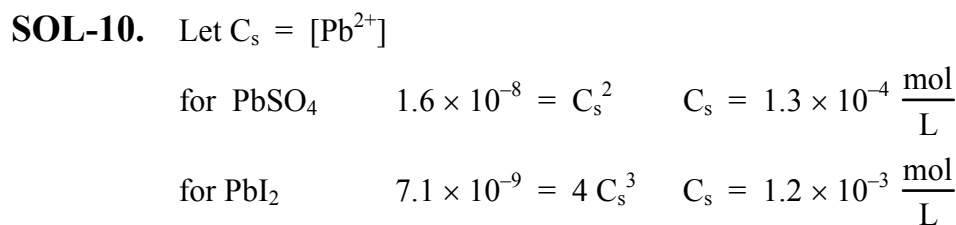
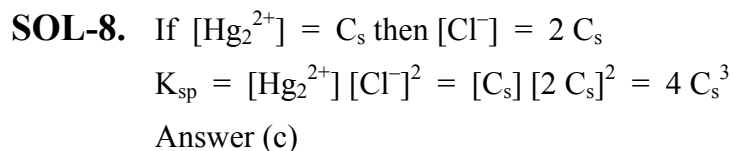
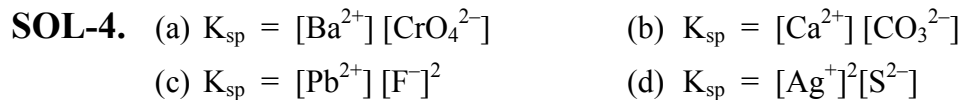
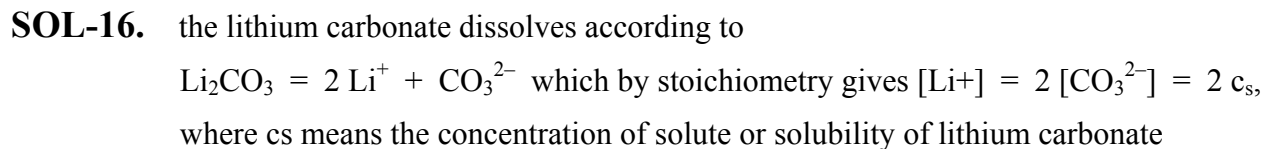


# Homework #10

## solution outlines



Lead (II) iodide is more soluble.

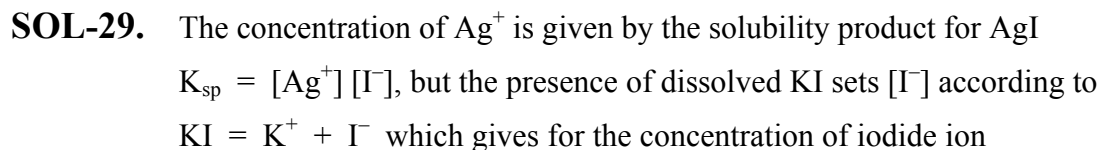
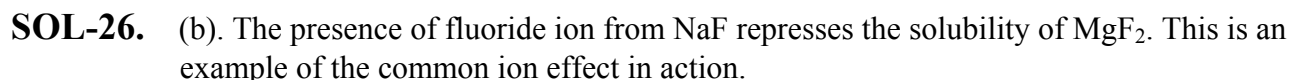


for this reaction  $K_{sp} = [\text{Li}^+]^2 [\text{CO}_3^{2-}] = 4 c_s^3$

$$\frac{1.36 \text{ g Li}_2\text{CO}_3}{100 \text{ mL water}} \times \frac{1 \text{ mol Li}_2\text{CO}_3}{73.89 \text{ g Li}_2\text{CO}_3} = \frac{1000 \text{ mL}}{1 \text{ L}} = 0.184 \text{ M} = c_s$$

$$K_{sp} = 2.49 \times 10^{-2}$$

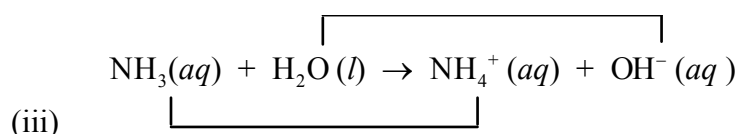
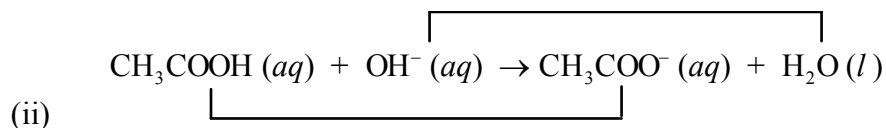
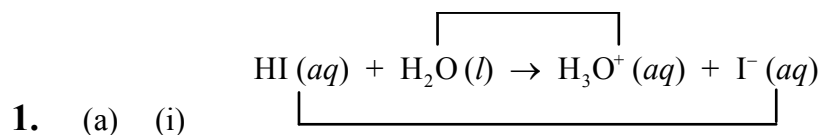
NOTE: By definition, molarity means moles of solute per liter of solution. In this instance we have taken 100 mL water to be 100 mL of solution. Stricly speaking, this is not correct, but the difference between the two is small enough to allow the approximation.



