Mastering Physics Solutions 4th Edition

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Physics With Mastering Physics 4th Edition Textbook Solutions

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Pressure of helium inside the balloon $P = 2.4\times10^{5}$ Pa

Temperature of the balloon $T = 18°C$

$= 273+18$

$= 291$ K

Radius of the balloon $r = 0.25$ m

Boltzmann constant $k = 1.38\times10^{-23}$ J/K.

(a)

Let the number of atoms in the balloon be N

Apply an ideal gas equation.

$PV = NkT$

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

Volume of helium inside the balloon $V = \frac{4}{3}\pi r^{3}$

$$= \frac{4}{3}\pi(0.25\text{ m})^{3}$$

$$= 0.065\text{ m}^{3}$$

Therefore

Number of atoms in the balloon $N = \frac{(2.4\times10^{5}\text{ Pa})(0.065\text{ m}^{3})}{(1.38\times10^{-23}\text{J/K})(291\text{ K})}$

$= 3.88 * 10^{24}$ atoms

$= \boxed{3.9\times10^{24}\text{ atoms}}$

(b)

If the number of helium atoms are doubled, keeping the pressure and temperature constant.

Then by the equation of state

$PV = NkT$

The volume of helium doubles.

Let this volume be V'

$\therefore V' = 2V$