Kinetic Molecular Theory

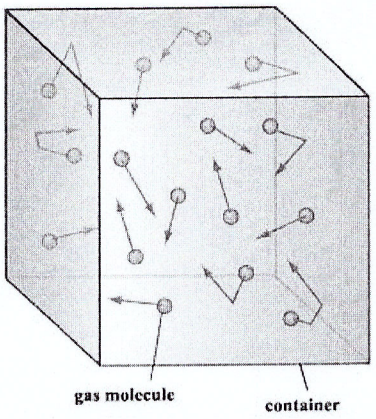
- Gases can be defined as fluids that have no shape or volume of their own, but take on the shape and volume of the container in which they are confined
  - Gases expand to fill any container
- Gases have unique properties that allow us to use gases in different technologies (ie. hot air balloons, SCUBA diving equipment, air tools, etc.)
- Gases have the following unique characteristics

need to know!

  - *Gases are compressible*. The volume of a gas decreases dramatically when pressure is exerted on the gas. The volume of liquids and solids remain almost constant during pressure changes.
  - *Gases expand as the temperature is increased* if the pressure remains constant. Liquids and solids can expand with temperature but to a much lesser extend
  - *Gases have a very low resistance to flow* – a property called **viscosity**
  - *Gases have much lower densities* than liquids or solids
  - *Gases mix evenly and completely* when put in the same container. Substances that mix completely with each other are said to **miscible**. All gases are miscible
- These properties of gases are **macroscopic**, which means they can be directly observed using your senses or a measuring instrument
- The **kinetic molecular theory (KMT)** explains the macroscopic properties of gases based on the behavior of individual particles (atoms or molecules) at a molecular level
- The KMT was developed based on an **ideal gas**. According to the KMT, molecules of an ideal gas:

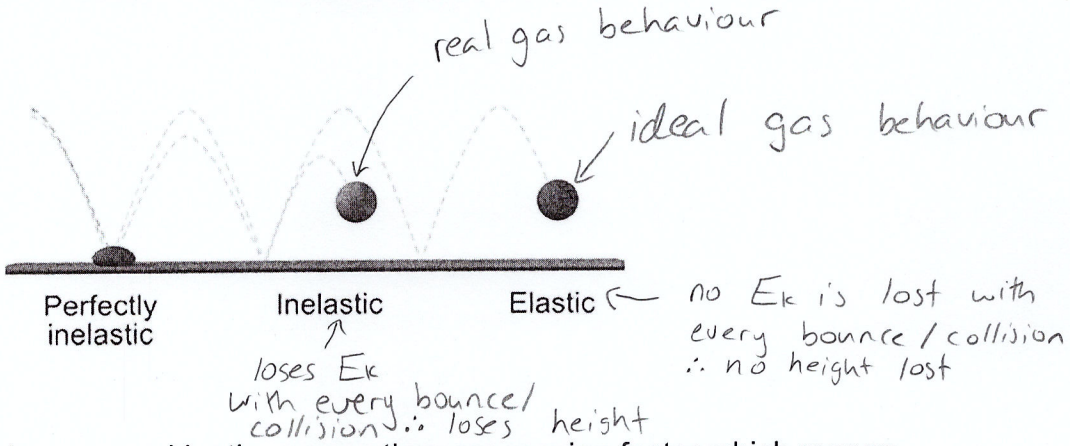
need to know!

  - are in constant, random motion
  - travel in straight lines until they collide with other gas particles or the walls of a container
  - collide with walls of a container and each other with *elastic collisions*
  - are *point masses*



- A **point mass** is an ideal particle that has mass but takes up no space – it has no volume

- In an **elastic collision**, kinetic energy is conserved
  - Kinetic energy is the energy of motion; any mass that has speed has kinetic energy
  - When ideal particles collide, they can transfer kinetic energy to one another but the total kinetic before and after the collision remains constant
  - The average kinetic energy of gas molecules is *proportional* to the temperature of the gas (ie. as the temperature increases, the kinetic energy of the gas molecules will also increase and as the temperature decreases, the kinetic energy of the gas molecules will also decrease)



- When particles have more kinetic energy, they are moving faster which means they will collide with the walls of a container more frequently increasing the pressure exerted on the walls of the container

- The KMT can be used to explain many properties of gases and situations that involve gases
  - Although no gas is ever ideal, the theory accurately describes the behavior of real gases at ordinary/atmospheric temperature and pressure

know how they compare!

Ideal Gases	Real Gases
▪ Gas molecules are far apart and therefore molecule size is negligible (ie. ideal gases are *point masses*)	▪ At high pressure, molecules are forced close together. This means the size of the molecule is now significant
▪ Gas molecules are in constant, random, straight line motion that is only transitional/linear	▪ As temperatures decrease, molecules slow down. Molecules have less kinetic energy to overcome intermolecular forces causing the molecules to stick together and condense into a liquid
▪ Gas molecules undergo perfect elastic collisions in which no kinetic energy is lost (ie. molecules just bounce off each other with no interaction)	▪ When molecules collide, they interact with one another which means the molecules lose kinetic energy

Assignment

You will be creating a poster that illustrates the macroscopic properties of gases that are applicable to a situation in which gases are used. Your poster will also need to explain the properties of the gas using the kinetic molecular theory.

Choose **one** situation to use in your poster:

1. Describe how hot air balloons work.
2. Explain how a full propane tank can provide enough fuel for an entire season of barbecues.
3. Explain the label on a can of hairspray that contains the warning, "caution may explode when heated".
4. Explain how a carbon monoxide leak in the basement spreads quickly throughout the house.
5. A bicycle tire develops a small hole and very rapidly becomes flat. Explain why the tire deflates quickly.
6. Explain how geysers happen.
7. Explain how a piston in an engine works.

What your poster needs to include:

- Pictures along with some words to explain your situation in terms of gas properties (macroscopic) and kinetic molecular theory.
- A picture showing what is happening at a molecular level when explaining the kinetic molecular theory component.
- Color!
- A neat, clean presentation.