

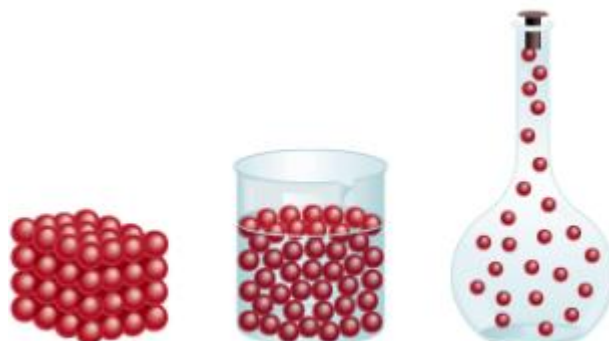


Kinetic Molecular Theory

I. MOLECULES IN MOTION:

A. Kinetic Molecular Theory (KMT) = the idea that particles of matter are always in motion and that this motion has consequences.

- 1) theory developed in the late 19th century to account for the behavior of the atoms and molecules that make up matter
 - 2) based on the idea that particles in all forms of matter are always in motion and that this motion has consequences
 - 3) can be used to explain the properties of solids, liquids, and gases in terms of the energy of particles and the forces that act between them
- 3 assumptions of KMT:
 1. All matter (solid, liquid, gas) is made of particles (atoms, ions, molecules)
 2. Particles are in constant motion (electrons move)
 - Particles of a GAS travel in completely *random* motion
 - Particles of a LIQUID appear to vibrate around *moving* points
 - Particles of a SOLID appear to vibrate around *fixed* points



3. Collisions are perfectly elastic (no change in the total kinetic energy of 2 particles before and after their collision); No loss of energy!

B. Kinetic energy (KE) = energy of motion

- Depends on the MASS of the object and its VELOCITY (SPEED)

C. Temperature = measure of kinetic energy (how fast molecules travel)

- Decrease in temperature means a *decrease* in particle speed (i.e. a *decrease* in kinetic energy)
- Increase in temperature means an *increase* in particle speed (i.e. an *increase* in KE)

⇒ Kelvin (K) = temperature scale used in Kinetic study

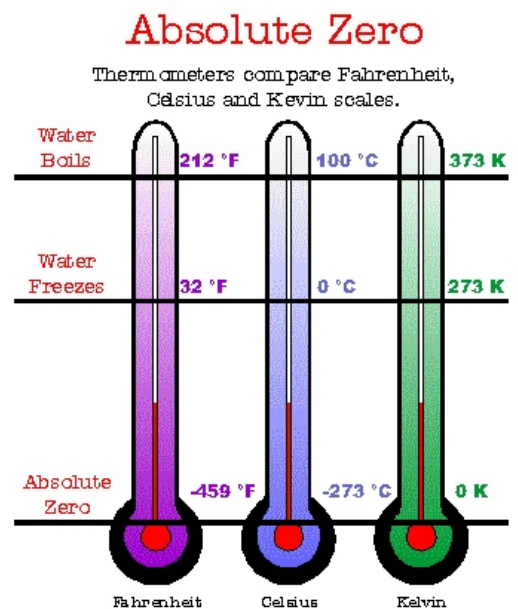
⇒ Absolute Zero = (0 K or - 273 °C) temperature in which all molecular motion stops

- Convert between °C and K:

$$\underline{K = ^\circ C + 273}$$

Practice:

- 86 K = -187 °C
- 23 °C = 296 K
- 533K = 260° C
- -90° C = 183 K



D. STP = Standard Temperature & Pressure @ sea level

Standard Temperatures:

- 0 ° C
- 273 K

Standard Pressures:

- 101.3 KPa (kilopascal)
- 1 atm (atmosphere)
- 760 mm Hg (millimeters of mercury)
- 760 torr

E. States of Matter:

- 1) Solid
- 2) Liquid
- 3) Gas
- 4) Plasma = (4th state of matter)

