Physics 260 Homework Assignment 6

1 PSE6 19.CQ.011

For an ideal gas, PV/nT is a constant. So

$$P_A V_A = P_B V_B$$

since the number of moles of the gas and temperature are the same for both cylinder. Therefore, $P_A = (V_B/V_A)P_B$.

2 PSE6 19.P.004

$$T_C = \frac{5}{9}(T_F + 32) \qquad\qquad T = T_C + 273.15$$

3 PSE6 19.P.005

$$\Delta T_C = \Delta T \qquad\qquad \Delta T_C = \frac{5}{9}T_F$$

4 PSE6 19.P.009

The wire has length L_i when temperature is T_i. Therefore, the change in length is

$$\Delta L = \alpha L_i (T_C - T_i)$$

The value of linear expansion coefficient can be found in Table 19.1.

5 PSE6 19.P.008

Applying the same method as the previous problem.

6 PSE6 19.P.018

a. In order for the Aluminum to just slip over the brass, we need the inner diameter of the Aluminum equal to the diameter of the brass rod. So the change in diameter is $\Delta L = L_{br} - L_{Al}$. We are only considering the linear expansion here because when changing length into radius there is a 2π terms involved. It applies to both materials and the effect cancels out. So $\Delta L = \alpha_{Al} L_{Al}(T - T_i)$. Solve for T.

b. If both are heated, both the diameters increase and they should equal each other at some temperature T. Therefore

$$L_{Al} + \alpha_{Al} L_{Al}(T - T_i)) = L_{br} + \alpha_{br} L_{br}(T - T_i))$$

Again solve for T. Remember that the melting temperature for Aluminum is 660°C. If the final temperature is greater than the melting temperature for Aluminum, this process doesn't work.

7 PSE6 19.P.026

a. Use the equation of state that describes an ideal gas system, $PV = nRT$ and solve for n, which gives the number of moles of the gas in the vessel. Make sure you change the pressure into Pascal unit first.

b. Use the number you found in part (a) multiplies the Avogadro's number to get the total number of molecules, $N = nN_A$.

8 PSE6 19.P.029

Same as the previous problem, $N = PVN_A/RT$.

9 PSE6 19.P.042

Same as the previous problem.

10 PSE6 19.P.050

a. If no gas escapes, then the number of moles of gas remains constant. Therefore, using $PV = nRT$, with n and R constant, we obtain a relationship between the initial and final values:

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

All quantities on the left hand side of the equations are known. The final volume is the initial volume plus the change in volume, which is the cross-sectional area of the piston times the height it's being raised ($V_f = V_i + Ah$). The final pressure is the original pressure plus addition pressure due to the force acting on the piston

$(P_f = P_i + \frac{F}{A} = P_i + \frac{kh}{A})$. Hence

$$\frac{P_i V_i}{T_i} = \frac{(P_i + \frac{kh}{A})(V_i + Ah)}{T_f}$$

Rearrange the terms and the equation turns out to be quadratic. Solve for h.

b.

$$P_f = P_i + \frac{kh}{A}$$

11 PSE6 19.QQ.001

From the object at the higher temperature to the object at lower temperature.

12 PSE6 19.QQ.002

Boiling water at 100°C and a glass of water at 50°C.

13 PSE6 19.QQx.002

The pressure of the gas is proportional to the temperature of the gas and the pressure of the gas is linearly dependent on the temperature of the gas.

14 PSE6 19.QQ.007

The number of moles of air in the room at the higher temperature is smaller than before since the pressure and volume stays constant. We have $n_i T_i = n_f T_f$.