Student Name: ______________________ Date: _____________________

Chemistry 30S

Course Outcomes
Organic Chemistry

Learning Outcomes:

- ❑ Compare and contrast inorganic and organic chemistry.

  Include: the contributions of Friedrich Wöhler to the overturn of vitalism
- ❑ Identify the origins and major sources of hydrocarbons and other organic compounds.

  Include: natural and synthetic sources
- ❑ Describe the structural characteristics of carbon.

  Include: bonding characteristics of the carbon atom in hydrocarbons (single, double, triple bonds)
- ❑ Compare and contrast the molecular structures of alkanes, alkenes, and alkynes.

  Include: trends in melting points and boiling points of alkanes only
- ❑ Name, draw, and construct structural models of the first 10 alkanes.

  Include: IUPAC nomenclature, structural formulas, condensed structural formulas, molecular formulas, general formula CnH(2n+2)
- ❑ Name, draw, and construct structural models of branched alkanes.

  Include: six-carbon parent chain, methyl and ethyl substituent groups, IUPAC nomenclature
- ❑ Name, draw, and construct structural models of isomers for alkanes up to six-carbon atoms.

  Include: condensed structural formulas
- ❑ Outline the transformation of alkanes to alkenes and vice versa.

  Include: dehydrogenation/hydrogenation, molecular models
- ❑ Name, draw, and construct molecular models of alkenes and branched alkenes.

  Include: six-carbon parent chain, methyl and ethyl substituent groups, IUPAC nomenclature, structural formulas, condensed structural formulas, molecular formulas, general formula C_nH_{2n}
- ❑ Differentiate between saturated and unsaturated hydrocarbons.

- ❑ Outline the transformation of alkenes to alkynes and vice versa.

  Include: dehydrogenation/hydrogenation, molecular models
- ❑ Name, draw, and construct structural models of alkynes and branched alkynes.

  Include: six-carbon parent chain, methyl and ethyl substituent groups, IUPAC nomenclature, structural formulas, condensed structural formulas, molecular formulas, general formula CnH2n-2
- ❑ Compare and contrast the structure of aromatic and aliphatic hydrocarbons.

  Include: molecular models, condensed structural formulas
- ❑ Describe uses of aromatic hydrocarbons.

  Examples: polychlorinated biphenyls, caffeine, steroids, organic solvents (toluene, xylene)…
- ❑ Write condensed structural formulas for and name common alcohols.

  Include: maximum of six-carbon parent chain, IUPAC nomenclature
- ❑ Describe uses of methyl, ethyl, and isopropyl alcohols.
- ❑ Write condensed structural formulas for and name organic acids.

  Include: maximum of six-carbon parent chain, IUPAC nomenclature
- ❑ Describe uses or functions of common organic acids.

  Examples: acetic, ascorbic, citric, formic, acetylsalicylic (ASA), lactic…
- ❑ Perform a lab involving the formation of esters, and examine the process of esterification.
- ❑ Write condensed structural formulas for and name esters.

  Include: up to 6-C alcohols and 6-C organic acids, IUPAC nomenclature
- ❑ Describe uses of common esters.

  Examples: pheromones, artificial flavourings…
- ❑ Describe the process of polymerization and identify important natural and synthetic polymers.

  Examples: polyethylene, polypropylene, polystyrene, polytetrafluoroethylene (Teflon®)…
- ❑ Describe how the products of organic chemistry have influenced quality of life.

  Examples: synthetic rubber, nylon, medicines, polytetrafluoroethylene (Teflon®)…
- ❑ Use the decision-making process to investigate an issue related to organic chemistry.

  Examples: gasohol production, alternative energy sources, recycling of plastics…

Labs:

- ❑ Constructing Models of Hydrocarbons
- ❑ Esterfication
- ❑ The Slime Lab!

Student Name: ______________________ Date: _____________________

Chemistry 30S

Course Outcomes
Physical Properties of Matter

Learning Outcomes:

- ❑ Describe the properties of gases, liquids, solids, and plasma.

  Include: density, compressibility, diffusion
- ❑ Use the Kinetic Molecular Theory to explain properties of gases.

  Include: random motion, intermolecular forces, elastic collisions, average kinetic energy, temperature
- ❑ Explain the properties of liquids and solids using the Kinetic Molecular Theory.
- ❑ Explain the process of melting, solidification, sublimation, and deposition in terms of the Kinetic Molecular Theory.

  Include: freezing point, exothermic, endothermic
- ❑ Use the Kinetic Molecular Theory to explain the processes of evaporation and condensation.

  Include: intermolecular forces, random motion, volatility, dynamic equilibrium
- ❑ Operationally define vapour pressure in terms of observable and measurable properties.
- ❑ Operationally define normal boiling point temperature in terms of vapour pressure.
- ❑ Interpolate and extrapolate the vapour pressure and boiling temperature of various substances from pressure versus temperature graphs.

Labs:

- ❑ Measuring the Vapour Pressure of a Liquid
- ❑ Identify Products of a Chemical Reaction

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Chemistry 30S

Course Outcomes

Chemical Reactions

Learning Outcomes:

- ❑ Determine average atomic mass using isotopes and their relative abundance.

  Include: atomic mass unit (amu)
- ❑ Research the importance and applications of isotopes.

  Examples: nuclear medicine, stable isotopes in climatology, dating techniques…
- ❑ Write formulas and names for polyatomic compounds using International Union of Pure and Applied Chemistry (IUPAC) nomenclature.
- ❑ Calculate the mass of compounds in atomic mass units.
- ❑ Write and classify balanced chemical equations from written descriptions of reactions.

