Key

Chemistry 12: Review of Solubility of Ionic Substances

1. Identify each of the following as **ionic** or **molecular** substances:

   a) $NaCl_{(aq)}$ .... Ionic

   b) $CH_3COOH_{(aq)}$ .... molecular/Ionic

   c) $CCl_{4(l)}$ .... molecular

   d) $HNO_{3(aq)}$ .... Ionic

   e) $C_2H_{6(l)}$ .... molecular

2. A good way to test a liquid to see if it contains **ions** is to measure conductivity

3. Define a **saturated solution**   dissolved solute is in EQm with undissolved solute

4. Define an **unsaturated solution**   A solution that contains less than the maximum amount of substance that can dissolve

5. What is meant by **solubility?**   EQm [J] of a substance in solution at a given temperature.

6. What is meant by a **polar molecule?**   Asymmetric Atoms with different electronegativities

7. Draw a diagram of a **water** molecule showing the **polarity**.
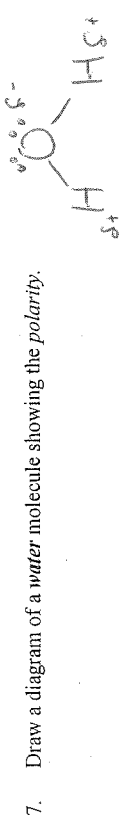
8. The process of an ionic solid breaking down into individual ions is called dissociation

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9. Given a saturated solution of sodium acetate, outline the procedure you could use to determine the **solubility** of sodium acetate at that particular temperature in grams per 100 mL.

   take 100.0 mL of solution, evaporate to dryness, determine mass of solute remaining

   Divide by 100.0 mL

10. Does an *increase in temperature* always increase the *rate* of dissolving?   yes

11. Does an *increase in temperature* always increase the solubility of a substance in water?   No
    Explain.

12. A chemistry stockroom contains a bottle of 12.0 M HCl. A teacher needs to make up 800.0 mL of a 3.0 M solution of HCl. What volume of the stock solution (12.0 M) does the teacher need to use?

$$V_2 = \frac{V_1 C_1}{C_2}$$

$$= \frac{(800.0 mL)(3.0 M)}{12.0 M}$$

= 200 mL   Answer 0.20 L

13. A chemistry student dilutes a 0.20 M solution by adding 200.0 mL of water to 50.0 mL of the original solution. Calculate the *molar concentration* of the final solution.

$$C_2 = \frac{C_1 V_1}{V_2}$$

$$= \frac{(0.20 M)(50.0 mL)}{(250.0 mL)}$$

= 0.040 M   Answer 0.040M

14. A student has 600.0 mL of a 0.30 M solution of HNO_3. How much water **must she add** in order to make it a 0.15 M solution? (Be careful that you answer the question!)

$$V_2 = \frac{C_1 V_1}{C_2} = \frac{(0.30M)(600.0\,mL)}{0.15M}$$

$$= 1200\,mL$$

$$1200\,mL - 600\,mL = 600\,mL$$

Answer _____ 0.60 L _____
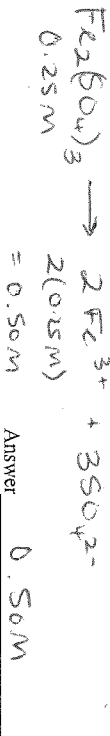
15. If 25.0 mL of 0.90 M HCl is added to 125.0 mL of water, what is the final [HCl]?

$$C_2 = \frac{C_1 V_1}{V_2} = \frac{(0.90M)(25.0mL)}{150.0mL}$$

$$= 0.15 M$$

Answer _____ 0.15 M _____

16. Calculate the $[Fe^{3+}]$ in a 0.25 M solution of $Fe_2(SO_4)_3$?

$$Fe_2(SO_4)_3 \longrightarrow 2Fe^{3+} + 3SO_4^{2-}$$
$$0.25M \qquad 2(0.25M)$$
$$= 0.50 M$$

Answer _____ 0.50 M _____

17. Calculate the $[Na^+]$ in a 0.55 M solution of sodium acetate. (Write the proper formula for sodium acetate first.) $NaCH_3COO$

Answer _____ 0.55M _____

18. Calculate the $[Na^+]$ in a 0.55 M solution of sodium carbonate. (Write the proper formula for sodium carbonate first.) Na_2CO_3

Answer _____ 1.1 M _____

19. Calculate the $[Na^{+1}]$ in a 0.55 M solution of sodium phosphate. (Write the proper formula for sodium phosphate first) Na_3PO_4

Answer _____ 1.7 M _____

$$\left(\begin{array}{c} or\ (1.6\,M\\ rounding\ rule \end{array}\right)$$

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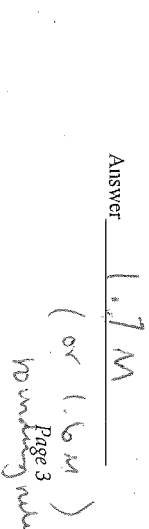
20. 300 mL of 0.500 M NaCl is mixed with 400 mL of 0.200 M HCl. Calculate the final total [Cl⁻].

$$NaCl\quad C_2 = \frac{(0.500M)(300mL)}{700mL} \qquad C_2 = \frac{(0.200M)(400mL)}{700mL}$$

$$= 0.214M$$

$$[Cl^-] = 0.214M + 0.114M \qquad = 0.114\,M$$

Answer _____ 0.328 M _____

21. 200 mL of 0.500 M NaCl is mixed with 300 mL of 0.200 M $CaCl_2$. Calculate the final total [Cl⁻].

$$NaCl\quad C_2 = \frac{(0.500M)(200mL)}{500mL} \qquad C_2 = \frac{(0.200M)(300mL)}{500mL}$$

$$= 0.200\,M \qquad\qquad = 0.120\,M$$

$$[Cl^-] = 0.200M \qquad [Cl^-] = 2(0.120M) = 0.240M$$

$$total\ [Cl^-] = 0.200M$$
$$+ 0.240M$$

Answer _____ 0.440 M _____

22. An aqueous solution of $Pb(NO_3)_2$ is mixed with an aqueous solution of KBr and a precipitate forms.

a) Write a *balanced formula equation* for this reaction. (*Include all subscripts.*)

$$Pb(NO_3)_2 + 2KBr_{(aq)} \longrightarrow PbBr_2(s) + 2KNO_3(aq)$$

b) Write a *balanced total ionic equation* for this reaction. (*Include all subscripts.*)

$$Pb^{2+}_{(aq)} + 2NO_3^-_{(aq)} + 2K^+_{(aq)} + 2Br^-_{(aq)} \longrightarrow PbBr_2(s) + 2K^+_{(aq)} + 2NO_3^-_{(aq)}$$

c) Write a balanced *net ionic equation* for this reaction. (*Include all subscripts.*)

$$Pb^{2+}_{(aq)} + 2Br^-_{(aq)} \longrightarrow PbBr_2(s)$$