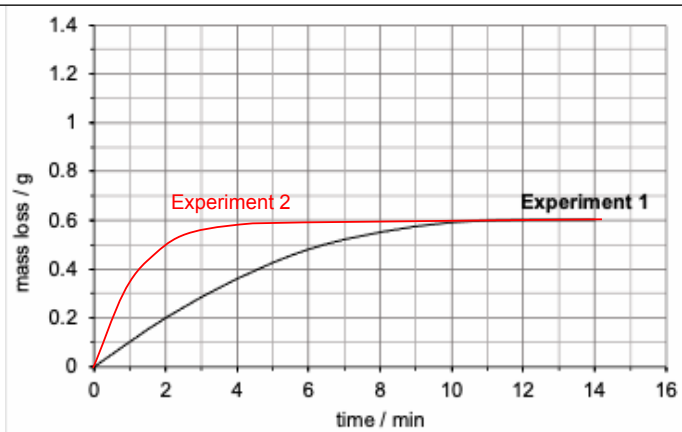
Marking Scheme

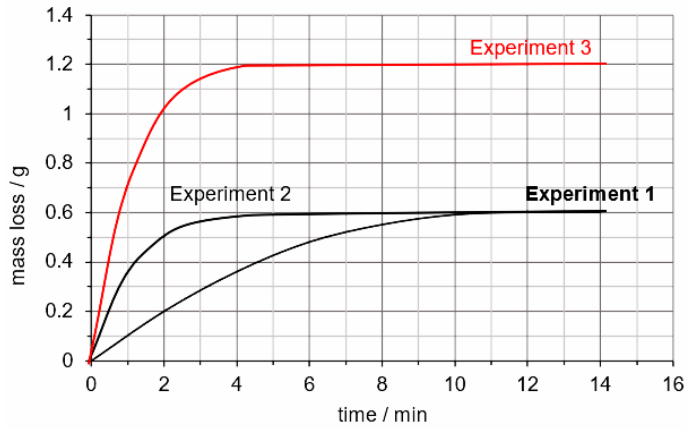
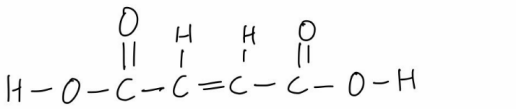
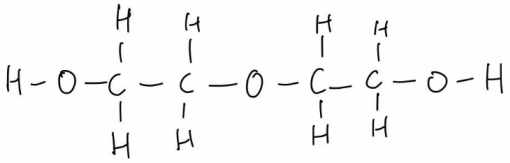
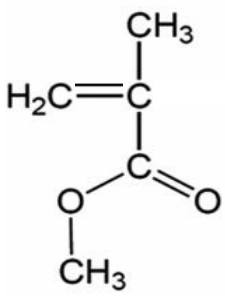
1	**a**	**i**	sulfur dioxide	1
		ii	copper (II) chloride	1
		iii	zinc sulfate	1
		iv	sulfur dioxide	1
	b	**i**	Arrangement: particles closely packed in an unorderly manner Movement: particles able to slide past each other	2
		ii	$Na_2O + H_2O \rightarrow 2NaOH$	1
		iii	Blue precipitate formed	1
2	**a**		No. of moles of $S_2O_3^{2-}$ = x 0.1 = 0.005 mol No of moles of I_2 = x 0.1 = 0.004 mol [1] Mole ratio of $S_2O_3^{2-}$: I_2 → 2 : 1 0.005 mol of $S_2O_3^{2-}$ requires 0.0025 mol of I_2 to react [1] Thus, the limiting reactant is $S_2O_3^{2-}$ [1]	3
	b		Mole ratio of $S_2O_3^{2-}$: I^- → 1 : 1 No. of moles of I^- = 0.005 mol [1] % yield = x 100 % = 26.0% [1] [Accept ECF from (a)]	2
	c		The oxidation state of iodine decreases [1] from 0 in I_2 to −1 in I^- [1] Accept answer where student show thiosulfate being oxidised and link it back to the characteristic of a reducing agent.	2
	d		No. Different elements are being reduced and oxidised at the same time.	1
3	**a**		$2Mg(s) + O_2(g) \rightarrow 2MgO(s)$ [Reject: state symbols not written or incorrect]	1
	b		Nitrogen.	1

	c	volume of O_2 reacted = 90 – 72 = 18 cm^3 number of moles of O_2 reacted = (18/1000) / 24 = 0.00075 mol [1] From the balanced chemical equation, 2 mol of Mg reacts with 1 mol of O_2. Hence, 0.0015 mol of Mg will react with 0.00075 mol of O_2. [1] Mass of Mg reacted = 0.0015 x 24 = 0.036 g [1] [Accept: ECF from (a)]		3
4	**a**	Most Least R, S, P, Copper, Q		1
	b	Anode: $R(s) \rightarrow R^+(aq) + e$ Cathode: $Cu^{2+}(aq) + 2e \rightarrow Cu(s)$ [Reject: state symbols not written or incorrect.]		2
	c	Any two: • Electrical energy is not supplied but produced through chemical reactions in a simple cell. • Electrons move spontaneously from the anode to the cathode. • The anode is the negative terminal in a simple cell.		2
5	**a**	$N_2 (g) + 3H_2 (g) \rightleftharpoons 2NH_3 (g)$ [1] From the equation, 1 mole / volume of N_2 reacts with 3 moles / volumes of H_2. [1]		2
	b	Temperature: about 450 °C Pressure: about 250 atm Catalyst: finely divided iron [1] for all 3 conditions		3
	c	Method: upward delivery [1] Reason: ammonia is less dense than air [1]		2
	d	**i**	When pressure increases, particles come closer together. [1] Frequency of effective collisions increases; rate of reaction increases.[1]	2
		ii	Since ammonia and nitrogen monoxide are gases, Volume ratio of NH_3 : NO → 1 : 1 Theoretical volume of NO = 440 dm^3 [1] 40% = x 100 % x = 176 dm^3 [1]	2

