Student Review Sheet

Chemistry Semester B Examination

Test Description

Length: 2 hours
Items: 70 SR (~85%), 2 BCRs (~15%)

Unit	Approximate Number of Selected Response Items
Skills and Processes	13
Bonding	14
Kinetic Molecular Theory	9
Solutions	12
Acids and Bases	13
Thermodynamics	9
Totals	**70**

The vocabulary terms and objectives are grouped into units for your convenience. Some items may occur in multiple units during the semester. The vocabulary includes terms that students may encounter when reading examination items. (H) indicates items found on the Honors Chemistry examination but not on the Chemistry examination.

Some Vocabulary for the Exam:

Skills & Processes
conclusion
control
data
dependent variable
experiment
hypothesis
independent variable

Bonding
cation
anion
ion
ionic bonding
valence electrons
covalent bonds
Lewis dot diagrams
electronegativity
octet rule
single bond
double bond
triple bond
bonding electron pair
non-bonding electron pair
central atom
linear
trigonal planar
tetrahedral
trigonal pyramidal
angular/bent
VSEPR theory
alkane
alkene
alkyne
hydrocarbon
organic compound
polymer
carboxylic functional group
alcohol functional group
dipole
bond polarity
molecular polarity
electrostatic attraction
hydrogen bond
surface tension
viscosity
volatile

Kinetic Molecular Theory
phases of matter
states of matter
solid
liquid
gas
melting
freezing
condensation
sublimation
vaporization
melting point
boiling point
freezing point
absolute zero
Celsius
Kelvin

kinetic energy
melting point
boiling point
freezing point
heating curve
cooling curve
crystallization
physical change
pressure
volume
temperature
Kinetic Molecular Theory
Boyle's Law
inverse relationship
Charles' Law
direct relationship
Combined Gas Law
Gay-Lussac's Law
molar volume
Ideal Gas Law

Solutions
electrolyte
ionic compound
covalent compound
solute
solvent
dissociation
ionization
miscible
immiscible
solubility
concentration
saturated
supersaturated
unsaturated
dilute
molarity
molality
boiling point elevation
freezing point depression
conductivity
solubility curves

Acids & Bases
acid
base
indicator
litmus paper
phenolphthalein
bromothymol blue
Arrhenius acid/base
Bronsted-Lowry acid/base
hydronium ion
hydroxide ion
electron pair acceptor/donor
amphoteric
pH
neutralization reaction
salt
antacid
buffer
titration

Thermodynamics
calorimetry
conservation of energy
specific heat
heat
closed system
calorimeter
energy change
endothermic
exothermic
activation energy
catalyst
surface area
equilibrium
activation energy
energy diagram
disorder
collisions

Upon successful completion of Semester B the student should be able to:

Skills and Processes
- interpret graphs and diagrams.
- identify trends revealed by data.
- analyze data to form conclusions.
- defend the need for verifiable data.
- identify the control in an experiment.
- read and interpret a technical passage.
- identify the hypothesis of an experiment.
- identify meaningful, answerable, scientific questions.
- identify appropriate methods for conducting an investigation.
- use ratio and proportion in appropriate situations to solve problems.
- distinguish between a dependent variable and an independent variable.
- describe similarities and differences when explaining concepts and/or principles.
- identify the appropriate instruments and materials needed to conduct an experiment.
- recognize safe laboratory procedures.

- organize data using appropriate techniques.
- determine the relationships between quantities and develop the mathematical model that describes these results.
- check graphs to determine that they do not misrepresent results.
- use analyzed data to confirm, modify or reject a hypothesis.

Bonding

- explain how atoms will interact with other atoms through the transfer and sharing of electrons in the formation of chemical bonds.
- construct electron dot structures of atoms and ions to demonstrate the formation of ionic and covalent compounds.
- distinguish among metallic, ionic, and covalent solids in terms of solubility, melting point, boiling point and conductivity.
- summarize that the properties of a molecule are determined by the atoms it contains and their arrangement.
- determine the molecular geometry through tetrahedral compounds based on Lewis dot diagrams and octet rule.
- explain why organic compounds are so numerous and diverse.
- relate the charge of ions to the number of electrons gained or lost.
- define chemical bonds.
- define ionic bonds.
- characterize bonds as ionic based on the metal-nonmetal combination.
- explain the role of valence electrons in ionic bond formation.
- define covalent bonds.
- characterize bonds as covalent based on the nonmetal-nonmetal combination.
- explain the role of valence electrons in covalent bond formation.
- explain the formation of single, double, and triple covalent bonds.
- define metallic bonds.
- analyze molecular geometry in order to classify molecules as polar or non-polar
- conceptually explain hydrogen bonding.
- recognize alkenes and alkynes, carboxylic and alcohol functional groups.
- recognize the ability of carbon to form chains and make rings.
- explain the shape and polarity of the water molecule.
- use the concept of electronegativity to define bond polarity.
- compare ionic and covalent bonds in terms of bond energy.

