Name _____ Test 1
PHYS 0111 (Gen Chem II) Spring 2005

Equations:

$\Delta T = imK_f$
$\Delta T = imK_b$
$\Pi = iMRT$

Constants:

for 95% H_2SO_4
$d_{25} = 1.840$ g/cm^3

760 torr = 1 atm
0 °C = 273.15 K

More Constants:

for H_2O
$d_{25} = 1.000$ g/cm^3
$K_f = 1.86$ °C/*m*

for benzene
$K_f = 5.12$ °C/*m*
FP = 5.50 °C
BP = 80.0 °C
$d_{25} = 0.874$ g/cm^3

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____
9. _____
10. _____

1. Assuming that the following chemicals are dissolved in water, predict the vant Hoff number for each chemical. Hint: Writing a dissolution reaction for each chemical might help.

a. NaCl **2**

b. C_3H_8O (rubbing alcohol) **1**

c. $Ca(NO_3)_2$ **3**

d. HCl (an acid) **2**

2. The concentration of ethanol (C_2H_6O) in some wines is as high as 13% by mass. At what temperature will this 3.2 *m* ethanol solution freeze?

$$\Delta T = i\ m\ K_f$$

$$\Delta T = 1\ (3.2\ m)\ (1.86\ °C/m)$$

$$\Delta T = 5.952\ °C$$

$$FP = 0 - 5.952$$

$$FP = -\ 6.0\ °C$$

3. How many grams of KNO_3 would be needed to make 250.0 mL of a 0.3450 M KNO_3 solution?

$$250.0\ mL\ soln \times \frac{0.3450\ mol}{1000\ mL\ soln} \times \frac{101.10\ g\ KNO_3}{1\ mol\ KNO_3} = 8.71988\ g \Rightarrow 8.720\ g\ KNO_3$$

4. In the following reaction was monitored over time, and the concentration of CO_2 was measured after 30.0 s. The data is tabulated below.

$$CH_4(g) + CO_2(g) \longrightarrow 2\ CH_2O(g)$$

Time (s)	Concentration CO_2 (M)
0	4.50
30.0	1.33

a. Determine the average rate of consumption of CO_2.

$$\frac{-\Delta[CO_2]}{\Delta t} = \frac{-(1.33 - 4.50)}{30 - 0} = \frac{-(-3.17)}{30} = 0.1056667 \Rightarrow 0.106 \text{ M/s}$$

b. Determine the average rate at which CH_2O is being produced during the reaction.

$$\frac{-\Delta[CO_2]}{\Delta t} = \frac{1}{2}\frac{\Delta[CH_2O]}{\Delta t}$$ so,

$$0.106 \text{ M/s} = \frac{1}{2}\frac{\Delta[CH_2O]}{\Delta t} \qquad \frac{\Delta[CH_2O]}{\Delta t} = 0.212 \text{ M/s}$$

c. Determine the average rate of the reaction.

Average rate of the reaction is the same as the rate at which CO_2 is consumed 0.106 M/s

5. An experiment was performed to determine the molar mass of an unknown solid. A solution of 2.016 g of the unknown solid dissolved in 50.00 g of the nonpolar solvent benzene was prepared, and the freezing point of the resulting solution was determined to be 4.35 °C. What is the molar mass of the unknown solid?

for molar mass need mass/mol. We have mass, use MP depression to find moles

$\Delta T = i\ m\ K_f$ Molality = mol of solute /kg solvent

$(5.50 - 4.35) = 1\ (m)\ (5.12\ °C/m)$ 0.22461 m = mol of solute / 0.050 kg benzene

$1.15 = (m)\ 5.12\ °C/m$ 0.22461 m = mol of solute / 0.050 kg benzene

$(m) = 0.22461\ m$ mol solute = 0.01123 mol

MM = 2.016 / .01123 mol = 179.5116 $\Rightarrow 1.80 \times 10^2$ g/mol

6. Sulfuric acid is sold commercially as a 95% solution of sulfuric acid in water. Determine the molarity of the H_2SO_4 solution.