$$\frac{3.21 \text{ g KI}}{350 \text{ mL water}} \times \frac{1 \text{ mol KI}}{166.00 \text{ g KI}} = \frac{1000 \text{ mL}}{1 \text{ L}} = 5.52 \times 10^{-2} \text{ M}$$

now return to the  $K_{sp}$  for AgI to solve for  $[\text{Ag}^+]$ :

$$[\text{Ag}^+] = K_{\text{sp}} / [\text{I}^-] = 8.3 \times 10^{-17} / 5.52 \times 10^{-2} = 1.50 \times 10^{-15} \text{ M}$$



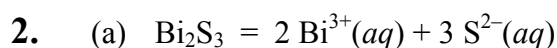
(b)  $\text{H}_3\text{O}^+$  and  $\text{SiH}_4$ .  $\text{SiH}_4$  cannot accept a proton due to lack of unpaired electrons. While  $\text{H}_3\text{O}^+$  does have a pair of nonbonding electrons and so, in principle, could accept another proton,  $\text{H}_4\text{O}^{2+}$  is not observed.

(c) HI is a strong acid  $\Rightarrow$  complete dissociation

$$\therefore 0.03091 \text{ M HI}(\text{aq}) \Rightarrow 0.03091 \text{ M} = [\text{H}^+] = [\text{I}^-]$$

$$\therefore \text{pH} = -\log_{10}[\text{H}^+] = -\log_{10} 0.03091 = 1.51$$

$$\text{pOH} + \text{pH} = 14 \Rightarrow \text{pOH} = 12.49$$



$$\therefore [\text{Bi}^{3+}] = 2 C_s \text{ and } [\text{S}^{2-}] = 3 C_s$$

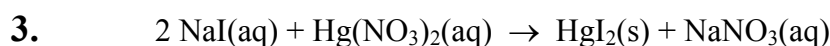
$$\therefore K_{\text{sp}} = (2 C_s)^2 (3 C_s)^3 = 4 C_s^2 \cdot 27 C_s^3 = 108 C_s^5$$

$$\therefore C_s = \left( \frac{K_{\text{sp}}}{108} \right)^{1/5} = 1.715 \times 10^{-15} \text{ mol/L}$$

$$\therefore \text{in } 3.091 \times 10^6 \text{ L} \Rightarrow 5.3 \times 10^{-9} \text{ mol Bi}_2\text{S}_3$$

(b)  $[\text{Bi}^{3+}] = 2 C_s = 1.06 \times 10^{-8} \text{ mol}$

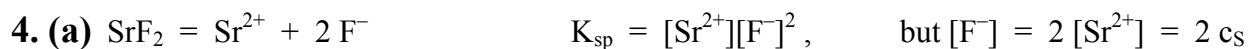
$N_{\text{av}}$  ions/mol  $\Rightarrow 6.38 \times 10^{15} \text{ Bi}^{3+}$  ions in the  $3.091 \times 10^6$  liters of water of part (a)



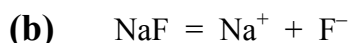
$$\frac{0.10 \text{ mol Hg}(\text{NO}_3)_2}{1 \text{ L}} \times 0.045 \text{ L} = 4.5 \times 10^{-3} \text{ mol Hg}(\text{NO}_3)_2$$

$$4.5 \times 10^{-3} \text{ mol Hg(NO}_3)_2 \times \frac{2 \text{ mol NaI}}{1 \text{ mol Hg(NO}_3)_2} = 9.00 \times 10^{-3} \text{ mol NaI}$$

$$\frac{9.00 \times 10^{-3} \text{ mol NaI}}{0.25 \frac{\text{mol NaI}}{\text{L}}} = 3.6 \times 10^{-2} \text{ L} \times \frac{1000 \text{ ml}}{1 \text{ L}} = 36 \text{ ml NaI}$$



$$\therefore K_{sp} = c_s (2 c_s)^2 = 4 c_s^3 \quad \therefore c_s = \left( \frac{K_{sp}}{4} \right)^{1/3} = 8.49 \times 10^{-4} \text{ M}$$

