AQA A-Level Chemistry

Acids and bases mark scheme · goes with “Acids and bases” · whiteboardchemistry.com/revision/aqa-a-level-chemistry/exam-questions

Mark schemes

Acids and bases · 13 questions

Q1 · June 2022 · Paper 3 · Q13 · [1 mark]

Answer: **A**

CH_3COO^-

Q2 · June 2023 · Paper 3 · Q18 · [1 mark]

Answer: **C**

1.00×10^{-4}

Q3 · June 2023 · Paper 3 · Q17 · [1 mark]

Answer: **D**

adding 10 cm^3 of 1.0 mol dm^{-3} HCl

Q4 · June 2024 · Paper 3 · Q4 · [11 marks]

(a) Only a (small) fraction of the molecules dissociate (into ions)/ionise (when added to water/in aqueous solution)

OR

partially dissociates/does not fully dissociate (into ions)/ionise (when added to water/in aqueous solution).

Not ‘reaction is reversible’

Not if incorrect ions suggested

Not “Hydrogen ions do not fully dissociate”

[1 mark]

(b) As there is a large pH change (for a small addition of alkali)

Need idea of rapid/large change in pH

Allow pH change is rapid/gradient is steep (at equivalence point)

Ignore equivalence/end point is very steep

Ignore so they do not miss the equivalence point

[1 mark]

(c) M1 $K_a = \dfrac{[H^+][CH_3CH_2COO^-]}{[CH_3CH_2COOH]}$

Allow $[H_3O^+]$ for $[H^+]$

NOT () for concentration

NOT $K_a = \dfrac{[H^+]^2}{[CH_3CH_2COOH]}$

M2 $[CH_3CH_2COOH] = [CH_3CH_2COO^-]$

Allow [HA] = [A⁻] / mol/amount of HA = mol/amount of A⁻

Allow $\dfrac{[HA]}{[A^-]}$ *OR* $\dfrac{[A^-]}{[HA]} = 1$

M3 $K_a = [H^+]$ (therefore pH = pK_a)

Allow Log 1 = 0

[3 marks]

(d) M1 Allow pH between 4.4 - 4.7

M2 Answer from $K_a = 10^{-M1}$ to min 2sf

M2 ECF from M1 only if M1 is in range 4.0 to <4.4 or >4.7 to 5.0

If M1 in range shown, M2 = 1.99526 x 10^{-5} to 3.9811 x 10^{-5} to at least 2 sf

Using pH at start (= 2.80) scores 0/2

[2 marks]

(e) M1 OH^- reacts with propanoic acid OR reacts with H^+

M2 EITHER

ratio of $[CH_3CH_2COOH]$ to $[CH_3CH_2COO^-]$ remains almost constant

OR

Equilibrium for dissociation of CH_3CH_2COOH moves right to maintain $[H^+]$ /replace H^+

Allow CH_3CH_2COOH dissociates to maintain $[H^+]$ /replace H^+

[2 marks]

(f) M1 Methyl orange - would not change colour at the equivalence point (allow end-point)/pH range does not match rapid pH change/pH range does not include/match equivalence point

Allow methyl orange changes colour before/below equivalence point

Allow pH range does not fall in the range of pH from 6-11

Ignore reference to this being a weak acid - strong base titration

M2 Universal indicator - idea of range of colours during titration/no distinct colour change (at equivalence/end-point)

[2 marks]

Q5 · June 2024 · Paper 3 · Q18 · [1 mark]

Answer: **A**

The concentration of hydroxide ions in water at 18 °C is 8.00×10^{-8} mol dm^{-3}

Q6 · June 2024 · Paper 1 · Q7 · [8 marks]

(a) M1 $K_w = [H^+]\,[OH^-]$

M2 $[H^+] = \sqrt{(2.92 \times 10^{-14})}$

M3 pH = 6.77

M3 = -log10 M2

Answer to 2 decimal places

[3 marks]

(b) M1 n OH^- = 5.25×10^{-3} and n H^+ = 2.00×10^{-3} mol

M2 excess OH^- = 3.25×10^{-3} mol

M2 = n(OH^-) - n(H^+) in M1

M3 $[OH^-] = \dfrac{(3.25 \times 10^{-3})}{(55.0 \times 10^{-3})} = 0.0591$ mol dm^{-3}

