Gases

(CH-3)

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Properties of Gases

- Three phases of matter
  - Solid: Definite shape and volume
  - Liquid: Definite volume, shape of container
  - Gas: Shape and volume of container
- A gas is a collection of molecules that are very far apart on average.
  - In air, gas molecules occupy only 0.1% of the total volume.
  - In liquids, molecules occupy ~ 70% of the total space

Properties of Gases

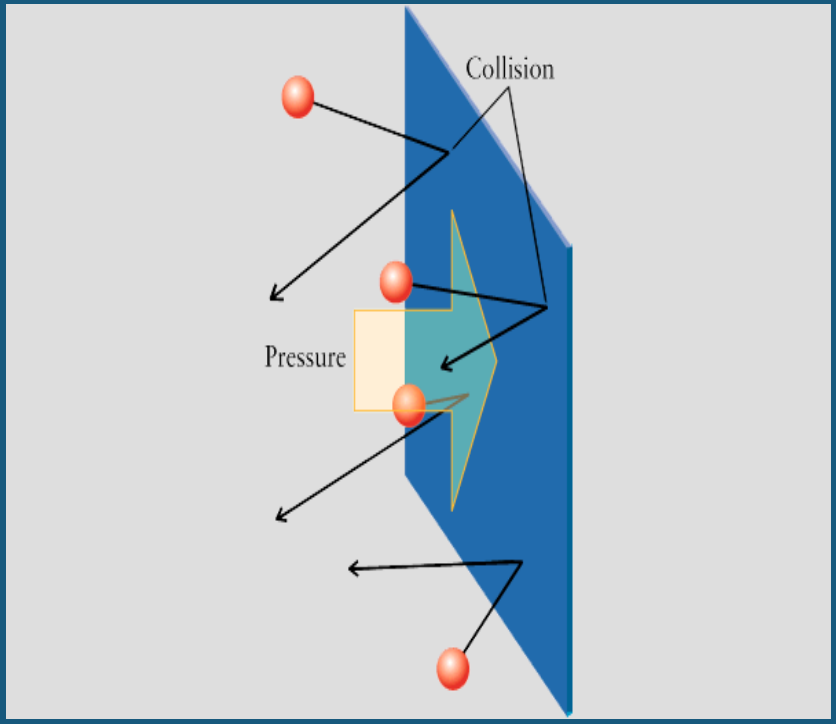
- Gases are highly compressible.
  - Volume decreases when pressure is applied.
- Gases form homogeneous mixtures with each other regardless of the identities or relative proportions of the different gases.
  - Water and gasoline
    - heterogeneous mixture.
  - Water vapor and gasoline vapor
    - homogeneous mixture.

Gas Pressure

- Four quantities are commonly needed to describe a gas:
  - Amount of gas
  - Temperature
  - Volume
  - Pressure

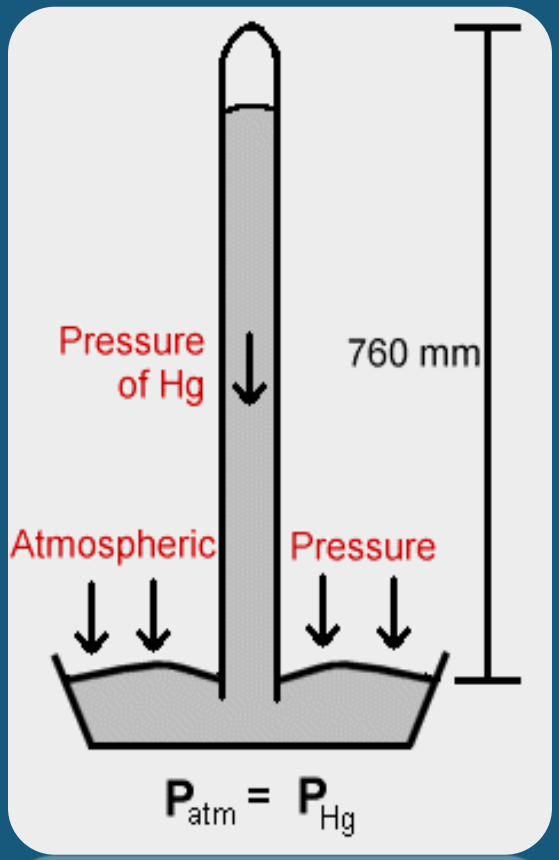
Gas Pressure

- Gases exerted pressure on the objects in their surrounding.
- Pressure is caused by collisions between the gas molecules and objects with which they are in contact.
- Pressure: the force exerted on a unit area.
  - $P = \frac{F}{A}$



