Example: Two containers at 25.0 °C, one 5.0 L and the other 10.0 L are connected by an empty valve with a volume of 125 mL.

The 5.0 L Container holds 5.00 g of hydrogen, the 10.0 L, 5.00 g of nitrogen.

What is the pressure of the system when the valve is opened if the gases react according to the following reaction?

$$3\ H_2\ (g) + N_2\ (g) \rightarrow 2\ NH_3\ (g)$$

First, find the limiting reactant:

$$5.00\ g\ H_2 * \frac{1\ mol\ H_2}{2.016\ g\ H_2} * \frac{1\ mol\ N_2}{3\ mol\ H_2} * \frac{28.014\ g\ N_2}{1\ mol\ N_2} = 23.2 g\ N_2 \text{ needed}$$

Since we only have 5.00 N_2 g, N_2 is limiting and H_2 is in excess.

Second, determine the moles of NH_3 produced and the amount of H_2 that is left-over.

$$5.00\ g\ N_2 * \frac{1\ mol\ N_2}{28.014\ g\ N_2} * \frac{3\ mol\ H_2}{1\ mol\ N_2} * \frac{2.016\ g\ H_2}{1\ mol\ H_2} = 1.08 g\ H_2 \text{ needed}$$

$$\text{Leftover } H_2 = 5.00\ g\ H_2 - 1.08\ g\ H_2 = 3.92\ g\ H_2$$

$$5.00\ g\ N_2 * \frac{1\ mol\ N_2}{28.014\ g\ N_2} * \frac{2\ mol\ NH_3}{1\ mol\ N_2} * \frac{17.031\ g\ NH_3}{1\ mol\ NH_3} = 6.08 g\ NH_3 \text{ produced}$$

$$3.92\ g\ H_2 * \frac{1\ mol\ H_2}{2.016 g\ H_2} = 1.94\ mol\ H_2$$

$$6.08\ g\ NH_3 * \frac{1 mol\ NH_3}{17.031\ g\ NH_3} = 0.357\ mol\ NH_3$$

Last,

n_{tot} = 1.94 mol H_2 + 0.357 mol N_2 = 2.30 moles total

V_{tot} = 5.0 L + 10.0 L + 125 mL = 5.0 L + 10.0 L + 0.125 L = 15.1 L total

we know that $P_{tot} V_{tot} = n_{tot} R T$ and we need P_{tot} ...

$$P_{tot} = \frac{n_{tot} RT}{V_{tot}} = \frac{2.30\ mol * 0.08206\ \frac{L*atm}{mol*K} * 298.15 K}{15.1\ L} = 3.73\ atm$$