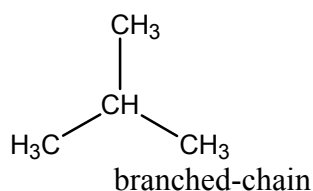
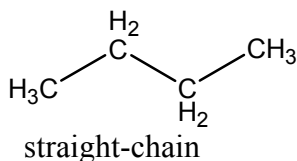


$\therefore [\text{F}^-] = 0.03 \text{ M}$ , which dominates the other equilibrium

$$\therefore K_{sp} = [\text{Sr}^{2+}][\text{F}^-]^2 \Rightarrow [\text{Sr}^{2+}] = \frac{K_{sp}}{[\text{F}^-]^2} = \frac{2.45 \times 10^{-9}}{(0.03)^2} = 2.72 \times 10^{-6} \text{ M}$$

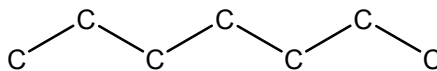
$$\therefore [\text{Sr}^{2+}] = c_s = 2.72 \times 10^{-6} \text{ M}$$

**O1-4.** Saturated hydrocarbons contain as many hydrogen atoms as possible. An example is propane,  $\text{CH}_3\text{CH}_2\text{CH}_3$ . Unsaturated hydrocarbons have fewer hydrogen atoms than the corresponding alkane, and an example would be propene,  $\text{CH}_2=\text{CHCH}_3$ . In a straight chain hydrocarbon, the carbon atoms form a chain that runs from one end of the molecule to the other without carbon atoms branching off the main chain. Branched hydrocarbons do not form a single chain that runs from one end of the molecule to the other. Examples of both are given below.

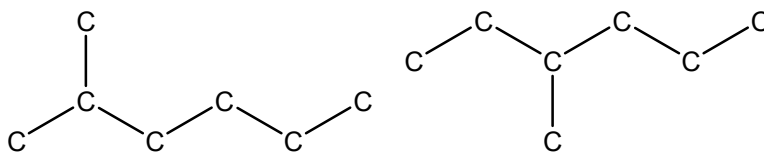


**O1-8.** Following the pattern suggested by the solution to exercise O-2, we can enumerate the isomers for heptane as:

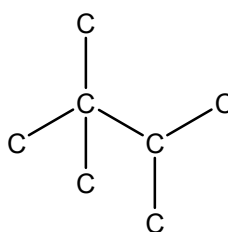
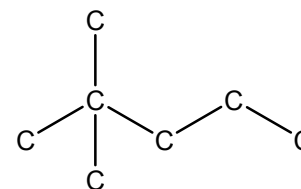
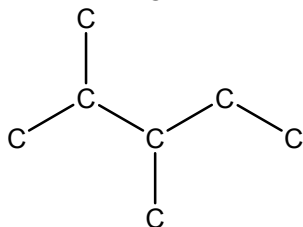
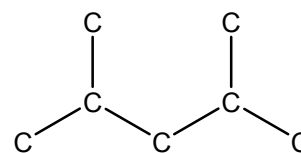
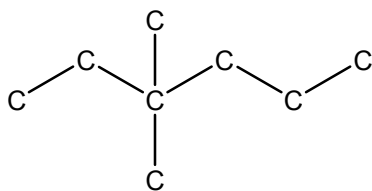
1 for unbranched chain



2 for single branched chain



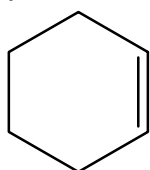
4 for double branched chain



1 for triple branched chain

- O1-26.** (a) Cannot have cis and trans isomers because only single carbon center is present.  
 (b) Cannot have cis and trans isomers because all groups on both carbon centers are the same.  
 (c) Cannot have cis and trans isomers because both groups on one carbon center are the same.  
 (d) Can have both cis and trans isomers.  
 (e) Cannot have cis and trans isomers because both groups on one carbon center are the same.

- O1-28.** Both (a) and (b) are pairs of constitutional isomers, since they have the same formula but different arrangement of atoms. (c) The compounds are the same. (d) The compounds are geometric or stereoisomers.

**O1-33.**

- O1-56.** Use the criterion spelled out in Figure O1.23 on p. 31 of the Module chapter. Draw the molecule so that the C–H bond is vertical and decide whether the mirror image can be superimposed after rotation about the vertical axis. Only CHFCIBr is chiral and therefore optically active.