

Name of the Student: _____

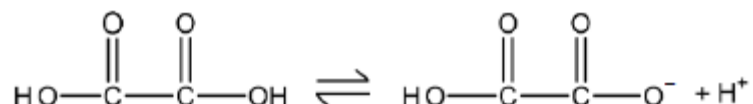
Max. Marks : 26 Marks

Time : 26 Minutes

Q1.

Ethanedioic acid is a weak acid.

Ethanedioic acid acts, initially, as a monoprotic acid.



- (a) Use the concept of electronegativity to justify why the acid strengths of ethanedioic acid and ethanoic acid are different.

(6)

- (b) A buffer solution is made by adding 6.00×10^{-2} mol of sodium hydroxide to a solution containing 1.00×10^{-1} mol of ethanedioic acid ($\text{H}_2\text{C}_2\text{O}_4$). Assume that the sodium hydroxide reacts as shown in the following equation and that in this buffer solution, the ethanedioic acid behaves as a monoprotic acid.



The dissociation constant K_a for ethanedioic acid is $5.89 \times 10^{-2} \text{ mol dm}^{-3}$.

Calculate a value for the pH of the buffer solution.

Give your answer to the appropriate number of significant figures.

pH = _____

(5)

- (c) In a titration, the end point was reached when 25.0 cm^3 of an acidified solution containing ethanedioic acid reacted with 20.20 cm^3 of $2.00 \times 10^{-2} \text{ mol dm}^{-3}$ potassium manganate(VII) solution.

Deduce an equation for the reaction that occurs and use it to calculate the original concentration of the ethanedioic acid solution.

Equation _____

Calculation

Original concentration = _____ mol dm^{-3}

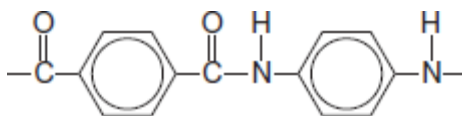
(4)

(Total 15 marks)

Q2.

Kevlar is a polymer used in protective clothing.

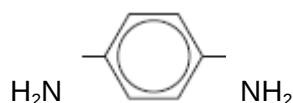
The repeating unit within the polymer chains of Kevlar is shown.



- (a) Name the strongest type of interaction between polymer chains of Kevlar.

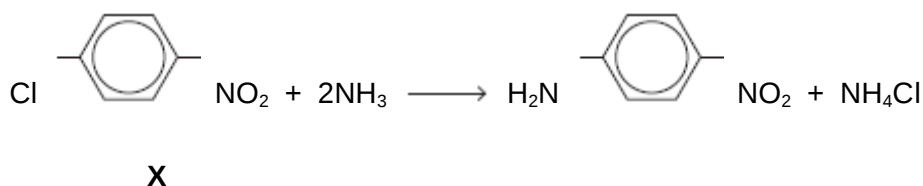
(1)

- (b) One of the monomers used in the synthesis of Kevlar is



An industrial synthesis of this monomer uses the following two-stage process starting from compound **X**.

Stage 1



Stage 2



- (i) Suggest why the reaction of ammonia with **X** in Stage 1 might be considered unexpected.

(2)

- (ii) Suggest a combination of reagents for the reaction in Stage 2.

(1)

- (iii) Compound **X** can be produced by nitration of chlorobenzene.

Give the combination of reagents for this nitration of chlorobenzene.
Write an equation or equations to show the formation of a reactive intermediate from these reagents.

Reagents _____

Equation(s) _____

(3)

- (iv) Name and outline a mechanism for the formation of **X** from chlorobenzene and the reactive intermediate in part (iii).

Name of mechanism _____

Mechanism

(4)

(Total 11 marks)