Physics 10154 - Exam #10B

Answer the following two questions. Be sure to clearly indicate your answer with a circle or box. Show all work. If I cannot see how you arrived at an answer, I will deduct points!

1. Helium gas is stored in a tank with a volume of 75 L at a pressure of 120 atm and a temperature of -35° C. When the gas is pumped out of the tank and into children's balloons, it is at a pressure of 1.0 atm and a temperature of 25° C. If a typical balloon has a radius of 13 cm, how many balloons can be filled from one tank of gas?

$V_1 = 75\ L \qquad V_2 = ?$

$P_1 = 120\ atm \qquad P_2 = 1.0$

$T_1 = 238K \qquad T_2 = 298K$

$n_1 = n_2$

$$\frac{V_2}{V_1} = \frac{\left(\frac{n_2}{n_1}\right)\left(\frac{R}{R}\right)\left(\frac{T_2}{T_1}\right)}{\left(\frac{P_2}{P_1}\right)} = \frac{(1)(1)\left(\frac{298}{238}\right)}{\left(\frac{1}{120}\right)} = 150.25$$

$$V_2 = (75)(150.3) = 11269\ L$$

$$= 11.27\ m^3$$

$$V_{balloon} = \frac{4}{3}\pi(.13)^3 = .0092\ m^3$$

$$N = \frac{11.27}{.0092} = \boxed{1224 \text{ balloons}}$$

~1200 balloons

2. A 250 gram lump of ice at a temperature of -25° C is placed in a 4.5 kg iron pot at a temperature of 93° C. What is the final temperature of the system? If the final temperature of the system is 0° C, then state how much of the ice melts.

The following constants are given in mks units.

The specific heat of iron is 448.
The specific heat of ice is 2090.
The specific heat of water is 4186.
The latent heat of fusion for water is 333,000.

To heat ice: $(.250)(2090)(25) = 13062.5$

To melt ice: $(.250)(333000) = 83250$

To cool pot: $(4.5)(448)(-93) = -187488$

So all ice melts, $T_F > 0$.

$$\Delta T_{pot} + \Delta T_{ice} = 0$$

$$(4.5)(448)(T_F - 93) + 13062.5 + 83250 + (.250)(4186)(T_F - 0)$$

$$2016 T_F - 187488 + 13062.5 + 83250 + 1046.5 T_F = 0$$

$$3062.5 T_F - 91175.5 = 0$$

$$T_F = \frac{91175.5}{3062.5} = \boxed{30°C}$$