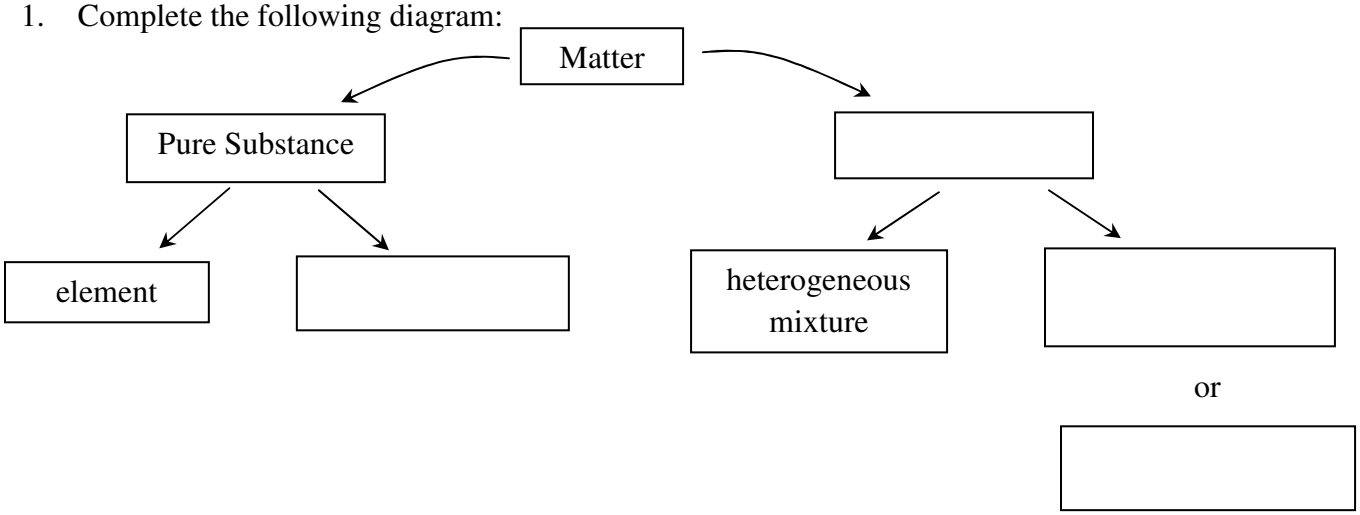
Solutions Review Worksheet

NOTE: Naming acids is introduced on pages 163-4 and again on pages 208-9.. You learned this and were quizzed on it, but since acid names are in the *Data Booklet* you will not be tested on this on your *Final Exam*. For Chem 30, you will not be required to know how to do acid nomenclature.

1. Complete the following diagram:



2. Aqueous solutions are only 1 type of solution. Give 2 examples of other types of solutions.
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   -

3. When a substance dissolves in water *three processes* occur. State the processes and indicate whether each is endothermic or exothermic.

Ionic	Molecular
•	•
•	•
•	•

4. What determines whether the complete dissolving process is endo or exothermic?

5. Use your **new** solubility chart (included here in reduced size) to decide whether each of the following ionic compounds will be high solubility {form an (aq) solution} and which will be low solubility {remain primarily in (s) state}.

