IB: Applying the Ideal Gas Law   Day 6

$PV = nRT$ n - # of moles

R = 8.314 J/mol K (univ gas const)

T - Temp K   P   Pa m^3

KPa L

1:10 Quest 1 $PV = nRT$ describes the behavior of real gases

Goal: Want no interactions between molecules - spaced apart

Want low Density Choice A: Low P Large V

Try w/Class

1:56 Quest 2

	Box X	Box Y
	n Moles	2n moles
$PV = nRT$ or	Temp T	Temp T/3
$P_x = \frac{nRT_x}{V_x}$	Pres. P_x	Pres P_y

$P_y = \frac{nRT_y}{V_y}$

same Volume

The ratio of $\frac{P_x}{P_y}$ is: $\frac{P_x}{P_y} = \frac{n_x R T_x}{V_x} \cdot \frac{V_y}{n_y R T_y} = \frac{1n}{2n} \frac{T}{\frac{T}{3}}$

$= \frac{1}{2} \cdot 3 = \frac{3}{2}$

Choice B $\frac{3}{2}$

scenario1   Scenario2

17:50 Quest 3 P = 6.0 atm   New Pressure $PV = nRT$

t = 30°C → t = 330°C   Variable $\frac{P}{T} = \frac{nR}{V}$ Const

gas   gas

Convert to Kelvin t = 303K   t = 603K   so $\frac{P_1}{T_1} = \frac{P_2}{T_2}$ Solve for $P_2 = \frac{T_2}{T_1} P_1$

so

$P_2 = \frac{603}{303} \cdot 6\,Atm = 12\,atm$ Choice C

Ideal Gas Law written in terms of Number of Molecules

$PV = nRT$ $\qquad N = \frac{\text{Molecules}}{\text{mole}} \times \text{mole}$

N = Number of Molecules

N = Avagadros # × mole

$PV = \frac{N}{Na} RT$ $\qquad N = N_A \times n$

so $n = \frac{N}{Na}$

Problem: 2 Constants $\frac{N}{Na}$ & R it is rewritten as

$PV = NK_B T$

K_B - Stephan Boltzman Constant $\quad K_B = \frac{R}{Na}$

In data booklet $K_B = 1.38 \times 10^{-23}$ J/K

Pg 6 Data Booklet Pg 6 ~~[illegible]~~ $KE_{AVG} \propto T$

~~[illegible]~~ $KE_{AVG} = \text{Constant}\ T$

$$KE_{AVG} = \frac{3}{2} K_B T$$

T in Kelvin

★ Good Quest ★

14:14 Quest: What is the average speed of a nitrogen molecule N_2, in air at 27 °C

(N_2 - 28)

T = 300 K

$KE = \frac{1}{2}mv^2 \quad KE_{AVG} = \frac{3}{2} K_B T$

$m = 1.67 \times 10^{-27}$ Kg × 28

$= 4.7 \times 10^{-26}$ Kg

K = C + 273

27 + 273 = 300

$\frac{1}{2}mv^2 = \frac{3}{2} K_B T$

$\frac{1}{2}(4.7 \times 10^{-26} \text{Kg}) V^2 = \frac{3}{2}(1.38 \times 10^{-23})(300)$

$v^2 = 2.6 \times 10^5$

$v = 500$ m/s