PROBLEM-SOLVING TACTICS

(a) Molar volume at STP:

(i) When STP conditions are taken as 0°C and 1 atm pressure, then the molar volume of a gas = 22,400 mL.

(ii) When STP condition are taken as 0°C and 1 bar pressure, then the molar volume of a gas = 22,700 mL.

(iii) When SATP conditions are used, i.e. 25°C (298.15 K) and 1 bar pressure, then the molar volume = 24,800 mL.

(b) While solving a problem, the value of 'R' can be taken as 22.4/273. As a result, the calculation becomes easy when STP conditions are mentioned and the terms will easily cancel out. Moreover, note the values of 'R' to be used in different units.

The gas constant (R)

8.31447 J K^{-1} mol^{-1}

8.20574 × 10^{-2} m^3 atm K^{-1} mol^{-1}

8.31447 × 10^{-2} m^3 bar K^{-1} mol^{-1}

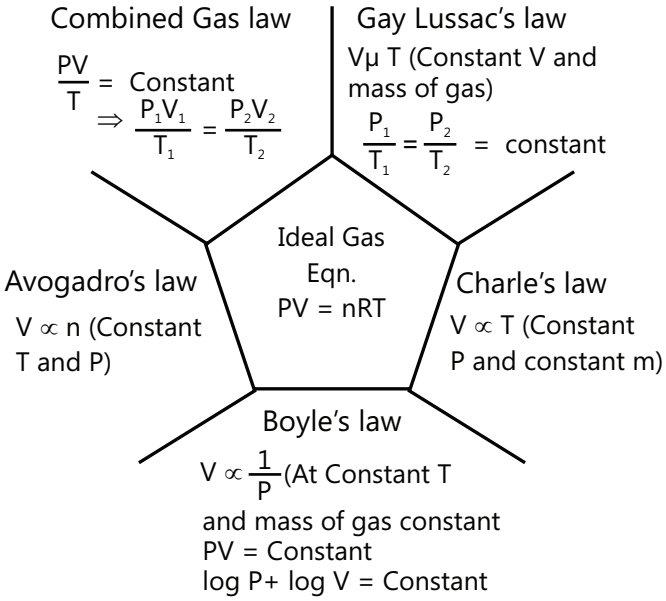
8.31447 Pa m^3 K^{-1} mol^{-1}

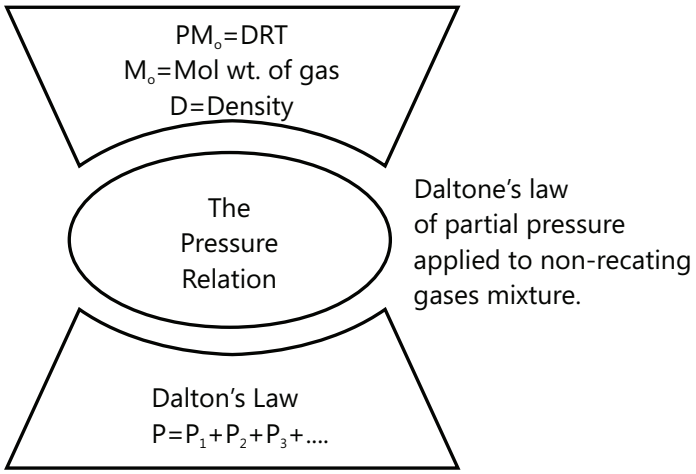
162.364 dm^3 torr K^{-1} mol^{-1}

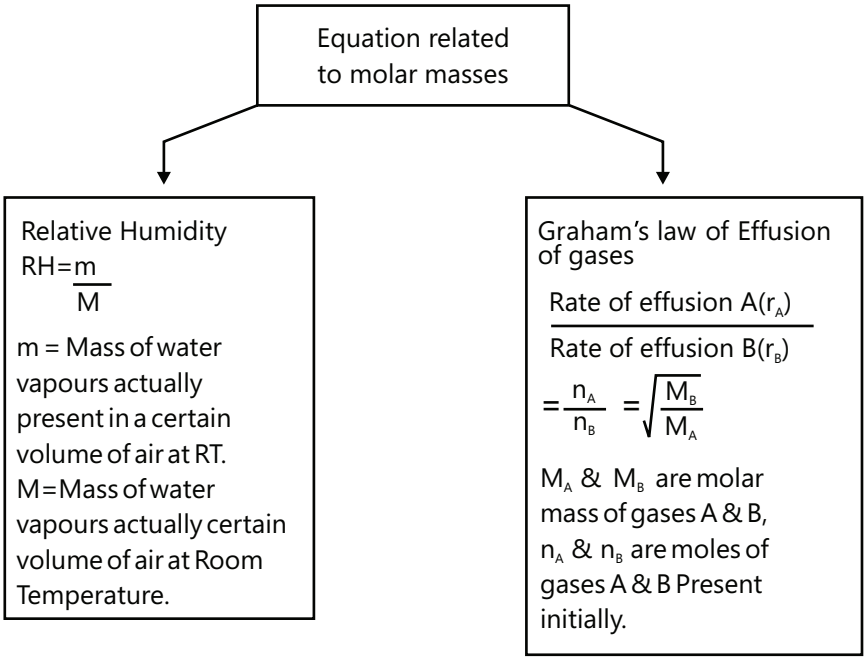
1.98721 cal K^{-1} mol^{-1}

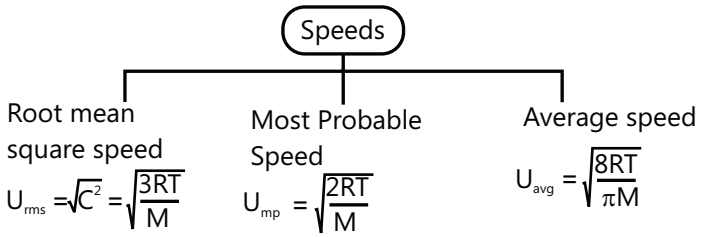
(c) Dalton's law is valid for gases that do not react chemically, e.g. the law is not valid for a mixture of SO_2 and O_2. This is because of the fact that Dalton's law involves conservation of moles, whereas in chemical reaction conservation of moles is not noticed.

