M5 Additional Chemistry 3

Course Syllabus - 2026 Term 2

Teacher: Kru Michael Nguyen

Department: Science and Technology **Subject Code**: ST32205

Periods per week: 3 **Credits**: 1.5

Course Description

This course provides an in-depth study of fundamental chemical concepts across four major units. The course begins with an exploration of Gases, covering concepts like pressure, the gas laws, and the ideal gas law. The second unit focuses on aqueous solutions, distinguishing between types of mixtures, detailing the solution process, and quantifying matter using concentration of solutions. Next, the course examines ions in aqueous solutions and colligative properties, where students will analyze compounds in aqueous solutions and investigate how solutes alter solvent properties through colligative properties of solutions. The final unit is dedicated to acids and bases, exploring their properties, contrasting different acid-base theories, and studying acid-base reactions. This curriculum is designed to build a strong foundational understanding of chemical behavior and reactions. As with any PHS science course, each unit will also include lab-based work.

Course Content

1. Chapter 11: Gases
    - 1.1. Gases and Pressure
    - 1.2. The Gas Laws
    - 1.3. Gas Volumes and the Ideal Gas Law

2. Chapters 12 and 13: Aqueous Solutions
    - 2.1. Types of Mixtures
    - 2.2. The Solution Process
    - 2.3. Concentration of Solutions
    - 2.4. Compounds in Aqueous Solutions
    - 2.5. Colligative Properties of Solutions

3. Chapter 14: Acids and Bases
    3.1. Properties of acids and bases
    3.2. Acid-base theories
    3.3. Acid-base reactions

4. (If time permits) Chapter 15: Acid-Base Titration and pH
    4.1. Aqueous solutions and the concept of pH
    4.2. Determining pH and titrations

Learning Outcomes

1. Gasses
    - Define pressure, give units of pressure, and describe how pressure is measured.
    - State the standard conditions of temperature and pressure and convert units of pressure.
    - Use Dalton's law of partial pressures to calculate partial pressures and total pressures.
    - Use the kinetic-molecular theory to explain the relationships between gas volume, temperature and pressure.
    - Use Boyle's law to calculate volume-pressure changes at constant temperature.
    - Use Charles's law to calculate volume-temperature changes at constant pressure.
    - Use Gay-Lussac's law to calculate pressure-temperature changes at constant volume.
    - Use the combined gas law to calculate volume-temperature-pressure changes.
    - State the law of combining volumes.
    - State Avogadro's law and explain its significance.
    - Define standard molar volume of a gas and use it to calculate gas masses and volumes.
    - State the ideal gas law.
    - Using the ideal gas law, calculate pressure, volume, temperature, or amount of gas when the other three quantities are known.
    - Describe the process of diffusion.
    - State Graham's law of effusion.
    - State the relationship between the average molecular velocities of two gasses and their molar masses.

2. Solutions
    - Distinguish between electrolytes and nonelectrolytes.
    - List three different solute-solvent combinations.

- Compare the properties of suspensions, colloids, and solutions.
- Distinguish between electrolytes and nonelectrolytes.
- List and explain three factors that affect the rate at which a solid solute dissolves in a liquid solvent.
- Explain solution equilibrium, and distinguish among saturated, unsaturated, and supersaturated solutions.
- Explain the meaning of “like dissolves like” in terms of polar and nonpolar substances.
- List the three interactions that contribute to the enthalpy of a solution, and explain how they combine to cause dissolution to be exothermic or endothermic.
- Compare the effects of temperature and pressure on solubility.
- Given the mass of solute and volume of solvent, calculate the concentration of solution.
- Given the concentration of a solution, determine the amount of solute in a given amount of solution.
- Given the concentration of a solution, determine the amount of solution that contains a given amount of solute.

