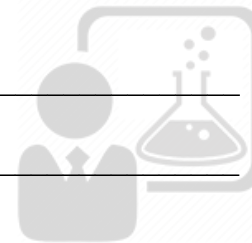


# Solutions *(ch 13)*

Cañada College — Chem 220

Name: \_\_\_\_\_

Student ID: \_\_\_\_\_

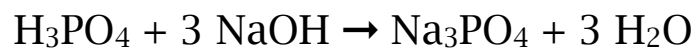


1. Of  $\text{Br}_2$ , Ne, HCl, HBr,  $\text{NH}_3$  and  $\text{N}_2$ , which is likely to have:
  - a. the largest intermolecular dispersion forces?
  - b. the largest dipole-dipole attractive forces?
  - c. The highest boiling point? The lowest melting point?
  
2. In which of the following substances is hydrogen bonding likely to play an important role in determining physical properties: methane ( $\text{CH}_4$ ), hydrazine ( $\text{H}_2\text{NNH}_2$ ), methyl fluoride ( $\text{CH}_3\text{F}$ ), or hydrogen sulfide ( $\text{H}_2\text{S}$ )?
  
3. Water bugs can walk on the surface of water ( $\text{H}_2\text{O}$ ). Would you expect them to be find it easier or harder to walk on the surface of di-methyl ether ( $\text{CH}_3\text{OCH}_3$ ). Why?

4. What is the molarity of 12.5 grams of NaOH dissolved in 255 mL of water?

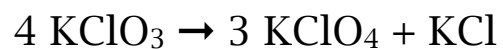
5. How many moles of silver ions are in 15.0 mL of 0.200 M AgNO<sub>3</sub> ?

6. In the following reaction, how many liters of 4.0 M phosphoric acid would you need to consume 0.60 moles of sodium hydroxide?



7. A student investigates the enthalpy of solution,  $\Delta H_{\text{soln}}$ , of LiCl. To measure  $\Delta H_{\text{soln}}$  for LiCl, a student adds 100.0 g of water initially at 15.0 °C to a calorimeter and adds 10.0 g of LiCl(s), stirring to dissolve. After the LiCl dissolves completely, the maximum temperature reached by the solution is 35.6 °C.
- a. Calculate the heat absorbed by the solution during the dissolution process, assuming that the specific heat capacity of the solution is 4.18 J/(g·°C). Include units with your answer.
- b. Determine the value of  $\Delta H_{\text{soln}}$  for LiCl in kJ/mol<sub>rxn</sub>.
- c. The lattice energy energy for LiCl is positive, it takes energy to break the ions apart LiCl. Why was dissolving LiCl in water exothermic?
- d. Would NaCl have greater or lesser lattice energy than LiCl? (justify your response)

**8.** Use dimensional analysis and show your calculation in each case.



**a.** If 0.237 moles of potassium chloride is produced, how many moles of potassium chlorate would be consumed?

**b.** If you decomposed 12.2 grams of potassium chlorate, how many grams of potassium perchlorate would be produced?

**c.** To produce 6.15 grams of potassium chloride, how many liters of 2.0 M potassium chlorate would you need?

9. A given substance has a molecular weight of 201.34 g/mol. If you dissolved 15.3 grams of this substance in 257.2 mL of water, what would be the molarity of the solution?

10. What mass of KCl is needed to precipitate all the silver ions in 15.0 mL of 0.200 M  $\text{AgNO}_3$  ?

11. When you dissolve ammonium chloride ( $\text{NH}_4\text{Cl}$ ) in solution, the solution becomes colder.

a. Is this process endothermic or exothermic?

b. What can you conclude about the relative lattice energy and heat of hydration of ammonium chloride?

c. Why does ammonium chloride dissolve? What drives the process?

12. In setting up a new aquarium, you use water that was boiled that then cooled. You put fish in and an hour later the fish are all dead. Explain what happened?

13. Lithium Iodide (LiI) has a lattice energy of  $-7.3 \times 10^2$  kJ/mol and a heat of hydration of -793 kJ/mol.

a. What is the heat of solution for lithium iodide?

b. When you dissolve 15.0 grams of lithium iodide in solution, does the flask get hotter or colder? How much heat is absorbed or released?

14. For water,  $K_f$  is  $1.86\text{ }^\circ\text{C/m}$  and  $K_b$  is  $0.512\text{ }^\circ\text{C/m}$ .

a. If I dissolve 55.8 grams of glucose ( $\text{C}_6\text{H}_{12}\text{O}_6$ ) in 455 grams of water, what is the boiling of the the solution?

b. If I dissolve 55.8 grams of glucose ( $\text{C}_6\text{H}_{12}\text{O}_6$ ) in 455 grams of water, what is the freezing point of the solution?

c. If I dissolve 55.8 grams of sodium chloride ( $\text{NaCl}$ ) in 455 grams of water, what is the boiling of the the solution?

d. If I dissolve 55.8 grams of ferric chloride ( $\text{FeCl}_3$ ) in 455 grams of water, what is the freezing point of the solution (assume complete dissociation)?

15. A 255 gram solution of chlorine ( $\text{Cl}_2$ ) dissolved in water is 25% chlorine by mass.

a. What is the molarity of this solution?

b. What is the molality of this solution?

c. What is the mole fraction of chlorine in this solution?



16. Determine the required molality of NaCl in aqueous solution to have a boiling point of  $104^{\circ}\text{C}$ . (assume complete dissociation) For water,  $K_f$  is  $1.86^{\circ}\text{C/m}$  and  $K_b$  is  $0.512^{\circ}\text{C/m}$ .

17. Ferric chloride ( $\text{FeCl}_3$ ) has a van't Hoff factor of 3.4. What is the boiling point of a solution of 55.8 grams ferric chloride ( $\text{FeCl}_3$ ) in 455 grams of water?

18. Which substance will likely have greater solubility in water, di-methyl ether ( $\text{CH}_3\text{OCH}_3$ ), ethanol ( $\text{CH}_3\text{CH}_2\text{OH}$ ), ethyl amine ( $\text{CH}_3\text{CH}_2\text{NH}_2$ ) or propane ( $\text{CH}_3\text{CH}_2\text{CH}_3$ )? Why?

19. You have two beakers and four substances, di-methyl ether ( $\text{CH}_3\text{OCH}_3$ ), ethanol ( $\text{CH}_3\text{CH}_2\text{OH}$ ), ethyl amine ( $\text{CH}_3\text{CH}_2\text{NH}_2$ ) or propane ( $\text{CH}_3\text{CH}_2\text{CH}_3$ ). You can only use each substance once. Which two substances would you put into each jar, two create two heterogeneous (not miscible, has phases) mixtures?

20. What is the vapor pressure of a  $25^\circ\text{C}$  solution containing 99.5 g sucrose ( $\text{C}_{12}\text{H}_{22}\text{O}_{11}$ ) and 300.0 mL of water? The vapor pressure of pure water at  $25^\circ\text{C}$  is 23.8 torr and the density of water is 1.00 g/mL. (assume an ideal solution)