Gas Pressure

- Gas pressure units
  - mm Hg (1 atm = 760 mm Hg)
  - in. Hg (= 29.92 in. Hg)
  - psi (= 14.7 psi)
  - atm
  - torr (= 760 torr)
  - pa (SI unit) (= 1.01325 x10^5 Pa)
  - kPa (= 101.325 kPa)

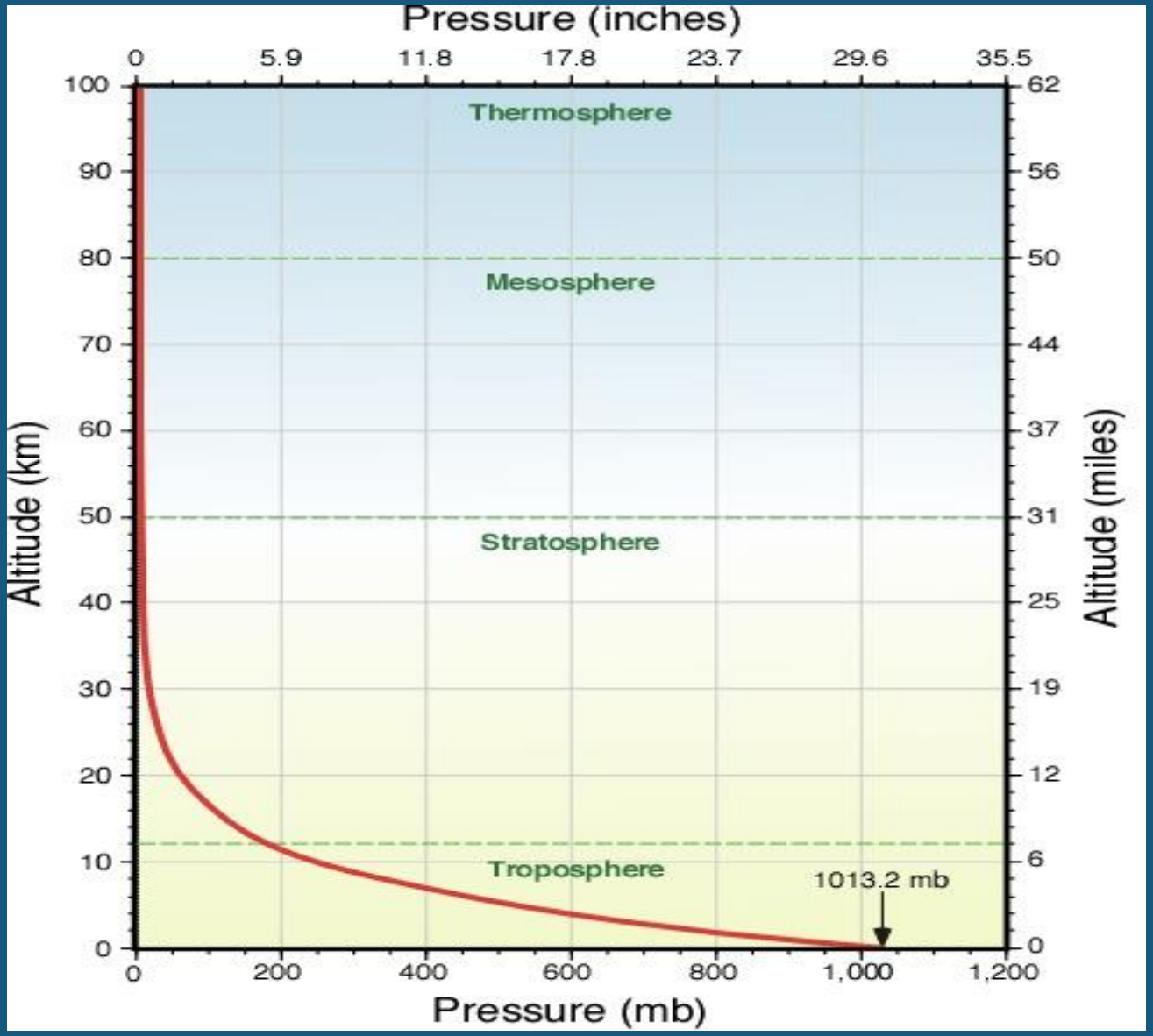


Gas Pressure

