Kinetic Energy and Potential Energy during Phase Changes

Kinetic Energy and Temperature

Kinetic Energy is the energy of **motion**: The faster a molecule moves, the more kinetic energy it has. The more speed and KE an object has, the more work it can do.

Temperature is the average kinetic energy of all molecules of a substance. The higher the temperature, the faster the molecules are moving. For example, when water vapor, H_2O (g) is 102°C, the molecules move faster than "ice", H_2O (s) at 0°C.

Summary: Temperature changes when kinetic energy changes.

Potential Energy and Phase Changes

Potential Energy is the **stored energy** of an object – stored energy that **can be converted to kinetic energy to do work**. For example, objects hanging above the ground have potential energy because when they are dropped, they begin to fall quickly towards earth.

There is **potential energy stored in covalent and ionic bonds of covalent molecules**. Additionally, there is potential energy stored of molecules based on their intermolecular forces.

When the particles of a substance have *greater freedom to move* (are spread apart), they have more Potential Energy (PE). For example, when an ice cube melts, the particles have more room to move, so they have more potential energy.

When the particles of a substance have *less freedom to move* (are sticking close together), they have less Potential Energy (PE). For example, when a glass of water freezes, the particles have less freedom to move, so they have less potential energy.

Summary: During a phase change, the potential energy changes but the kinetic energy and temperature remain constant.

Intermolecular Forces (Attraction between different molecules)

When two molecules are close together, their positively-charged protons attract (pull on) the other molecules's electrons. This is called an **intermolecular force**, and makes the molecules stick together (because **opposite charges attract**).

When energy is added to H_2O(l), the temperature increases because the molecules move faster. When the H_2O(l) reaches the boiling point, the added energy doesn't increase the speed or the temperature. During a phase change, the added energy does not make the molecules move faster, and the temperature does not increase. **During a phase change, the added energy is used to separate the particles from each other by breaking the intermolecular forces.** This gives the particles more freedom to move and more potential energy.

When atoms are separated from each other during a phase change, the substance has an increase in potential energy. This is because when the atoms are further apart, they have more ability to move.

1. Which water sample has the **highest kinetic energy?**
(a) H_2O (s) , 0C
(b) H_2O (l) , 50 C
(c) H_2O (g) , 100C

2. The **temperature** of a sample of matter is a measure of the

a) kinetic energy of its particles
b) potential energy of its particles
c) chemical energy of its particles
d) total energy of its particles

3. What is **potential energy**?

4. Where is potential energy **stored** in molecules?

7. When an ice cube is in the phase change of melting(S-->L), which statement is true?
a) Potential Energy decreases
b) Potential Energy increases
c) Kinetic Energy increases

6. Which substance has particles with the **strongest intermolecular forces**?
(a) H_2O (s)
(b) H_2O (l)
(c) H_2O (g)

7. Which substance has particles with the **weakest intermolecular forces**?
(a) H_2O (s)
(b) H_2O (l)
(c) H_2O (g)