Unit IV Learning Log: Nature of Acids and Bases

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| **Learning Intentions** | **Practice** | **Evidence** |
| D1: Identify acids and bases through experimentation.   * List general properties of acids and bases * Write balanced equations representing the neutralization of acids by bases in solution * Outline some of the uses and commercial names of common household acids and bases |  |  |
| D2: Identify various models for representing acids and bases.   * Define Arrhenius acids and bases * Define Bronsted-Lowry acids and bases |  |  |
| D3: Analyse balanced equations representing the reaction of acids or bases with water.   * Identify Bronsted-Lowry acids and bases in an equation * Define conjugate acid-base pair * Identify the conjugate of a given acid or base * Show that in any Bronsted-Lowry acid-base equation there are two conjugate pairs present * Identify H3O+ as a protonated H2O molecule that can be represented in shortened form as H+ |  |  |
| D4: Classify an acid or a base in solution as either weak or strong   * Relate electrical conductivity in a solution to the total concentration of ions * Define and give several examples for the following terms: strong acid, strong base, weak acid, weak base * Write equations to show what happens when strong and weak acids and bases are dissolved in water |  |  |
| D5: Analyse the equilibria that exist in weak acid systems.   * Compare the relative strengths of acids or bases by using a table or relative acid strengths * Predict whether products or reactants are favoured in an acid-base equilibrium by comparing the strength of the two acids (or two bases) * Compare the relative concentrations of H3O+ (or OH-) between two acids (or two bases) using their relative positions on an acid strength table |  |  |
| D6: Identify chemical species that are amphiprotic   * Define amphiprotic * Describe situations in which H2O would act as an acid or base |  |  |
| E1: Analyse the equilibrium that exists in water.   * Write equations representing the ionization of water using either H3O+ and OH- or H+ and OH- * Predict the effect of the addition of an acid or a base to the equilibrium system:   2H2O  H3O+ + OH-   * State the relative concentrations of H3O+ and OH- in acid, base, and neutral solutions * Write the equilibrium expression for Kw and state the value of Kw and 25oC * Describe and explain the variation in the value of Kw with temperature * Calculate the concentration of H3O+ or OH- using Kw |  |  |
| E2: Perform calculations relating pH, pOH, [H3O+], and [OH-]   * Define pH and pOH * Define pKw, give its value at 25oC, and its relation to pH and pOH * Calculate [H3O+] or [OH-] from pH and pOH * Describe the pH scale with reference to everyday solutions |  |  |
| E3: Explain the significance of the Ka and Kb equilibrium expressions   * Write Ka and Kb equilibrium expressions for weak acids or weak bases * Relate the magnitude of Ka or Kb to the strength of the acid or base |  |  |
| E4: Perform calculations involving Ka and Kb   * Given the Ka, Kb, and initial concentration, calculate any of the following: [H3O+], [OH-], pH, pOH * Calculate the value of Kb for a base given the value of Ka for its conjugate acid (or vice versa) * Calculate the value of Ka or Kb given the pH and the initial concentration * Calculate the initial concentration of acid or base, given the appropriate Ka, Kb, pH, or pOH values |  |  |
| F2: Describe an indicator as an equilibrium system   * Describe an indicator as a mixture of a weak acid and its conjugate base, each with distinguishing colours * Describe the term transition point of an indicator, including the conditions that exist in the equilibrium system * Describe the shift in equilibrium and resulting colour changes as an acid or a base is added to an indicator |  |  |
| F3: Perform and interpret calculations involving the pH in a solution and Ka for an indicator   * Predict the approximate pH at the transition point using the Ka value of an indicator * Predict the approximate Ka value for an indicator given the approximate pH range of the colour change * Match an indicator’s colour in solution with an approximate pH, using a table of indicators |  |  |
| F4: Describe the hydrolysis of ions in salt solutions   * Write a dissociation equation for a salt in water * Write net ionic equations representing the hydrolysis of ions in solution |  |  |
| F5: Analyse the extent of hydrolysis in salt solutions   * Predict whether a salt solution would be acidic, basic, or neutral (compare Ka and Kb values where necessary) * Determine whether an amphiprotic ion with act as a base or an acid in solution (compare Ka and Kb values where necessary) * Calculate the pH of a salt solution from relevant data, assuming the predominant hydrolysis reaction is the only reaction determining the pH |  |  |

Mid Unit Test (includes above learning outcomes)

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| F1: Demonstrate an ability to design, perform, and analyse a titration experiment involving the following: primary standards, standardized solutions, titration curves, appropriate indicators   * Write formulae, complete ionic equations, and net ionic equations for: a strong acid reacting with a strong base, a weak acid reacting with a strong base, a strong acid reacting with a weak base * Demonstrate proper titration technique when performing a titration experiment * Explain the difference between the equivalence point of a strong acid-strong base titration and the equivalence point of a titration involving a weak acid-strong base or strong acid-weak base * Interpret titration curves plotted from experimental data * Select indicators whose transition point coincides with the equivalence point of the titration reaction * Calculate the concentration of an acid or base using titration data or similar data * Calculate the volume of an acid or base with known molarity needed to completely react with a given amount of base or acid * Calculate the pH of a solution formed when a strong acid is mixed with a strong base |  |  |
| F6: Describe buffers as equilibrium systems   * Describe the tendency of buffer solutions to resist changes in pH * Describe the composition of an acidic buffer and a basic buffer * Describe qualitatively how the buffer equilibrium shifts as small quantities of acid or base are added to the buffer; the stress being the change in the concentration of the stronger acid or base * Describe in detail a common buffer system (ex/ the blood buffer system) |  |  |
| F7: Describe the preparation of buffer systems   * Outline a procedure to prepare a buffer solution * Identify the limitations in buffering action |  |  |
| F8: Predict what will happen when oxides dissolve in rain water   * Write equations representing the formation of acidic solutions or basic solutions from non-metal and metal oxides * Describe the pH conditions required for rain to be called acid rain (pH 5.0 and lower) * Relate the pH of normal rain water to the presence of dissolved CO2 * Describe sources of NOx (automobile engines) and SOx (fuels containing sulphur and smelters of sulphide ores) * Discuss general environmental problems associated with acid rain |  |  |

End of Unit Test (includes all learning outcomes)