- Atmospheric pressure: the pressure exerted by gas molecules in the air on all objects exposed to the atmosphere
- Atmospheric pressure varies with altitude.

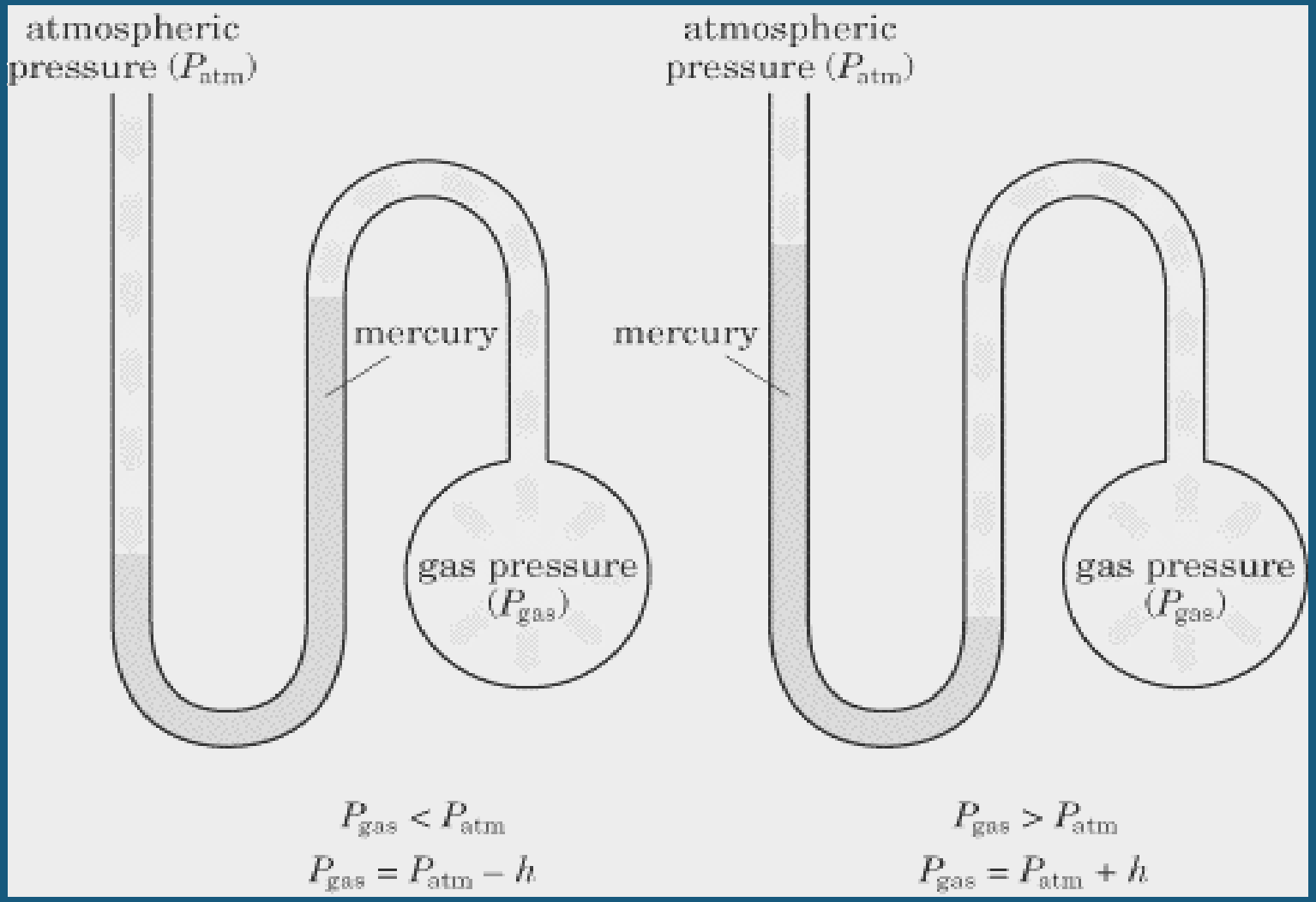
Altitude (ft above sea level)	Atmospheric Pressure		
	in. Hg	Torr	psi
0	29.92	760	14.7
5000	24.9	632.5	12.23
10,000	20.58	522.7	10.1

