Molar Volume

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Solution: for the liquid we can calculate the molar volume using the formula:

$$V_m = \frac{M_m}{\rho}$$

Remember that density has units of grams per unit volume. Therefore, is also has units of molar mass per unit molar volume.

$$\rho = \frac{M_m}{V_m}$$

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Therefore, for liquid H_2O we have

$$V_m = \frac{18\ gm/mol}{1\ gm/cm^3} = 18\frac{mol}{cm^3} = 0.018\frac{mol}{L}$$

For the vapor we will use the ideal gas law

$$V_m = \frac{RT}{P} = \frac{(0.08206\ Latm/molK)(373\ K)}{1\ atm}$$

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We find that the molar volume of water vapor is:

$$V_m = 30.6 \frac{mol}{L}$$

The ratio between the vapor and liquid is:

$$Ratio = \frac{30.6\ L/mol}{0.018\ L/mol} = 1700$$