## Homework 6

1. An open vessel containing (a) water, (b) benzene, (c) mercury stands in a laboratory measuring 5.0 m  $\times$  5.0 m  $\times$  3.0 m at 25°C. What mass of each substance will be found in the air if there is no ventilation? (The vapor pressures are (a) 24 Torr, (b) 98 Torr, (c) 1.7 mTorr).

2. Naphthalene,  $C_{10}H_8$ , melts at 80.2°C. If the vapor pressure of the liquid is 10 Torr at 85.8°C and 40 Torr at 119.3°C, use the Clausius-Clapeyron equation to calculate (a) the enthalpy of vaporization, (b) the normal boiling point, and (c) the entropy of vaporization at the boiling point.

3. The enthalpy of fusion of mercury is 2.292 kJ mol<sup>-1</sup>, and its normal freezing point is 234.3 K with a change in molar volume of +0.517 cm<sup>3</sup> mol<sup>-1</sup> on melting. At what temperature will the bottom of a column of mercury (density 13.6 g cm<sup>-3</sup>) of height 10 m be expected to freeze.

4. Estimate the vapor pressure of sea water at 20°C given the vapor pressure of pure water is 2.338 kPa at that temperature and the solute is largely Na<sup>+</sup> and Cl<sup>-</sup> ions, each present at about 0.50 mol L<sup>-1</sup>.

5. At 300 K, the vapor pressure of dilute solutions of HCl in liquid GeCl<sub>4</sub> are as follows

<i>x</i> (HCl)	0.005	0.012	0.019	
p/kPa	32.0	76.9	121.8	
Show that	t the solution	obeys Henry	's law in this range c	of mole fraction
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ons and calculate the Henry's law constant at 300 K.

6. The molar mass of an enzyme was determined by dissolving it in water, measuring the osmotic pressure at 25°C, and extrapolating the data to zero concentration. The following data were used:

$c/({\rm mg \ cm^{-3}})$	3.221	4.618	5.112	6.722
<i>h</i> /cm	5.746	8.238	9.119	11.990
lculate the molar m	ass of the en	zume		

Calculate the molar mass of the enzyme.

7. Calculate the cryoscopic and ebullioscopic constants of tetrachloromethane.

8. The vapor pressure of benzene is 400 Torr at 60.6°C, but it fell to 386 Torr when 19.0 g of involatile organic compound was dissolved in 500 g of benzene. Calculate the molar mass of the compound.

9. The mole fractions of  $N_2$  and  $O_2$  in air at sea level are approximately 0.78 and 0.21. Calculate the molalities of the solution formed in an open flask of water at 25°C.

10. Calculate the freezing point of a glass of water of volume  $250 \text{ cm}^3$  sweetened with 7.5 g of sucrose.