

1. (a) (i) Describe what would be seen if dilute sodium hydroxide solution was added, until in excess, to aqueous solutions of magnesium nitrate and barium nitrate.

Magnesium nitrate

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Barium nitrate

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(2)

- (ii) Account for the observations given in (i) and write any relevant ionic equations.

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(3)

- (b) (i) State, and explain, the trend in the thermal stability of Group 2 carbonates.

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(3)

- (ii) Suggest, with a reason, how the thermal stability of sodium carbonate differs from that of magnesium carbonate.

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(2)

(Total 10 marks)

2. The standard reduction potentials, E^{\ominus}_{298}/V for some electrodes are listed below. This data should be used, where appropriate, to help answer the questions that follow.

	E^{\ominus}_{298}/V
$Mg^{2+}(aq) + 2e^{-} \rightleftharpoons Mg(s)$	-2.38
$Fe^{2+}(aq) + 2e^{-} \rightleftharpoons Fe(s)$	-0.44
$I_2(aq) + 2e^{-} \rightleftharpoons 2I^{-}(aq)$	+0.54
$Fe^{3+}(aq) + e^{-} \rightleftharpoons Fe^{2+}(aq)$	+0.77
$Br_2(aq) + 2e^{-} \rightleftharpoons 2Br^{-}(aq)$	+1.07
$Cl_2(aq) + 2e^{-} \rightleftharpoons 2Cl^{-}(aq)$	+1.36

- (a) Give the formula of the species given in the data which, under standard conditions, is

- (i) the most powerful reducing agent;

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(1)

- (ii) the most powerful oxidising agent.

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(1)

- (b) Which of the halogens listed would oxidise $Fe^{2+}(aq)$ to $Fe^{3+}(aq)$ under standard conditions?

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(1)

- (c) (i) Write an equation to show the reaction that occurs when chlorine is bubbled into a solution containing bromide ions. Give a reason why you would expect the reaction you suggest.

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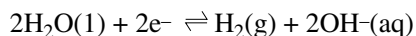
(2)

- (iii) Give an industrial application of this reaction.

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(1)

- (d) The redox potential for the following reaction at pH 7 is +0.42 V.



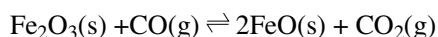
When magnesium is added to water at room temperature, little apparent reaction occurs. Give two reasons to account for this.

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(2)
(Total 8 marks)

3. Iron is extracted from its oxides in a blast furnace. Carbon, in the form of coke, is one of the raw materials mixed with the iron ore.

(a) The reaction between iron(III) oxide and carbon monoxide to produce iron occurs in many stages; one stage might be represented by the equation



Write the expression for the equilibrium constant, K_p , for this reaction.

(1)

(b) When an acidified solution of potassium dichromate(VI), $\text{K}_2\text{Cr}_2\text{O}_7$, is added to a solution of an iron(II) compound the dichromate(VI) ions are reduced to chromium(III) ions and the iron(II) ions are oxidised to iron(III) ions.

(i) Write an ionic half equation for the reduction of dichromate(VI) ions in acidic solution.

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(1)

(ii) Write an equation for the reaction between dichromate(VI) and iron(II) ions.

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(2)

(c) A 0.204 g sample of steel was reacted with excess dilute sulphuric acid. The resulting solution required 27.4 cm³ of 0.0220 mol dm⁻³ potassium dichromate(VI) solution for complete reaction.

Calculate the percentage of iron in the sample of steel.

(4)
(Total 8 marks)

4. (a) Values for the lattice enthalpy of some sodium halides are listed below.

Sodium halide	Lattice enthalpy/kJ mol ⁻¹
NaF	-902
NaCl	-771
NaBr	-733
NaI	-684

(i) Define the term *lattice enthalpy*, given the data shown above.

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(ii) Suggest an explanation for the trend shown in the lattice enthalpy values of the sodium halides.

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(2)

(b) Describe how you would distinguish between aqueous solutions of sodium chloride and sodium iodide.

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(3)

(c) Explain why silicon tetrachloride is readily hydrolysed by water at room temperature but carbon tetrachloride cannot be hydrolysed under the same conditions.

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(4)

- (d) Dichlorodifluoromethane, CCl_2F_2 , has been widely used as a refrigerant but it is now being phased out. Identify the feature of the molecule that leads both to its widespread use and to its decline.

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(1)

(Total 12 marks)