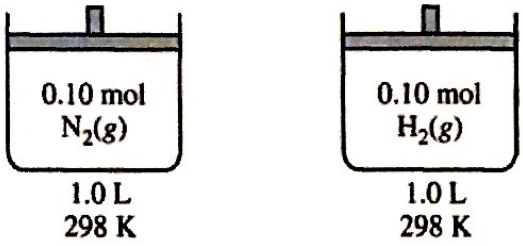
FR Practice #3 (2005B #6, 8 points)



3. Consider two containers of volume 1.0 L at 298 K, as shown above. One container holds 0.10 mol $N_2(g)$ and the other holds 0.10 mol $H_2(g)$. The average kinetic energy of the $N_2(g)$ molecules is 6.2×10^{-21} J. Assume that the $N_2(g)$ and the $H_2(g)$ exhibit ideal behavior.

   a. Is the pressure in the container holding the $H_2(g)$ less than, greater than, or equal to the pressure in the container holding the $N_2(g)$? Justify your answer. (2 points)

   b. What is the average kinetic energy of the $H_2(g)$ molecules? (1 point)

   c. The molecules of which gas, N_2 or H_2, have the greater average speed? Justify your answer. (1 point)

   d. What change could be made that would decrease the average kinetic energy of the molecules in the container? (1 point)

   e. If the volume of the container holding the $H_2(g)$ was decreased to 0.50 L at 298 K, what would be the change in each of the following variables? In each case, justify your answer.

      i. The pressure within the container (2 points)

      ii. The average speed of the $H_2(g)$ molecules (1 point)

(2 pt) (a) Equal, b/c there are an equal # moles of both gases at the same temp. + volume (1 pt)] (1 pt)

(1 pt) (b) 6.2×10^{-21} J (the same as N_2) b/c both gases are at the same temp.

(1 pt) (c) H_2 molecules have greater average speed, b/c $KE = \frac{1}{2}mv^2$ and thus at the same temp. the molecules w/ the lowest molar mass (H_2) will have the greater average speed

(1 pt) (d) Since average kinetic energy of a gas depends on depends on temperature, lowering temperature of the gas sample would lower its kinetic energy.

(2 pt) (e)(i) pressure doubles! (1 pt)

$P_1V_1 = P_2V_2 = P_2(\frac{1}{2}V_1) \Rightarrow P_1 = P_2(\frac{1}{2}) \Rightarrow P_2 = 2P_1$ (1 pt)

(1 pt) (ii) Unchanged, since average speed depends on the value of temperature, not volume.