Ch 16, supplementary problems.

Here are some additional problems for Ch 16. They are mainly on weight percentage and on dilutions. (If you want more, see my self-help worksheets on these topics, at the web site.)

In all questions here, assume that given ambiguous zeroes are significant. (That is, take "200 mL" as 3 sig fig.)

Answers are below; complete set-ups are shown for some problems.

1. Calculate the concentration of each of the following solutions, in % by weight, %(w/w):
a. 24 g of sugar in 135 g of solution.
b. 24 g of sugar dissolved in 135 g of water.

2. a. You dissolve 12.5 g of sodium chloride in 100 g of water. What is the concentration of this solution, in %(w/w)?
b. You dissolve 12.5 g of potassium chloride in 100 g of water. What is the concentration of this solution, in %(w/w)?
c. In part a, what would be different (or what would you do differently) if the amount of solvent were given as 100 mL?

3. The parts here refer to a 15% (w/w) sugar solution.
a. You want to make 250 g of this solution. How much sugar do you need?
b. You need 35 g of sugar. What mass of this solution do you need in order to get that?
c. If part b asked you for the volume of the solution, what additional information would you need to know?

> In the following two dilution problems, first do the calculation using the logical two-step method I present in class (parts a and b). Then do the calculation using the dilution equation (part c). Of course, you should get the same answer both ways (parts b and c); if you don't, please check with me.

4. You take 250 mL of 6.00 M nitric acid, and add water until the final volume is 2.00 L.
a. How many moles of nitric acid are in the sample you take?
b. Using your answer from part a, what is the concentration of the nitric acid in the final solution?
c. Use the dilution equation to calculate the final concentration.

5. You want to make 20.0 mL of 0.10 M NaCl solution. You have a 2.00 M stock solution.
a. How many moles of salt do you need?
b. Using your answer from part a, what volume of the concentrated solution do you need?
c. Use the dilution equation to calculate the volume you need.

Answers

1. a.

$$\frac{24\ \text{g sugar}}{135\ \text{g solution}} = 18\%\text{(w/w)}$$

b.

$$\frac{24\ \text{g sugar}}{(135+24)\ \text{g solution}} = 15\%\text{(w/w)}$$

2. a & b. The identity of the solute is irrelevant, since the problem is entirely in mass.

$$\frac{12.5\ \text{g solute}}{112.5\ \text{g solution}} = 11.1\%\text{(w/w)}$$

c. Since the question asked for %/(w/w), you would need to convert the given volume of solvent to mass. That requires using the density. Of course, with water this is a simple conversion, but be careful.

3. a.

$$\cancel{250\ \text{g solution}} \times \frac{15\ \text{g solute}}{\cancel{100\ \text{g solution}}} = 38\ \text{g solute (2 SF)}$$

b.

$$\cancel{35\ \text{g solute}} \times \frac{100\ \text{g solution}}{\cancel{15\ \text{g solute}}} = 2.3\text{x}10^2\ \text{g solution (2 SF)}$$

4. a.

$$250\ \cancel{\text{mL}} \times \frac{\cancel{\text{L}}}{1000\ \cancel{\text{mL}}} \times \frac{6.00\ \text{mol}}{\cancel{\text{L}}} = 1.50\ \text{mol}$$

b.

$$\frac{1.50\ \text{mol}}{2.00\ \text{L}} = 0.750\ \text{M}$$

c. $M_d = V_c M_c / V_d =$

$$\frac{250\ \cancel{\text{mL}} * 6.00\ \text{M}}{2.00\ \cancel{\text{L}}} \times \frac{1\ \cancel{\text{L}}}{1000\ \cancel{\text{mL}}} = 0.750\ \text{M}$$

5. a.

$$20.0\ \cancel{\text{mL}} \times \frac{\cancel{\text{L}}}{1000\ \cancel{\text{mL}}} \times \frac{0.10\ \text{mol}}{\cancel{\text{L}}} = 0.0020\ \text{mol}$$ (2 SF; 0.10 M is 2 SF)

b.

$$0.0020\ \cancel{\text{mol}} \times \frac{\text{L}}{2.00\ \cancel{\text{mol}}} = 0.0010\ \text{L}\ (= 1.0\ \text{mL})$$

c. $V_c = M_d V_d / M_c =$

$$\frac{0.10\ \cancel{\text{M}} * 20.0\ \text{mL}}{2.00\ \cancel{\text{M}}} = 1.0\ \text{mL}$$

Please let me know of any other topics for which it would be useful to have supplemental problem sets.