Chemistry Honors

Course Honors Chemistry

Overview

CHEMISTRY H – 4310 Full year - 1 credit

Grades 10, 11, 12

Prerequisites: Successful completion of Earth Science and Living Environment

Honors Policy Applies

"Theoretical Chemistry" is a rigorous treatment of this science with a quantitative emphasis. This course is designed for the **high ability science/mathematics student**. The Course has alternating lab periods each week (meets 7 or 8 times each week). Extensive written laboratory reports are required. The Chemistry Regents Examination terminates the course. **Very strong math skills are especially important for the course**. Since chemistry is a physical science, **success in the Living Environment often has no correlation with success in this course.**

Instructional Philosophy

All Students must be challenged. The challenge that each student faces should be one that will raise them to the next level. The challenge that they face should not set them up to fail. Rather, the challenge should allow them to critically think and problem solve so that they can realistically make decisions. Honors Chemistry is a course which will allow students to acquire these necessary skills and prepare them for the next level. Students are asked to constantly learn through Inquiry. This comes in the form of lecture (questioning), group discussions, demonstrations, and laboratory experiments. They will be asked to take data, analyze it and then draw specific conclusions. In addition, they will be asked to write extensive reports based on the experiments they have performed. The material in Honors Chemistry is always made relevant to real world applications so that students can relate to the concepts. The standards in this course are rigorous and high. This is to ensure that each of these students receives the best possible education. Once students have completed this course they will be well prepared to take Advanced Placement Chemistry class which is a college level chemistry course.

Knowledge and Skills Objectives

Ø Students will learn how to Analyze Data

Ø Students will Increase data taking, problem solving and critical thinking skills

Ø Students will learn to take notes based on the details. This includes experiments, demonstrations, words I might say, and most importantly what their colleagues say.

Ø Students will learn how to write in science.

Ø Students will learn the importance of details.

Ø Students will learn the importance of their input to the class.

Ø Students will learn the beauty of this very interesting and relevant science.

Units of Study

Required Materials:

Notebook for lecture

Bound marble note book for laboratory experiments

Scientific calculator (**NO GRAPHING CALCULATORS**)

I) Review of Mathematical Principles

Scientific Notation.

Students will be able to convert decimal numbers to scientific notation and the reverse.

Students will be able to use their scientific calculators to perform calculations with decimal numbers, very large numbers, and very small numbers using scientific notation on their calculators.

Students will be able to solve mathematical equations for ant type of variable ie. Solve for m, in $KE= ½mv^2$

II) Measurement

Students will understand the fundamental units of mass, time, distance, and volume.

Students will be able to perform unit conversions using the ***factor label method only.***

Students will be able to solve chemistry problems that are mathematically based using dimensional analysis.

Students will understand the meaning and reason for significant figures and how to apply them to their computations.

Students will be able to determine the difference between accuracy and precision.

III) Matter

Physical and Chemical changes

Students will be able to determine what physical and chemical properties are. They will then be able to associate this to physical and chemical changes.

Density will be discussed as a physical property with mathematical applications.

Students will be able to distinguish between elements, compounds, atoms and molecules.

Students will be able determine the difference between homogenous and heterogeneous mixtures.

Students will understand what alloys are.

Students will be able to understand and perform mixture separation through various types of filtration, distillation, chromatography etc.

Students will understand the principle of mass conservation.

IV) Energy (Thermodynamics Part I)

Students will be able to understand what energy is through a simple definition of force and work.

Students will understand the units of work that will then relate to energy.

Students will understand that there are only two types of energy; Kinetic and Potential. All other misconceptions that they have must be made clear to them.

Students will understand Internal Energy.

Students will understand that ***heat is not a form of energy*** but rather it is the flow of energy.

Students will understand the definition of temperature, how to measure temperature, its units and Celsius/Kelvin conversions.

Students will understand that temperature is not a measure of heat.

Students will know the definitions of all of the phase changes. They must understand that these are physical changes that are **equilibrium** processes.

Students will understand the meaning of heats of fusion and vaporization. They will also under stand specific heat.

Students will use mathematical applications of heat and temperature. These include the equations $Q=mc_p\Delta t$, $Q= mH_f$ and $Q=mH_v$.

