Chemistry

Standard level

Paper 2

Practice paper

Topic: Acid/Base Chemistry

Chemistry

Standard level

Paper 2

Specimen paper

1 hour 15 minutes

Instructions to candidates

- Answer all questions.
- Answers must be written within the answer boxes provided.
- A calculator is required for this paper.
- The maximum mark for this examination paper is [40 marks].

1. A student titrates a 25.0 cm^3 sample of an unknown weak monoprotic acid, HA(aq), with 0.150 mol dm^{-3} sodium hydroxide, NaOH(aq). The student finds that exactly 18.5 cm^3 of the base is required to reach the equivalence point.

(a) Calculate the amount, in moles, of NaOH(aq) required for neutralization. **[1]**

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(b) Determine the initial concentration of the weak acid, HA(aq). **[2]**

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(c) State and explain whether the pH at the equivalence point of this titration will be less than 7, equal to 7, or greater than 7. **[2]**

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(d) A different acid-base indicator must be selected for titrating HA(aq) with NaOH(aq) compared to titrating HCl(aq) with NaOH(aq). Explain why. **[2]**

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2. Acid deposition has significant environmental consequences, including effects on aquatic life and vegetation.

(a) State one anthropogenic (human-made) source of nitrogen oxides, NO_x, and one anthropogenic source of sulfur oxides, SO_x. **[2]**

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(b) Write the balanced chemical equation for the formation of sulfuric acid, $H_2SO_4(aq)$, from sulfur trioxide, $SO_3(g)$. **[1]**

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(c) Outline how acid rain damages marble or limestone statues. Include a chemical equation in your answer. **[3]**

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3. Water and the hydrogen carbonate ion, HCO_3^-, are both examples of amphiprotic species.

(a) Define the term amphiprotic. **[1]**

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(b) Write two equations to demonstrate the amphiprotic nature of the HCO_3^- ion in water. **[2]**

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(c) Identify the conjugate base of HCO_3^-. **[1]**

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4. Aqueous solutions containing hydronium ions, H_3O^+, have a quantifiable pH.

(a) Calculate the pH of a 0.050 mol dm^{-3} solution of nitric acid, $HNO_3(aq)$. **[1]**

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(b) State the mathematical relationship between $[H^+]$ and $[OH^-]$ in an aqueous solution at 298 K. **[1]**

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(c) A 25.0 cm^3 sample of 0.100 mol dm^{-3} $Ba(OH)_2(aq)$ is diluted with water to a final volume of 500 cm^3. Calculate the pH of the diluted solution at 298 K. **[3]**

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5. A student is given two unlabelled beakers. One contains 1.0 mol dm^{-3} HCl(aq) and the other contains 1.0 mol dm^{-3} HF(aq).

(a) Describe two different experimental methods (other than measuring pH) that could be used to distinguish between the two solutions. State the expected observations for each. **[4]**

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