3. Ions in Aqueous Solutions and Colligative Properties
    - Write equations for the dissolution of soluble ionic compounds in water.
    - Predict whether a precipitate will form when solutions of soluble ionic compounds are combined, and write net ionic equations for precipitation reactions.
    - Compare dissociation of ionic compounds with ionization of molecular compounds.
    - Draw the structure of the hydronium ion, and explain why it is used to represent the hydrogen ion in solution.
    - Distinguish between strong electrolytes and weak electrolytes.
    - List three colligative properties, and explain why they are classified as colligative properties.
    - Calculate freezing-point depression, boiling-point elevation, and solution molality of nonelectrolyte solutions.
    - Calculate the expected changes in freezing point and boiling point of an electrolyte solution.
    - Discuss causes of the differences between expected and experimentally observed colligative properties of electrolyte solutions.

4. Acids and Bases
    - List five general properties of aqueous acids and bases.
    - Name common binary acids and oxyacids, given their chemical formulas.

- List five acids commonly used in industry and the laboratory, and give two properties of each.
- Define acid and base according to Arrhenius's theory of ionization.
- Explain the differences between strong and weak acids and bases.
- Define and recognize Brønsted-Lowry acids and bases.
- Define a Lewis acid and a Lewis base.
- Name compounds that are acids under the Lewis definition but are not acids under the Brønsted-Lowry definition.
- Describe a conjugate acid, a conjugate base, and an amphoteric compound.
- Explain the process of neutralization.
- Define acid rain, give examples of compounds that can cause acid rain, and describe effects of acid rain.

5. Acid-Base Titration and pH
    - Describe the self-ionization of water.
    - Define pH, and give the pH of a neutral solution at 25°C.
    - Explain and use the pH scale.
    - Given $[H_3O^+]$ or $[OH^-]$, find pH.
    - Given pH, find $[H_3O^+]$ or $[OH^-]$.
    - Describe how an acid-base indicator functions.
    - Explain how to carry out an acid-base titration.
    - Calculate the molarity of a solution from titration data.

Learning Resources

Textbook: HMH Modern Chemistry (ISBN 9780544817845)

Lesson slides, lesson notes, worksheets, and lab handouts (all will be available in Google Classroom)

Virtual experiment from Explorelearning.com (Gizmos)

Other online learning resources (PHeT, EdPuzzle, Quizizz, CK12, Simbucket, and others.)

Assessment Methods

Assignments and in class quizzes will be used to assess students' skills and understanding of basic concepts within each unit. Assignments will not be graded based on accuracy, but will instead be graded for completion and submission by assigned deadlines. The quizzes will typically be short in duration and will be

open-note in order to assess students' ability to complete basic problems without the need to memorize formulas or the steps required to finish problems.

Students' lab work will be assessed on preparation and planning, attention to detail, ability to draw conclusions and depth of evaluation. Each semester students will also have to choose a project to demonstrate their level of understanding of a particular topic. Details will be provided at the appropriate time.

Unit tests and a formal final exam will include a range of problems. About 50% of the exam will consist of problems that will cover the fundamental skills. About 30% of the exam will consist of problems that will require a deeper understanding of each topic and will require students to combine skills from several topics. About 20% of the final exam will consist of real-world application problems.

Homework Policy

An assignment that is complete and submitted on-time will receive 100% of the points.

Any complete assignment that is submitted up to 1 week late will receive 75% of the points. Any complete assignment that is submitted up to 3 weeks late will receive 50%.

Over three weeks after the due date, assignments will not be accepted and a grade of 0 will be given.

If students are absent when assignments are assigned or on an assignment due date, then it is the responsibility of the student to contact the teacher to make arrangements for submission.

Information on all assignments can be found in Google Classroom. Students should read instructions carefully to know how assignments should be submitted (either attached to Google Classroom or handed in during class) and the due date.

Evaluation Breakdown

Assessments ● Unit Tests ● Short Quizzes ● Lab Quizzes	30%
Student Work	40%

- Online Practice
- Homework/Classwork
- Labs
- Projects

Final Exam	30%