

SCHROEDER PROBLEM 1.10

(PHYS 313 SAMPLE SOLUTION)

AN AVERAGE SIZE ROOM, SAY A BEDROOM, HAS A CEILING HEIGHT OF ABOUT 2.5 m, AND FLOOR DIMENSIONS 3 m x 4 m. ITS VOLUME IS THEN

$$V = (2.5 \text{ m}) (3 \text{ m}) (4 \text{ m}) = 30 \text{ m}^3$$

FROM THE IDEAL GAS LAW, $PV = NkT$ THE NUMBER OF MOLECULES N IS

$$N = \frac{PV}{kT}$$

AT ATMOSPHERIC PRESSURE $P = 1 \text{ atm} \approx 10^5 \text{ Pa}$
AND ROOM TEMPERATURE $T = 300 \text{ K}$

$$N = \frac{(10^5 \text{ Pa}) (30 \text{ m}^3)}{(1.4 \cdot 10^{-23} \text{ J/K}) (300 \text{ K})} = 7 \cdot 10^{26}$$

THERE ARE SOME $7 \cdot 10^{26}$ (OR 10^{27}) PARTICLES IN A ROOM, OR 1000 TIMES THE AVOGADRO NUMBER N_A .