Gas Pressure



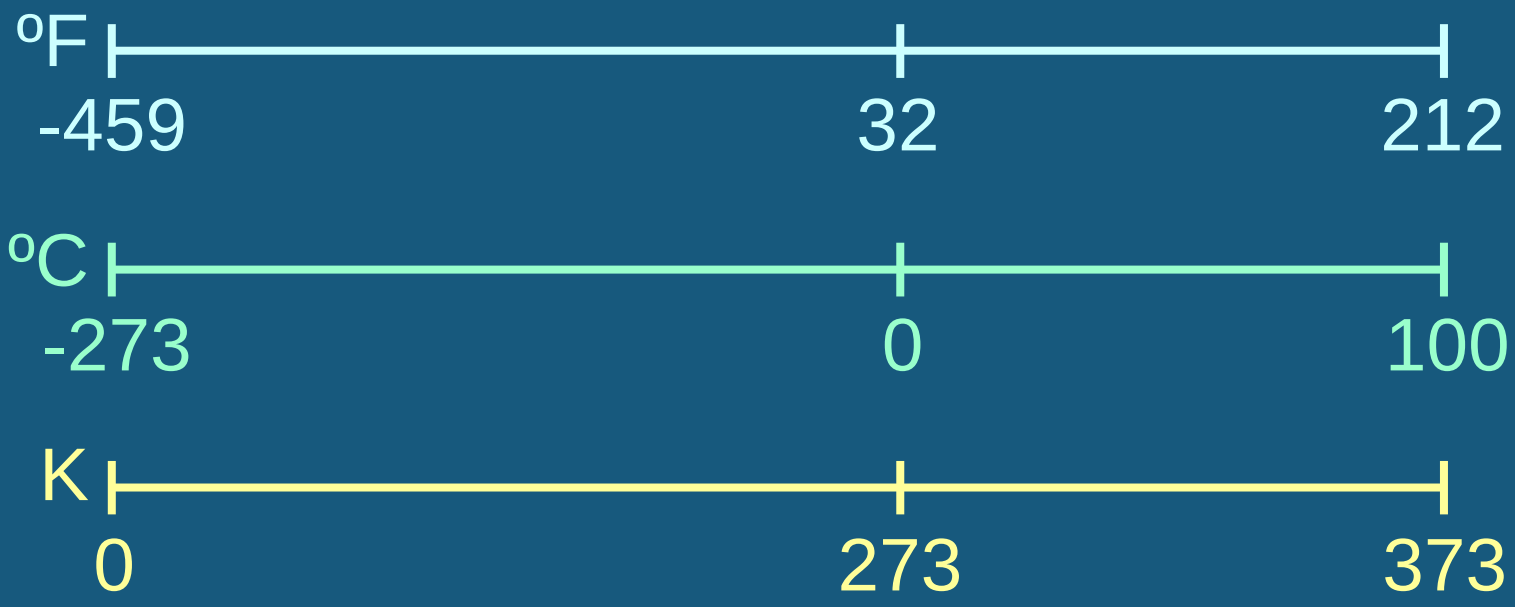
Gas Pressure

- Gas pressure measurement



Gas Temperature

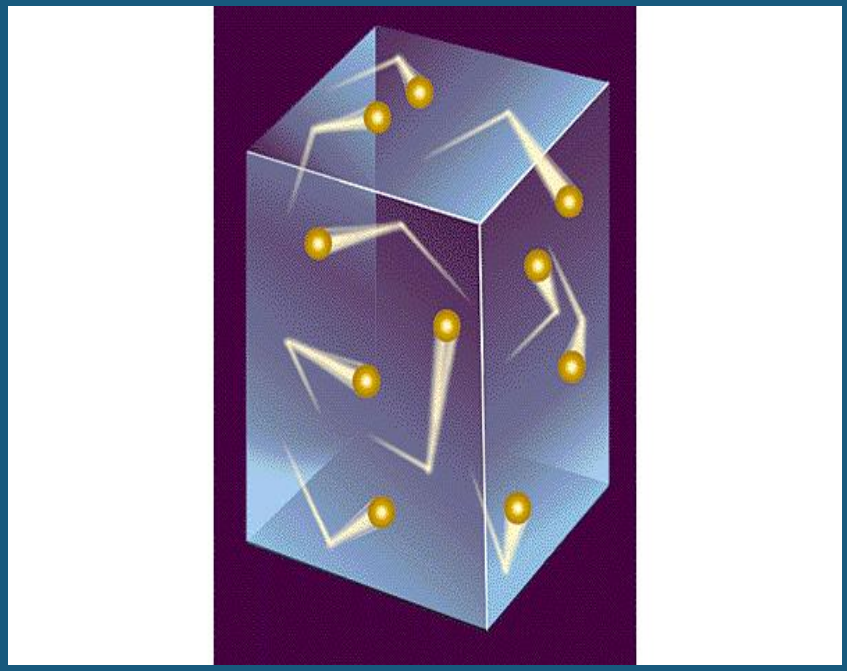
- Always use absolute temperature (Kelvin) when working with gases.



$$°C = \frac{5}{9}(°F - 32) \qquad K = ºC + 273$$

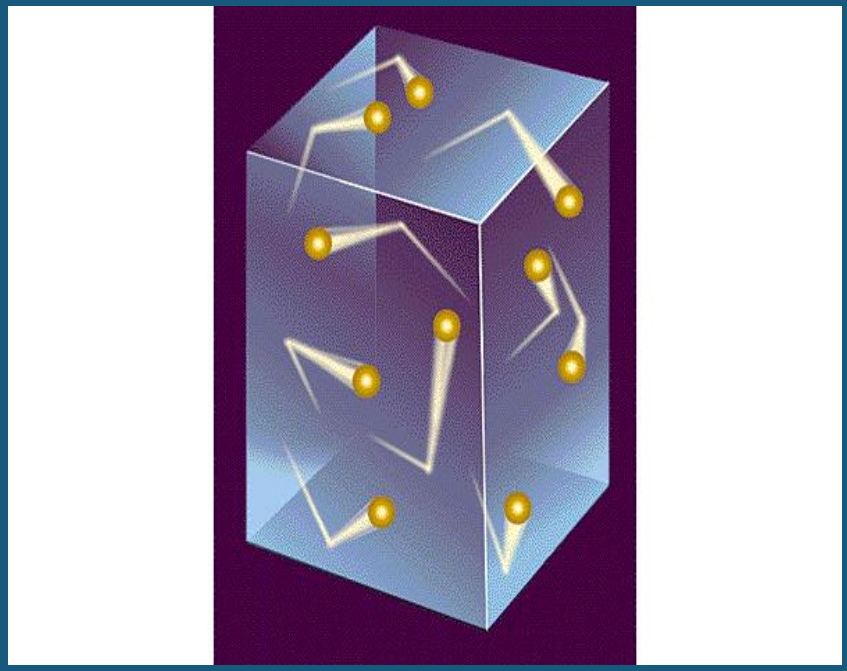
Kinetic Molecular Theory

- The behavior of gases can be described using kinetic molecular theory - "theory of moving molecules"
- Gases consist of large numbers of molecules that are in continuous, random motion.



Kinetic Molecular Theory

- The combined volume of all the molecules of the gas is negligible compared to the total volume in which the gas is contained.
  - *i.e.* the molecules are very far apart on average



Kinetic Molecular Theory

- Particles in an ideal gas…
  - have no volume.
  - have elastic collisions.
  - are in constant, random, straight-line motion.
  - don't attract or repel each other.
  - have an avg. KE directly related to Kelvin temperature.
    - At any given temperature all molecules of a gas have the same average kinetic energy.
    - As T (in K) increases, KE increases.