

# Kinetic Theory

# Kinetic Theory of Matter

- Matter is composed of many small particles
- The particles are in constant motion
- All collisions between particles are perfectly elastic
  - There is no change in kinetic energy before and after their collision

# Oxygen molecules in motion

- Speed at 25 °C 443 m/s
- Mean free path (average distance a molecule travels between collisions) 106 nm
  1. Diameter .339 nm
  2. Travel 313 x diameter before colliding
  3. 4.5 billion collisions/second/molecule @ STP
- These factors vary with temperature and mass of particles

# Pressure

- Force/unit area
  - Unit of pressure = Pascal = Newton/meter<sup>2</sup>
  - Average pressure of air at sea level is 101.325 kpa
- Pressure increases as volume decreases
  - Pushes molecules closer together so there is more collisions

# Measuring pressure

- Manometer is used to measure
- There are two types of manometers
  - Open arm and closed arm
  - Barometer is a closed manometer to measure air pressure
- The atmosphere pushes mercury up a closed manometer 760 mm
  - 101.325 kpa/760mm of mercury or 29.9 inches or 760 torr or 1013.3 millibars

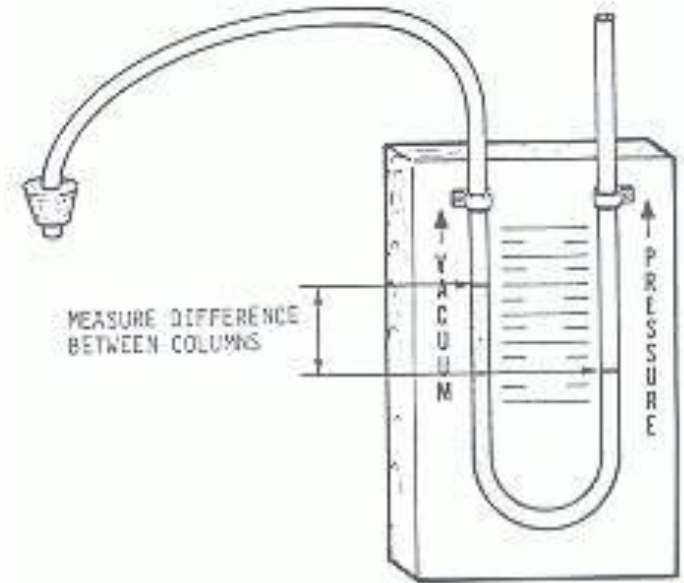
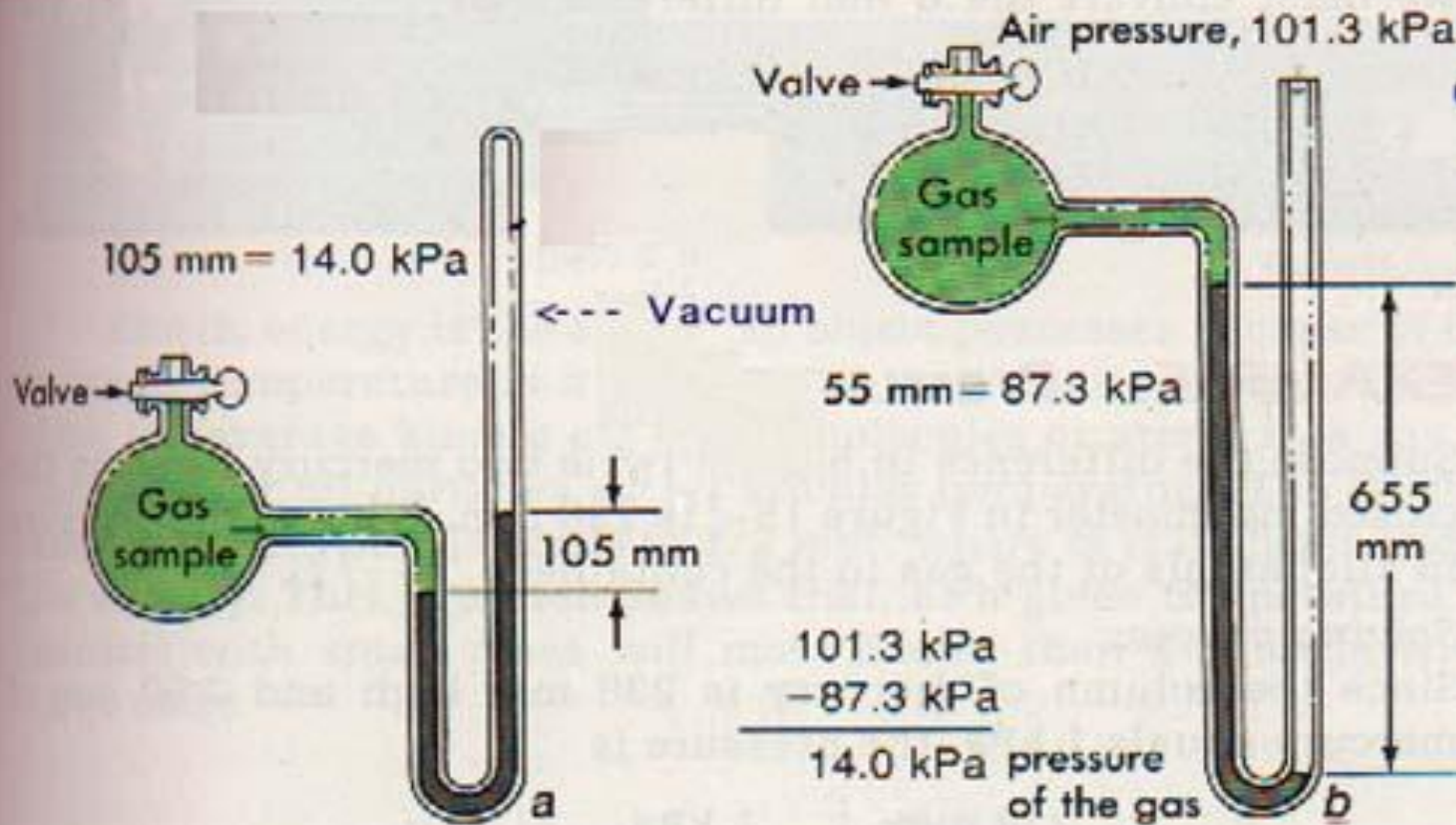


Figure 15-3

Closed tube Manometer has a vacuum above.