M3 = $\dfrac{M2}{(55 \times 10^{-3})}$

M4 $[H^+] = \dfrac{(2.92 \times 10^{-14})}{0.0591} = 4.94 \times 10^{-13}$ mol dm^{-3}

M4 = $\dfrac{(2.92 \times 10^{-14})}{M3}$

M5 12.31

M5 = -log10(M4)

[5 marks]

Q7 · June 2023 · Paper 3 · Q16 · [1 mark]

Answer: **B**

HCO_3^-

Q8 · November 2020 · Paper 3 · Q14 · [1 mark]

Answer: **A**

Q9 · November 2020 · Paper 3 · Q13 · [1 mark]

Answer: **B**

Q10 · June 2023 · Paper 3 · Q20 · [1 mark]

Answer: **A**

ammonia and ammonium chloride

Q11 · June 2022 · Paper 3 · Q15 · [1 mark]

Answer: **B**

KOH and CH_3COOH

Q12 · June 2022 · Paper 3 · Q14 · [1 mark]

Answer: **B**

1.40

Q13 · June 2025 · Paper 1 · Q8 · [17 marks]

08.1

M1 $pH = -\log_{10}[H^+]$ or $pH = -\log_{10}(0.150)$

M2 pH = 0.82

Correct value to 2dp scores 2 marks

[2 marks]

08.2

M1 $[H^+] = 10^{-pH} = 10^{-2.89}$ $(= 1.29 \times 10^{-3})$

M2 $K_a = \dfrac{([H^+]^2)}{([CH_3CH_2COOH])}$ OR $= \dfrac{([H^+]^2)}{([HA])}$

M3 $[CH_3CH_2COOH] = \dfrac{([H^+]^2)}{(K_a)} = \dfrac{((1.29 \times 10^{-3})^2)}{(1.35\times10^{-5})}$

M4 0.123 (mol dm^{-3})

M2 allow with numbers or symbols

M3 allow rearrangement with numbers or

symbols

M4 0.12 to 0.13 to 2 significant figures or more scores 4 marks

[4 marks]

08.3

strong alkali added to weak acid

[1 mark]

08.4

these 3 indicators all ticked

cresol red

naphtholphthalein

cresolphthalein

[1 mark]

08.5

M1 OH^- ions react with H^+

M2 The $HA \rightleftharpoons H^+ + A^-$ equilibrium shifts right to maintain $[H^+]$

OR

M2 ratio of $[CH_3COOH]$ / $[CH_3COO^-]$ remains roughly constant

Alternative

M1 OH^- ions react with CH_3COOH/ethanoic acid/HA

OR

M1 $HA + OH^- \rightarrow H_2O + A^-$

M2 ratio of $[CH_3COOH]$ / $[CH_3COO^-]$ remains roughly constant

[2 marks]

08.6

M1 amount HA at start = $0.120 \times \frac{(50)}{(1000)} = 0.00600$

M2 amount A^- at start = $\frac{(0.656)}{(82.0)} = 0.00800$

M3 amount of H^+ added = $0.200 \times \frac{(1.50)}{(1000)} = 0.000300$

M4 amount of HA after reaction = M1 + M3 and amount of A^- after reaction = M2 – M3

M5 $[H^+] = K_a \frac{([\text{HA answer from M4}])}{([A^- \textit{ answer from M4}])} = 1.78 \times 10^{-5} \times \frac{(\text{M1} + \text{M3})}{(\text{M2} - \text{M3})}$

M6 pH = – log M5

M7 = 4.87 – M6

M1 amount HA at start = $0.120 \times \frac{(50)}{(1000)} = 0.00600$

M2 amount A^- at start = $\frac{(0.656)}{(82.0)} = 0.00800$

M3 amount of H^+ added = $0.200 \times \frac{(1.50)}{(1000)} = 0.000300$

M4 amount of HA after reaction = 0.0063 and amount of A^- after reaction = 0.0077

M5 is dependent on an attempt at M4

M5 $[H^+] = K_a \frac{([HA])}{([A^-])} = 1.78 \times 10^{-5} \times \frac{(0.00630)}{(0.00770)} = 1.46 \times 10^{-5}$

M6 pH = –log $1.46 \times 10^{-5} = 4.84$

M7 change = 4.87 – 4.84 = 0.03 (answer to 2 decimal places)

[7 marks]

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