

Conceptual Chemistry

STUDENTS SHOULD KNOW

EXAMPLES OF WHAT STUDENTS SHOULD BE ABLE TO DO

Act

Properties Of Matter

1. There are differences and similarities among pure substances, solutions, and heterogeneous mixtures.
 2. Changes in substances can be classified as chemical and/or physical.
 3. The concentrations of solutions can be expressed in a variety of units. Concentration affects physical properties of the solution.
 4. There are standard methods of naming and formula writing for elements and compounds (emphasize IUPAC system).
 5. Elements can be classified as metals, metalloids or nonmetals.
 6. Bonds can be classified as ionic, nonpolar covalent or polar covalent.
 7. Bonds hold molecules together, intermolecular forces hold substances together.
- Separate a mixture of sand, salt, iron filings, and sulfur.
 - Determine how many colored candies contain yellow dye #5.
 - Observe reactions to conclude whether a reaction is chemical or physical on the basis of evidence such as formation of a precipitate, production of gas, change of color, and/or change in energy using simple kitchen materials and substances.
 - Determine how dissolved impurities affect boiling and freezing points (as in making ice cream, ice melt, etc.).
 - Relate dissolved gases and temperature to carbonated sodas and aquariums.
 - Determine the chemical names of standard household substances.
 - Given samples of C, Si, Pb, Zn, Mg, Al, S, test physical and chemical properties (conductivity, malleability, reactions with hydrochloric acid and cupric chloride).
 - Build models of molecules and ionic compounds.
 - Graph boiling point and 1st 10 alkanes to show effect of more C bonds and use extrapolation to predict boiling point of C₁₁ and C₁₂ alkanes.
 - Compare surface tensions of common liquids.

STUDENTS SHOULD KNOW

8. Substances can be classified as acids, bases, or neutral.

9. The strength of an acid and/or base is related to its composition and degree to which it breaks down.

Chemical Change

1. Chemical changes are described with balanced chemical equations.

2. The number of particles is measured in a unit called mole.

3. Balanced chemical equations are used to predict the amount of products formed.

EXAMPLES OF WHAT STUDENTS SHOULD BE ABLE TO DO

- Experimentally determine pH using indicators (such as purple cabbage), pH meters, and/or test papers.

- Evaluate the effects of antacids that are commonly used to treat heartburn.

- Perform a drop titration or neutralization on Vitamin C or other common acid.

- Perform an acid/base titration to determine the concentration of an acid in vitamin C or a base in a Tums.

- Balance chemical equations given the reactants and products. Recognize reaction types and predict products for simple reactions.

- Determine the amounts of reactants needed in a cookie recipe.

- Experimentally determine the best ratio of oxygen to hydrogen gas to launch a film canister rocket (or use vinegar and baking soda).

- Convert between units of moles, mass, and number of particles.

- Determine the amount of product formed or reactant used knowing an initial amount of one other chemical present.

Act

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4. Reaction rate will be affected by changes of temperature, concentration, surface area, and use of catalysts.

5. Many reactions do not go to completion, but consist of forward and reverse reactions occurring simultaneously. This can happen in both physical and chemical changes.

Structure Of Matter

1. Physical changes/chemical changes and properties of matter can be explained through sketches, models, graphs, and descriptions of the particles.

EXAMPLES OF WHAT STUDENTS SHOULD BE ABLE TO DO

- Describe effects of chemical degradation and effect of temperature over time on aspirin.
- Determine the factors that affect reaction rate in a clock reaction.
- Predict and explain the effect on reaction rate and time caused by concentration changes or for solids changes in surface area.
- Explain the effect of adding a catalyst to a given reaction. The explanation should include both a potential energy graph and activation energy.
- Explain the working of a match in terms of rate factors.

- Construct sketches or physical models of solids, liquids, and gases. Use these to determine how phase changes proceed.
- Construct molecular models to determine shape and molecular polarity in simple compounds.
- Use manipulatives like elastics to predict molecular shape.
- Use sketches and models to describe chemical reactions.

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2. Kinetic molecular theory explains changes in gas volumes, pressure, and temperature. This allows for calculations to be performed relating these quantities.
3. Atoms are made of a positive nucleus surrounded by negative electrons.
4. The outermost electrons determines how the atom can interact with other atoms. Atoms form bonds to other atoms by transferring or sharing electrons.
5. The nucleus, a tiny fraction of the volume of an atom, is composed of protons and neutrons, each almost two thousand times heavier than an electron. The number of positive protons in the nucleus identifies the element. In a neutral atom, the number of electrons equals the number of protons. An atom may acquire a charge by gaining or losing electrons.
6. Neutrons have a mass that is nearly identical to that of protons and have no electrical charge. Neutrons affect the mass and stability of the nucleus. Isotopes of an element have the same number of protons but differ in the number of neutrons.
7. An element's location on the periodic table can be used to determine similarities and trends among the elements.

EXAMPLES OF WHAT STUDENTS SHOULD BE ABLE TO DO

- Use the particle model of gases to explain the relationship of pressure, volume, moles, and temperature in gases.
- Determine experimentally the relationships of pressure versus volume, pressure versus temperature, and volume versus temperature. Express these relationships in graphs and interpret these graphs.
- Suggest and recognize practical applications using these relationships, i.e. tire pressure.
- Determine the number of protons and neutrons in the nucleus and the electrons surrounding it for a particular isotope.
- Determine if a bond between atoms is ionic, polar covalent, or nonpolar covalent on the position on the periodic table.
- Relate conductivity to the type of bonds in a substance.
- Construct a model showing the positions and sizes of the subatomic particles.
- Discuss the formation of ions by gaining or losing electrons only.
- Determine the identity, mass, and reactivity of an element from the number of protons, neutrons, and electrons.
- Identify heavy metals and describe effects of exposure to contaminants/pollution.
- Predict the properties of an element on the basis of the position on the periodic chart.

Act

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8. The arrangement of atoms in a molecule determines the molecule's properties. Shapes are particularly important in how molecules interact with others.
9. Nuclear changes are different than chemical changes. The nucleus can change, resulting in a different element and/or radioactivity.

Energy Change

1. Temperature is a measurement of average kinetic energy. Heat is a measurement of transferable energy.
2. Chemical and physical changes can be classified as exothermic or endothermic.

EXAMPLES OF WHAT STUDENTS SHOULD BE ABLE TO DO

- Determine a simple molecule's shape
 - Determine molecular polarity experimentally and relate to shape.
 - Relate the strength of intermolecular forces to physical properties such as boiling point, melting point, surface tension, solubility, vapor pressure, adhesion, cohesion, and viscosity.
 - Mix polar and non-polar substances to develop a rule for predicting solubility and relate this to dry-cleaning and cleaning in general.
 - Distinguish between nuclear and chemical reactions.
 - Write balanced reactions involving alpha, beta, and gamma emission.
 - List general applications of nuclear reactions discussing their advantages and disadvantages (such as the medical uses of radioactive isotopes such as technetium-99m).
 - Use manipulatives (M & M's, pennies) to develop the concept of half-life.
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- Measure temperature in appropriate units.
 - Perform an experiment to measure heat flow.
 - Measure the amount of calories released from burning a peanut.
 - Use dye in different temperature water to relate temperature and speed of particles.
 - Identify reactions as either exothermic or endothermic from experimental data or an equation including an energy term.
 - Explain the difference between temperature and heat.