Homework Solutions to HW Set # 9 , due 11 / 11 / 03

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C.Q.

10.3 The answer is that it doesn't matter if you say kelvin or celcius.

$1.5 \times 10^7 = 15,000,000$

Celcius and kelvin differ by $\approx 273^\circ$ so when given only 2 signifigant figures 1.5×10^7 the 273° difference is meaningless.

10.12 After heating the tape up, it gets longer. So the unit of measurements you made previously get bigger. This makes the thing you measure look too small.

Problems

10.15 To seperate them $d^f_{ring} = d^f_{cylinder}$

a) $d_{r_f} = d_r + \alpha_{brass} d_r \Delta T = d_c + \alpha_{al} d_c \Delta T = d_{c_f}$

$$\Delta T = \frac{d_r - d_c}{\alpha_{al} d_c - \alpha_{brass} d_r} = -199^\circ C$$

$d_r = 10.00$ cm

$d_c = 10.01$ cm

So $T_f = 20^\circ C - 199^\circ C = -179^\circ C$

b) $d_c = 10.02$ cm

plug into same formula get

$\Delta T = -396^\circ C$

$\Rightarrow T_f = -376^\circ C$

Which is less than absolute zero.

10.30 Use $PV = nRT$

$P_i V_i = P_f V_f$ P_i: 50 atm, $P_f = 1.20$ atm, $V_i = .100m^3$, $R = \frac{.300m}{2}$

$V_f = V_i \left(\frac{P_i}{P_f} \right) = 12.5\ m^3$

Each ballon has volume $\frac{4}{3}\pi R^3$ Let N = # of ballons

So $N \frac{4}{3}\pi R^3 = 12.5\ m^3$

$\Rightarrow N = \frac{12.5m}{\frac{4}{3}\pi R^3} \equiv 884$ ballons

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10.43 $F = \frac{I}{\Delta t}$ ← impulse $= \frac{\Delta P}{\Delta t} = \frac{150 \cdot (m_B)(v_B - (-v_B))}{\Delta t}$

$\frac{2 \cdot 150\ m_B V_B}{\Delta t} = 16N$

Graded problems:

10.6 using the linear relationship $P = A + BT_c$

$.900\ atm = A + B(-80.0C)$, $1.635\ atm = A + B(78.0°c)$

Solving for A and B gives $A = 1.27$ atm $B = 4.65 \times 10^{-3} \frac{atm}{C°}$

a) At absolute zero $P = 0$ so $T_0 = \frac{-.27atm}{4.65 \times 10^{-3} \frac{atm}{C°}} = -273°c$

b) Use $1.27\ atm + 4.65 \times 10^{-3} \frac{atm}{C°} T_c = P$

Freezing $T_c = 0 \Rightarrow P = 1.27atm$ $T_c = 100°c \Rightarrow P = 1.74\ atm$

10.31 Use $PV = nRT$ and V is constant

$$\frac{n_i R T_i}{P_i} = \frac{n_f R T_f}{P_f} \Rightarrow \frac{n_i T_i}{P_i} = \frac{n_f T_f}{P_f}$$

$$= \frac{n_f T_f}{n_i T_i} P_i = \frac{1}{2} \frac{338\,k}{288\,k} 10.0\,atm = 5.87\,atm$$

10.41 a) $KE = \frac{3}{2} k_B T = \frac{3}{2}(1.38 \times 10^{-23} \frac{J}{k})(423\,k) = 8.76 \times 10^{-21}\,J$

b) $KE = \frac{1}{2} m v^2 \Rightarrow v = \sqrt{\frac{2\,KE}{m}}$ so we need m for each

$$= \frac{M}{} = \frac{4.00 \times 10^{-3}\,kg/mol}{6.02 \times 10^{23}\,\frac{molecules}{mol}} = 6.64 \times 10^{-27}\,kg$$

$V_{He} = 1.62\,\frac{km}{s}$

Do the same for argon with $M = 39.9 \times 10^{-3}\,\frac{kg}{mol}$

gives $V_{ar} = 514\,m/s$

10.44

$$\bar{F} = \frac{I}{\Delta t} = \frac{N|\Delta p|}{\Delta t} = \frac{2Nmv}{\Delta t} = 14\ N$$

$$P = \frac{\bar{F}}{A} = \frac{14\,N}{8.0\,cm^2}\left(\frac{10^4\,cm^2}{1\,m^2}\right) = 1.8 \times 10^4\ N/m^2$$

10.54

$$P_1 = P_{atm} + P_{1\,gauge} = .00\ atm + .80\ atm = 2.80\ atm$$

a) The point here is that the gauge measures pressure above the atmospheric pressure.

$P_2 = 3.20$ atm, use $PV = nRT$ with V constant

$$T_2 = \frac{P_2}{P_1} T = \frac{3.20\ atm}{2.80\ atm}(300\,K) = 343\ K$$

b) Use $PV = nRT$ with V, T constant

$$\frac{n_3}{P_3} = \frac{n_2}{P_2} \qquad \text{want } P_2 = 2.80\ atm$$

So $$\frac{n_3}{n_2} = \frac{P_3}{P_2} = \frac{2.80\ atm}{3.20\ atm} = .875 \text{ of the original mass}$$