Name: KEY Date: _____ Period _____

1. A solution of hydrogen peroxide is 20.1 % H_2O_2 by mass and has a density of 1.11 g/cm^3. The molarity of the solution is:
   A) 6.16 M
   B) 0.223 M
   C) 6.56 M
   D) 6.84 M
   E) none of these

$\frac{20.1\ g\ H_2O_2}{100\ g\ soln}$ $\frac{20.1\ g\ H_2O_2}{79.9\ g\ H_2O}$

$\frac{20.1\ g\ H_2O_2}{1} \times \frac{1\ mol}{34.02\ g} = .591\ mol\ H_2O_2$

$\frac{100\ g\ soln}{1} \times \frac{1\ mL}{1.11\ g} \times \frac{1\ L}{1000\ mL} = .0901\ L$

$M = \frac{moles\ H_2O_2}{L\ soln} = \frac{.591}{.0901} = 6.56M$

2. How many milliliters of 15.1 M H_2SO_4 are needed to prepare 600.0 mL of 0.10 M H_2SO_4?
   A) 0.25 mL
   B) 91 mL
   C) 4.0 mL
   D) 2.0 mL
   E) 5.0 mL

$(.10M)(600.0\ mL) = (15.1M)(V_2)$

$V_2 = 3.97\ mL$

3. A 20.0-g sample of methyl alcohol (CH_3OH, molar mass = 32.0 g/mol) was dissolved in 39.1 g of water. The mole fraction of CH_3OH is:
   A) 0.288
   B) 0.624
   C) 0.338
   D) 4.48
   E) 0.223

$\frac{20.0\ g}{1} \times \frac{1\ mol}{32.0\ g} = .625\ mol$

$\frac{39.1\ g}{1} \times \frac{1\ mol}{18.02\ g} = 2.17\ mol$

$X_{CH_3OH} = \frac{mol\ CH_3OH}{mol\ CH_3OH + mol\ H_2O} = \frac{.625}{.625+2.17} = .223$

4. What volume of a 0.962 M solution of $CaCl_2$ contains 1.28 g of solute?
   A) 83.4 mL
   B) 12.0 mL
   C) 1.33 mL
   D) 11.10 mL
   E) 88.0 mL

$\frac{1.28\ g}{1} \times \frac{1\ mol}{110.98\ g} = .0115\ mol\ CaCl_2$

$.962M = \frac{.0115\ mol}{X\ L}$ $X = .0120\ L$

5. Find the mass percent of $CuSO_4$ in a solution whose density is 1.30 g/mL and whose molarity is 1.58 M.
   A) 80.6 %
   B) 2.05 %
   C) 19.4 %
   D) 2.88 %
   E) none of these

$\frac{1.58\ mol\ CuSO_4}{1\ L\ soln}$

$\% CuSO_4 = \frac{g\ CuSO_4}{total\ g} \times 100 = \frac{252\ g}{1300\ g} \times 100 = 19.4\%$

$\frac{1.58\ mol\ CuSO_4}{1} \times \frac{159.62\ g}{1\ mole} = 252\ g\ CuSO_4$

$\frac{1\ L\ soln}{1} \times \frac{1000\ mL}{1\ L} \times \frac{1.30\ g}{1\ mL} = 1300\ g\ soln$

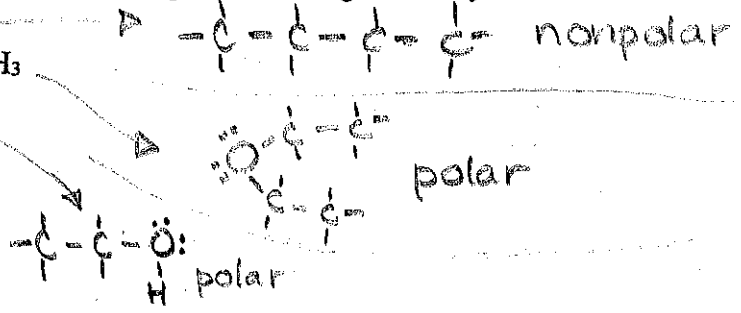
6. Rank the following compounds according to increasing solubility in water.

I. $CH_3–CH_2–CH_2–CH_3$

II. $CH_3–CH_2–O–CH_2–CH_3$

III. $CH_3–CH_2–OH$

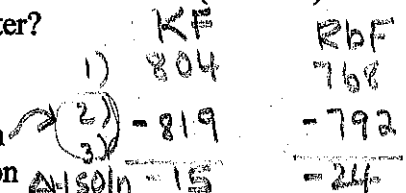
IV. $CH_3–OH$



A) I < III < IV < II
B) I < II < IV < III
C) III < IV < II < I
D) I < II < III < IV
E) None of these (a-d) is correct.

7. Which statement about hydrogen bonding is true?
A) Hydrogen bonding is the intermolecular attractive forces between two hydrogen atoms in solution.
B) The hydrogen bonding capabilities of water molecules cause $CH_3CH_2CH_2CH_3$ to be more soluble in water than CH_3OH.
C) Hydrogen bonding of solvent molecules with a solute will not affect the solubility of the solute.
D) Hydrogen bonding interactions between molecules are stronger than the covalent bonds within the molecule.
E) Hydrogen bonding arises from the dipole moment created by the unequal sharing of electrons within certain covalent bonds within a molecule.