Students will understand how to thoroughly interpret heating and cooling curves. Calculations of determining heat, specific heat, heats of fusion and vaporization will be required.

These curves will have x axis units of both time and heat.

Students will understand the principle of energy conservation.

Mathematical problems involving this principle will be required; Heat lost equals heat gained. ($mc_p\Delta t_{(lost)} = mc_p\Delta t_{(gained)}$)

V) Gas Laws

Students will learn the properties of gases.

Students will learn the important quantities associated with gases including pressure, volume, temperature, # of particles.

Students will understand the meaning of these quantities.

Students will understand the units of pressure from fundamental units. For example, P=Force/Area. Newton/m^3= Pascal (Pa) They should be able to convert to kPa.

An in depth discussion of Kinetic Molecular Theory (KMT) and Ideal gases will be taught.

Students will understand fully the affects of atmospheric pressure and how strong it is.

Students will understand both a qualitative and quantitative description of the following gas laws:

a) Boyles Law

b) Charles' Law

c) Gay-Lussac Law

d) Avogadro's Hypothesis

e) Combined Gas Law

f) Dalton's Law of Partial Pressures

g) Graham's Law of Effusion

h) Ideal Gas Law

Students will understand the meaning of vapor pressure.

Students will understand how to interpret table H.

Students will understand factors that affect vapor pressure.

Students will understand what boiling is.

Students will understand boiling at high and low atmospheric pressure situations.

VI) Chemical Equations

Students will learn how to write chemical formulas.

Students will learn how to name compounds.

Students will learn what a chemical equation is.

Students will learn how to write chemical equations.

Students will learn how to balance chemical equations.

Students will learn the types of chemical equations. These include synthesis, decomposition, single replacement, double replacement, combustion, etc.

VII) Stoichiometry

Students will understand molecular mass.

Students will be able to do conversions from moles to grams to #of molecule to # of atoms to # of liters in any order. They must use ***factor label methods***.

Students will understand what a stoichiometric ratio in a chemical equation means.

Students will solve problems involving chemical equations and Stoichiometry.

Students will understand and solve problems involving limiting and excess reagents in a chemical equation.

Students will be able to determine % yield.

Students will understand and solve problems involving % composition by mass.

Students will under stand qualitatively and quantitatively how to solve problems to determine empirical and molecular formulas.

VIII) Atomic Theory and Structure

Students will learn the historical approach to the atom. That is,

Greeks
John Dalton
Thompson
Ernest Rutherford
Niels Bohr
Max Planck
Erwin Schrödinger

Specifics should include JJ Thompson's discovery of the electron through cathode ray tube, Rutherford's gold foil experiment, Niels Bohr's planetary model including the idea of ***ALLOWED ENERGY LEVELS.*** The qualitative and quantitative use of Planck's Equation and the excitation of electrons.

During this time students will learn the parts of the atom including their mass and charges.

$E=hf$ and $V=f\lambda$ will be taught for their qualitative and quantitative use.

Electromagnetic spectrum and relative scale will be understood and learned by all students. Units of nanometers and meters will both be used.

Students will learn the meaning of complete electron configurations. The must also be able to construct the complete electron configurations for any element. They will be able to rational these through the periodic table s block, p block, d block and f block elements. This includes the

a) Principle energy levels

b) Sublevels

c) Orbital shape and direction

d) Electron spin

Students should be able to answer questions about the configurations.

IX) Nuclear Chemistry

Students will learn Radioactivity.

Students will learn Nuclear Reactions.

Students will learn Natural transmutations including alpha and beta decay as well as positron emission.

Students will learn artificial transmutations including fission and fusion.

Students will learn Nuclear reactors. All parts as well as breeder reactors and the discussion of fissionable materials.

Students will learn $E=mc^2$, thorough explanation as well as evaluation.

X) Chemical Bonding and the Periodic Table

Students will learn The Chemical bond as an electrostatic attraction between + and – Charges.

Students will learn Interpretation of the chemical bond as described by Linus Pauling.

Students will learn Ionic Bonding.

Students will learn Covalent Bonding:

i. Polar covalent Bonding

ii Non-polar Covalent bonding

Students will learn Construction of Lewis electron dot Diagrams.

