

Name of the Student: _____

Max. Marks : 17 Marks

Time : 17 Minutes

Q1.

This question is about complexes containing the aluminium ion.

- (a) Give the electron configuration of the Al^{3+} ion.

(1)

- (b) When anhydrous aluminium sulfate, $\text{Al}_2(\text{SO}_4)_3$, is added to water a solution forms that contains the complex aluminium ion, $[\text{Al}(\text{H}_2\text{O})_6]^{3+}$

Give the equation for the reaction.

(1)

- (c) Explain why the solution containing $[\text{Al}(\text{H}_2\text{O})_6]^{3+}$ is acidic.

(2)

- (d) State why the concentration of aluminium sulfate solution can **not** be determined by colorimetry.

(1)

- (e) An excess of aqueous ammonia is added to a solution containing $[\text{Al}(\text{H}_2\text{O})_6]^{3+}$

Give an ionic equation for the reaction and state one observation.

Equation

Observation

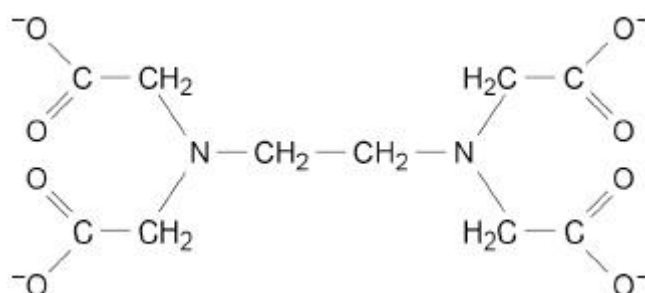
(2)

- (f) An excess of dilute sulfuric acid is added to the products of the reaction in part (e).

Identify the aluminium species produced.

(1)

- (g) The figure below shows the structure of the EDTA^{4-} ion.



Atoms of two different elements in EDTA^{4-} can form co-ordinate bonds with an aluminium ion.

On the figure above, draw circles around the atoms of **two** different elements that would link to an aluminium ion by a co-ordinate bond.

(2)

- (h) Hydrated aluminium sulfate, $\text{Al}_2(\text{SO}_4)_3 \cdot x\text{H}_2\text{O}$, is soluble in water.

The relative formula mass and value of x can be found from a titration experiment.

Aqueous $[\text{Al}(\text{H}_2\text{O})_6]^{3+}$ ions react to form a stable complex when treated with an excess of EDTA^{4-} ions.

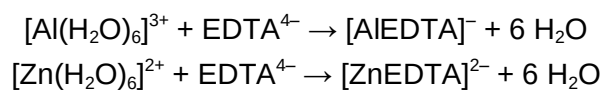
The excess of EDTA^{4-} ions is determined by titration with ZnSO_4 solution.

Method

- Dissolve 1.036 g of $\text{Al}_2(\text{SO}_4)_3 \cdot x\text{H}_2\text{O}$ in distilled water and make up to 250 cm^3
- Add 25.0 cm^3 of this solution to 50.0 cm^3 of a solution containing EDTA^{4-} ions of concentration $0.0100 \text{ mol dm}^{-3}$
- Determine the excess of EDTA^{4-} ions by titrating with ZnSO_4 solution in the presence of an indicator.

The excess of EDTA^{4-} ions requires 18.00 cm^3 of $0.0105 \text{ mol dm}^{-3}$ ZnSO_4 solution to react completely.

The equations for the reactions are



For $\text{Al}_2(\text{SO}_4)_3$ $M_r = 342.3$

Use the information given to calculate the M_r of $\text{Al}_2(\text{SO}_4)_3 \cdot x\text{H}_2\text{O}$

Calculate x

Give your answer as an integer.

M_r _____

x _____

(7)

(Total 17 marks)