Name of the Student:_____
Max. Marks : 20 Marks **Time : 20 Minutes**

Q1.

This question is about ethanedioic acid (HOOCCOOH) and the ethanedioate ion ($^{-}$OOCCOO^{-}).

(a) Ethanedioic acid reacts with propane-1,3-diol ($HOCH_2CH_2CH_2OH$) to form a polyester.

Draw the repeating unit of this polyester.

(2)

(b) Explain why polyesters are biodegradable but polyalkenes are not biodegradable.

_____

_____

_____

_____

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_____

(2)

(c) Sodium ethanedioate is used to find the concentration of solutions of potassium manganate(VII) by titration. The equation for this reaction is

$$2\ MnO_4^- + 16\ H^+ + 5\ C_2O_4^{2-} \rightarrow 2\ Mn^{2+} + 8\ H_2O + 10\ CO_2$$

A standard solution is made by dissolving 162 mg of $Na_2C_2O_4$ (M_r = 134.0) in water and making up to 250 cm^3 in a volumetric flask.

25.0 cm^3 of this solution and an excess of sulfuric acid are added to a conical flask.
The mixture is warmed and titrated with potassium manganate(VII) solution.
The titration is repeated until concordant results are obtained.

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The mean titre is 23.85 cm^3

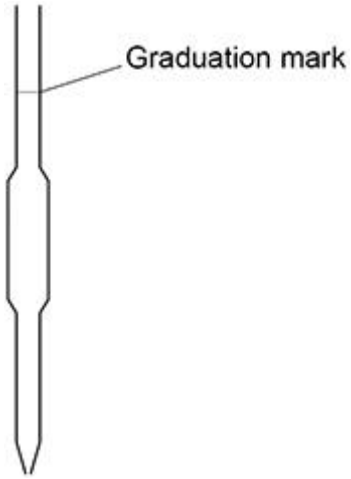
Calculate the concentration, in mol dm^{-3}, of the potassium manganate(VII) solution.

Concentration _____ mol dm^{-3}

(4)

(d) **Figure 1** shows the 25.0 cm^3 pipette used to measure the sodium ethanedioate solution.

Figure 1



On **Figure 1**, draw the meniscus of the solution when the pipette is ready to transfer 25.0 cm^3 of the sodium ethanedioate solution.

(1)

(e) Potassium manganate(VII) is oxidising and harmful.
Sodium ethanedioate is toxic.

Suggest safety precautions, other than eye protection, that should be taken when:
- filling the burette with potassium manganate(VII) solution
- dissolving the solid sodium ethanedioate in water.

Filling the burette _____

_____

Dissolving the solid _____

_____

(2)

(f) State the colour change seen at the end point of each titration.

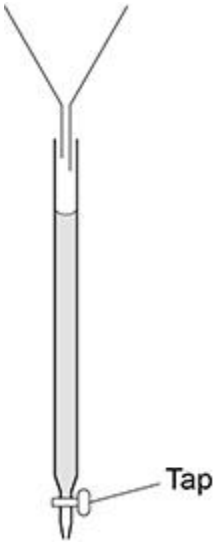
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_____

(1)

(g) **Figure 2** shows the burette containing potassium manganate(VII) solution.

Figure 2



Give **two** practical steps needed before recording the initial burette reading.

1 _____

2 _____

(2)

(h) When $Na_2C_2O_4(aq)$ is added to a solution containing $[Fe(H_2O)_6]^{3+}$ ions, a reaction occurs in which all six water ligands are replaced by ethanedioate ions.

Explain why the replacement of the water ligands by ethanedioate ions is favourable. In your answer refer to:

- the enthalpy and entropy changes for the reaction
- how the enthalpy and entropy changes influence the free-energy change for the reaction.

_____

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(6)

(Total 20 marks)

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