Open tube Manometer is open to the atmospheric pressure.



# States of matter

- Gas particles are independent of each other and move in a straight line
- Only change direction as the result of a collision

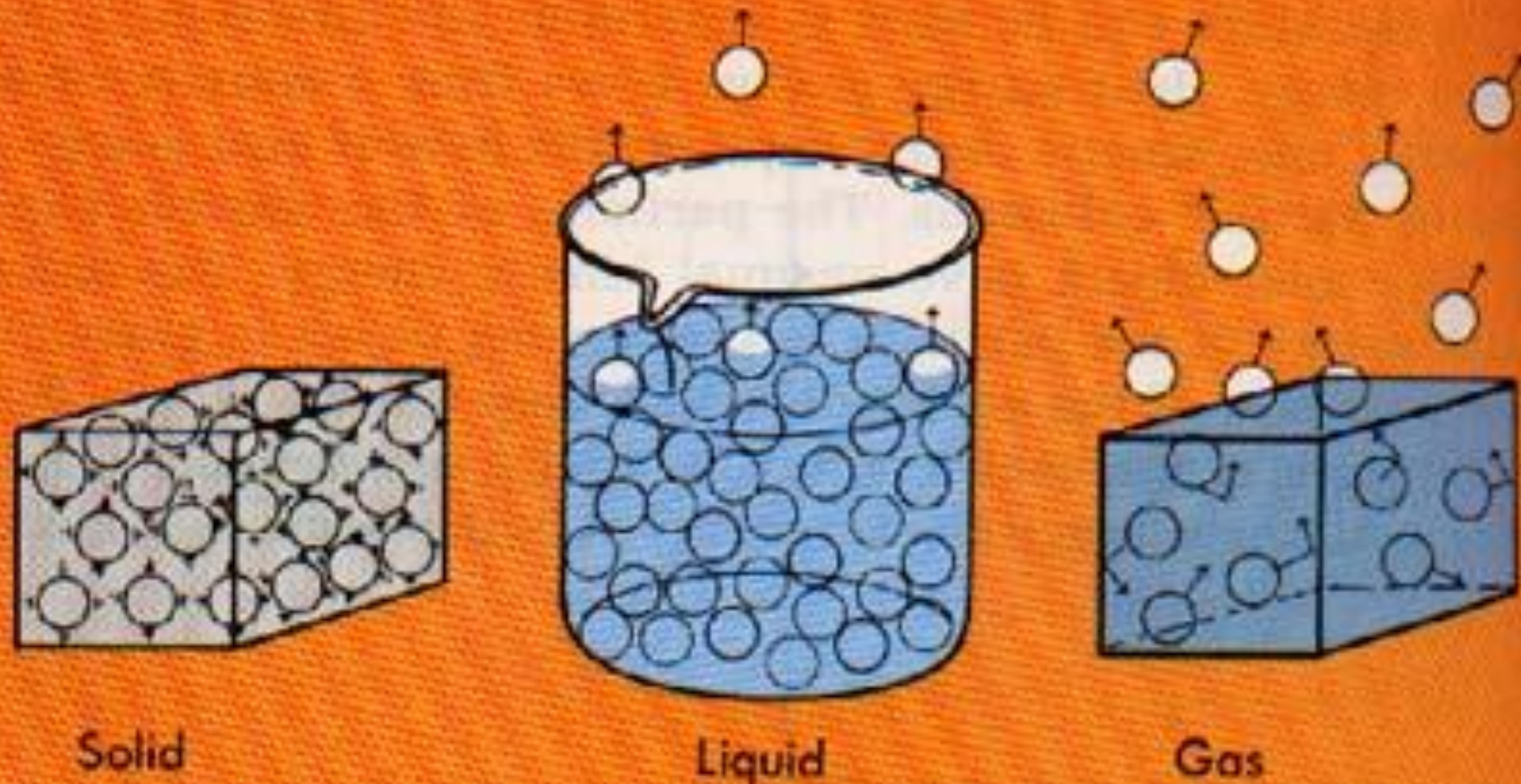
# States of Matter Liquid

- Particles travel in a straight line until collisions
- Particles are closer together than gas
- They can change their relative position
- Take the shape of the container
- There is an attraction toward each other



# Solid

- Particles occupy relatively fixed positions
- Vibrate about a fixed point
- Travel in straight line it collides
- Particles are much closer together
- Definite shape and volume



**FIGURE 15-9.** The particles of a solid vibrate about fixed points. The particles of a liquid vibrate about moving points. The particles of a gas travel in straight lines between collisions.

# Plasma

- When matter is heated to high temperatures greater than 5000 degrees Celsius and the collisions between particles are so violent that electrons are knocked away from the atoms
- Composed of electrons and positive ions



# Kinetic energy and temperature

- Kinetic energy is the energy an object possesses because of its motion
- Kinetic energy =  $\frac{1}{2}mv^2$
- Thus small particles move faster and large particles move slower
- An increase in temperature means the particles are moving faster
- The temperature which all motion stops in  $-273$  °C
- The Kelvin scale starts at 0
- $-273^{\circ}\text{C} = 0$  Kelvin