

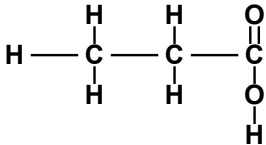
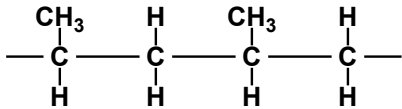
Science (Chemistry) 5086/5088 – Set I
Marking Scheme

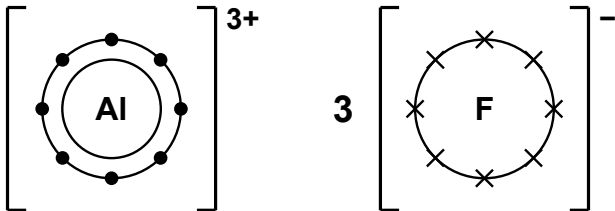
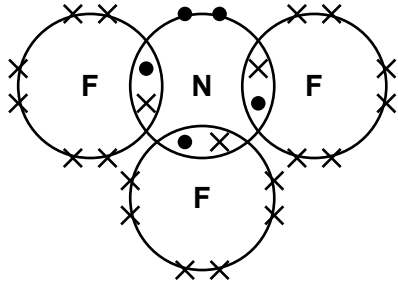
Paper 1: (20 marks)

1	2	3	4	5	6	7	8	9	10
A	B	A	B	D	B	D	C	B	A
11	12	13	14	15	16	17	18	19	20
C	C	C	D	C	D	C	C	D	D

Paper 3 Section A: (55 marks)

1	(a)	sulfur	[1]												
	(b)	calcium	[1]												
	(c)	Ammonium nitrate, sodium hydroxide	[1]												
	(d)	Aluminium OR calcium	[1]												
2	(a)	Fractionating column	[1]												
	(b)	Ethanol has a lower boiling point than the dyes.	[1]												
	(c)	The <u>thermometer should show a fixed temperature / boiling point of ethanol</u> while ethanol is collected.	[1]												
	(d)	Movement of particles changes from moving randomly at high speeds to sliding over one another. Arrangement of particles changes from disorderly and spaced far apart to disorderly and quite closely packed.	[1] [1]												
3	(a)	They react with water to form strongly alkaline solutions.	[1]												
	(b)	Melting and boiling point decreases down the group OR reactivity of the metals increases down the group	[1]												
	(c)(i)	They have the <u>same number of valence electrons</u> and <u>would lose 1 valence electron during reactions</u> .	[1]												
	(c)(ii)	<table border="1"> <thead> <tr> <th>particle</th><th>number of protons</th><th>number of neutrons</th><th>number of electrons</th></tr> </thead> <tbody> <tr> <td>$^{22}_{11}\text{Na}$</td><td>11</td><td>11</td><td>11</td></tr> <tr> <td>$^{24}_{11}\text{Na}^+$</td><td>11</td><td>13</td><td>10</td></tr> </tbody> </table> [1 mark for correct number of protons and neutrons ; 1 mark for correct number of electrons]	particle	number of protons	number of neutrons	number of electrons	$^{22}_{11}\text{Na}$	11	11	11	$^{24}_{11}\text{Na}^+$	11	13	10	[2]
particle	number of protons	number of neutrons	number of electrons												
$^{22}_{11}\text{Na}$	11	11	11												
$^{24}_{11}\text{Na}^+$	11	13	10												
4	(a)	No. It does not produce a salt and hydrogen gas only / copper usually does not react with acids.	[1]												
	(b)	<table border="1"> <thead> <tr> <th>substance</th><th>oxidation state of nitrogen</th><th>substance</th><th>oxidation state of copper</th></tr> </thead> <tbody> <tr> <td>HNO_3</td><td>+5</td><td>Cu</td><td>0</td></tr> <tr> <td>NO_2</td><td>+4</td><td>$\text{Cu}(\text{NO}_3)_2$</td><td>+2</td></tr> </tbody> </table> [3 marks for all correct answers ; 2 marks for 3 correct answers ; 1 mark for 2 correct answers ; 0 marks for 1 or no correct answer]	substance	oxidation state of nitrogen	substance	oxidation state of copper	HNO_3	+5	Cu	0	NO_2	+4	$\text{Cu}(\text{NO}_3)_2$	+2	[3]
substance	oxidation state of nitrogen	substance	oxidation state of copper												
HNO_3	+5	Cu	0												
NO_2	+4	$\text{Cu}(\text{NO}_3)_2$	+2												