Kinetic Molecular Theory

- define the phase changes of matter.
- describe observed changes in pressure, volume or temperature of a sample in terms of macroscopic changes and the behavior of particles.
- classify matter as solids, liquids, and gases, in reference to the relative position, motion and energy of particles.
- describe kinetic theory of ideal gases at STP.
- observe and explain the change in density of water as phase changes occur.
- apply the combined and ideal gas laws in calculations.

- illustrate that thermal energy in a material consists of the ordered and disordered motions of its colliding particles.
- differentiate between thermal energy and temperature.
- interpret the different parts of a heating/cooling curve in terms of motion, kinetic energy, and organization of particles.
- describe the changes in particle motion and organization between phase changes.
- identify the melting/freezing and boiling point on a heating/cooling curve.
- describe the effect of pressure or volume changes to a sample of solid, liquid, or gas when temperature is held constant.
- describe the effect of pressure or temperature changes to a sample of solid, liquid, or gas when volume is held constant.
- describe the effect of temperature or volume changes to a sample of solid, liquid, or gas when pressure is held constant.

Solutions

- differentiate among elements, compounds, mixtures, and solutions.
- describe the properties of solutions.
- identify the solute and solvent of a solution.
- define solubility.
- compare solutions to suspensions and colloids.
- recognize gaseous solutions and alloys.
- distinguish among the types of solutions by degree of concentration, dilute through supersaturated.
- conceptually define molarity.
- interpret solubility curves.
- explain how factors of solute surface area, temperature, and agitation influence the rate of dissociation/ionization.
- define electrolytes in terms of composition and properties.
- calculate the quantities needed to prepare molar solutions.
- describe how to prepare molar solutions.
- define electrolytes in terms of composition and properties.
- predict a boiling point elevation and a freezing point depression conceptually.

Acids & Bases

- differentiate among acids, bases and salts based on their properties.
- distinguish among strong and weak acids and bases.
- describe the characteristics of salts.
- describe how indicators can be used to identify acids and bases.
- describe the pH scale.
- describe a neutralization reaction
- define an acid or base using the Arrhenius definition including the hydronium ion.
- describe concentrated and dilute as they apply to acids and bases.
- define an acid or base using the Bronsted-Lowry definition.
- recognize the ability of water to act as either an acid or a base.

- describe the function of buffers.
- predict whether a substance is an acid or base based on its pH value.
- explain the relationship between the hydronium ion concentration and the pH.
- calculate the pH given the hydronium or hydroxide ion concentration (whole number without calculators).
- determine the concentration of an unknown acid or base using titration data.
- Use calculations to determine the relationship among pH, pOH, and Kw. (H)

Thermodynamics

- illustrate that thermal energy in a material consists of the ordered and disordered motions of its colliding particles.
- explain why the interactions among particles involve a change in the energy system.
- define exothermic changes in terms of bond formation, dissociation, and thermal energy release.
- define endothermic changes in terms of bond breaking, dissociation, and thermal energy absorption.
- state that the total amount of energy in any isolated system remains constant.
- explain that all systems tend towards disorder and lower energy.
- recognize that chemical reactions occur at different speeds.
- explain that atoms must collide with sufficient energy to react.
- describe the direct relationship between reaction rate and frequency of molecular collisions.
- define specific heat.
- use the law of conservation of energy to solve calorimetry problems.
- define activation energy.
- analyze energy graphs for endothermic and exothermic chemical reactions.
- describe the effects of surface area, temperature, and concentration on the frequency of molecular collisions.
- explain the concept of catalyst behavior.
- describe systems at equilibrium.
- describe factors that affect systems at equilibrium.
- predict the effect of a change (stress) on a system at equilibrium.
- Use Hess's law to calculate the energy of a reaction. (H)

BCRs were put on the exam review sheets to encourage appropriate student collaboration and review of concepts in preparation for the entire exam (not just the BCRs). Teachers should <u>not</u> address these BCRs during the course of their instruction nor should they assist in preparing students for the BCRs during exam review. Students are able to collaborate and use other resources to review and solidify concepts. Students should be prepared to answer any of the following BCRs. Teachers will select TWO from the list below on the day of the exam:

BCR: Which Towel?

