Chemistry 141 Name

Dr. Cary Willard

Quiz 7 (20 points) May 6, 2010

All work must be shown to receive credit.

$$ln\left(\frac{P\_{2}}{P\_{1}}\right)=\frac{-∆H\_{vap}}{R}\left(\frac{1}{T\_{2}}-\frac{1}{T\_{1}}\right)=\frac{∆H\_{vap}}{R}\left(\frac{T\_{2}-T\_{1}}{T\_{1}T\_{2}}\right)$$

$$log\left(\frac{P\_{2}}{P\_{1}}\right)=\frac{-∆H\_{vap}}{2.303 R}\left(\frac{1}{T\_{2}}-\frac{1}{T\_{1}}\right)=\frac{∆H\_{vap}}{2.303R}\left(\frac{T\_{2}-T \_{1}}{T\_{1}T\_{2}}\right)$$

R=0.0821 L atm/mol K = 62.4 L torr/mol K = 8.31 J/mol K

1. (10 points) Ethanol has a heat of vaporization of 38.56 kJ/mol and a normal boiling point of 78.4oC. What is the vapor pressure of ethanol at 25oC?

|  |  |
| --- | --- |
| $$P\_{1}=1 atm$$ | $$T\_{1}=78.4℃=351.6 K$$ |
| $$P\_{2}= ?$$ | $$T\_{2}=25℃=298 K$$ |

$$∆H\_{vap}=\frac{38.56 kJ}{mol}=\frac{38560 J}{mol}$$

$$ln\left(\frac{P\_{2}}{P\_{1}}\right)=\frac{∆H\_{vap}}{R}\left(\frac{T\_{2}-T\_{1}}{T\_{1}T\_{2}}\right)$$

$$ln\left(\frac{P\_{2}}{1 atm}\right)=\frac{\left(38560 J\right)mol K}{\left(8.31 J\right)mol}\left(\frac{298 K-352 K}{\left(298 K\right)\left(352 K\right)}\right)$$

$$ln\left(\frac{P\_{2}}{1 atm}\right)=\frac{\left(38560 J\right)mol K}{\left(8.31 J\right)mol}\left(\frac{-0.000515}{K}\right)$$

$$ln\left(\frac{P\_{2}}{1 atm}\right)=-2.389$$

$$\frac{P\_{2}}{1 atm}=e^{-2.389}=0.0917$$

$$P\_{2}=0.0917 atm=69.7 torr$$

1. (10 points) Argon has a normal boiling point of 87.2 K and a melting point (at 1 atm) of 84.1 K. Its critical temperature is 150.8 K and critical pressure is 48.3 atm. It has a triple point at 83.7 K and 0.69 atm. Sketch the phase diagram of argon. Which has the greater density, solid argon or liquid argon?

critical point

48.3 atm

liquid

solid

 1 atm

Pressure

(atm)

boiling point

melting point

gas

 0.69 atm

triple point

 83.7 84.1 87.2 150.8

Temperature (K)

At any given temperature, if you increase the pressure on liquid argon it will convert to a solid. Solid argon is more dense than liquid argon!

+ 4 for graph with solid, liquid, and gas in the correct locations

+4 for having mp and bp reasonably located

+2 for density