	(c)	The oxidation state of nitrogen decreases from +5 in HNO_3 to +4 in NO_2, hence nitrogen in HNO_3 is reduced. The oxidation state of copper increases from 0 in Cu to +2 in $\text{Cu}(\text{NO}_3)_2$, hence copper in Cu is oxidised. Since both oxidation and reduction occurs, this is a redox reaction. (Award ecf from (b) and if correctly conclude oxidation/reduction occurring)	[1] [1]
5	(a)	L: iron / Fe M: zinc chloride / ZnCl_2 N: silver chloride / AgCl O: zinc hydroxide / $\text{Zn}(\text{OH})_2$ P: iron(III) nitrate / $\text{Fe}(\text{NO}_3)_3$ [1 mark each]	[5]
	(b)	[1 mark for balanced chemical equation ; 1 mark for state symbols] Eg: $2 \text{Fe}(\text{s}) + 6 \text{HNO}_3(\text{aq}) \rightarrow 2 \text{Fe}(\text{NO}_3)_3(\text{aq}) + 3 \text{H}_2(\text{g})$ $\text{ZnCl}_2(\text{aq}) + 2 \text{AgNO}_3(\text{aq}) \rightarrow 2 \text{AgCl}(\text{s}) + \text{Zn}(\text{NO}_3)_2(\text{aq})$ $4 \text{Fe}(\text{s}) + 3 \text{O}_2(\text{g}) + 2 \text{H}_2\text{O}(\text{l}) \rightarrow 2 \text{Fe}_2\text{O}_3 \cdot 2\text{H}_2\text{O}(\text{s})$	[2]
6	(a)	C_nH_{2n}	[1]
	(b)	Cyclohexane has a lower boiling point / density / less flammable than cycloheptane. [Any 2 points, 1 mark each]	[2]
	(c)	$\text{C}_5\text{H}_{12} + 8 \text{O}_2 \rightarrow 5 \text{CO}_2 + 6 \text{H}_2\text{O}$	[1]
	(d)	Reagent: hydrogen gas / H_2 Conditions: 150°C, Nickel catalyst	[1]
7	(a)	Yes. It contains carbon and hydrogen atoms only.	[1]
	(b)(i)	Reagent: <u>Acidified</u> potassium manganate (VII) / KMnO_4 Condition: heat	[1]
	(b)(ii)	Purple KMnO_4 turns colourless.	[1]
	(b)(iii)		[1]
	(c)	Add magnesium ribbon / magnesium carbonate to W and Z respectively. [1] If bubbles of gas are seen, compound Z is present. If no bubbles of gas are seen, compound X is present. [1] OR Add a few drops of aqueous bromine to compound W and compound Z in different test tubes. [1] If reddish-brown aqueous bromine decolourises, compound W is present. If reddish-brown aqueous bromine remains, compound Z is present. [1]	[2]
	(d)		[1]
8	(a)	X, iron, Y	[1]

