InkChemistry

QUESTION WORKBOOK

Weak acids, Ka and pKa; Kw and strong bases

Acids and bases · Unit C11

AQA 3.1.12.3, 3.1.12.4 · OCR A 5.1.3

21 questions · 65 marks

NAVY SCREEN EDITION

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SECTION A · Short, 1 to 2 marks

A1 WA-Q1 State the expression for the ionic product of water, Kw, and give its value with units at 298 K. [2]

A2 WA-Q4 Calculate the pH of 0.0250 mol dm^{-3} potassium hydroxide at 298 K. [2]

A3 WA-Q17 Describe how the pH of a strong base is calculated from its concentration at 298 K. [2]

A4 WA-Q21 Suggest why a value of Ka found from one pH reading of a weak acid of known concentration is more affected by a badly calibrated pH meter than a value found at the half-neutralisation point. [2]

SECTION B · Standard, 3 to 5 marks

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B1 WA-Q7 Calculate Ka and pKa for a weak monoprotic acid, given that a 0.0800 mol dm^{-3} solution of it has a pH of 3.10 at 298 K. [4]

B2 WA-Q10 Explain why the pH of pure water falls as its temperature rises, and why the water remains neutral. [4]

B3 WA-Q15 Compare 0.100 mol dm^{-3} hydrochloric acid with 0.100 mol dm^{-3} ethanoic acid in their pH, their rate of reaction with magnesium ribbon, and the volume of 0.100 mol dm^{-3} sodium hydroxide needed to neutralise 25.0 cm^3 of each. [4]

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B4 WA-Q2 Give the expression for the acid dissociation constant, Ka, of propanoic acid, CH_3CH_2COOH, with its units, and give the relationship between pKa and Ka, saying whether a larger pKa means a stronger or a weaker acid. [3]

B5 WA-Q5 Calculate the pH of 0.0150 mol dm^{-3} barium hydroxide, $Ba(OH)_2$, at 298 K. Barium hydroxide is fully dissociated. [3]

B6 WA-Q6 Calculate the pH of 0.0500 mol dm^{-3} methanoic acid at 298 K. Ka = 1.78×10^{-4} mol dm^{-3}. [3]

B7 WA-Q8 Calculate the concentration of ethanoic acid that has a pH of 3.00 at 298 K. Ka = 1.74×10^{-5} mol dm^{-3}. [3]

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B8 WA-Q9 Calculate the pH of pure water and the pH of 0.100 mol dm^{-3} sodium hydroxide at 50 °C, where Kw = 5.48 × 10^{-14} mol^2 dm^{-6}. [3]

B9 WA-Q11 Explain the two approximations made when the pH of a weak acid HA is calculated from its Ka and concentration. [3]

B10 WA-Q12 Explain why diluting a weak acid tenfold raises its pH by about 0.5 units, not by 1 unit. [3]

B11 WA-Q13 Suggest why the usual weak-acid approximations give a poor value for the pH of 0.00100 mol dm^{-3} dichloroethanoic acid, which has Ka = 5.0 × 10^{-2} mol dm^{-3}. [3]

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B12 WA-Q14 Suggest why chloroethanoic acid, $ClCH_2COOH$, pKa 2.87, is a stronger acid than ethanoic acid, pKa 4.76. [3]

B13 WA-Q16 Evaluate a student's method for the pH of 1.00×10^{-4} mol dm^{-3} ethanoic acid. The student uses $[H^+] = \sqrt{(Ka \times [HA])}$ and gets 4.38; the pH found without approximations is 4.47. [3]

B14 WA-Q18 Explain why 0.100 mol dm^{-3} ammonia solution has a pH of about 11.1, while 0.100 mol dm^{-3} sodium hydroxide has a pH of 13.00. [3]

B15 WA-Q20 Calculate the pH of pure water and of 0.0100 mol dm^{-3} sodium hydroxide at 0 °C, where pKw = 14.94. [3]

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B16 WA-Q22 Show that the pH of 0.100 mol dm^{-3} ethanoic acid at 298 K is 2.88. Ka = 1.74×10^{-5} mol dm^{-3}. [3]

SECTION C · Long, 6 marks or more

C1 WA-Q3 Describe how a student could find Ka and pKa for benzoic acid from a single pH measurement on a solution of known concentration, and explain the assumptions in the calculation and when they would fail. [6]

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