95 g H_2SO_4 x $\frac{1 \text{ mol } H_2SO_4}{98.078 \text{ g } H_2SO_4}$ = 0.96862 mol H_2SO_4

100 g soln x $\frac{1 \text{ mL soln}}{1.840 \text{ g soln}}$ = 54.348 mL

H_2SO_4 = 1.0079 x 2 + 32.066 + 15.9994 x 4 = 98.078 g/mol

molarity = 0.96862 mol/0.054348 L = 17.82 = 18 M

7. At high concentrations ionic compounds tend to form ion pairs in solution. How does the formation of ion pairs affect the vant Hoff number of the solution?

The formation of ion pairs will lower the vant Hoff number

8. The osmotic pressure of a solution of 20.00 g NaOH (MM_{NaOH} = 40.0 g/mol) dissolved in a total volume of 500.0 mL was compared to the osmotic pressure of a solution of 14.61 g of NaCl (MM_{NaCl} = 58.44 g/mol) dissolved in a total volume of 250.0 mL. Is the osmotic pressure of the NaOH solution higher, lower, or the same as the osmotic pressure of the NaCl solution? Explain.

Vapor pressures are the same because the concentrations are the same and the vant Hoff numbers are the same

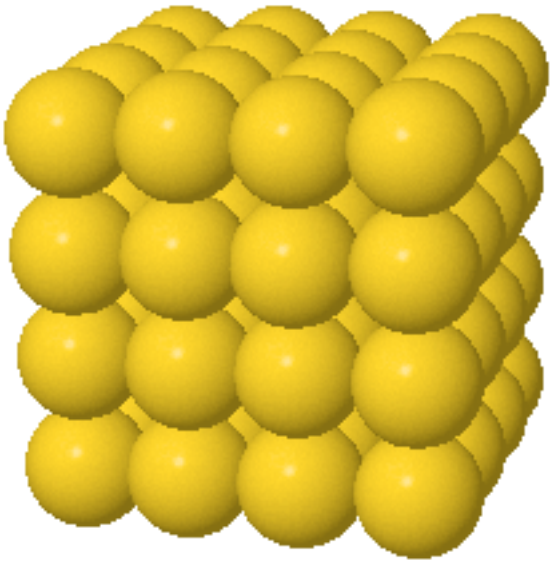
20.00 g / 40.0 g/mol = 0.500 mol NaOH

0.500 mol / 0.500 L = 1 M

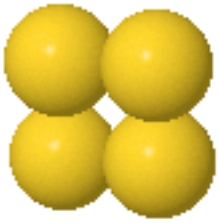
14.61 g / 58.44 g/mol = 0.25 mol NaCl

0.25 mol / 0.25 L = 1 M

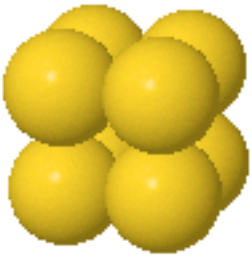
9. A crystal is pictured to the left. From the selection of pictures on the right, choose the structure that is the unit cell for the crystal on the left.



a.

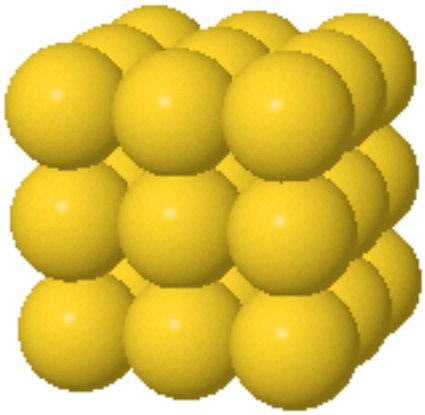


b.



b is the unit cell

c.



d.

10. What kind of crystal is pictured in the previous question, a simple cubic cell, a face-centered cubic cell, or a body-centered cubic cell.

SCC