P E5 (pg 1 of 3) Molarity

Name_________________________Per____

Questions 1-6 ask you to manipulate the molarity equation. If you can work those with no trouble, you are probably in good shape. If ytou had difficulty, perhaps you would try some similar questions, by proceeding on to problems 7-12.

1. What is the molarity when 8.75 g of ammonium chloride is dissolved to produce 200. ml of a solution?

2. A student wants to make 500. ml of 0.350 M sodium phosphate solution?
   a. Calculate the mass of sodium phosphate required.
   b. After the solution is produced, what is the molarity of the sodium ions in this solution?

3. You wanted to use up all 10.0 grams of sodium hydroxide that you have available, to produce a 1.0 M solution,
   a. What size volumetric flask should you get off the shelf to make this solution?
   b. How many moles of sodium ions are present in this solution?
   c. How many moles of hydroxide ions are present in this solution?

4. What volume of 1.00 M stock solution of sulfuric acid should you measure out to produce 500. ml of 0.0250 M solution?

5. If you diluted 10.0 ml of 12 M HCl to 2.0 L, what would be the concentration of the new solution?

6. Consider 100.0 ml of a 0.025M aluminum chloride solution?
   a. How many millimoles of aluminum chloride are present in the solution?
   b. How many millimoles of aluminum ions would be present in this solution?
   c. How many millimoles of chloride ions would be present in this solution?

7. What is the molarity when 3.27 g of calcium nitrate is dissolved to produce 500. ml of a solution?

8. A student wants to make 250. ml of 0.156 M potassium oxalate solution?
   a. Calculate the mass of potassium oxalate required.
   b. After the solution is produced, what is the molarity of the oxalate ions in this solution?
   c. After the solution is produced, what is the molarity of the potassium ions in this solution?

9. You wanted to use up all 4.00 grams of sodium hydroxide that you have available, to produce a 1.0 M solution,
   a. What size volumetric flask should you get off the shelf to make this solution?
   b. How many moles of sodium ions are present in this solution?
   c. How many moles of hydroxide ions are present in this solution?

10. What volume of 3.00 M stock solution of acetic acid should you measure out to produce 1000. ml of 0.250 M solution.

11. If you diluted 10.0 ml of 3.0 M HNO_3 to 500.0 mL, what would be the concentration of the new solution?

12. Consider 100.0 ml of a 0.025M barium nitrate solution?
    a. How many millimoles of barium nitrate are present in the solution?
    b. How many millimoles of barium ions would be present in this solution?
    c. How many milli moles of nitrate ions would be present in this solution?

Molarity

$$Molarity = \frac{moles\ of Solute}{Volume\ of Solution(in Liters)}$$

1. NH_4Cl MM = 14.01+4(1.01) + 35.45 = 53.5 g/mol

   $8.75g \times \frac{1mol}{53.5g} = 0.164mol \qquad \frac{0.164mol}{0.2L} = 0.818M$

2. Na_3PO_4 MM = 3(23) + 31 + 4(16) = 164 g/mol
   when Na_3PO_4 dissolve it dissociates into ions: $Na_3PO_4 \rightarrow 3Na^+ + PO_4^-$

   a. $0.35M \times 0.5L = 0.175molNa_3PO_4 \qquad 0.175molNa_3PO_4 \times \frac{164g}{1mol} = 28.7gNa_3PO_4$

   b. $0.350MNa_3PO_4 \times \frac{3Na^+}{1Na_3PO_4} = 1.05MNa^+$

3. NaOH MM = 23 + 16 + 1.01 = 40.01 g/mol when NaOH dissolve it dissociates into ions: $NaOH \rightarrow Na^+ + OH^-$

   a. $10g \times \frac{1mol}{40.01g} = 0.25mol \qquad 1.0M = \frac{0.25mol}{V} \qquad V = 0.25L$ Thus 250 ml volumetric flask is needed.

   b. $0.25molNaOH \times \frac{1molNa^+}{1molNaOH} = 0.25molNa^+$

   c. $0.25molNaOH \times \frac{1molOH^-}{1molNaOH} = 0.25molOH^-$

4. *When diluting a solution, the moles of the solute in the concentrated solution will equal the moles of the solute in the diluted solution. Thus the equation to the right is very useful. In this equation, the volume units do not need to be in liters, it is only important that the volume unitas are the same on both sides of the equation.*

