1) How many milliliters of 15.7 \( M \) \( H_2SO_4 \) are needed to prepare 600.0 mL of 0.10 \( M \) \( H_2SO_4 \)?
   A) 0.26 mL
   B) 94 mL
   C) 3.8 mL
   D) 1.9 mL
   E) 4.8 mL

2) Determine the Molarity of a solution containing 6.76 g \( BaCl_2 \) in 750.0 mL of solution.
   A) \( 3.25 \times 10^{-2} \) M
   B) \( 2.44 \times 10^{-2} \) M
   C) \( 9.01 \times 10^{-3} \) M
   D) \( 4.33 \times 10^{-2} \) M
   E) 9.01 M

3) Calculate the molality of \( C_2H_5OH \) in a water solution that is prepared by mixing 50.0 mL of \( C_2H_5OH \)
   with 112.7 mL of \( H_2O \) at 20°C. The density of the \( C_2H_5OH \) is 0.789 g/mL at 20°C. (Assume the density of water at this temperature is 1.00 g/mL.)
   A) 0.00963 m
   B) 0.155 m
   C) 0.132 m
   D) 7.60 m
   E) 9.63 m

4) What is the molality of a solution of 30.1 g of propanol (\( CH_3CH_2CH_2OH \)) in 152 mL water, if the density of water is 1.00 g/mL?
   A) 3.29 m
   B) 0.00330 m
   C) 0.303 m
   D) 0.501 m
   E) 5.01 m

5) A 3.140 molal solution of \( NaCl \) is prepared. How many grams of \( NaCl \) are present in a sample containing 2.314 kg of water?
   A) 726.6 g
   B) 124.3 g
   C) 257.6 g
   D) 424.6 g
   E) none of these

6) If 2.00 g of helium gas and 3.82 g of oxygen gas are mixed together, what is the mole fraction of helium in the solution?
   A) 0.344
   B) 0.193
   C) 0.807
   D) 0.119
   E) 1.24
7) What is the molarity of a HNO₃ solution prepared by adding 255.4 mL of water to 350.0 mL of 12.3 M HNO₃?
   A) 16.9 M  
   B) 7.45 M  
   C) 7.11 M  
   D) 2.61 M  
   E) 3.14 M

8) When a 49.1-g sample of an unknown compound is dissolved in 500.0 g of benzene, the freezing point of the resulting solution is 3.77°C. The freezing point of pure benzene is 5.48°C and $K_f$ for benzene is 5.12°C/m. Calculate the molar mass of the unknown compound.
   A) 147 g/mol  
   B) 28.7 g/mol  
   C) 251 g/mol  
   D) 588 g/mol  
   E) 294 g/mol

9) Determine the change in boiling point for 397.7 g of carbon disulfide ($K_b = 2.34°C \text{ kg/mol}$) if 35.0 g of a nonvolatile, nonionizing compound is dissolved in it. The molar mass of the compound is 70.0 g/mol and the boiling point of the pure carbon disulfide is 46.2°C.
   A) 0.206 °C  
   B) 1.86 °C  
   C) 5.88 °C  
   D) 24.8 °C  
   E) 2.94 °C

10) A cucumber is placed in a concentrated salt solution. What will most likely happen?
    A) Water will flow from the cucumber to the solution.  
    B) Water will flow from the solution to the cucumber.  
    C) Salt will flow into the cucumber.  
    D) Salt will precipitate out.  
    E) No change will occur.

11) Consider pure water separated from an aqueous sugar solution by a semipermeable membrane, which allows water to pass freely but not sugar. After some time has passed, the concentration of sugar solution:
    A) will have increased  
    B) will have decreased  
    C) will not have changed  
    D) might have increased or decreased depending on other factors  
    E) will be the same on both sides of the membrane
12) What is reverse osmosis?
   A) the application, to a concentrated solution, of a pressure that is greater than the osmotic pressure, such that solvent flows from the concentrated solution to the dilute solution
   B) the application, to a dilute solution, of a pressure that is greater than the osmotic pressure, such that solvent flows from the concentrated solution to the dilute solution
   C) the application, to a concentrated solution, of a pressure that is greater than the osmotic pressure, such that solute flows from the concentrated solution to the dilute solution
   D) the application, to a dilute solution, of a pressure that is greater than the osmotic pressure, such that solute flows from the concentrated solution to the dilute solution
   E) the application, to a concentrated solution, of a pressure that is greater than the osmotic pressure, such that solvent flows from the dilute solution to the concentrated solution

13) What is the freezing point of an aqueous 1.58 molal NaCl solution? \( (K_f = 1.86°C/m) \)
   A) −2.94°C
   B) 2.94°C
   C) −5.88°C
   D) 5.88°C
   E) 0.00°C

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) What is the expected boiling point of a solution prepared by dissolving 7.27 g of sodium iodide (NaI) in 68.6 g of water (H₂O)? For water, \( T_b = 100.00°C \) and \( K_b = 0.512°C \, m^{-1} \).
   A) 0.72°C
   B) 100.36°C
   C) 103.72°C
   D) 100.72°C
   E) 0.36°C

16) A solution is made by dissolving 27.8 g of nicotine (molar mass = 160 g/mol) in 145 g of cyclohexane (C₆H₁₂) to form 142 mL of solution. Calculate the mole fraction of the solute and the molarity, respectively, of this solution.
   A) 0.174, 1.22 M
   B) 0.101, 12.1 M
   C) 0.101, 1.22 M
   D) 0.091, 1.22 M
   E) 0.174, 12.1 M
17) Which of the following aqueous solutions will have the LOWEST vapor pressure?
   A) 0.20 m C₆H₁₂O₆
   B) 0.20 m NaCl
   C) 0.10 m CaCl₂
   D) 0.40 m C₂H₅OH
   E) 0.20 m Na₂SO₄

18) Which of these solutions 0.1 m NaCl, 0.15 m glucose, 0.1 m CaCl₂ would have
   I. the highest vapor pressure
   II. the lowest boiling point
   A) 0.1 m CaCl₂, 0.1 m CaCl₂
   B) 0.15 m glucose, 0.1 m CaCl₂
   C) 0.1 m CaCl₂, 0.15 m glucose
   D) 0.15 m glucose, 0.15 m glucose
   E) 0.1 m NaCl, 0.1 m CaCl₂

19) Use the following drawing of a gaseous solute in equilibrium with a solution to help answer the question below.

![Diagram of gas solute in solution]

Which of the following statements are true when the piston is pushed in (downward)?
   A) This will cause the pressure of the gas to increase and the concentration of the dissolved gas to go down.
   B) This will cause the pressure of the gas to decrease and the concentration of the dissolved gas to go down.
   C) This will cause the pressure of the gas to increase and the concentration of the dissolved gas to go up.
   D) This will cause the volume of the gas to decrease and the concentration of the dissolved gas to go down.
   E) This will cause the volume of the gas to increase and the concentration of the dissolved gas to go up.

20) Which compound has a Van’t Hoff factor of 3.0
   a) Sodium Nitrate
   b) Ammonium Sulfide
   c) Potassium Phosphate
   d) Nickel (II) Carbonate
   e) Glucose

Go Vikings!!