The McGraw-Hill Companies

Unit I - Lecture 1

Chemistry

The Molecular Nature of Matter and Change

Fifth Edition

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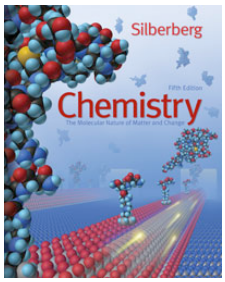


Chapter 1 : Keys to the Study of Chemistry

1.1 Some Fundamental Definitions

1.2 Chemical Arts and the Origins of Modern Chemistry

1.3 The Scientific Approach: Developing a Model

CHEMISTRY

Is the study of matter,
its properties,

the changes that matter undergoes,

and

the energy associated with these changes.

Definitions

Matter anything that has mass and volume -the "stuff" of the universe: books, planets, trees, professors, students

Composition the types and amounts of simpler substances that make up a sample of matter

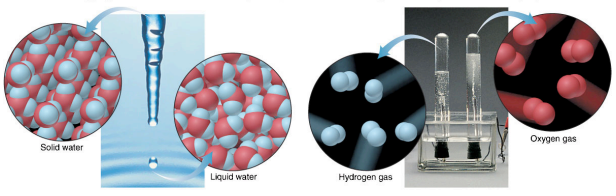
Properties the characteristics that give each substance a unique identity

⇩

Physical Properties
those which the substance shows by itself without interacting with another substance such as color, melting point, boiling point, density

Chemical Properties
those which the substance shows as it interacts with, or transforms into, other substances such as flammability, corrosiveness

Figure 1.1 The distinction between physical and chemical change.



A Physical change: Solid form of water becomes liquid form; composition does *not* change because particles are the same.

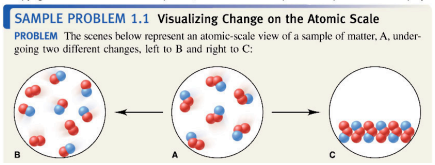
B Chemical change: Electric current decomposes water into different substances (hydrogen and oxygen); composition *does* change because particles are different.

Table 1.1 Some Characteristic Properties of Copper

Physical Properties	Chemical Properties
 *reddish brown, metallic luster*	*slowly forms a basic blue-green sulfate in moist air* 
easily shaped into sheets (malleable) and wires (ductile) 	*reacts with nitric acid and sulfuric acid* 
good conductor of heat and electricity	
can be melted and mixed with zinc to form brass	*slowly forms a deep-blue solution in aqueous ammonia* 
density = 8.95 g/cm³	
melting point = 1083°C	
boiling point = 2570°C	

Sample Problem 1.1 Visualizing Change on the Atomic Scale

PROBLEM: Atomic scale scenario of A undergoing change to B or C. Decide whether each depiction shows a physical or a chemical change.



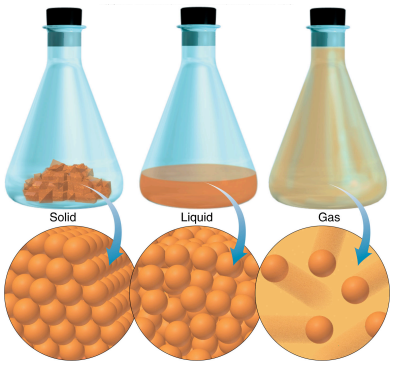
PLAN: "Does the substance change composition or just change form?"

SOLUTION: Conversion A → B is a **chemical change.**

Conversion A → C is a **physical change**.

The physical states of matter.

Figure 1.2



Sample Problem 1.2 Distinguishing Between Physical and Chemical Change

PROBLEM: Decide whether each of the following processes is primarily a physical or a chemical change, and explain briefly:

(a) Frost forms as the temperature drops on a humid winter night.

(b) A cornstalk grows from a seed that is watered and fertilized.

(c) A match ignites to form ash and a mixture of gases.

(d) Perspiration evaporates when you relax after jogging.

(e) A silver fork tarnishes slowly in air.

PLAN: "Does the substance change composition or just change form?"

SOLUTION:

(a) physical change (b) chemical change (c) chemical change

(d) physical change (e) chemical change

Energy is the ability to do work.

Potential Energy energy due to the **position** of the object

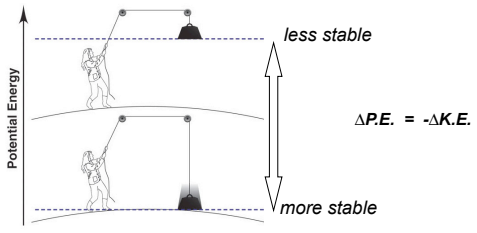
Kinetic Energy energy due to the **motion** of the object

T.E. = P.E. + K.E.

Energy is conserved, not destroyed.
Potential and kinetic energy can be interconverted.

Energy is the ability to do work.

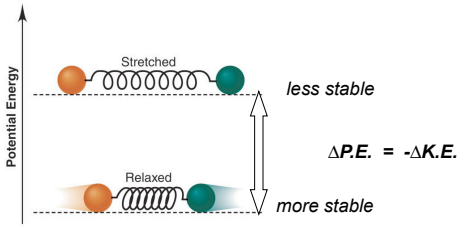
Figure 1.3A



A gravitational system. The potential energy gained when a lifted weight is converted to kinetic energy as the weight falls.

Energy is the ability to do work.

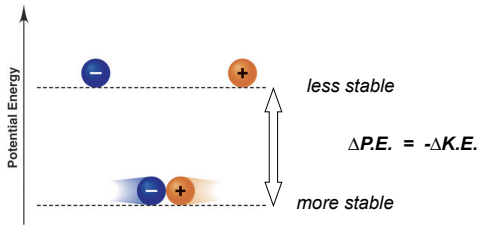
Figure 1.3B



A system of two balls attached by a spring. The potential energy gained by a stretched spring is converted to kinetic energy when the moving balls are released.

Energy is the ability to do work.

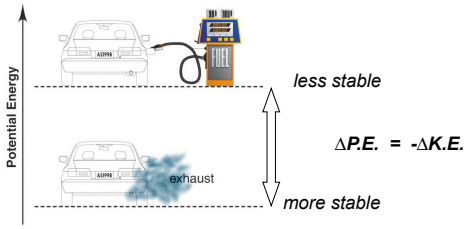
Figure 1.3C



A system of oppositely charged particles. The potential energy gained when the charges are separated is converted to kinetic energy as the attraction pulls these charges together.

Energy is the ability to do work.

Figure 1.3D



A system of fuel and exhaust. A fuel is higher in chemical potential energy than the exhaust. As the fuel burns, some of its potential energy is converted to the kinetic energy of the moving car.

Scientific Approach: Developing a Model

Observations: Natural phenomena and measured events; universally consistent ones can be stated as a natural law.

Hypothesis: Tentative proposal that explains observations.

revised if experiments do not support it

Experiment: Procedure to test hypothesis; measures one variable at a time.

Model (Theory): Set of conceptual assumptions that explains data from accumulated experiments; predicts related phenomena.

altered if predictions do not support it

Further Experiment: Tests predictions based on model.