Paper 1

1	2	3	4	5	6	7	8	9	10
C	D	D	D	B	C	D	B	C	A
11	12	13	14	15	16	17	18	19	20
A	C	B	A	B	C	C	B	B	C
21	22	23	24	25	26	27	28	29	30
C	C	B	A	A	B	D	B	D	B
31	32	33	34	35	36	37	38	39	40
D	C	D	A	D	C	A	A	B	B

Section A

1	**ai**	**D**	1
	aii	**A**	1
	aiii	**E**	1
	aiv	**D**	1
	b	**C and F**	1
			5
2	**ai**	The number of protons does not equal the number of electrons in T.	1
	aii	P and Q	1
	b	Relative atomic mass = 0.02 x 80 + 0.12 x 82 +0.12 x 83 +0.57 x 84 + 0.17 x 85 = 83.73 = **83.7 (3sf)**	1
			3
3	**a**	**Diamond and calcium oxide**	1
	b	The molecules **slide freely and randomly** around one another. The molecules are **closely packed and disorderly** arranged.	1 1
	c	Calcium ion has higher charge of 2+ as compared with sodium ion of 1+. The electrostatic forces of attraction between calcium and oxide ions are stronger than that between sodium and oxide ions. Hence more heat energy is required to overcome the attractive forces.	1 1

	d	Diamond has a three-dimensional tetrahedral structure where each carbon atom is covalently bonded to four neighbouring carbon atoms. There are no free electrons available to carry charge and conduct electricity. Hence it is a poor electrical conductor.	1 1
			7
4	**a**	M: iron(II) carbonate N: carbon dioxide O: iron(II) chloride P: iron(II) hydroxide	 4
	b	**$\underline{FeCO_3(s)}$** + $2H^+(aq)$ → **$\underline{Fe^{2+}}$**(aq) + $H_2O(l)$ + $CO_2(g)$ [1] correct formule [1] correct coefficients and state cymbols	2
			6
5	**a**	No. of moles of dilute nitric acid = 24.00/1000 x 0.75 = **$\underline{0.018\ mol}$**	1
	b	No. of moles of potassium oxide = 23.5 / 94 = **$\underline{0.25\ mol}$** 0.25 mol of potassium oxide requires 0.50 mol of nitric acid to react completely. [Statement is needed to obtain the mark] Or 0.018 mol of HNO_3 will require 0.009 mol of K_2O to react completely **dilute nitric acid is the limiting reactant**. -allow ecf from (a) [no final mark if working does not convince nitric acid is limiting reactant]	1 1 1
	c	By mole ratio, 2 moles of dilute nitric acid produces 1 mole of water vapour. Number of moles of water vapour = **$\underline{0.018/2 = 0.009\ mol}$** Volume = 0.009 x 24000 = **$\underline{216\ cm^3}$** -allow ecf from (b)	 1 1
			6

<table>
<tr><td>6</td><td>a</td><td><table>
<tr><th>halogen</th><th>melting point / °C</th><th>boiling point / °C</th></tr>
<tr><td>bromine</td><td>-7</td><td>59</td></tr>
<tr><td>chlorine</td><td>-103</td><td>-34</td></tr>
<tr><td>iodine</td><td>113</td><td>185</td></tr>
</table></td><td>1</td></tr>
<tr><td></td><td>b</td><td>Fluorine is more reactive than bromine.

Fluorine displaces bromine from potassium bromide solution to form bromine, (which is reddish-brown).</td><td>1

1</td></tr>
<tr><td></td><td>c</td><td>Yes. Iodine has the largest atomic radius / outer electrons are furthest from nucleus.

Iodine's outer electrons are most easily lost / least strongly attracted to nucleus / highest tendency to lose electrons / lowests effective nuclear charge.</td><td>1

1</td></tr>
<tr><td></td><td></td><td></td><td>5</td></tr>
<tr><td>7</td><td>a</td><td>Energy changes:

1. The magnitude / size / value / amount of energy change is larger when calcium chloride is dissolved in water as compared to sodium chloride.
2. Dissolving calcium chloride in water is an exothermic change but dissolving sodium chloride is an endothermic change.

