1. At 41°C, the vapor pressure of a liquid is 400.0 mmHg. The enthalpy of vaporization is 31.4 kJ/mol. Calculate the normal boiling point of this liquid. (Show all of your work in a logical fashion to receive full credit.)

\[
\ln \frac{P_2}{P_1} = \frac{\Delta H_{\text{vap}}}{R} \left( \frac{1}{T_1} - \frac{1}{T_2} \right) \]

\[
\ln \frac{760 \text{ mmHg}}{400 \text{ mmHg}} = -\frac{1}{314 \text{ K}} \Rightarrow T_2 = 332 \text{ K} = 59^\circ \text{C}
\]

2. An element has an atomic mass of 296 amu. It crystallizes in a primitive cubic cell with an edge length of 380 pm.

A. Calculate the diameter of an atom of this element in pm.

\[r = \frac{l}{2} \Rightarrow d = 380 \text{ pm}
\]

B. Calculate the density of this element in g/mL.

in each unit cell (primitive cubic) \(\Rightarrow\) 1 atom (Each cell is a cube)

\[
m = \left(\text{atom}\right) \left(296 \text{ amu}\right) \left(1.66 \times 10^{-24} \text{ g}\right) = 4.91 \times 10^{-22} \text{ g}
\]

\[
V = \left(380 \text{ pm}\right)^3 \left(1 \times 10^{-10} \text{ cm}\right)^3 = 5.49 \times 10^{-23} \text{ cm}^3 = 5.49 \times 10^{-23} \text{ mL}
\]

C. Calculate the packing efficiency of this element in %.

\[
\% = \frac{V_{\text{atoms}}}{V_{\text{cell}}} \times 100\% = \frac{\left(\frac{4}{3} \pi r^3\right) \left(\text{atom}\right)}{(2r)^3} \times 100\% = 52.3 \%
\]