A student asks a testable question: "Which brand of paper towel absorbs the greatest volume of water?"

Design an investigation to provide an answer for the student.

Be sure to include

- the materials needed.
- a numbered procedure.
- the independent and dependent variables.
- important data that will answer the question.
- ways to help ensure the accuracy of the results.

BCR: Water Molecule

An important property of water is its ability to dissolve other substances. Water dissolves more substances than any other liquid. Were it not for the solvent property of water, life could not exist, because water transfers nutrients vital to life in animals and plants.

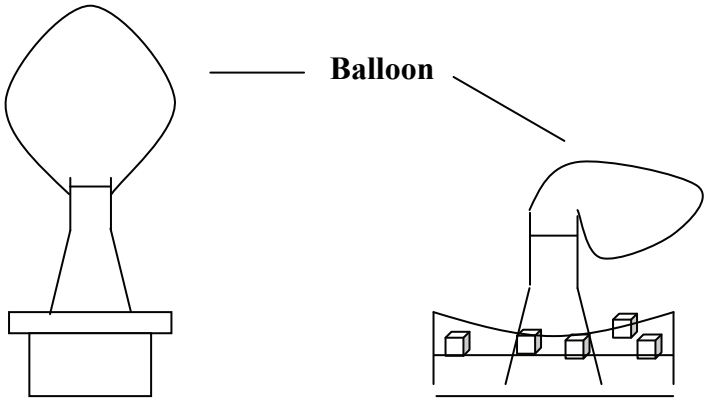
Describe how the arrangement of atoms in the water molecule determines its properties.

Be sure to

- diagram the arrangement of the electrons around the atoms in a water molecule.
- describe how the arrangement of atoms determines the shape of the water molecule.
- describe how the shape of the water molecule contributes to its solvent properties.

BCR: The Balloon

A balloon is placed over an empty flask. The flask is heated on a hot plate and then cooled in a container of ice water. The effect on the balloon is shown in the diagram below.



Explain this observation based on the Kinetic Molecular Theory.

In your response, be sure to

- describe the effect of temperature on the kinetic energy of the gas particles.
- describe the motion of the gas particles.
- describe the effects of this change on the pressure and volume of the gas sample.

BCR: The Race is On!

It's race time! You've been given the task of generating hydrogen gas from magnesium ribbon and hydrochloric acid and collecting it in a gas collection bottle. The challenge of this is to collect the gas in the smallest amount of time that you can. Using chemical principles, describe how you would accomplish this task.

In your response, be sure to

- explain the conditions necessary for a chemical reaction to occur between atoms.
- describe the relationship between the rate of a chemical reaction and the frequency of collisions between molecules.
- describe how the methods you would use to speed up this reaction are related to the frequency of collisions between molecules.

Student Review Sheet

The following information will be provided in the test book for students to use during their exam:

- Science Rubric for BCRs
- Solubility Table
- Common Ions
- Periodic Table of the Elements
- Reference Sheet

REFERENCE SHEET

Chemistry Equations

$\%\ \text{yield} = \frac{actual}{theoretical} \times 100$ $\%\ \text{error} = \frac{experimental - accepted}{accepted} \times 100$

$PV = nRT$ $\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$ $P_T = P_1 + P_2 + P_3 + \ldots$ $\frac{RateA}{RateB} = \sqrt{\frac{Molar\ Mass\ B}{Molar\ Mass\ A}}$

$\text{Molarity} = \frac{moles(solute)}{L(solution)}$ $\text{molality} = \frac{moles(solute)}{kg(solvent)}$ $M_1V_1 = M_2V_2$

$\Delta T_f = K_f \bullet m$ $\Delta T_b = K_b \bullet m$

$K_w = [H_3O^+][OH^-]$ $pH + pOH = 14$ $pH = -\log[H_3O^+]$

$pOH = -\log[OH^-]$ $[H_3O^+] = 10^{-pH}$

$q = mC_p\Delta T$ $q_{metal} = -q_{water}$ $\Delta H^0_{reaction} = \Sigma\, n_p \Delta H_f{}^0(\text{products}) - \Sigma\, n_r \Delta H_f{}^0(\text{reactants})$

$\Delta G = \Delta H - T\Delta S$

Constants & Conversions

1 atm = 760 torr = 760 mmHg = 101.3 kPa $^oC + 273 = K$ STP: 1 atm & 273 K

$R = 0.0821\ L \bullet atm/mol \bullet K$ or $R = 8.31\ L \bullet kPa/mol \bullet K$ At STP: 1 mole = 22.4 L

$K_w = 1.0 \times 10^{-14}$