   a) $Mg(OH)_2$ _____

   b) MnF_4 _____

   c) $Sn(ClO_4)_2$ _____

   d) $Co(IO_3)_2$ _____

   e) $KMnO_4$ _____

Solubility of Some Common Ionic Compounds in Water at 298.15 K

Ion	Group 1 ions NH_4^+ NO_3^- ClO_3^- ClO_4^- CH_3COO^-	F^-	Cl^- Br^- I^-	SO_4^{2-}	CO_3^{2-} PO_4^{3-} SO_3^{2-}	IO_3^- $OOCCOO^{2-}$	OH^-
Solubility greater than or equal to 0.1 mol/L **(very soluble)**	most	most	most	most	Group 1 ions NH_4^+	Group 1 ions NH_4^+ $Co(IO_3)_2$ $Fe_2(OOCCOO)_3$	Group 1 ions NH_4^+ Sr^{2+}
Solubility less than 0.1 mol/L **(slightly soluble)**	$RbClO_4$ $CsClO_4$ $AgCH_3COO$ $Hg_2(CH_3COO)_2$	Li^+ Mg^{2+} Ca^{2+} Sr^{2+} Ba^{2+} Fe^{2+} Hg_2^{2+} Pb^{2+}	Cu^+ Ag^+ Hg_2^{2+} Pb^{2+} Tl^+	Ca^{2+} Sr^{2+} Ba^{2+} Ag^+ Hg_2^{2+} Pb^{2+} Ra^{2+}	most	most	most

Note: This solubility table is only a guideline that is established using the K_{sp} values. A concentration of 0.1 mol/L corresponds to approximately 10 g/L to 30 g/L depending on molar mass. Hg_2^{2+} is a polyatomic ion of mercury.

The **new** solubility chart without the rest of the *Data Booklet* is available on my website. If you've lost yours, print a new one for yourself.

6. Write dissociation or ionization equations for each of the following in water. **Assume each forms an unsaturated solution unless otherwise indicated.**

   a) NaCl(s)

   b) $Fe(CH_3COO)_3(s)$

   c) $HNO_3(aq)$

   d) equation for formation of a **saturated solution** from

      $CaCO_3(s)$

7. A Chemistry 20 class did an experiment like the one you did to determine the solubility of NaCl, except that they used $CaCl_2$. The following data were recorded:

   final mass of evaporating dish, watch glass, and $CaCl_2(s)$ ..... 123.65 g
   initial mass of evaporating dish and watch glass ..... 116.25 g
   room temperature 20.0ºC
   volume of solution ..... 10.00 mL

   Calculate the solubility in g/100 mL.

   What is the % error if the solubility from the *CRC Handbook of Chemistry and Physics* is 74.5 g/100 mL?

8. Explain why a pot full of water will start to develop bubbles along the walls of the pot as it heats up. This occurs well before the water begins to boil.
   What gas is in the bubbles?

9. If you and your friends take a 2 L bottle of pop and drink ¾ of the pop in it, the next time you open it the pop will be nearly "flat". What are 2 things you could do to stop this from happening?

   •

   •

10. A saturated solution is said to be in dynamic equilibrium. Explain the meaning of the term in a general sense and then explain why a saturated solution is a special case of dynamic equilibrium.

11. Sailors on the Franklin expedition to the North Pole in 1872-3 died from lead poisoning. They had high lead concentrations in their body due to consumption of tinned food in cans soldered with tin/lead solder.
    The skeletal remains of 1 sailor, having a weight 10.5 kg, contained 0.0107 g of lead.

    What was the concentration of lead in the bones in ppm, ppb, and % m/m?

12. What is the molar concentration of glucose in a solution containing 4.82 g of glucose in 29.5 mL of solution?

13. Calculate the molar concentration of **sodium ions** in a solution containing 2.56 g of sodium carbonate in 500 mL of solution.

14. A student was instructed to prepare 125 mL of a 0.250 mol/L $CuSO_4(aq)$ solution. Calculate the mass of solute, $CuSO_4 \bullet 5\ H_2O(s)$ she would need to prepare the solution. (Note: when $CuSO_4 \bullet 5\ H_2O(s)$ dissolves in water you get $CuSO_4(aq)$.)

15. A different student was given 1.95 g of $KNO_3(s)$. He was instructed to prepare a 0.115 mol/L solution of $KNO_3(aq)$. What volume of solution could be prepared?

16. Concentrated $H_2SO_4(l)$ is approximately 17.6 mol/L. What volume of concentrated acid would be required to prepare 200 mL of 1.50 mol/L $H_2SO_4(aq)$?

17. What is one important thing to remember when doing the dilution described in question 15?

18. What is the Arrhenius Theory of acids and bases. (don't worry – its short)

19. • Why did the Arrhenius Theory require modifications?

    • What were the modifications?

