

1. True/False Circle either T or F for each statement (10 points each)

T F The vapor pressure of a solid can never be higher than the pressure at the triple point.

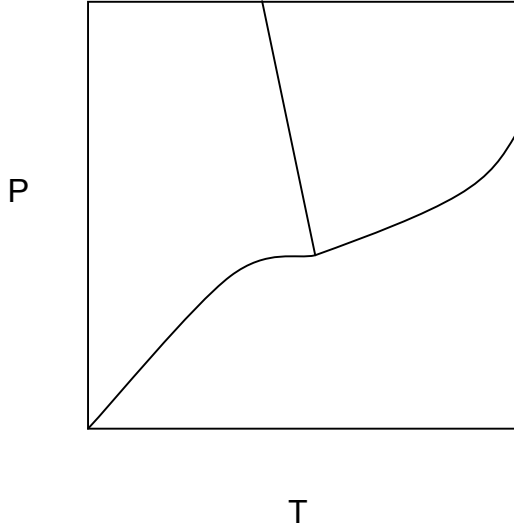
T F The melting temperature of solids always increases when the pressure is increased.

T F The chemical potential always increases with increasing pressure.

T F The chemical potential of an undissolved grain of salt in water, is higher than the chemical potential of water in a dilute salt water solution.

T F For a pure substance at its melting temperature, the solid and the liquid have the same enthalpy

2A. (25 points)



The picture at left shows a possible phase diagram for a pure substance around its solid, liquid, vapor triple point. Based on the slopes and curvatures of the lines, it is possible that this a diagram for an actual substance? Why or why not?

2B. (25 points)

What is the difference in Gibb's Free Energy between 3 moles of benzene at a temperature of 25°C and pressure of 1 bar, and 3 moles of benzene at a 25°C and a pressure of 10 bar?.

benzene

density = 0.88 g cm⁻³, MW = 78.11 g mol⁻¹, S° = 173.1 J K⁻¹ mol⁻¹, Δ_fG° = -124.3 kJ mol⁻¹

3. (50 points)

A mixture of 1 liter of a solvent **A** with a non-volatile solute **B** forms an ideal solution that has an osmotic pressure that is measured as 2 bar at 25°C. The density of **A** is 1.0 g cm^{-3} , the molecular weight 30 g mol^{-1} , and its pure vapor pressure at 25°C is 50 Torr. The density of **B** is 2.5 g cm^{-3} and the molecular weight is 50 g mol^{-1} (it has no vapor pressure).

What is the vapor pressure of the solution?

4. (50 points)

Substance **X** has a triple point at 25°C with a vapor pressure of 250 Torr. The vapor pressure of the liquid is 500 Torr at 40°C. What is $\Delta_{\text{VAP}}H^\circ$? What is $\Delta_{\text{FUS}}H^\circ$? What is the melting temperature of **X** at 500 bar?

$$\Delta_{\text{SUB}}H^\circ = 48 \text{ kJ mol}^{-1}$$

$$\text{density (s)} = 3.2 \text{ g cm}^{-3}$$

$$\text{density (l)} = 3 \text{ g cm}^{-3}$$

$$\text{MW} = 40 \text{ g mol}^{-1}$$