Chapter 12

(18)

Eq 12.3 $\Delta L = \alpha L_0 \Delta T$

ΔT : change in temperature (either units $^\circ C$ or $^\circ K$)

α : Coefficient of linear expansion $\left(\text{Lab}_{\text{exp}}\right)$

~~Fro~~ For brass $\alpha = 18.9 \times 10^{-6} K^{-1}$

Temperature change $\Delta T = T_f - T_i = -1^\circ C = -1^\circ K$

So the length of the rod ~~is~~ will change by

$\Delta L = \alpha L_0 \Delta T = (18.9 \times 10^{-6} K^{-1})(1 m)(-1 K)$

$$\boxed{\Delta L = -1.89 \times 10^{-5} m}$$

(19) Again $\Delta L = \alpha L_0 \Delta T$

α : coefficient of linear expansion

in our case, we are dealing with

Aluminum $\alpha = 25\ 10^{-6} K^{-1}$

$\Delta T = 50 - 30^\circ C = 20^\circ C = 20^\circ K$

$L_0 = 10 m$

$\Delta L = 25\ 10^{-6} (\cancel{K^{-1}}) (10 m) (20 \cancel{K})$

$$\boxed{\Delta L = 5.\ mm}$$

(27)

$T_c = \frac{5}{9}(T_F - 32°)$

$T_F = 32 + \frac{9}{5} T_c$

$T_i = 20°C$

$\alpha = 12 \times 10^{-6} K^{-1}$

$L_0 = 10 m$

$\underset{\substack{\text{length} \\ \text{at summer} \\ \text{day}}}{L} = \underset{\substack{\text{length} \\ \text{at } T = 20°C}}{L_0} + \underset{\text{Change in length.}}{\Delta L}$

T_F (summer day) $= 96.8 °F$

$T_c = \frac{5}{9}(96.8 - 32) = 36 °C = T_f$

$\Delta L = \alpha L_0 \Delta T$

$\Delta T = T_f - T_i = 36 - 20 = 16 K$

$L = L_0 + \Delta L = L_0 + \alpha L_0 \Delta T = L_0(1 + \alpha \Delta T)$

$L = 10_m\left(1 + (12 \times 10^{-6} \cancel{K^{-1}})(16 \cancel{K})\right)$

$\boxed{L = 10.002 m}$

which longer than the correct length by 0.002 m or 2 mm. This is not likely to trouble the

Carpenter

(44)

Gas

$PV = nRT$ $\left(STP \to 273\,K \; (0°C)\right)$

Since the Container is sealed $\Delta V = 0$

(12.7) Gay - Lussac's Law

if $V = \text{const}$ $\frac{P}{T} = \text{Const}$ $1 / 10^5$ Pa

initial $P = 1\,atm = 0.101$ MPa $T_i = 273\,K$

$$\frac{P_f}{T_f} = \frac{P_i}{T_i} \Rightarrow P_f = \frac{P_i T_f}{T_i}$$

$$P_f = \frac{(0.101\,MPa)(730\,K)}{273\,K} = 0.271\,MPa$$

(49) ~~similar to~~ $PV = RT$

The pressure is kept constant

So $\frac{V_i}{T_i} = \frac{V_f}{T_f}$

$V_i = 300\,cm^3$ $T_i = 25 + 273.15$

$V_f = 200\,cm^3$

$$T_f = \frac{T_i V_f}{V_i} = \frac{(298.15)(200)}{300}$$

$$\boxed{T_f = 199\,K}$$

(53)

A water molecule, H_2O is made of Hydrogen atoms and one oxygen atom. thus its mass is:

$$m = \left[2(1.008)u + 15.999u\right](\cancel{1.66\,10^{-27}}\ 1,6606\,10^{-27}\ kg/u)$$

$$= 2.992\ 10^{-26}\ kg$$

(64) Apply 12.8 $\boxed{\frac{PV}{T} = \text{Constant.}}$

Hydrogen Gas
Ideal gas.

$$\frac{P_i V_i}{T_i} = \frac{P_f V_f}{T_f}$$

$P_i = 2\,atm$, $V_i = 30$ liters, $T_i = 273\,K$, $P_f = 3\,atm$
$V_f = 15$ liters.

$$T_f = T_i \left(\frac{P_f}{P_i}\right)\left(\frac{V_f}{V_i}\right) = (273)\left(\frac{3}{2}\right)\left(\frac{15}{30}\right)$$

$$\boxed{T_f = 205\,K}$$

72 Ideal Gas (12.10) $PV = nRT$

$$V = \frac{nRT}{P}$$

$P = 93\ 10^3\ Pa$ $\quad n = 3\ mol$ $\quad T = 60 + 273 = 333k$

$$V = \frac{nRT}{P} = \frac{(3m)(8.3144\ J/mol.k)(333k)}{93.10^3\ Pa}$$

$$\boxed{V = 0.089\ m^3}$$

$n = \frac{N}{N_A}$ Avogadro number
N_A: Avogadro $= 6.022 \times 10^{23}$
in 1 mole there is N_A atoms.

76 (12.11) $PV = Nk_BT$

$P = 0.01 \times 10^6\ Pa$, $V = 0.1\ m^3$ $\quad T = 273 + 20 = 293°k$

$$N = \frac{PV}{k_BT} = \frac{(0.01 \times 10^4 Pa)(0.1 m^3)}{(1.380662\ 10^{-23} J/K)(293k)}$$

$$\boxed{N = 2.5 \times 10^{23}}$$