20. Write modified Arrhenius equations to explain the acidic behaviour of:

    a) HCl(g)

    b) $SO_2(g)$

    and the basic behaviour of
    c) $NH_3(g)$

21. A weak acid and a strong acid of the same concentrations have very different properties. The strong acid conducts electricity better, has a lower pH, and reacts more quickly with Mg(s).
    Explain this **theoretically**.

22. It's possible to have a solution of a strong acid that behaves in a less acidic manner than a solution of a weak acid. Explain how this can be accomplished.

23. Explain the difference between a polyprotic acid and a monoprotic acid. Give an example of each.

24. Calculate the pH of a 0.250 mol/L solution of HCl(aq).

    What is pOH of the same solution?

25. What is the pH of a solution produced by dissolving 2.75 g of HBr(g) in water to make 700 mL of solution?

26. A solution has pH = 3.9. Calculate $[H_3O^+]$ and $[OH^-]$.

27. A solution has pH = 2.15. What is the maximum pH that can be obtained by diluting the solution?

28. What is the pH of a solution obtained by taking 20.0 mL of a solution of pH = 3.40 and diluting it to a final volume of 125 mL?

29. Separate samples of a solution of unknown pH produced the following colours with the addition of the listed indicators. What is the pH of the solution?

indicator	solution colour
methyl violet	blue
orange IV	yellow
methyl orange	red
bromocresol green	yellow

30. What two groups of gases are the major contributors to acid deposition?

31. Define or describe the following terms:

electrolyte

dissociation

solubility

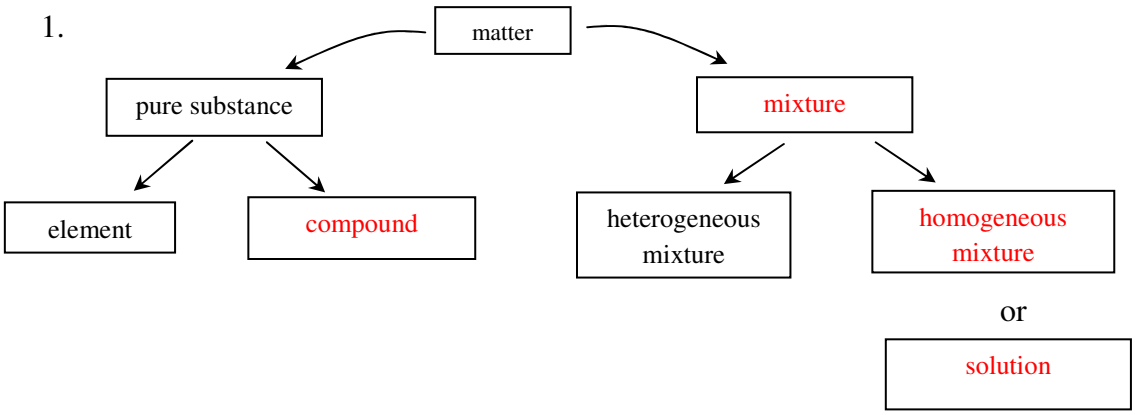
hydronium ion

neutralization reaction

acid deposition

Answers

1.



2. p. 166-8
3. p. 168-9
4. p. 168-9
5. p. 172, solubility chart
6. p. 171-3, p. 175, p. 179
7. Inv 5.B.1 handout
8. p. 181-2
9. p. 182-3
10. p. 178-9
11. 1.02×10^{-4} %m/m
    1.02 ppm
    1.02×10^{3} ppb
12. 0.907 mol/L
13. 0.0966 mol/L
14. 7.80 g
15. 0.168 L
16. 17.0 L
17. notes, demonstration
18. p. 211-3
19. p. 215-7
20. p. 216-7
21. p. 218-222
22. p. 218-222
23. p. 222-3
24. p. 228-230
25. p. 228-230
26. p. 240-1
27. p. 234-5
28. p. 234-5
29. p. 231-3
30. p. 238
31. throughout – I encourage you to find the terms and read the background information rather than just looking in the glossary