Name: KEY Date: 3/28/14 Period: ALL

Solutions Quiz – ANSWER KEY

1. Which of the following explains why water is the universal solvent?

   A. Water is a small molecule
   B. Water has a polar structure
   C. Water is made of nonmetals
   D. None of the above

The one key point you needed to know was that water is polar. This is what gives water unique properties, and allows it to dissolve most solutes.

2. Which of the following compounds is likely to dissolve in water?

   A. CH_3OH
   B. NaCl
   C. Both A and B
   D. C_2H_6

Because water is polar, it can dissolve other charged substances. Both ionic compounds and polar covalent compounds are charged, so both A and B can dissolve in water.

3. Which of the following are likely to dissolve in water?

   I. $BaCl_2$
   II. CH_4
   III. OCl_2
   IV. NH_3

   A. I only
   B. I and IV only
   C. II and III only
   D. I, II, and III only

This is just like #2. Ionic compounds and polar covalent compounds can dissolve in water. "I" is ionic, "II" is nonpolar, "III" is nonpolar, and "IV" is polar covalent. Therefore, I and IV would dissolve in water.

4. For the following reaction, which products, if any, would form a precipitate in water?

$$CaCO_3 + KOH \rightarrow Ca(OH)_2 + K_2CO_3$$

A. $Ca(OH)_2$
B. K_2CO_3
C. $Ca(OH)_2$ and K_2CO_3
D. No precipitates would form

This problem requires you to use your solubility rules. Remember that precipitate = insoluble. Also, you are looking at the products, so these are $Ca(OH)_2$ and K_2CO_3.

OH is usually insoluble, but Ca is an exception. Therefore, $Ca(OH)_2$ is soluble. CO_3 is usually insoluble, unless it has an alkali metal. Since K is an alkali metal, K_2CO_3 is actually soluble.

Therefore, no precipitates would form.

5. Which of the following best explains why barium sulfate is insoluble?

A. It is an ionic compound
B. It is a covalent compound
C. All sulfates are insoluble
D. Sulfates are generally soluble, but Barium is a common exception

This problem requires solubility rules again. Barium is a metal, so barium sulfate cannot be a covalent compound (B is wrong). Sulfates are generally soluble (C is also wrong). However, barium is a common exception to this rule. This leaves us with D as the best answer.

6. Which of the following compounds are soluble?

I. K_2CO_3
II. $Ba(ClO_2)_2$
III. AgI
IV. CaS

A. I only
B. I and IV only
C. II and III only
D. I, II, and IV only

This requires our solubility rules again. For "I", CO_3 is generally insoluble, but since K is an alkali metal, K_2CO_3 is actually soluble. Therefore, our answer must have "I" in it (C is wrong). For "II", ClO_2 is always soluble, no exceptions. Therefore, our answer must have "II" in it (A and B are wrong). This leaves us with D as the correct answer.

7. Which of the following solutions has the highest concentration of solute?

   A. 1.5 mol solute in 0.300L solvent
   B. 3.0 mol solute in 0.600L solvent
   C. 0.5 mol solute in 0.05L solvent
   D. 5.0 mol solute in 5.0L solvent

This is another way of asking molarity. The formula for molarity is M = n/V, where M is molarity, n is number of moles, and V is the volume (in liters). Calculating the molarity for each choice, we find:

A: 5 M
B: 5M
C. 10M
D: 1M

Therefore, the highest concentration is C.

8. In a solution of 2.44L, 0.65 moles of Sodium Chloride are dissolved. What is the molarity of the solution?

   A. 0.27 M
   B. 3.8 M
   C. 1.6 M
   D. 1.8 M

This is another molarity question. The formula is M = n/V. We are given n and V, so dividing them:

$$M = \frac{n}{V} = \frac{0.65\ moles}{2.44\ L} = 0.27\ M$$

9. How many grams of $Ca(CN)_2$ are dissolved in 1.75L of a 0.770 M solution of $Ca(CN)_2$?

A. 209g $Ca(CN)_2$
B. 40.5g $Ca(CN)_2$
C. 124g $Ca(CN)_2$
D. 107g $Ca(CN)_2$

This is a molarity, question, but it is a little more complicated. In the formula, M = n/V, we are given M and V. Solving would give us n, but we are looking for grams, not moles.

$$M = \frac{n}{V} \rightarrow n = MV = 0.770 * 1.75 = 1.3475\ moles$$

The relationship between moles and grams is below:

Mass (in grams) = moles * molar mass.

We calculate the molar mass of $Ca(CN)_2$ by adding up all the elements.

$Ca(CN)_2$ = 40.078 + 2(12.011) + 2(14.007) = 92.114 g/mol

Therefore:

Mass (in grams) = 1.3475 * 92.114 = 124g $Ca(CN)_2$

10. Brandon has a 2.55 M solution of zinc (II) bromide. How many liters of the solution would contain 4.6 moles of zinc (II) chloride?

