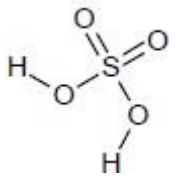
Name of the Student:_____
Max. Marks : 15 Marks **Time : 15 Minutes**

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: $H_2SO_4 \rightarrow HSO_4^- + H^+$ / $H_2SO_4 + H_2O \rightarrow HSO_4^- + H_3O^+$
Equation 1: NOT $\rightleftharpoons$

1

Equation 2: $HSO_4^- \rightleftharpoons SO_4^{2-} + H^+$ / $HSO_4^- + H_2O \rightleftharpoons SO_4^{2-} + H_3O^+$
Equation 2: NOT $\rightarrow$ *or* $\leftrightarrow$
Allow $\leftrightharpoons$ *or* $\rightleftarrows$ *or* $\leftrightarrows$

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 <u>dissolve</u> in water in suitable container (NOT in 250 cm^3 of water)
M2 *NOT if any other solution added*

1

M3 transfer with washings into 250 cm^3 volumetric/graduated flask
M3 *Reference to 250 cm^3 can appear anywhere*

1

M4 make up to mark / 250 cm^3 AND THEN shake / invert / mix
M4 *Allow if conical flask used*
NOT if beaker used

1

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Alternative method (M2-4)

M2 *in 250 cm^3 volumetric/graduated flask*

M3 *dissolve (NOT in 250 cm^3 of water)*

M4 *make up to mark / 250 cm^3 AND THEN shake/invert/mix*

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

1

M2 amount $NaHSO_4$ = 0.605/120.1 (= 5.04×10^{-3} (mol))

1

M3 initial $[NaHSO_4] = [HSO_4^-]$ = **M2** x 10 (= 5.04×10^{-2} (mol dm^{-3}))

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

1

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

1

M5 K_a = 1.17×10^{-2} ($1.15 - 1.18 \times 10^{-2}$) 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} ($7.15 - 7.26 \times 10^{-3}$) 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} ($7.15 - 7.26 \times 10^{-2}$) gives **M1,2,4,5** (by alternative method omitting **M3**)*

(e) **M1** ($HSO_4^- \rightleftharpoons SO_4^{2-} + H^+$) equilibrium moves/shifts left (to counteract / remove increased $[SO_4^{2-}]$)

M1 *Allow H^+ reacts with SO_4^{2-}/sulfate*

Ignore favours the reverse / left / backwards reaction

NOT base / A^- / sodium sulfate in place of SO_4^{2-}/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]

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