

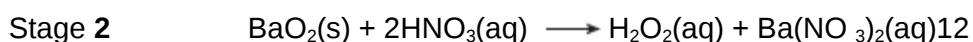
Name of the Student: _____

Max. Marks : 26 Marks

Time : 26 Minutes

Q1.

Pure hydrogen peroxide is a colourless liquid with a boiling point of 150 °C. Hydrogen peroxide was originally produced commercially in a two-stage process. In the first stage barium was heated in air to form barium peroxide. In the second stage barium peroxide was added to aqueous nitric acid. The equations for the reactions are shown below.



- (a) Suggest **one** method of separating hydrogen peroxide from the reaction mixture in Stage 2.

(1)

- (b) Apart from cost, suggest **one** reason why nitric acid was eventually replaced by sulfuric acid in Stage 2.

(1)

- (c) Suggest **one** reason why infrared spectroscopy could **not** be used to indicate the presence of a small amount of water in hydrogen peroxide.

(1)

(Total 3 marks)

Q2.

Group 2 metals and their compounds are used commercially in a variety of processes and applications.

- (a) State a use of magnesium hydroxide in medicine.

(1)

- (b) Calcium carbonate is an insoluble solid that can be used in a reaction to lower the acidity of the water in a lake.

Explain why the rate of this reaction decreases when the temperature of the water in the lake falls.

(3)

- (c) Strontium metal is used in the manufacture of alloys.

- (i) Explain why strontium has a higher melting point than barium.

(2)

- (ii) Write an equation for the reaction of strontium with water.

(1)

- (d) Magnesium can be used in the extraction of titanium.

- (i) Write an equation for the reaction of magnesium with titanium(IV) chloride.

(1)

- (ii) The excess of magnesium used in this extraction can be removed by reacting it with

dilute sulfuric acid to form magnesium sulfate.

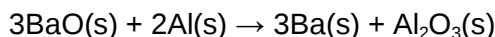
Use your knowledge of Group 2 sulfates to explain why the magnesium sulfate formed is easy to separate from the titanium.

(1)

(Total 9 marks)

Q3.

Barium can be extracted from barium oxide (BaO) in a process using aluminium. A mixture of powdered barium oxide and powdered aluminium is heated strongly. The equation for this extraction process is shown below.



Some standard enthalpies of formation are given in the table below.

Substance	BaO(s)	Al ₂ O ₃ (s)
$\Delta H_f^\circ / \text{kJ mol}^{-1}$	-558	-1669

- (a) (i) State what is meant by the term *standard enthalpy of formation*.

(3)

- (ii) State why the standard enthalpy of formation of barium and that of aluminium are both zero.

(1)

- (iii) Use the data to calculate the standard enthalpy change for the reaction shown by the equation above.

(3)

- (b) (i) Suggest the major reason why this method of extracting barium is expensive.

(1)

- (ii) Using barium oxide and aluminium powders increases the surface area of the reactants. Suggest **one** reason why this increases the rate of reaction.

(1)

- (c) (i) Write an equation for the reaction of barium with water.

(1)

- (ii) A solution containing barium ions can be used to test for the presence of sulfate ions in an aqueous solution of sodium sulfate.

Write the **simplest ionic** equation for the reaction which occurs and state what is observed.

Simplest ionic equation

Observation _____

(2)

- (iii) State how barium sulfate can be used in medicine. Explain why this use is possible, given that solutions containing barium ions are poisonous.

Use _____

Explanation _____

(2)

(Total 14 marks)