Practice Question Set For A-Level
Subject : Chemistry
Paper-2 Topic: Chemical Equilibria, Le Chatelier's Principle And Kc

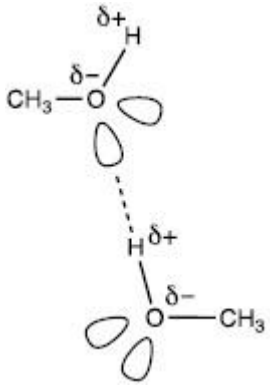
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Name of the Student:_____
Max. Marks : 25 Marks **Time : 25 Minutes**

Mark Schemes

Q1.

(a)



M1 on at least one O atom two lone pairs and
on at least one OH δ+ on H and δ- on O

1

M2 dotted line shown between lone pair on one molecule and the correct H on another

1

M3 O····H–O in straight line

1

Accept pair of dots or crosses for lone pair in place of orbital shape (orbital shape may or may not include two electrons)

Ignore any partial charges on C–H or C–O bonds

*For straight line in **M3**, allow a deviation of up to 15°*

If a different molecule containing hydrogen bonding due to O–H bond drawn (e.g. ethanol, water) or an incorrect attempt at the structure of methanol, then maximum of 2 marks (i.e. only penalise if would score all three marks otherwise)

(b) Idea that lone pairs have greater repulsion than bonding pairs

There must be a comparison between the repulsion of a lone pair and bonding pair

Allow covalent bond = bonding pair

1

(c)

This question is marked using levels of response. Refer to the Mark

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Scheme Instructions for Examiners for guidance on how to mark this question.	
Level 3 **5-6 marks**	**All stages are covered and the explanation of each stage is generally correct and virtually complete.** (6 v 5) Answer is well structured, with no repetition or irrelevant points, and covers all aspects of the question. Accurate and clear expression of ideas with no errors in use of technical terms.
Level 2 **3-4 marks**	**All stages are covered but stage(s) may be incomplete or may contain inaccuracies OR two stages are covered and are generally correct and virtually complete** (4 v 3) Answer has some structure and covers most aspects of the question. Ideas are expressed with reasonable clarity with, perhaps, some repetition or some irrelevant points. If any, only minor errors in use of technical terms.
Level 1 **1-2 marks**	**Two stages are covered but stage(s) may be incomplete or may contain inaccuracies OR only one stage is covered but is generally correct and virtually complete** (2 v 1) Answer includes statements which are presented in a logical order and/or linked.
0 marks	Insufficient correct chemistry to gain a mark.

Stage 1
Describes the effect of catalyst use
1a use of a catalyst has no impact on equilibrium yield
1b use of a catalyst gives faster rate
1c use of catalyst lowers costs

Stage 2
Describes the effect of pressure
2a higher pressure gives a higher equilibrium yield
2b higher pressure gives a faster rate
2c the higher the pressure, the greater the cost

Stage 3
Describes the effect of temperature
3a lower temperature gives a higher equilibrium yield
3b higher temperature gives a faster rate
3c the higher the temperature, the greater the cost
Note that converse statements are fine (e.g. 1a higher temperature gives a lower equilibrium yield)

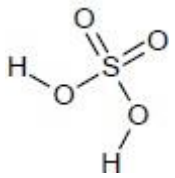
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Q2.

(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

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}))

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$K_a = \frac{[H^+][SO_4^{2-}]}{[HSO_4^-]}$ 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 x 10^{-2} (1.15 – 1.18 x 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 x 10^{-3} (7.15 – 7.26 x 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 x 10^{-2} (7.15 – 7.26 x 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

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