Unit 6: Answers to Review for Solubility Equilibria

Answers to Multiple Choice Questions:

1. c	9. a	17. a	25. d	33. a	41. b
2. d	10. c	18. b	26. d	34. b	
3. b	11. c	19. c	27. a	35. b	
4. b	12. c	20. d	28. c	36. d	
5. a	13. a	21. a	29. c	37. a	
6. a	14. b	22. c	30. b	38. d	
7. c	15. b	23. b	31. d	39. d	
8. c	16. a	24. c	32. b	40. a	

Answers to Short and Long Answer Practice Questions:

1. Write the dissociation equations that occur when the following salts are dissolved in water.

a) $Na_2S\ (s) \rightarrow 2\ Na^{1+}\ (aq) + S^{2-}\ (aq)$

b) $CaCl_2\ (s) \rightarrow Ca^{2+}\ (aq) + 2\ Cl^{1-}\ (aq)$

c) $Ba(NO_3)_2\ (s) \rightarrow Ba^{2+}\ (aq) + 2\ NO_3^{1-}\ (aq)$

d) $(NH_4)_3PO_4\ (s) \rightarrow 3\ NH_4^{1+}\ (aq) + PO_4^{3-}\ (aq)$

2. Using the solubility rules that you have **MEMORIZED**, classify the following substances as either soluble or insoluble (slightly soluble):

a) $Pb(OH)_2$ **insoluble**

b) $Sr(CH_3COO)_2$ **soluble**

c) $AgNO_3$ **soluble**

d) $BaCO_3$ **insoluble**

e) $CaSO_4$ **insoluble**

f) $(NH_4)_2S$ **soluble**

3. A solution contains a mixture of 0.10 M CO_3^{2-} ions, 0.10 M SO_4^{2-} ions and 0.10 M IO_3^{1-} ions. $Ba(NO_3)_2$ solution is added slowly to the mixture. Identify the order in which the barium salts will precipitate.

Look up K_{sp} values. A smaller K_{sp} means the substance is **less** soluble. (Remember, as a negative exponent gets larger, the number is getting smaller). $BaSO_4$ ($Ksp = 1.08 \times 10^{-10}$) will ppte first, then $BaCO_3$ ($Ksp = 2.58 \times 10^{-9}$) and then $Ba(IO_3)_2$ ($Ksp = 4.01 \times 10^{-9}$)

4. Write balanced chemical equations for the double displacement reactions that occur when the following solutions are mixed. Identify any possible precipitates by including the states of all species. Write net ionic equations for any precipitation reactions.

a) sodium hydroxide + silver acetate

double displacement reaction (write as whole molecules):

$NaOH\ (aq) + AgCH_3COO\ (aq) \rightarrow \mathbf{AgOH\ (s)} + NaCH_3COO\ (aq)$

net ionic equation (show only the ions that form the precipitate):

$Ag^{1+}\ (aq) + OH^{1-}\ (aq) \rightarrow AgOH\ (s)$

b) ammonium sulfate + potassium phosphate

double displacement reaction (write as whole molecules):
$3\ (NH_4)_2SO_4\ (aq)\ +\ 2\ K_3PO_4\ (aq)\ \rightarrow\ 2\ (NH_4)_3PO_4\ (aq)\ +\ 3\ K_2SO_4\ (aq)$

net ionic equation (show only the ions that form the precipitate):
-because no precipitate forms, all of the ions are "spectator ions" so there is no net ionic equation

c) lithium carbonate + lead (II) nitrate

double displacement reaction (write as whole molecules):
$Li_2CO_3\ (aq)\ +\ Pb(NO_3)_2\ (aq)\ \rightarrow\ PbCO_3\ (s)\ +\ 2\ LiNO_3\ (aq)$

net ionic equation (show only the ions that form the precipitate):
$Pb^{2+}\ (aq)\ +\ CO_3^{2-}\ (aq)\ \rightarrow\ PbCO_3\ (s)$

d) potassium sulfide + silver (II) chlorate

double displacement reaction (write as whole molecules):
$K_2S\ (aq)\ +\ 2\ AgClO_3\ (aq)\ \rightarrow\ Ag_2S\ (s)\ +\ 2\ KClO_3\ (aq)$

net ionic equation (show only the ions that form the precipitate):
$2\ Ag^{1+}\ (aq)\ +\ S^{2-}\ (aq)\ \rightarrow\ Ag_2S\ (s)$

5. Ksp = 3.5×10^{-2}.

6. molar solubility is 4.0×10^{-5} mol/L; this is equal to 0.022 g/L or 22 mg/L

7. $Q_{sp} = 2.4 \times 10^{-5}$; this is less than K_{sp} so **no** ppte will form

8. Qsp = 4.1×10^{-3}; this is greater than Ksp so a ppte will form

9. molar solubility of $BaSO_4$ in 1.20 M H_2SO_4 is 9.0×10^{-11} mol/L

10. molar solubility of $CaCO_3$ in 0.500 M $Ca(NO_3)_2$ is 6.72×10^{-9} mol/L

11. molar solubility of BaF_2 is 3.58×10^{-3} mol/L; this is 0.628 g of BaF_2 in one litre
b) BaF_2 will be more soluble in cold water (the eq'm will shift to the right to produce more heat is if cold water is used because the forward reaction is exothermic)