2 for [2]

Temperature changes:

3. The magnitude of temperature change is larger when calcium chloride is dissolved in water as compared to sodium chloride.
4. The temperature of the solution / (accept: surrounding temperature) rises when calcium chloride is dissoved in water but the temperature of the solution drops when sodium chloride is dissolved in water.

2 for [2]</td><td>

2

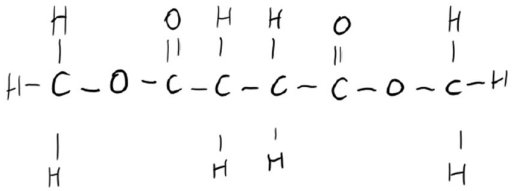
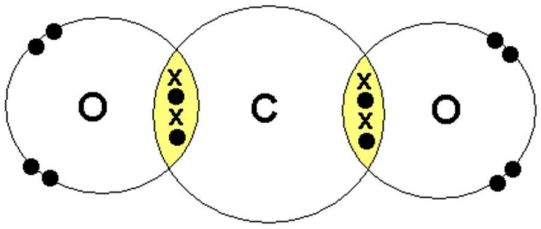
2</td></tr>
<tr><td></td><td>bi</td><td>Cathode: $2H^+(aq) + 2e^- \rightarrow H_2(g)$

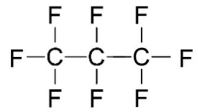
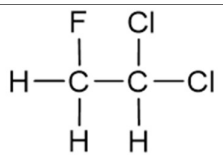
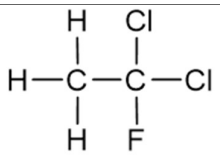
Anode: $2Cl^-(aq) \rightarrow Cl_2(g) + 2e^-$</td><td>1

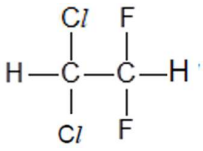
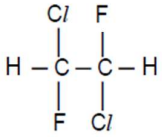
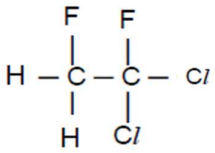
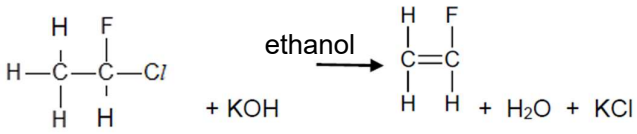
1</td></tr>
<tr><td></td><td>bii</td><td>The solution will turn blue / purple.

During the electrolysis process, H^+ ions are discharged. The concentration of H^+ ions in the solution decreases / the concentration of OH^- ions increases.</td><td>1

1</td></tr>
</table>

	biii	In the electrolysis of concentrated aqueous sodium choride, hydrogen and chlorine gas are produced whereas in the electrolysis of dilute aqueous sodium chloride, hydrogen and oxygen are produced.	1
			9
8	**a**	Add acidified aqueous potassium manganate(VII) to both acids. When added to acid P, purple acidified aqueous potasium manganate(VII) decolourises to colourless. When added to acid Q, purple acidified aqueous potasium manganate(VII) remains purple.	1 1
	b	H – O -H and 	1 1
			4
9	**a**	The larger the volume of sodium thiosulfate added, the faster the rate of reaction.	1
	b	The greater the volume of sodium thiosulfate used, the greater the concentration of sodium thiosulfate. The number of reactant particles per unit volume increases, hence increasing the frequency of effective collision.	1 1
	c	Catalyst 1. It is a larger exposed surface area. (Higher frequency of collision between the reactant particles and the catalyst.)	1 1
			5
10	**ai**	 [1] correct number of bonding electrons [1] correct number of non-bonding electrons Deduct 1 mark if key is not indicated	2

