

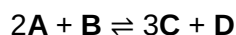
Name of the Student: _____

Max. Marks : 27 Marks

Time : 27 Minutes

Q1.

Compounds **A** and **B** react together to form an equilibrium mixture containing compounds **C** and **D** according to the equation



- (a) A beaker contained 40 cm^3 of a 0.16 mol dm^{-3} aqueous solution of **A**.
 $9.5 \times 10^{-3} \text{ mol}$ of **B** and $2.8 \times 10^{-2} \text{ mol}$ of **C** were added to the beaker and the mixture was left to reach equilibrium.
The equilibrium mixture formed contained $3.9 \times 10^{-3} \text{ mol}$ of **A**.

Calculate the amounts, in moles, of **B**, **C** and **D** in the equilibrium mixture.

Amount of **B** _____ molAmount of **C** _____ molAmount of **D** _____ mol

(5)

- (b) Give the expression for the equilibrium constant (K_c) for this equilibrium **and** its units.

 K_c

Units _____

(2)

- (c) A different equilibrium mixture of these four compounds, at a different temperature, contained 0.21 mol of **B**, 1.05 mol of **C** and 0.076 mol of **D** in a total volume of $5.00 \times 10^2 \text{ cm}^3$ of solution.
At this temperature the numerical value of K_c was 116

Calculate the concentration of **A**, in mol dm^{-3} , in this equilibrium mixture.
Give your answer to the appropriate number of significant figures.

Concentration of **A** _____ mol dm^{-3}

(3)

- (d) Justify the statement that adding more water to the equilibrium mixture in part (c) will lower the amount of **A** in the mixture.

(3)

(Total 13 marks)

Q2.

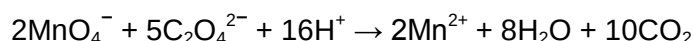
This question is about compounds containing ethanedioate ions.

- (a) A white solid is a mixture of sodium ethanedioate ($\text{Na}_2\text{C}_2\text{O}_4$), ethanedioic acid dihydrate ($\text{H}_2\text{C}_2\text{O}_4 \cdot 2\text{H}_2\text{O}$) and an inert solid. A volumetric flask contained 1.90 g of this solid mixture in 250 cm^3 of aqueous solution.

Two different titrations were carried out using this solution.

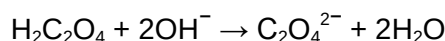
In the first titration 25.0 cm^3 of the solution were added to an excess of sulfuric acid in a conical flask. The flask and contents were heated to 60°C and then titrated with a $0.0200 \text{ mol dm}^{-3}$ solution of potassium manganate(VII). When 26.50 cm^3 of potassium manganate(VII) had been added the solution changed colour.

The equation for this reaction is



In the second titration 25.0 cm^3 of the solution were titrated with a $0.100 \text{ mol dm}^{-3}$ solution of sodium hydroxide using phenolphthalein as an indicator. The indicator changed colour after the addition of 10.45 cm^3 of sodium hydroxide solution.

The equation for this reaction is



Calculate the percentage by mass of sodium ethanedioate in the white solid.

Give your answer to the appropriate number of significant figures.

Show your working.

Percentage by mass of sodium ethanedioate _____ %

(8)

- (b) Ethanedioate ions react with aqueous iron(III) ions in a ligand substitution reaction.

Write an equation for this reaction.

Suggest why the value of the enthalpy change for this reaction is close to zero.

(2)

- (c) Draw the displayed formula of the iron complex produced in the reaction in part (b)

Indicate the value of the O—Fe—O bond angle.

State the type of isomerism shown by the iron complex.

Bond angle _____

Type of isomerism _____

(3)

- (d) Ethanedioate ions are poisonous because they react with iron ions in the body. Ethanedioate ions are present in foods such as broccoli and spinach.

Suggest one reason why people who eat these foods do not suffer from poisoning.

(1)

(Total 14 marks)