6	**a**		Silicon(IV) dioxide is a <u>covalent compound</u> and with <u>no mobile charge carriers</u>.	1
	b		They both have a macromolecular structure. [1] They both have atoms in a rigid tetrahedral arrangment. [1]	2
	c	**i**	Any two • Silicate contains only covalent bonds while wine glass contains both covalent and ionic bonds. • Silicate has a regular arrangement while wine glass has an irregular arrangement. • In silicate, each silicon atom is bonded to three oxygen atoms but in wine glass, each silicon atom can be bonded to one or more oxide ions. • Silicate contains no ions but wine glass has calcium and sodium ions.	2
		ii	The strong electrostatic forces of attraction between the ions are overcome when the glass is melted. [1] The ions become free to move about / act as mobile charge carriers to conduct electricity [1].	2
7	**a**		A strong acid is a substance that <u>ionises/dissociates completely in water to produce high concentration of hydrogen ions/ H^+ ions.[1]</u>	1
	b		The iron stirrer would react with the sulfuric acid immediately.	1
	c		$Ba(OH)_2(aq) + H_2SO_4(aq) \rightarrow BaSO_4(s) + 2H_2O(l)$ 1m – correct balanced equation 1m – correct state symbols	2
	d		The <u>conductivity was high</u> at the start as there were <u>free moving mobile barium and hydroxide ions [1].</u> As more sulfuric acid was added, <u>the ions are being removed from the solution</u> when they <u>combine with the hydrogen and sulfate ions</u>. Hence, the <u>number of free moving mobile ions in the solution decreases [1]</u>. When a total of 5 cm^3 of sulfuric acid was added, only the insoluble barium sulfate salt and water are present. There are <u>no free moving mobile ions in the solution at that time [1]</u>, Hence, conductivity of the solution is zero. When excess acid was added, the conductivity of the solution increases as there is an <u>increase in the number of free moving mobile ions from the sulfuric acid [1].</u>	4
	e		= = concentration of barium hydroxide, M_b = =<u>0.100 mol/dm^3</u> [Accept ECF from (c)]	1

8	**a**	$CH_3OCH_3 + 3O_2 \rightarrow 2CO_2 + 3H_2O$	1
	b	M_r of diethylether = 74 [1] Enthalpy change of combustion in kJ/g = Enthalpy in kJ/mol / M_r = -2726 / 74 = -36.8 kJ/g [1]	2
	c	The overall enthalpy change is calculated by the difference between the energy absorbed during bond breaking and the energy released during bond forming. [1] In the combustion reaction of these products, there is more energy released from bond forming than energy absorbed for bond breakling. [1]	2
	d	Increase	1
	e	The <u>types of bonds</u> in the molecules that need <u>to be overcome are different</u> so different amount of energy are needed when these bonds are broken.	1
	f	Butanol  Methylproponal  [Accept: hydroxyl group on any carbon]	1
	g	The potassium manganate (VII) solution will be decolourised / turn from purple to colourless in the sample with the alcohol. The potassium manganate (VII) solution will remain purple in the sample with ethoxyethane	1
	h	 1m – correct hydroxyl groups 1m – correct carbon backbone	2
9	**a**		2

		 1m – shared electrons; 1m – unshared electrons [Minus 1m if legend not shown.]		
	b	CCl_3F is a simple molecule [structure] with weak intermolecular forces of attraction [bonding] [1] that require a low amount of energy to overcome [1]. Hence, it would have a low boiling point.		2
	d	**i**	Allotropes	1
		ii	The ClO particle that is produced in step 1 reacts with an ozone molecule in step 2 to produce another Cl atom. [1] This Cl atom is then able to start step 1 again / to be reused in step 1 / used again for step 1 [1] and react with more ozone molecules.	2
		<u>Excessive UV radiation/light</u> that prevents risk of skin cancer will not be absorbed.		1
10	**a**	Calcium carbonate reacts with hydrochloric acid to form carbon dioxide gas. The mass loss is due to the <u>carbon dioxide gas being liberated.</u>		1
	b	Any 2: • Reading on the electronic balance remains unchanged. • There would be no more zinc carbonate left in the reaction mixture • No more effervescence is observed.		2
	c	**i**		1
		ii	In the same concentration and volume, sulfuric acid <u>has twice the number of hydrogen ions</u> as compared to hydrochloric acid. [1] <u>Concentration of reactant particles increases, increase frequency of effective collision</u>, rate of reaction increases. Since calcium carbonate is the limiting reagent, total mass loss remains at 0.6 g. [1]	2

		iii		1
	d	**i**	The lead(II) sulfate produced <u>forms an insoluble layer on the surface of the lead (II) carbonate</u>, preventing further reaction with the acid.	1
		ii	Precipitation method [1] Lead(II) nitrate [1]	2
11	**a**		<u>Add aqueous bromine</u> to the polymers seperately. Aqueous bromine will <u>decolourise</u> in the sample with polymer W.	1
	b		 	2
	c		n = 14000 / [(4x12)+(8x1)] = 250 [1] No. of carbon atoms = 250 x 4 = 1000 [1]	2
	d		No. Polymer Y is a polyamide which does not require an alcohol / which requires a diacid and diamine.	1
	e	**i**		1
		ii	Methanol	1

	f	Disadvantage: Polymer can only be disposed off by burying in landfills which will lead to land or air pollution.[1] Advantage: Polymer is durable and resistant to corrosion in daily use. [1]	2