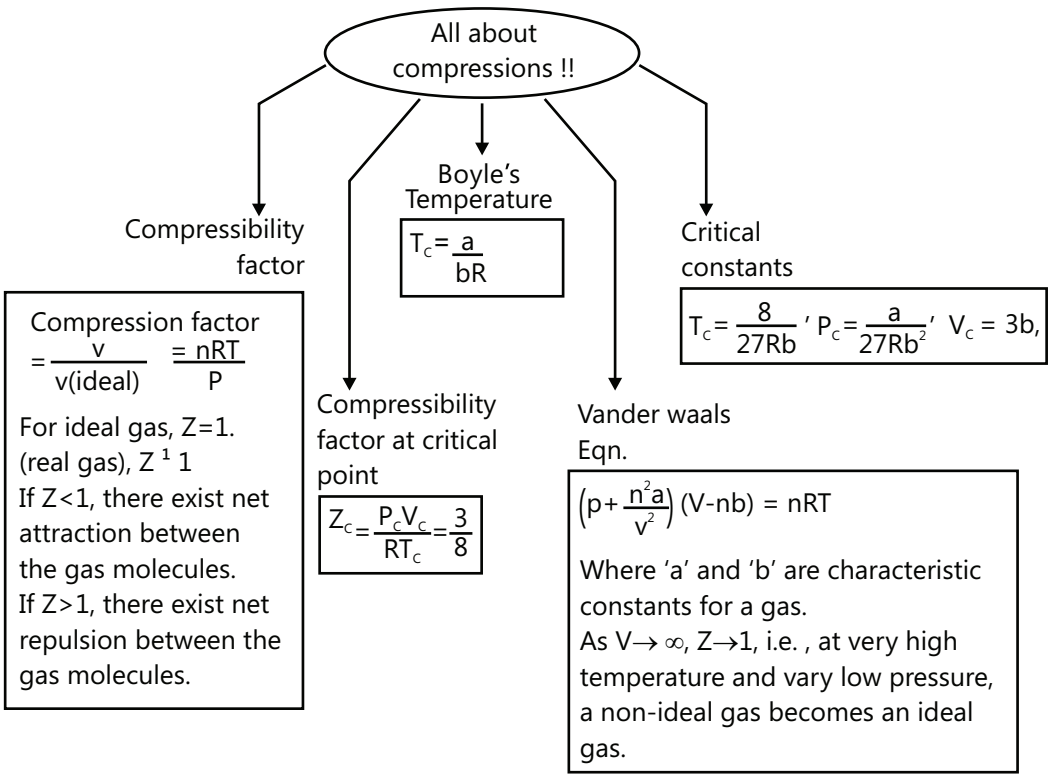
POINTS TO REMEMBER






Equation related to molar masses
Relative Humidity
RH = m/M
m = Mass of water vapours actually present in a certain volume of air at RT.
M = Mass of water vapours actually certain volume of air at Room Temperature.
Graham's law of Effusion of gases
Rate of effusion A(r_A) / Rate of effusion B(r_B) = n_A/n_B = √(M_B/M_A)
M_A & M_B are molar mass of gases A & B, n_A & n_B are moles of gases A & B Present initially.


Speeds
Root mean square speed
U_rms = √C² = √(3RT/M)
Most Probable Speed
U_mp = √(2RT/M)
Average speed
U_avg = √(8RT/πM)


All about compressions !!
Compressibility factor
Compression factor = v / v(ideal) = nRT / P
For ideal gas, Z=1.
(real gas), Z ¹ 1
If Z<1, there exist net attraction between the gas molecules.
If Z>1, there exist net repulsion between the gas molecules.
Boyle's Temperature
T_C = a/bR
Compressibility factor at critical point
Z_C = P_C V_C / RT_C = 3/8
Critical constants
T_C = 8/27Rb , P_C = a/27Rb² , V_C = 3b,
Vander waals Eqn.
(p + n²a/v²)(V-nb) = nRT
Where 'a' and 'b' are characteristic constants for a gas.
As V→ ∞, Z→1, i.e. , at very high temperature and vary low pressure, a non-ideal gas becomes an ideal gas.