Unit 1: Structure and Properties of Matter

PARTICLE VIEW OF STATES OF MATTER

A.1 Create and/or evaluate models that illustrate how the motion and arrangement of particles differ among solids, liquids, and gases.

A.2 Describe how the properties of solids, liquids, and gases are related to particle arrangement.

A.3 Create and/or evaluate models that illustrate how changes in temperature influence the motion of particles in solids, liquids, and gases.

B.1 Justify the choice of equipment used to make a measurement, based on precision.

B.2 Record measured values to the proper experimental precision.

C.1 Create and/or evaluate particulate and graphical models representing the density of pure substances.

C.2 Explain the relationship between the density and the arrangement of particles within a pure substance.

C.3 Perform calculations relating to the density of pure substances.

PHASE CHANGES AND PARTICLE INTERACTIONS

A.1 Create and/or evaluate a claim about the relationship between transfer of thermal energy and the temperature change in different samples.

A.2 Perform calculations using data gathered from a simple constant-pressure calorimetry experiment.

B.1 Use data to explain the direction of energy flow into or out of a system.

C.1 Explain the relationship between changes in states of matter and the attractions among particles.

C.2 Create and/or interpret models representing phase changes.

D.1 Create and/or interpret heating and cooling curves and/or phase diagrams of pure substances.

D.2 Calculate the energy transferred when a substance changes state.

Learning Objectives

KINETIC MOLECULAR THEORY

A.1 Create and/or evaluate models that illustrate how a gas exerts pressure.

A.2 Explain the relationship between pressure in a gas and collisions.

B.1 Explain the relationships between the macroscopic properties of a sample of a gas using the kinetic molecular theory.

B.2 Create and/or evaluate models that illustrate how a sample of gas responds to changes in macroscopic properties.

C.1 Determine mathematically and/or graphically the quantitative relationship between macroscopic properties of gases.

C.2 Perform calculations relating to the macroscopic properties of gases.

Unit 2: Chemical Bonding and Interactions

CLASSIFICATION AND INTERACTIONS OF MATTER

A.1 Distinguish between atoms, molecules, and compounds at the particle level.

A.2 Create and/or evaluate models of pure substances.

B.1 Create and/or evaluate models of mixtures.

B.2 Interpret the results of an experiment involving the separation of a mixture.

C.1 Relate the total and partial pressure of a gas mixture to the number of particles and their proportions.

D.1 Create and/or evaluate a claim about the types of forces that are overcome during the melting, boiling, and/or dissolving of substances.

MOLECULAR STRUCTURE AND PROPERTIES

A.1 Create and/or evaluate models that illustrate how molecular properties influence the type(s) of intermolecular force(s) present in a substance.

A.2 Create and/or evaluate a claim about the type(s), strength(s), and origin(s) of intermolecular forces present in a substance.

B.1 Create and/or evaluate a claim that uses relative strength of intermolecular forces to explain trends in the physical properties of substances.

C.1 Describe trends in properties of elements based on their position in the periodic table and the shell model of the atom.

D.1 Create and/or evaluate Lewis diagrams for molecular compounds and/or polyatomic ions.

D.2 Determine if given molecules are structural isomers.

E.1 Determine molecular geometry from a Lewis diagram using valence shell electron pair repulsion theory.

F.1 Determine the polarity of a molecule from its molecular geometry and electron distribution.

G.1 Create and/or evaluate a claim about the strength and type(s) of intermolecular forces present in a sample based on molecular polarity.

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COVALENT AND IONIC BONDING

2.3.A.1 Create and/or evaluate a claim about the type of bonding in a compound based on its component elements and its macroscopic properties.

2.3.B.1 Interpret the results of an experiment to determine the type of bonding present in a substance.

2.3.C.1 Explain the relationship between the relative strength of attractions between cations and anions in an ionic solid in terms of the charges of the ions and the distance between them.

2.3.D.1 Create and/or evaluate representations of ionic and covalent compounds.

Unit 3: Chemical Quantities

COUNTING PARTICLES IN SUBSTANCES

A.1 Explain the relationship between the mass of a substance, the number of particles of that substance, and the number of moles of that substance.

A.2 Use the mole concept to calculate the mass, number of particles, or number of moles of a given substance.

B.1 Explain the relationships between macroscopic properties of gas samples.

B.2 Perform calculations using the ideal gas law.

B.3 Create and/or evaluate models based on the ideal gas law.

COUNTING PARTICLES IN CHEMICAL REACTIONS

A.1 Create and/or evaluate models of chemical transformations.

B.1 Explain the relationship between the quantity of reactants consumed and the quantity of products formed in a chemical transformation.

B.2 Perform stoichiometric calculations involving the quantity of reactants and products in a chemical system.

C.1 Create and/or evaluate models of a reaction mixture before and/or after a reaction has occurred, including situations with a limiting reactant.

D.1 Calculate the theoretical yield and/or percent yield of a chemical reaction.

Unit 4: Chemical Transformations

PRECIPITATION CHEMISTRY

A.1 Predict the products of a precipitation reaction.

B.1 Create and/or evaluate models of precipitation reactions.

C.1 Create and/or evaluate models that represent the concentration of a solution.

C.2 Perform calculations relating to the molarity of volume of that solution.

D.1 Predict the amount of solid produced in a precipitation reaction using gravimetric analysis based on the concentrations of the starting solutions.

D.2 Evaluate the results of a gravimetric analysis.

OXIDATION-REDUCTION CHEMISTRY

A.1 Identify a reaction as an oxidation-reduction based on the change in oxidation numbers of reacting substances.

A.2 Create and/or evaluate a claim about which reacting species is oxidized or reduced in an oxidation-reduction reaction.

B.1 Predict whether a redox reaction will occur between two reactants using an activity series.

B.2 Create and/or evaluate an activity series from experimental measurements.

C.1 Create and/or evaluate models of redox reactions.

ACID-BASE CHEMISTRY

A.1 Create and/or evaluate models of strong and weak acids and bases.

A.2 Distinguish between strong and weak acids in terms of degree of dissociation in aqueous solution.

A.3 Evaluate a claim about whether a compound is a strong or weak acid or base.

B.1 Explain the relationship between the hydrogen ion concentration and the pH of a solution.

B.2 Calculate the pH of a solution.

C.1 Predict the products of a reaction between a strong acid and a strong base.

D.1 Create and/or evaluate models of a reaction between a strong acid and a strong base.

Learning Objectives

THERMOCHEMISTRY

A.1 Create and/or evaluate a claim about whether a reaction is endothermic or exothermic from experimental observations.

A.2 Explain the relationship between the measured change in temperature of a solution and the energy transferred by a chemical reaction.

A.3 Calculate energy changes in chemical reactions from calorimetry data.

B.1 Create and/or evaluate a claim about the energy transferred as a result of a chemical reaction based on bond energies.

REACTION RATES

A.1 Construct and/or evaluate particulate representations that illustrate how changes in concentration, temperature, or surface area of reactants alter the rate of a chemical reaction.

A.2 Explain how experimental changes in the rate of a reaction are related to changes in the concentration, temperature, or surface area of the reactants.