Warm up

Draw the Lewis structures of all 7 diatomic elements

States of Matter - Part 1 - Gases

Definitions

kinetic-molecular theory

particles of matter are always in motion

ideal gas

hypothetical gas that perfectly fits all the assumptions of the kinetic-molecular theory of gases

Five assumptions of the kinetic-molecular theory as it applies to gases...

1) gases consist of large numbers of tiny particles that are far apart relative to their size

-typically the volume of a gas is about 1000 times greater than the volume of the same number of particles in the liquid state

2) Collisions between gas particles and between particles and container walls are elastic collisions.

-an elastic collision is one in which no net loss of total kinetic energy

-kinetic energy is transferred between particles during collisions, but the total energy of the two particles remains the same as long as the temperature is constant

3) Gas particles are in continuous, rapid, random motion. They therefore possess kinetic energy (energy of motion).

-the kinetic energy overcomes the attractive forces between the particles

-as temperature lowers, so does kinetic energy and thus the attractive forces can start to condense the gas into a liquid

4) There are no forces of attraction between gas particles.

-for ideal gases, all attraction between particles can be ignored.

5) The temperature of a gas depends on the average kinetic energy of the particles of the gas.

-The kinetic energy of any object is given by the equation

$$KE = (1/2)mv^2$$

where m is the mass of the particle and v is its speed. Since all of the particles of a gas will have the same mass, their kinetic energy depends only on their speed.

-Gases at the same temperature have the same average kinetic energy, therefore lighter molecules, such as hydrogen, will have higher speeds than heavier ones, such as oxygen.
(Zombieland rule)

-Ideal gases do not actually exist, however, many gases behave in this manner so long as the pressure is not too high or the temperature too low

Expansion

-gases will fill the container they are in based on 3 (rapidly moving in all directions) and 4 (no attraction between particles)

Fluidity

-particles easily slide past one another due to 4 (no attraction between particles).

- since both liquids and gases "flow", they are both refered to as fluids.

Low density

-the density of a gas at 1 ATM is about 1000 times less than its liquid

Compressibility

-since the particles are so spread out, they can be compressed

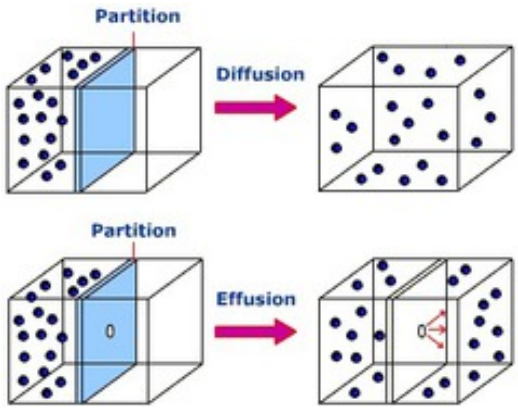
Diffusion vs Effusion

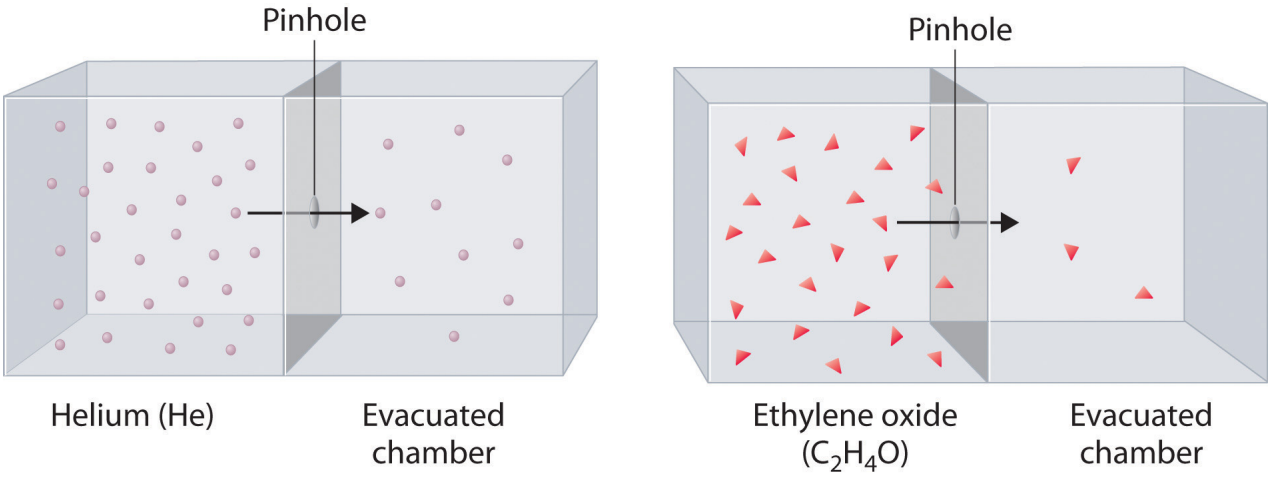
-Diffusion is when particles of two substances spontaneously mix due to their random motion

example: the odor from a candle

-Effusion is a process by which gas particles pass though a tiny opening.

-rates of effusion are directly proportional to the velocity of the particles. Hydrogen will have a faster effusion rate than oxygen.





Effusion after time x for both situations. Why are there more He particles in the evacuation chamber than Ehtylene oxide?

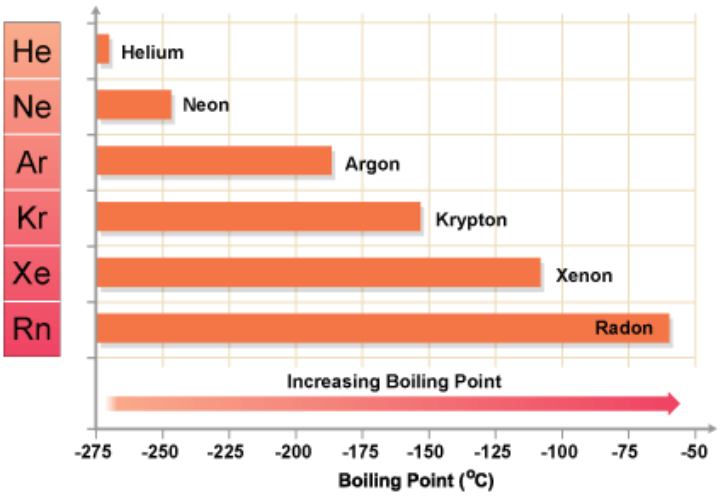
Not so ideal gases

-A real gas is one that does not behave completely according to the assumptions of the kinetic-molecular theory.

-When temperature becomes too low or the pressure too high, the attractive forces between the molecules are no longer overcome by the kinetic energy of the particles

Noble gases, since they are monatomic and happy, can withstand higher pressures and lower temperatures and still remain a gas.

This also applies to the nonpolar diatomic gases since they are happily bonded to one another. Hence, the condensation/boiling point of noble gases and the diatomics are very low.



Boiling Points of diatomics

H = -252.9 C

N = -195.8 C

O = -183°C

F = -188.1°C

Cl = -34.04 C

More polar molecules, such as water and ammonia tend to act less like an ideal gas because they have stronger attractions between the molecules and therefore deviate from the kinetic-molecular theory at lower pressures and higher temperatures.

Boiling point of ammonia = -33 C

Boiling point of water = 100 C

Drawing Conclusions:

Molecules of hydrogen escape from Earth, but molecules of oxygen and nitrogen are held to the surface and remain in the atmosphere. Explain why this is.