

## AP Questions Set Chapter 13 Solutions

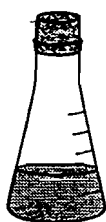
- 1.
- Calculate the molality of a 20.0 percent by weight aqueous solution of  $\text{NH}_4\text{Cl}$ . (Molecular weight:  $\text{NH}_4\text{Cl} = 53.5$ )
  - If this  $\text{NH}_4\text{Cl}$  solution is assumed to be ideal and is completely dissociated into ions, calculate the pressure of this solution at  $29^\circ\text{C}$
  - Actually a solution of  $\text{NH}_4\text{Cl}$  of this concentration is not ideal. Calculate the apparent degree of dissociation of the  $\text{NH}_4\text{Cl}$  if the freezing point of this solution is  $-15.3^\circ\text{C}$ ? (Molal freezing point constant =  $1.86^\circ\text{C}$ )

2.  
Elemental analysis of an unknown pure substance indicated that the percent composition by mass is as follows.

Element	Percent by Mass
Carbon	49.02%
Hydrogen	2.743%
Chlorine	48.23%

A solution that is prepared by dissolving 3.150 grams of the substance in 25.00 grams of benzene,  $\text{C}_6\text{H}_6$ , has a freezing point of  $1.12^\circ\text{C}$ . (The normal freezing point of benzene is  $5.50^\circ\text{C}$  and the molal freezing-point depression constant,  $K_f$ , for benzene is  $5.12^\circ\text{C}/\text{molal}$ .)

- Determine the empirical formula of the unknown substance.
- Using the data gathered from the freezing-point depression method, calculate the molar mass of the unknown substance.
- Calculate the mole fraction of benzene in the solution described above.
- The vapor pressure of pure benzene at  $35^\circ\text{C}$  is 150. millimeters of Hg. Calculate the vapor pressure of benzene over the solution described above at  $35^\circ\text{C}$ .



0.10 M  
NaF



0.10 M  
 $\text{MgCl}_2$



0.10 M  
 $\text{C}_2\text{H}_5\text{OH}$



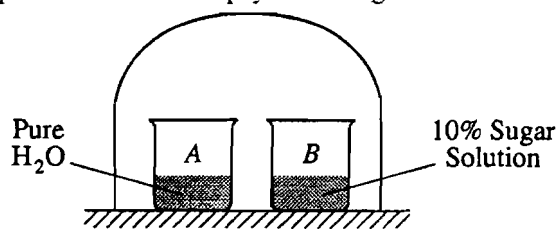
0.10 M  
 $\text{CH}_3\text{COOH}$

7. Answer the following questions, which refer to the 100 mL samples of aqueous solutions at  $25^\circ\text{C}$  in the stoppered flasks shown above.

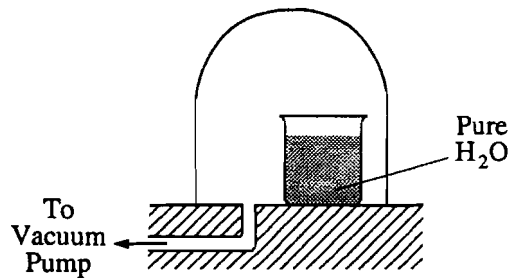
- Which solution has the lowest electrical conductivity? Explain.
- Which solution has the lowest freezing point? Explain.
- Above which solution is the pressure of water vapor greatest? Explain.
- Which solution has the highest pH? Explain.

3.

Discuss the following phenomena in terms of the chemical and physical properties of the substances involved and general principles of chemical and physical change.



(a) As the system shown above approaches equilibrium, what change occurs to the volume of water in beaker A? What happens to the concentration of the sugar solution in beaker B? Explain why these changes occur.



(b) A bell jar connected to a vacuum pump is shown above. As the air pressure under the bell jar decreases, what behavior of water in the beaker will be observed? Explain why this occurs.