  Include: polyatomic ions
- ❑ Predict the products of chemical reactions, given the reactants and type of reaction.

  Include: polyatomic ions
- ❑ Describe the concept of the mole and its importance to measurement in chemistry.
- ❑ Calculate the molar mass of various substances.
- ❑ Calculate the volume of a given mass of a gaseous substance from its density at a given temperature and pressure.

  Include: molar volume calculation
- ❑ Solve problems requiring interconversions between moles, mass, volume, and number of particles.
- ❑ Determine empirical and molecular formulas from percent composition or mass data.
- ❑ Interpret a balanced equation in terms of moles, mass, and volumes of gases.

- ❑ Solve stoichiometric problems involving moles, mass, and volume, given the reactants and products in a balanced chemical reaction.

  Include: heat of reaction problems
- ❑ Identify the limiting reactant and calculate the mass of a product, given the reaction equation and reactant data.
- ❑ Perform a lab involving mass-mass or mass-volume relations, identifying the limiting reactant and calculating the mole ratio.

  Include: theoretical yield, experimental yield
- ❑ Discuss the importance of stoichiometry in industry and describe specific applications.

  Examples: analytical chemistry, chemical engineering, industrial chemistry…

Labs:

- ❑ Formula of a Hydrate

Student Name: ______________________ Date: _____________________

Chemistry 30S

Course Outcomes
Solutions

Learning Outcomes:

- ❑ Describe and give examples of various types of solutions.

  Include: all nine possible types
- ❑ Describe the structure of water in terms of electronegativity and the polarity of its chemical bonds.
- ❑ Explain the solution process of simple ionic and covalent compounds, using visual, particulate representations and chemical equations.

  Include: crystal structure, dissociation, hydration
- ❑ Explain heat of solution with reference to specific applications.

  Examples: cold packs, hot packs…
- ❑ Perform a lab to illustrate the formation of solutions in terms of the polar and nonpolar nature of substances.

  Include: soluble, insoluble, miscible, immiscible
- ❑ Construct, from experimental data, a solubility curve of a pure substance in water.
- ❑ Differentiate among saturated, unsaturated, and supersaturated solutions.
- ❑ Use a graph of solubility data to solve problems.
- ❑ Explain how a change in temperature affects the solubility of gases.
- ❑ Explain how a change in pressure affects the solubility of gases.
- ❑ Perform a lab to demonstrate freezing-point depression and boiling-point elevation.
- ❑ Explain freezing-point depression and boiling-point elevation at the molecular level.

  Examples: antifreeze, road salt…

- ❑ Differentiate among, and give examples of, the use of various representations of concentration.

  Include: grams per litre (g/L), % weight-weight (% w/w), % weight-volume (% w/v), % volume/volume (% v/v), parts per million (ppm), parts per billion (ppb), moles per litre (mol/L) (molarity)
- ❑ Solve problems involving calculation for concentration, moles, mass, and volume.
- ❑ Prepare a solution, given the amount of solute (in grams) and the volume of solution (in millilitres), and determine the concentration in moles/litre.
- ❑ Solve problems involving the dilution of solutions.

  Include: dilution of stock solutions, mixing common solutions with different volumes and concentrations
- ❑ Perform a dilution from a solution of known concentration.
- ❑ Describe examples of situations where solutions of known concentration are important.

  Examples: pharmaceutical preparations, administration of drugs, aquaria, swimming-pool disinfectants, gas mixes for scuba, radiator antifreeze…
- ❑ Describe the process of treating a water supply, identifying the allowable concentrations of metallic and organic species in water suitable for consumption.

Labs:

- ❑ Saturated, Unsaturated and Supersaturated Solutions
- ❑ Concentrations and Dilutions
- ❑ Freezing Point Depression

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Chemistry 30S

Course Outcomes
Gases and the Atmosphere

Learning Outcomes:

- ❑ Identify the abundances of the naturally occurring gases in the atmosphere and examine how these abundances have changed over geologic time.

  Include: oxygenation of Earth's atmosphere, the role of biota in oxygenation, changes in carbon dioxide content over time

- ❑ Research Canadian and global initiatives to improve air quality.

- ❑ Examine the historical development of the measurement of pressure.

  Examples: the contributions of Galileo Galilei, Evangelista Torricelli, Otto von Guericke, Blaise Pascal, Christiaan Huygens, John Dalton, Joseph Louis Gay-Lussac, Amadeo Avogadro…

- ❑ Describe the various units used to measure pressure.

  Include: atmospheres (atm), kilopascals (kPa), millimetres of mercury (mmHg), millibars (mb)

- ❑ Experiment to develop the relationship between the pressure and volume of a gas using visual, numeric, and graphical representations.

  Include: historical contributions of Robert Boyle

- ❑ Experiment to develop the relationship between the volume and temperature of a gas using visual, numeric, and graphical representations.

  Include: historical contributions of Jacques Charles, the determination of absolute zero, the Kelvin temperature scale

- ❑ Experiment to develop the relationship between the pressure and temperature of a gas using visual, numeric, and graphical representations.

  Include: historical contributions of Joseph Louis Gay-Lussac

- ❑ Solve quantitative problems involving the relationships among the pressure, temperature, and volume of a gas using dimensional analysis.

  Include: symbolic relationships

- ❑ Identify various industrial, environmental, and recreational applications of gases.

  Examples: self-contained underwater breathing apparatus (scuba), anaesthetics, air bags, acetylene welding, propane appliances, hyperbaric chambers…

Labs:

- ❑ Boyle's Law
- ❑ Cartesian Diver
- ❑ The Density of Carbon Dioxide