   $1M \times V = 0.025M \times 500ml \qquad V = 12.5ml\ StockSolution$

For Dilution

$$Molarity \times Volume = Molarity \times Volume$$

$$M_{concentrated}V_{concentrated} = M_{diluted}V_{diluted}$$

5. $12M \times 10ml = M_{dilute} \times 2000ml \qquad M_{dilute} = 0.0600M$

6. $AlCl_3 \rightarrow Al^{3+} + 3\ Cl^-$

   a. $0.025M \times 100ml = 2.5mmolAlCl_3$

   b. $2.5mmolAlCl_3 \times \frac{1Al^{3+}}{1AlCl_3} = 2.5mmolAl^{3+}ions$

   c. $2.5mmolAlCl_3 \times \frac{3Cl^-}{1AlCl_3} = 7.5mmolCl^- ions$

Embrace the Millimole

$$Molarity = \frac{1moles}{1Liter} \times \frac{1000mmol}{1mol} \times \frac{1Liter}{1000ml} \qquad thus\ Molarity = \frac{1mmol}{1ml}$$

Problems 7−12 are very similar to 1-6, and would only be necessary if you feel you struggled, or did not learn the problem types very well the first time through, and you needed more practice to really feel quiz and test ready.

7. $Ca(NO_3)_2$ MM = 40.08+2(14.01) + 6(16) = 164.2 g/mol

   $3.27g \times \frac{1mol}{164.1} = 0.0199mol \qquad \frac{0.0199mol}{0.5L} = 0.0399M$

Molarity

8. $K_2C_2O_4$ MM = 2(39.1) + 2(12.01) + 4(16) = 166.22 g/mol
(Take note, that it may look like this formula can be reduced to KCO_2, it can not be reduced because CO_2^- would not represent oxalate, which must be $C_2O_4^{2-}$)
when $K_2C_2O_4$ dissolve it dissociates into ions: $K_2C_2O_4 \rightarrow 2\,K^+ + C_2O_4^{2-}$

   a. $0.156M \times 0.25L = 0.039 mol K_2C_2O_4$ $\quad 0.039 mol K_2C_2O_4 \times \frac{166.2g}{1mol} = 6.48 g K_2C_2O_4$

   b. $0.039 M K_2C_2O_4 \times \frac{1C_2O_4^{2-}}{1K_2C_2O_4} = 0.0390 M C_2O_4^{2-}$

   c. $0.039 M K_2C_2O_4 \times \frac{2K^+}{1K_2C_2O_4} = 0.0780 M K^+$

9. NaOH MM = 23 + 16 + 1.01 = 40.01 g/mol when NaOH dissolve it dissociates into ions: $NaOH \rightarrow Na^+ + OH^-$

   a. $4g \times \frac{1mol}{40.01g} = 0.1mol$ $\quad 1.0M = \frac{0.1mol}{V}$ $\quad V = 0.1L$ Thus 100 ml volumetric flask is needed.

   b. $0.1 mol NaOH \times \frac{1 mol Na^+}{1 mol NaOH} = 0.1 mol Na^+$

   c. $0.1 mol NaOH \times \frac{1 mol OH^-}{1 mol NaOH} = 0.1 mol OH^-$

10. $3M \times V = 0.25M \times 1000ml$ $\quad V = 83.3ml\ Stock Solution$

11. $3M \times 10ml = M_{dilute} \times 500ml$ $\quad M_{dilute} = 0.060M$

12. $Ba(NO_3)_2 \rightarrow Ba^{2+} + 2\,NO_3^-$

   a. $0.025M \times 100ml = 2.5 mmol Ba(NO_3)_2$

   b. $2.5 mmol Ba(NO_3)_2 \times \frac{1Ba^{2+}}{1Ba(NO_3)_2} = 2.5 mmol Ba^{2+} ions$

   c. $2.5 mmol AlCl_3 \times \frac{2NO_3^-}{1Ba(NO_3)_2} = 5.0 mmol NO_3^- ions$