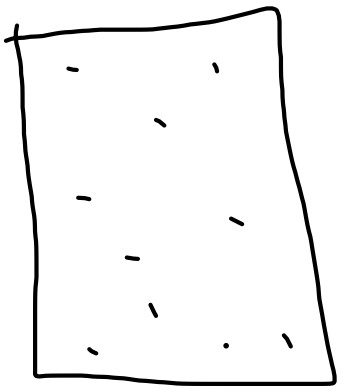
PBL: How ideal is the Ideal Gas Law?

Does it work better at high temp or low temp?

Does it work better under high pressure or low pressure?



← Volume = V

Actual volume

$= V - n b$

↑ # mol

↑ molar volume

$$PV = nRT$$

$$P = \frac{nRT}{V}$$

$$P = \frac{nRT}{V - nb} - a\left(\frac{n}{V}\right)^2$$

$$P + a\left(\frac{n}{V}\right)^2 = \frac{nRT}{V - nb}$$

$$\left(P + a\left(\frac{n}{V}\right)^2\right)\left(V - nb\right) = nRT$$

Van der Waals Equation

An unknown gas has a density of 1.859 $\frac{g}{L}$ when the temp is 50.0°C and the pressure is 1.120 atm. What is the molecular weight of the gas?

$$PV = nRT$$

$$MWT = \frac{m}{n} = \frac{1.859\,g}{0.042236\,mol} = 44.01\,\frac{g}{mol}$$

$$d = \frac{m}{V} = \frac{1.859}{1L} = 1.859\,\frac{g}{L}$$

$$PV = nRT \rightarrow n = \frac{PV}{RT}$$

$$n = \frac{(1.120\,\cancel{atm})(1\,\cancel{L})}{(0.08206\,\frac{\cancel{L}\,\cancel{atm}}{\cancel{K}\,mol})(323.15\,\cancel{K})}$$

$$= 0.042236\,mol$$

The gas in the previous question is one of the following. Which is it?

a) CH_4 b) CO_2 c) NH_3

d) O_2 e) SO_2

$-\text{heat lost} = \text{heat gained}$

$$\left(-4.18\frac{J}{g^\circ C}\right)(25.0\,g)(T_f - 95.0^\circ C) = \left(4.18\frac{J}{g^\circ C}\right)(29.88\,g)(T_f - 29.0^\circ C)$$

$$-(25.0\,g)(T_f - 95.0^\circ C) = 29.88\,g(T_f - 29.0^\circ C)$$

$$-25.0\,g\,T_f + 25.0\,g(95.0^\circ C) = 29.88\,g\,T_f - 29.88\,g(29.0^\circ C)$$

$$-25.0\,g\,T_f - 29.88\,g\,T_f = -25.0\,g(95.0^\circ C) - 29.88\,g(29.0^\circ C)$$

$$(-25.0\,g - 29.88\,g)T_f = -3241.52\,g^\circ C$$

$$(-54.88\,g)\,T_f = -3241.52\,g^\circ C$$

$$T_f = \frac{-3241.52\,g^\circ C}{-54.88\,g}$$

$$T_f = 59.1^\circ C$$