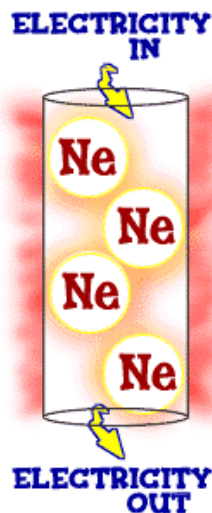
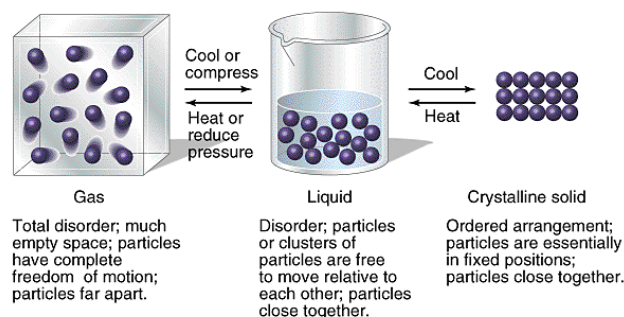
heated to very high

temperatures, the collisions between particles are so violent that electrons are knocked away from atoms.

- Atoms are made up of free electrons and ions of the element.
- Don't happen *regularly* on Earth
- Takes a special environment to keep plasmas going
- Ex: Fluorescent light bulb or a neon sign-

- Inside the long tube is a gas and electricity flows through the tube when the light is turned on. The charging and exciting of the atoms creates glowing plasma inside the bulb

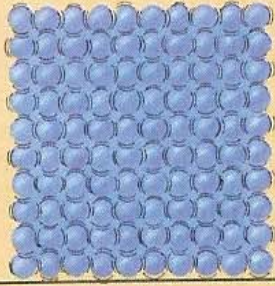
- Ex: Stars -



- Large balls of gases at really high temperatures. The high temperatures charge up the atoms and create plasma.
- *Note: Fluorescent lights are cold compared to really hot stars. They are still both forms of plasma, even with different physical characteristics.*

F. Summary of the 4 PHASES of Matter:

<u>Phase</u>	<u>Shape</u>	<u>Volume</u>	<u>Avg. Kinetic Energy</u>
<u>Solid</u>	Definite	Definite	Slow
<u>Liquid</u>	Not Definite	Definite	Medium
<u>Gas</u>	Not Definite	Not Definite	Fast
<u>Plasma</u>	Not Definite	Not Definite	Violent



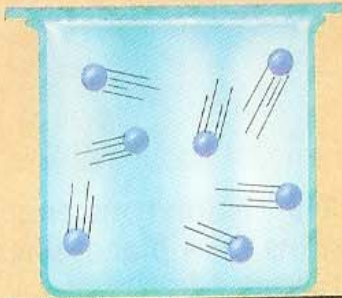
Solid

decreasing temperature \uparrow increasing temperature \downarrow



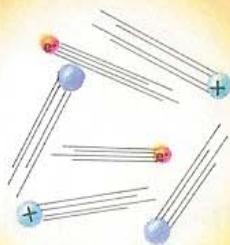
Liquid

decreasing temperature \uparrow increasing temperature \downarrow



Gas

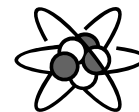
decreasing temperature \uparrow increasing temperature \downarrow



Plasma

This picture shows how increasing or decreasing the temperature affects the particles of solids, liquids, gases, and plasmas.

Kinetic Molecular Theory (KMT) Worksheet



Name: _____ Period: _____ Date: _____

Directions: Answer the following questions completely and concisely.

1. What is kinetic energy?
2. Describe the 3 assumptions of the KMT (Kinetic Molecular Theory).
3. According the KMT, “collisions between particles are perfectly elastic”. What does that mean?
4. Describe the particle motion of solids, liquids, and gases.
5. How would **increasing** the temperature affect kinetic energy of molecules?
6. How would **decreasing** the temperature affect kinetic energy of molecules?

7. Compare the average kinetic energies of solids, liquids, gases, and plasma.
8. What happens at absolute zero?
- a. What temperatures are considered absolute zero? _____
9. What does STP stand for? _____
10. List the standard temperatures.
11. List the standard pressures.
12. _____ would contain atoms made up of free electrons and ions of the element.
13. Where could you find the fourth state of matter, plasma? _____
14. How are Kelvin and Celsius related? (write the equation showing this relationship) _____
15. Conversions:
- | | |
|------------------------------------|--|
| a. $137^{\circ}\text{C} =$ _____ K | d. $93\text{ K} =$ _____ $^{\circ}\text{C}$ |
| b. $23^{\circ}\text{C} =$ _____ K | e. $497\text{ K} =$ _____ $^{\circ}\text{C}$ |
| c. $121^{\circ}\text{C} =$ _____ K | f. $270\text{ K} =$ _____ $^{\circ}\text{C}$ |