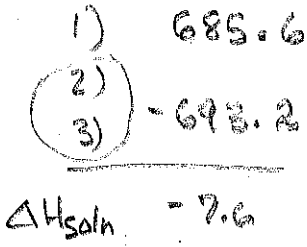
8. Solid KF has a lattice energy of 804 kJ/mol and a heat of solution (in water) of –15 kJ/mol. RbF has a lattice energy of 768 kJ/mol and a heat of solution (in water) of –24 kJ/mol. Which salt forms stronger attractions with water?



A) KF, since it has a larger lattice energy
B) RbF, since it has a smaller lattice energy
C) KF, since it has a more negative heat of hydration
D) RbF, since it has a more negative heat of hydration
E) They form equally strong attractions with water, since they both have negative heats of mixing.

9. The lattice energy of NaI is 685.6 kJ/mol and its heat of solution is -7.6 kJ/mol. Calculate the hydration of energy of NaI(s).

A) 15.2 kJ/mol
B) –678.4 kJ/mol
C) –693.2 kJ/mol
D) 678.0 kJ/mol
E) 693.2 kJ/mol



Use the following to answer questions 10-12:

For each of the following solutions, describe the deviation with respect to Raoult's Law.

10. hexane (C_6H_{14}) and chloroform ($CHCl_3$)
    A) relatively ideal
    B) positive deviation
    C) negative deviation
    D) More information is needed.
    E) None of these.

LDFs: C_6H_{14} → nonpolar, LDFs
$CHCl_3$ → polar, dipole-dipole
overall → IMFs weakened

11. acetone (C_3H_6O) and water
    A) relatively ideal
    B) positive deviation
    C) negative deviation
    D) More information is needed.
    E) None of these.

H-bond: H_2O → polar, H-bonds
C=O → polar, dipole-dipole
overall → IMFs strengthened

12. hexane (C_6H_{14}) and octane (C_8H_{18})
    A) relatively ideal
    B) positive deviation
    C) negative deviation
    D) More information is needed.
    E) None of these.

LDFs: C_6H_{14} → nonpolar, LDFs
C_8H_{18} → nonpolar, LDFs

13. A solution is prepared from 41.8 g of a nonvolatile, nondissociating solute and 85.0 g of water. The vapor pressure of the solution at 60°C is 142 torr. The vapor pressure of water at 60°C is 150. torr. What is the molar mass of the solute? (Ignore significant figures for this problem.)
    A) 44.2 g/mol
    B) 8.86 g/mol
    C) 11.11 g/mol
    D) 184 g/mol
    E) 157 g/mol

$P_{soln} = (X_{solvent})(P^\circ_{solvent})$

$142\ torr = \left(\frac{4.72}{4.72+x}\right)(150\ torr)$

$\frac{142}{150} = .947 = \frac{4.72}{4.72+x}$

$4.47 + .947x = 4.72$

$.947x = .25$

$x = .264$

$\frac{85.0\ g\ H_2O}{18.02\ g/mol} = 4.72\ mol\ H_2O$

$MM = \frac{g}{mol} = \frac{41.8\ g}{x\ mol}$

$= \frac{41.8\ g}{.264\ moles}$

$= 158\ g/mol$

14. A salt solution sits in an open beaker. Assuming constant temperature and pressure, the vapor pressure of the solution
    A) increases over time.
    B) decreases over time.
    C) stays the same over time.
    D) Need to know which salt is in the solution to answer this.
    E) Need to know the temperature and pressure to answer this.

15. Liquid A and liquid B form a solution that behaves ideally according to Raoult's law. The vapor pressures of the pure substances A and B are 247 torr and 135 torr, respectively. Determine the vapor pressure over the solution if 1.20 moles of liquid A is added to 5.30 moles of liquid B.
    A) 156 torr
    B) 226 torr
    C) 382 torr
    D) 1012 torr
    E) 45.6 torr

16. All of the following are colligative properties except:
    A) osmotic pressure
    B) boiling point elevation
    C) freezing point depression
    D) density elevation
    E) none of these

17. Determine the molarity of a solution containing 6.74 g $BaCl_2$ in 750.0 mL of solution.
    A) 3.24×10^{-2} M
    B) 2.43×10^{-2} M
    C) 8.99×10^{-3} M
    D) 4.32×10^{-2} M
    E) 8.99 M

$\frac{6.74\text{ g } BaCl_2}{1} \times \frac{1\text{ mol}}{208.23\text{ g}} = .0324\text{ mol}$

$\frac{.0324\text{ mol}}{.7500\text{ L}} = .0432\text{ M}$

18. Use the solubility curve below to answer the following question.
    → use curve in notes packet.
    Approximately how many grams of potasssium nitrate would be required to make 350 mL of saturated solution at 50 degrees Celsius?
    A) 60 grams
    B) 113 grams
    C) 396 grams
    D) 210 grams
    E) Cannot be determined from this graph.