	aii	Carbon dioxide produced as a product in the reactions occuring within the catalytic converted. It leads to global warming and contribute to extreme weather events.	1
	aiii	Reduces pollution because catalytic converter removes the the unburnt hydrocarbons / oxides of nitrogen / nitrogen dioxides that are very polluting.	1
	b	(Using physical method), small pieces of plastics are melted, cooled, pulled into long strands and cut into pellets to make new plastics. (Using chemical method), plastics undergo cracking to form alkanes and alkenes to be used as fuel or used to make other useful chemicals (chemical feedstock). (Using chemical method), depolymerisation of plastics to produce monomers that are made into other chemicals. Any 2 for [2]	2
	c	The rate of planting/growing of trees cannot keep up with the rate of carbon dioxide being released. The amount of trees planted is limited by land space hence the amount of carbon dioxide absorbed is limited. Any 1 for [1]	1
	d	Biofuels are made by the fermentation of sugar in sugarcane plants.	1
			8
11	**a**		1
	b	HCFC-141a:  HCFC-141b:  [1] per correct drawing	2
	c	HCFCs and CFCs contain chlorine that reacts with ozone to deplete the ozone layer.	1
	di	CFC-114a [1] correct format, i.e CFC-114 [1] correct variation, i.e 'a'	1 1
	dii	HCFC-132	1

	e	Isomers:  or  or  Any 2 for [2]	2
	f	Step 1:  [1] correct HCFC [1] correct product and presentation of equation Step 2: 	2 1
			12

Section B

12	**a**	copper, nickel, iron, zinc, scandium	1
	bi	Oxygen and water / moisture are needed	1
	bii	It will prevent iron from rusting. Zinc will corrode in place of iron. Zinc is more reactive than iron.	1 1
	c	Blue solution becomes pale blue / colourless Reddish-brown solid forms at the bottom of the solution / on the surface of the zinc block Size of zinc block becomes smaller Accept: the test-tube feels warm Any 2 for [2]	1 1
	di	$3Zn + 2Fe(NO_3)_3 \rightarrow 2Fe + 3Zn(NO_3)_2$ [1] correct formulae [1] correct coefficients	2
	dii	Colourless solution turns brown.	1

	e	Electrolysis	1 10
13	ai	<table><tr><td>element</td><td>oxidation state before decomposition</td><td>oxidation state after decomposition</td></tr><tr><td>Fe</td><td>+3</td><td>**0**</td></tr><tr><td>C</td><td>**+2**</td><td>+4</td></tr></table>	2
	aii	Carbon monoxide. The oxidation state of carbon increases from +2 in CO to +4 in CO_2. Or Carbon monoxide gains oxygen to form carbon dioxide.	1 1
	bi	Transfer 2 g (consistent mass) sample of each deposit into separate test-tubes. Add 5 cm^3 of 0.5 mol/dm^3 of dilute nitric acid (consistent concentration and volume) into each test-tube and connect it to a **gas syringe** immediately. Collect and record the total volume of gas produced / collect and record the volume of gas produced every minute for each gas syringe (regular interval with a fixed duration of time) The test-tube that produces the largest total volume of gas / produces the gas at the fastest rate, contains the ore with a larger amount of barium carbonate. -diagram is optional. Description of chemicals used or apparatus used can be accepted if included in diagram but not stated in description. -check that dilute sulfuric acid is not used by the student. If used, second mark is not awarded. Accept: Transfer 2 g (consistent mass) sample of each deposit into separate conical flasks and place them on separate electronic balances. Add 5 cm^3 of 0.5 mol/dm^3 of dilute nitric acid (specify the acid and constant concentration) into the conical flask, stopper with some cotton wool. Record the total mass immediately.	1 1 1 1

		Record the mass of each conical flask and its contents at every one minute. (regular interval) The conical flask that shows a largest decrease in recorded mass / shows a decrease in mass at the fastest rate, contains the ore with a larger amount of barium carbonate.	
	bii	temperature of experiment kept constant / mass of barium carbonate to be tested kept the same /same concentration and volume of dilute acid / no. of moles of dilute nitric acid kept the same. Any 1 for [1] -no mark for 'powdered carbonate', given in the question.	1
	biii	No other substance within the ore produces a gas when reacting with dilute acid.	1
			10