

Name of the Student: _____

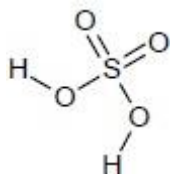
Max. Marks : 16 Marks

Time : 16 Minutes

Mark Schemes

Q1.

(a)

*Ignore shape / bond angles**Ignore lone pair(s) on O atoms**NOT lone pair(s) on S atom*

1

(b) Equation 1: $\text{H}_2\text{SO}_4 \rightarrow \text{HSO}_4^- + \text{H}^+$ / $\text{H}_2\text{SO}_4 + \text{H}_2\text{O} \rightarrow \text{HSO}_4^- + \text{H}_3\text{O}^+$ *Equation 1: NOT $\rightleftharpoons$*

1

Equation 2: $\text{HSO}_4^- \rightleftharpoons \text{SO}_4^{2-} + \text{H}^+$ / $\text{HSO}_4^- + \text{H}_2\text{O} \rightleftharpoons \text{SO}_4^{2-} + \text{H}_3\text{O}^+$ *Equation 2: NOT $\rightarrow$ or $\leftrightarrow$* *Allow $\rightleftharpoons$ or $\rightleftharpoons$ or $\rightleftharpoons$*

1

*Ignore state symbols in both equations**Allow multiples in both equations*(c) **M1** weigh solid and transfer using a method that Allows exact mass to be known (there should be two weighings, one of which could be zeroing, and method could be by difference or with washings or directly weighed into container)**M1** *Ignore any mass quoted**NOT if any other solid added*

1

M2 dissolve in water in suitable container (NOT in 250 cm³ of water)**M2** *NOT if any other solution added*

1

M3 transfer with washings into 250 cm³ volumetric/graduated flask**M3** *Reference to 250 cm³ can appear anywhere*

1

M4 make up to mark / 250 cm³ AND THEN shake / invert / mix**M4** *Allow if conical flask used**NOT if beaker used*

1

Alternative method (M2-4)**M2** in 250 cm³ volumetric/graduated flask**M3** dissolve (NOT in 250 cm³ of water)**M4** make up to mark / 250 cm³ AND THEN shake/invert/mix

(d) **M1** $[H^+] = 10^{-1.72} (= 0.0191 \text{ (mol dm}^{-3}\text{)})$

1

M2 amount NaHSO₄ = 0.605/120.1 (= 5.04 × 10⁻³ (mol))

1

M3 initial [NaHSO₄] = [HSO₄⁻] = **M2** × 10 (= 5.04 × 10⁻² (mol dm⁻³))

$$K_a = \frac{[H^+][SO_4^{2-}]}{[HSO_4^-]} \text{ or } K_a = \frac{[H^+]^2}{[HSO_4^-]}$$

1

M4 $K_a = \frac{0.0191^2}{0.0504 - 0.0191}$

1

M5 $K_a = 1.17 \times 10^{-2}$ (1.15 – 1.18 × 10⁻²) must be 3sf

1

M6 mol dm⁻³

1

Correct answer scores **M1-5** (must be 3sf)**Alternative method** that does not subtract 0.0191:

7.21×10^{-3} (7.15 – 7.26 × 10⁻³) scores **M1-5**

(where **M4** $K_a = \frac{0.0191^2}{0.0504}$)

If not correct answer:

For **M1-3**, if answer is shown, it must be correct (Ignore sf)Allow ECF from **M1/2/3** to **M4/5** (but not from **M3** to **M5** if omission of **M3** gives negative **M5**)NOT ECF from incorrect K_a expression in **M4** to **M5****M6** If not mol dm⁻³, Allow ECF for units from incorrect K_a expression in **M4** 7.21×10^{-2} (7.15 – 7.26 × 10⁻²) gives **M1,2,4,5** (by alternative method omitting **M3**)

(e) **M1** (HSO₄⁻ ⇌ SO₄²⁻ + H⁺) equilibrium moves/shifts left (to counteract / remove increased [SO₄²⁻])

M1 Allow H⁺ reacts with SO₄²⁻/sulfate

Ignore favours the reverse / left / backwards reaction

NOT base / A⁻ / sodium sulfate in place of SO₄²⁻/sulfate

M2 so [H⁺] decreases

1

M2 Allow fewer H⁺ (ions) or amount of H⁺ lower or removes H⁺**M2** independent of **M1**

1

[15]

Q2.

A

[1]