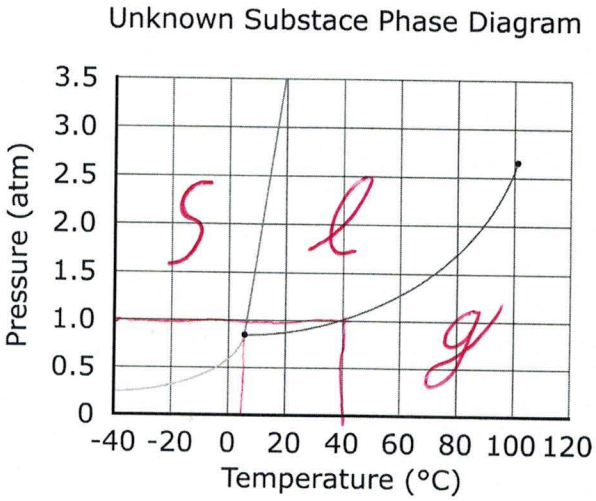
Quiz 12.3 – Vapor Pressure and Phase Diagrams

Name: Key

All questions will refer to the phase diagram for an unknown substance shown below



Question 1

On the diagram, label the regions which represent each phase (solid, liquid, and gas)

Question 2

Estimate the normal boiling temperature

40 °C

Question 3

Is the liquid or solid phase more dense?

Solid

Question 4

Estimate the temperature and pressure at the triple point and the critical point

$P_t = 0.75$ atm $\quad P_c = 2.65$ atm

Question 5 $T_t = 5\,^\circ C \quad T_c = 102\,^\circ C$

Use your estimates to calculate ΔH_{vap}

$$\ln\left(\frac{2.65\text{ atm}}{0.75\text{ atm}}\right) = \frac{\Delta H_{vap}}{8.314\text{ J/mol·K}}\left(\frac{1}{278\text{ K}} - \frac{1}{375\text{ K}}\right)$$

Question 6 $\Delta H_{vap} = 11{,}300\text{ J/mol} = 11.3\text{ kJ/mol}$

Use the normal boiling point and your estimate of ΔH_{vap} to predict what the vapor pressure *would be* at 120 °C, if there were no critical point

$$\ln\left(\frac{P_{120}}{1\text{ atm}}\right) = \frac{11{,}300\text{ J/mol}}{8.314\text{ J/mol·K}}\left(\frac{1}{313\text{ K}} - \frac{1}{393\text{ K}}\right)$$

$$\ln\left(\frac{P_{120}}{1\text{ atm}}\right) = 0.8839 \quad \frac{P_{120}}{1\text{ atm}} = 2.42 \rightarrow P_{120} = 2.42\text{ atm}$$

$e^{\uparrow}$ $e^{\uparrow}$