

AP Practice - Solutions

1) A solution that is prepared by dissolving 3.150 grams of the C_3H_2Cl in 25.00 grams of benzene, C_6H_6 , has a freezing point of $1.12^\circ C$. (The normal freezing point of benzene is $5.50^\circ C$ and the molal freezing-point depression constant, K_f , for benzene is $5.12\ C^\circ/molal$.)

- (a) Using the data gathered from the freezing point depression method, calculate the molar mass of the unknown substance.
- (b) Calculate the mole fraction of benzene in the solution described above.
- (c) The vapor pressure of pure benzene at $35^\circ C$ is 150. millimeters of Hg. Calculate the vapor pressure of benzene over the solution described above at $35^\circ C$.

2) Use appropriate chemical principles to explain the following observation:

Sodium chloride may be spread on an icy sidewalk in order to melt the ice; equimolar amounts of calcium chloride are even more effective.

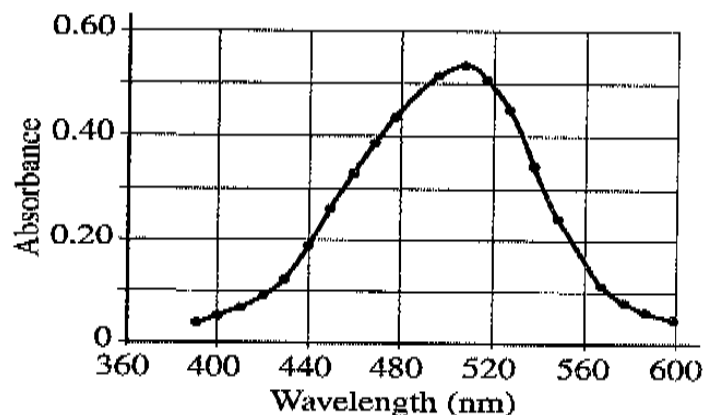
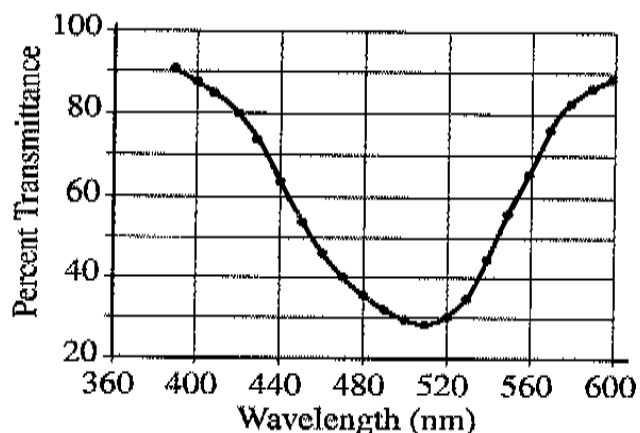
3) The following 0.10M solutions are placed in stoppered flasks: NaF, $MgCl_2$, C_2H_5OH and HCl.

- (a) Which solution has the lowest freezing point? Explain.
- (b) Above which solution is the pressure of water vapor greater? Explain.

4. A student is instructed to determine the concentration of a solution of CoCl_2 based on absorption of light (spectrometric/colorimetric method). The student is provided with a 0.10 M solution of CoCl_2 with which to prepare standard solutions with concentrations of 0.020 M , 0.040 M , 0.060 M and 0.080 M .

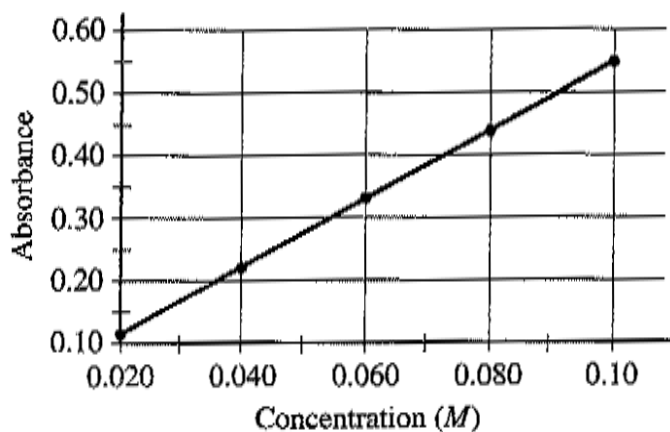
- (a) Describe the procedure for diluting the 0.10 M solutions to a concentration of 0.020 M using distilled water, a 100 mL volumetric flask, and a pipet or buret. Include specific amounts where appropriate.

The student takes the 0.10 M solution and determines the percent transmittance and the absorbance at various wavelengths. The two graphs below represent the data.



- (b) Identify the optimum wavelength for the analysis.

The student measures the absorbance of the 0.020 M , 0.040 M , 0.060 M , 0.080 M and 0.10 M solutions. The data are plotted below.



- (c) The absorbance of the unknown solution is 0.275 . What is the concentration of the solution?
- (d) Beer's Law is an expression that includes three factors that determine the amount of light that passes through a solution. Identify two of these factors.
- (e) The student handles the sample container (*e.g.*, test tube or cuvette) that holds the unknown solution and leaves fingerprints in the path of the light beam. How will this affect the calculated concentration of the unknown? Explain your answer.
- (f) Why is this method of determining the concentration of CoCl_2 solution appropriate, whereas using the same method for measuring the concentration of NaCl solution would not be appropriate?