Name of the Student:_____
Max. Marks : 23 Marks **Time : 23 Minutes**

Mark Schemes

Q1.

(a) Moles MnO_4^- $\frac{26.50 \times 0.02}{1000}$ $= 5.30 \times 10^{-4}$ **1**

Moles in 25cm^3 sample / pipette $C_2O_4^{2-}$ (from acid and salt)
$= 5.30 \times 10^{-4}$ **$\times$ 5/2 = (1.325×10^{-3})** **1**

Moles NaOH = $\frac{10.45 \times 0.1}{1000}$ ($= 1.045 \times 10^{-3}$) **1**

So moles $C_2O_4^{2-}$ from acid in 25cm^3 sample / pipette
$= 1.045 \times 10^{-3}$ **$\div$ 2** $= 5.225 \times 10^{-4}$ **1**

Hence moles $C_2O_4^{2-}$ in sodium ethanedioate in 25 cm^3

$= 1.325 \times 10^{-3} - 5.225 \times 10^{-4}$ $(= 8.025 \times 10^{-4})$ **1**

So moles $C_2O_4^{2-}$ in sodium ethanedioate in original sample
$= 8.025 \times 10^{-4}$ **$\times$ 10** **($= 8.025 \times 10^{-3}$)** **1**

Mass $Na_2C_2O_4 = 8.025 \times 10^{-3}$ **$\times$ 134(.0) = 1.075(35) g** **1**
So % sodium ethanedioate in original sample

$\frac{1.075(35)}{1.90} \times 100$ $= 56.6$ % to 3 sig fig **1**

The first CE is penalised by 2 marks; further errors are penalised by one mark each

M2 = M1 × 5/2

M4 = M3 ÷ 2
M5 = M2 – M4 (do not allow if negative and do not allow = M4-M2)
If no subtraction, max = 5 (M1, M2, M3, M4 and M6)
If incorrect subtraction, max = 6 (M1, M2, M3, M4, M6 and M7)

M6 = M5 × 10
(M6 can be scored by multiplying M2 and M4 by 10 before subtraction (giving $1.325 \times 10^{-2} - 5.225 \times 10^{-3} = 8.025 \times 10^{-3}$)
M7 = M6 × 134
M8 = (M7/1.90) × 100 Allow 56.5 – 56.8%

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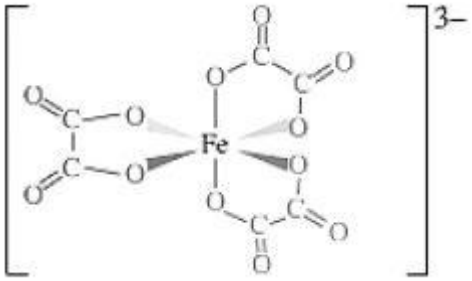
(b) $[Fe(H_2O)_6]^{3+} + 3C_2O_4^{2-} \longrightarrow [Fe(C_2O_4)_3]^{3-} + 6H_2O$

1

There are 6 Fe–O bonds broken and then made / same number and type of bond being broken and made.

1

(c)



Ignore all charges even if wrong
Ignore absence of square brackets
Candidates do not need to show 3D shape

1

90° or 180°

1

optical

1

(d) The ethanedioic acid is only present in small quantities/low

concentration in these foods.

1

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Q16.

(a) 7–10.2

any range (i.e. 2 values) within this range

1

(b) $K_a = \frac{[H^+][X^-]}{[HX]}$

ALLOW H_3O^+ for H^+ and A for X
IGNORE $[H^+]^2/[HX]$
must be square brackets
IGNORE state symbols

1

(c) Amount NaOH = $(24.0 \times 0.100)/1000 = 2.40 \times 10^{-3}$ mol

(= amount HX)

Conc HX = $2.40 \times 10^{-3}/0.025 = 0.0960$ mol dm^{-3}

ecf for M1/0.025

(d) ($K_a = 2.62 \times 10^{-5} = [H^+]^2/0.0960$)

$[H^+] = \sqrt{(2.62 \times 10^{-5} \times 0.0960)}$ ($= 1.59 \times 10^{-3}$ mol dm^{-3})

ecf from part (c) $[H^+] = \sqrt{(2.62 \times 10^{-5} \times$ ans to part (c))
From alternative data
$[H^+] = \sqrt{(2.62 \times 10^{-5} \times 0.600)}$ ($= 3.96 \times 10^{-3}$ mol dm^{-3})

(pH = –log 1.59×10^{-3} =) 2.80 (must be 2 or more dp)

1

pH = 2.40 (must be 2 or more dp)
M2 dependent on a calculation of $[H^+]$

1

(e) (pH at half-neutralisation = pK_a)

= –log $2.62 \times 10^{-5} = 4.58$ (must be 2 or more dp)

ALLOW 1dp if already penalised in part (d)

1

(f) Both points plotted correctly and line touches both points

ecf from (d) and (e) within 1 small square

1

<u>Line steeper at start</u> then levels (to show buffering)

Mark independently

1

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