Students will learn The relation of electron cloud symmetry to the chemical bond.

Students will learn The use of simple VSEPR model to predict molecular shape.

Students will learn Using the periodic table to predict atomic structure as well as molecular structure and properties.(s,p,d,f block elements).

Students will learn Periodic trends as related to atomic radius, electronegativity and ionization energy.

Students will learn Shielding and $Z_{effective}$ to predict the above trends.

Students will learn Group names.

Students will learn Properties of each group.

XI) Intermolecular Forces

Students will learn Hydrogen bonding.

Students will learn Dipole-Dipole interactions.

Students will learn London Dispersion Forces.

Students will learn Molecule-ion interactions.

Students will learn Intermolecular forces and their relationship to physical properties including boiling and melting point, heat of vaporization, vapor pressure, and surface tension.

Students will learn Students will understand the partial negative and positive charges developed on a molecule. **(δ-, δ+)**

XII) Solutions

Students will learn the process of solvolysis and dissolution will be understood through intermolecular forces.

Students will learn Electrolytic and non electrolytic solutions.

Students will learn Saturation, unsaturation, supersaturation as related to solution equilibrium.

Students will learn Concentrations

i. Molarity

ii. Molality

iii. Parts per million

iv. Parts per billion

Students will learn Solubility; reading and constructing solubility curves.

Students will learn Preparing solutions from a solid or liquid and dilutions.

Students will learn Colligative properties

i. Boiling point elevation $\Delta T = m \times k_{bp} x\ n$

ii. Freezing point depression $\Delta T = m \times k_{fp} x\ n$

iii. Vapor pressure lowering

XIII) Thermodynamics Part II

Students will learn Internal Energy.

Students will learn Heat of formation.

Students will learn Using Heat of formation to calculate Heat of reaction (ΔH).

Students will learn Entropy and disorder (ΔS).

Students will learn Using Entropy and heat of reaction to determine spontaneity through the Gibbs-Helmholtz Equation ($\Delta G = \Delta H - T\Delta S$).

XIV) Kinetics

Students will learn Collision theory.

Students will learn Determining simple rate laws.

Students will learn Potential energy diagrams.

XV) Chemical Equilibrium

Students will learn The equilibrium Process

i. Phase equilibrium

ii. Solution equilibrium

iii. Chemical equilibrium.

Students will learn LeChatlier’s Principles.

Students will learn Solubility equilibrium.

Students will learn Net-ionic equations.

Students will learn Equilibrium constants

i. Writing

ii. Evaluating

iii. Finding concentrations

iv. Understanding $K_{eq}<1$ and $K_{eq}>1$

XVI) Acid and Bases

Students will learn Understandings of Acids and bases

i. Arrhenius

ii. Bronsted-Lowry

iii. Lewis

Students will learn Understanding the pH scale. The purpose of a Log scale.

Students will learn Solving problems with pH for both strong and weak acids $pH= -Log [H^+]$.

Students will learn Students will learn Ka values, understanding significance, evaluating and calculating.

Students will learn The titration experiment.

Students will learn Titration problems.

Students will learn Acid Base indicators.

XVII) Redox and Electrochemistry

Students will learn Understanding oxidation and reduction.

Students will learn Writing half reactions.

Students will learn Balancing Redox reactions in Acid .

Students will learn Electrochemical Cells (voltaic).

Students will learn Electrolytic Cells.

XVIII) Organic Chemistry

Properties.

Students will learn Hydrocarbons: Naming &Building

i. Alkanes

ii. Alkenes

iii. Alkynes

Students will learn Functional Groups: Naming and Building

i. Aldehydes

ii. Ketones

iii. Carboxylic Acids

iv. Esters

v. Ethers

vi. Amides

vii. Amines

viii. Alcohols

Students will learn Organic Reactions

i. Addition

ii. Substitution

iii. Esterefication

iv. Saponification

v. Fermentation

vi. Combustion

Major Resources

Ø Textbook

Ø Class notes

Ø Every other student in class. Since the class is inquiry based, it is essential that each student participates and gives his/her analysis of the material. As mentioned above this material is presented through a variety of means: Questioning and group discussion, Chemical Demonstrations, Laboratory Experiments.