	(b)	Magnesium (or any metal above C in the reactivity series) X cannot be reduced/extracted by heating with C and hence must be above C in the reactivity series.	[1] [1]
9		[1 mark – brief description of set up which states volume of acid used, mass of zinc granules used and appropriate apparatus used to take measurements. 1 mark – brief description of repeating the experiment using acid of a higher/lower temperature by heating the acid / placing the acid in an ice bath 1 mark – stating the measurements taken 1 mark – expected results and conclusion] <u>Example:</u> To 20 cm³ of nitric acid in a conical flask, add 1 g of zinc granules. Stopper the flask with a rubber bung connected to a gas syringe. Measure the volume of gas collected in the first 5 seconds. Heat 20 cm³ of nitric acid in a conical flask until the temperature is 40 °C. Add 1 g of zinc granules and stopper the flask with a rubber bung connected to a gas syringe. Measure the volume of gas collected in the first 5 seconds. The experiment using nitric acid at a higher temperature should have a higher volume of gas collected in the first 5 seconds. Thus the higher the temperature, the faster the rate of reaction.	[1] [1] [1] [1]
10	(a)(i)	 [1 mark for each correct ion. Show valence electrons only]	[2]
	(a)(ii)	Each fluorine atom gains 1 electron from an aluminium atom, in order to obtain a fully-filled valence shell.	[1] [1]
	(b)(i)	 [1 mark for correct number of bonding electrons ; 1 mark for correct number of non-bonding electrons]	[2]
	(b)(ii)	NF₃ has a <u>low boiling point</u> as it has a <u>simple molecular structure</u>. <u>Low amount of energy is needed to overcome the weak intermolecular forces between molecules</u> during boiling, hence it is a gas at room temperature.	[1] [1]
	(b)(iii)	Increased levels of greenhouse gases will give rise to global warming and <u>climate change</u> causing: • Decrease in crop yield due to droughts • Melting of ice caps leading to flooding which destroys habitats • Increase in heat-related illnesses due to higher temperatures • Death and destruction of property due to increase in frequency and intensity of typhoons / tornadoes [Accept any 2 answers – 1 mark each]	[2]

Paper 3 Section B: (10 marks)

11	(a)	50 s	[1]
	(b)	The reactants are being used up.	[1]
	(c)	$\text{CuCO}_3(\text{s}) + 2 \text{H}^+(\text{aq}) \rightarrow \text{Cu}^{2+}(\text{aq}) + \text{CO}_2(\text{g}) + \text{H}_2\text{O}(\text{l})$	[1]
	(d)(i)	$100 / 24000 = 0.0041667 \text{ mol (to 5 s.f.)}$ $= 0.00417 \text{ mol (to 3 s.f.)}$	[1]
	(d)(ii)	$64 + 12 + 12 \times 3 = 124 \text{ g/mol}$	[1]
	(d)(iii)	By mol ratio, $\text{CO}_2 : \text{CuCO}_3$ 1 : 1 $0.0041667 \text{ mol} : 0.0041667 \text{ mol}$ [1] Mass of $\text{CuCO}_3 = 0.0041667 \times 124 = 0.51667 \text{ g (to 5 s.f.)}$ $= 0.517 \text{ g (to 3 s.f.)}$ [1]	[2]
	(e)(i)	[graph should have a steeper gradient, reaction should end earlier, total volume of gas produced should be the same]	[1]
	(e)(ii)	CuCO_3 powder has a <u>smaller particle size and larger surface area exposed for collisions</u> . Thus <u>frequency of effective collisions is higher and hence the rate of reaction will be faster</u> which results the gradient of the graph being steeper.	[1] [1]
12	(a)(i)	The larger the volume of water used, the longer the time taken for the cross to be covered. OR the smaller the volume of water used, the shorter the time taken for the cross to be covered.	[1]
	(a)(ii)	When <u>more water is present, the concentration</u> of sodium thiosulfate in the flask is <u>lower</u> . There are <u>fewer reactant particles per unit volume</u> in the flask, hence <u>frequency of effective collisions decreases</u> , and it takes <u>longer</u> for enough precipitate to form and cover the cross. OR When <u>less water is present, the concentration</u> of sodium thiosulfate solution in the flask is <u>higher</u> . There are <u>more reactant particles per unit volume</u> in the flask, hence <u>frequency of effective collisions increases</u> , and the time taken for enough precipitate to form and cover the cross is <u>shorter</u> .	[1] [1] [1] [1] [1] [1]
	(b)(i)	<u>Filter</u> the mixture and collect the precipitate as <u>residue</u> .	[1]
	(b)(ii)	$0.2 / 32 = 0.00625 \text{ mol}$	[1]
	(b)(iii)	By mol ratio, S : HC/ 1 : 2 $0.00625 \text{ mol} : 0.0125 \text{ mol}$ [1] Concentration of HC/ = $0.0125 / 0.01 = 1.25 \text{ mol/dm}^3$ [1]	[2]
	(c)	The sulfur dioxide gas produced is an acidic gas / air pollutant. The student will experience irritation to his eyes, nose and have breathing difficulties.	[1] [1]