A. 1.8 L
B. 0.55 L
C. 12 L
D. 8.1 L

This is another molarity problem. In the formula, M = n/V, we are given M and n. Solving for V:

$$M = \frac{n}{V} \rightarrow V = \frac{n}{M} = \frac{4.6\ moles}{2.55\ M} = 1.8\ L$$

11. If a solution is diluted by tripling its volume with water, what will happen to the concentration?

A. It will increase by a factor of 5
B. It will triple
C. It will decrease by a third
D. It will decrease by a factor of 5

This is a problem testing your knowledge of dilutions. Diluting something always makes it less concentrated (A and B are wrong). The key word here is triple (which means 3x). If we triple the volume, then the concentration must decrease by a factor of 3 (D is wrong). Therefore, the answer is C.

12. A chemistry student dilutes 0.85L of 3.6 M sodium chloride to prepare 5.0L solution. What is the concentration of the new diluted solution?

A. 0.61 M
B. 6.1M
C. 21 M
D. 10 M

This is a dilutions problem. $M_1V_1 = M_2V_2$. We are given M_1, V_1, and V_2, so we need to solve for M_2.

$$M_1V_1 = M_2V_2$$

$$M_2 = \frac{M_1V_1}{V_2} = \frac{3.6 * 0.85}{5.0} = 0.61\ M$$

13. A chemist has a contained of concentrated 15.0 M sodium hydroxide solution. If she wants to prepare 0.500L of 1.5 M sodium hydroxide, how much of the concentrated solution will she need to use?

A. 5.0 L
B. 0.5 L
C. 0.05 L
D. 0.005 L

This is a dilutions problem. $M_1V_1 = M_2V_2$. We are given M_1, M_2, and V_2, so we need to solve for V_1.

$$M_1V_1 = M_2V_2$$

$$V_1 = \frac{M_2V_2}{M_1} = \frac{1.5 * 0.500}{15.0} = 0.05\ L$$

14. How much water must be added in order to dilute 0.6L of 10.0 M HCl to a concentration of 5.0 M?

A. 1.2 L
B. 1.8 L
C. 0.6 L
D. 1.4 L

This is a dilutions problem. $M_1V_1 = M_2V_2$. We are given M_1, V_1, and M_2, so we need to solve for V_2.

$$M_1V_1 = M_2V_2$$

$$V_2 = \frac{M_1V_1}{M_2} = \frac{10.0 * 0.6}{5.0} = 1.2\ L$$

However, the problem asks how much water needs to be added. Therefore, we need to subtract $V_2 - V_1$.

$$1.2\ L - 0.6\ L = 0.6L$$

15. Which of the following is an example of an electrolyte?

A. $BaCr_2O_7$
B. KOH
C. Both A and B
D. H_2CO_3

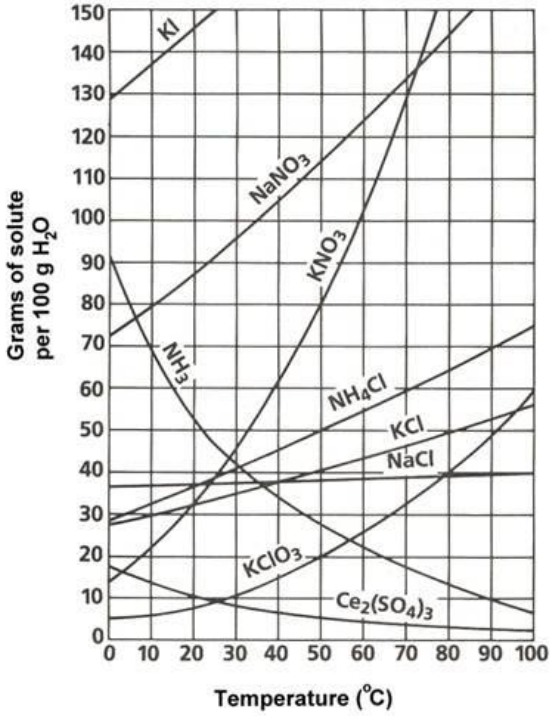
This problem requires you to know what an electrolyte is. All electrolytes are ionic compounds, which means that they have a metal. Both A and B have a metal (Ba and K).

16. What is true of all electrolytes?

A. They are solutions of ionic compounds
B. They contain metals
C. They conduct electricity
D. All of the above

This problem requires you to know the definition of an electrolyte. From #15, we know that electrolytes are ionic compounds and that they contain metals. Since A and C are both correct, our answer must be D, all of the above (electrolytes also conduct electricity).

Questions 17-18 use the following graph:



17. A chemistry student prepares a saturated solution of NH_4Cl in 100g water at 70ºC. She then rapidly cools the solution to 50ºC. Use the graph to estimate how much solute will likely precipitate:

A. About 20g
B. About 10g
C. About 15g
D. About 30g

This problem requires you to read the graph. A saturated solution is one that is on the line. We first look at NH_4Cl at 70ºC. This gives us 60g. We then go to 50ºC on the same curve, which gives us 50g. Since the problem asks how much solute would precipitate (come out of solution), we do 60g – 50g = 10g

Note that the 100g is for water, not NH_4Cl. We don't actually use it in the problem

18. If 80g of $NaNO_3$ are dissolved in 100g H_2O at 10 ºC, what type of solution was made?

A. Saturated
B. Unsaturated
C. Supersaturated
D. Semi-Saturated

This problem requires us to read the graph again. At 10ºC, a saturated solution of $NaNO_3$ would have ~80g. Since we dissolved exactly 80g, our solution must be saturated.