1. In the Clausius-Clapeyron equation, only one value for ΔH is used to represent both the individual states. Why?

1. We assume that ΔH does not change between the two states in order to simplify the calculation.
2. The value of ΔH does not change because of temperature or pressure.
3. ΔH represents the difference between the individual enthalpies of the two states.
4. The Clausius-Clapeyron equation does not work because it only uses one value for ΔH.

ΔH does change with temperature and pressure, but this change is small enough to be ignored.

2. Sketch a phase diagram using the following information: triple point at 45 atm and 310 K. Critical point at 65 atm and 575 K. The diagram intersects the Y axis at 5 atm. Y axis: 0 to 70 atm. X-axis: 0 to 600 K.

Which of the following would result in sublimation?

1. at 250 K, increasing the pressure from 10 atm to 50 atm.
2. at 400 K, increasing the pressure from 20 atm to 60 atm.
3. at 20 atm, increasing the temperature from 100 K to 300 K.
4. at 50 atm, increasing the temperature from 575 K to 550 K.

3. Consider a 27 g sample of ice at 1 atm. Initially, the sample is frozen at -20 °C. How much heat must be added to the sample for it to become a liquid at 78 °C. Heat capacity of ice: 2 J/gK. Heat capacity of water: 4 J/gK. ΔH of melting: 330 J/g.

1. 9.5 kJ
2. 18.4 kJ
3. 5.3 kJ
4. 10.6 kJ

$q = mc\Delta T$ (for the ice) + $m\Delta H$ (for melting) + $mc\Delta T$ (for the water)

$q = 27\text{ g} * 2\text{ J/gK} * 20\text{ K} + 27\text{ g} * 330\text{ J/g} + 27\text{ g} * 4\text{ J/gK} * 78\text{ K}$

$q = 18.4\text{ kJ}$

4. You have a salt whose dissolution is exothermic. Which of the following are possible values for $\Delta H_{solution}$, $\Delta H_{hydration}$, and $\Delta H_{lattice}$?

1. +310, +450, and -140 kJ/mol
2. -49, -36, and +13 kJ/mol
3. -420, -490, and -70 kJ/mol
4. -37 , -52, and +15 kJ/mol

$\Delta H_{solution} = \Delta H_{hydration} + \Delta H_{lattice}$

The dissolution is exothermic, so the first term must be negative. Match the other two values accordingly remembering that $\Delta H_{lattice}$ is always positive.

5. Rank the following in order of increasing solubility in water: C_8H_{18}, C_2H_5OH, (ethanol) CH_3OH, (isopropyl alcohol) $(CH_3)_2CHOH$.

1. $C_8H_{18} < (CH_3)_2CHOH < CH_3OH < C_2H_5OH$
2. $C_8H_{18} < (CH_3)_2CHOH < C_2H_5OH < CH_3OH$
3. $C_2H_5OH < CH_3OH < (CH_3)_2CHOH < C_8H_{18}$
4. $C_8H_{18} < (CH_3)_2CHOH < C_2H_5OH < C_2H_5OH$

Like dissolves like - if the solvent is polar then it will dissolve polar compounds best. Water is polar and can form hydrogen bonds so compounds that are polar and can form hydrogen bonds will be easily dissolved. Isopropyl alcohol is less polar than ethanol. Methanol is very polar.

6. Raising the temperature of a solution with a dissolved gas will (increase/decrease) solubility of the gas. Increasing the pressure will (increase/decrease) solubility.

1. Increase/Decrease

2. Decrease/Increase
3. Increase/Increase
4. Decrease/Decrease

Why do you refrigerate soda? Colder temperatures keep gases dissolved. You also keep a cap on you soda bottle because increased pressure increases solubility.

7. You have an equimolar mixture of benzene and toluene. At 25 °C the vapor pressure of these liquids in pure form are 0.126 atm and 0.038 atm, respectively. Calculate the total vapor pressure exerted by the mixture.

1. 0.294 atm
2. 0.082 atm
3. 0.164 atm
4. 0.101 atm

$P_{benzene}$ = .5(0.126 atm) =0.063 atm
$P_{toluene}$ = .5(0.038 atm) =0.019 atm
P_{total} = $P_{toluene}$+ $P_{benzene}$ = 0.063 atm + 0.019 atm = 0.082 atm

8. Calculate the change in boiling point and freezing point when 15 g of NaCl is added to 100 g of water.

1. ΔTb = - 2.62 °C ; ΔTf = 9.5 °C
2. ΔTb = - 2.62 °C ; ΔTf = -9.5 °C
3. ΔTb = 2.62 °C ; ΔTf = -9.5 °C
4. ΔTb = - 2.62 °C ; ΔTf = 9.5 °C

14g/(58.5 g/mol) = .256 moles of NaCl
.256 moles NaCl / .1 kg H_2O = 2.56 moles NaCl/kg water
van't Hoff factor = 2 because NaCl dissociates into 2 ions
ΔTf = iK_f m = (2)(-1.86 °C kg/mol)(2.56 moles NaCl/kg H_2O) = -9.5 °C
ΔTb = iK_b m = (2)(0.512 °C kg/mol)(2.56 moles NaCl/kg H2O) = 2.62 °C