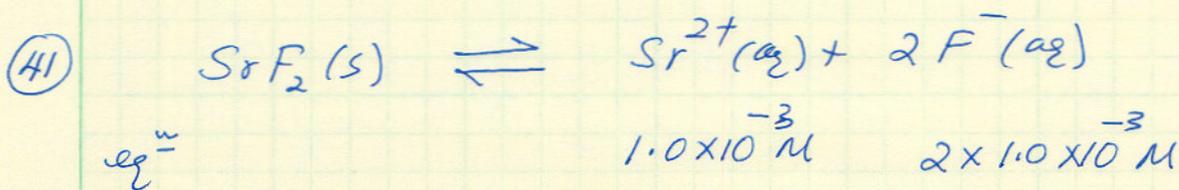
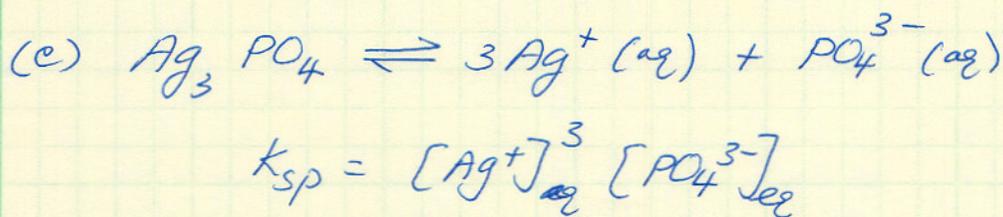
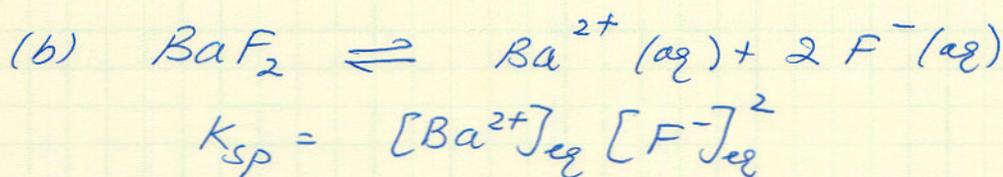
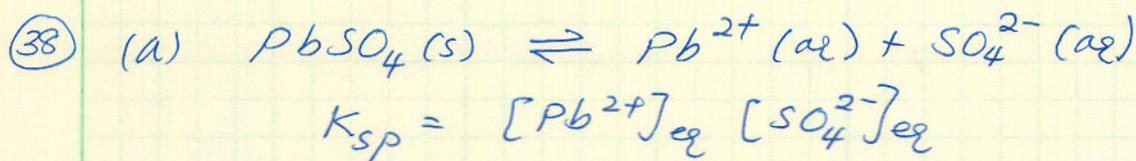


1

INTRODUCTION TO NATURAL SCIENCE  
CHEMISTRY HOMEWORK - SPRING - WEEK 7

Chapter 18

- (35) (a) ~~soluble~~ soluble (b) soluble (c) insoluble  
(d) insoluble



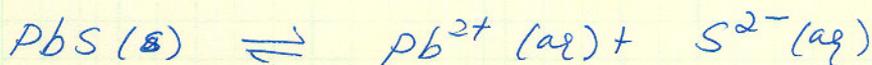
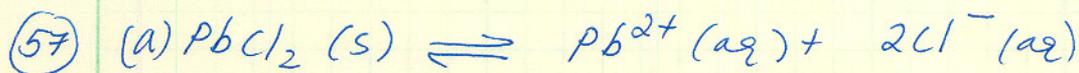
$$K_{sp} = [Sr^{2+}]_{eq} [F^{-}]_{eq}^2 = (1.0 \times 10^{-3})(2 \times 1.0 \times 10^{-3})^2$$
$$= \underline{\underline{4.0 \times 10^{-9}}}$$



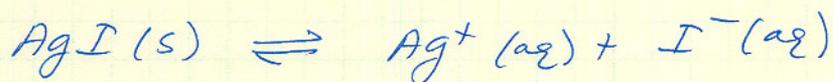
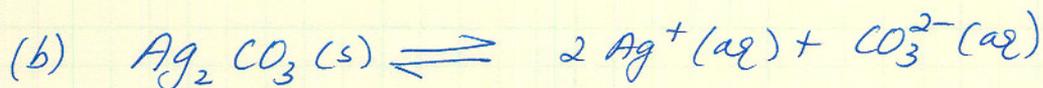
∴ Since  $\alpha$  is very small,  $\alpha^2$  is extremely small and hence negligible

$$\Rightarrow 0.020\alpha = 8.5 \times 10^{-17}$$

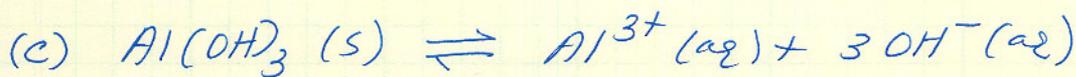
$$\alpha = \underline{\underline{4.25 \times 10^{-15} \text{ M}}} = \text{solubility in AgNO}_3$$



Of the two bases  $[\text{Cl}^{-}$  and  $\text{S}^{2-}]$ ,  $\text{S}^{2-}$  is the stronger base, hence will react with nitric acid more readily than  $\text{Cl}^{-}$ . ∴  $\text{PbS}$  is more soluble than  $\text{PbCl}_2$ .



$\text{CO}_3^{2-}$  is the stronger base of the two bases. ∴  $\text{Ag}_2\text{CO}_3$  dissolves more readily.

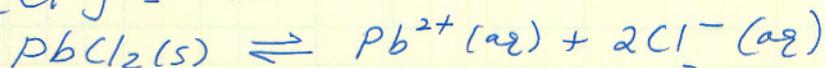


$\text{OH}^{-}$  is a stronger base than  $\text{Cl}^{-}$ . ∴  $\text{Al}(\text{OH})_3$  will dissolve more readily.

(59)

$$[Pb^{2+}] = 0.0012 M$$

$$[Cl^-] = 0.010 M$$



$$K_{sp} \text{ of } PbCl_2 = [Pb^{2+}]_{aq} [Cl^-]_{aq}^2$$

$$Q = [Pb^{2+}] [Cl^-]^2 = (0.0012) (0.010)^2$$

$$= 1.2 \times 10^{-7}$$

$$K_{sp} \text{ of } PbCl_2 = 1.7 \times 10^{-5}$$

$Q < K_{sp} \Rightarrow PbCl_2$  will not precipitate.

### Chapter 19

(2) (a) the piece of Si with other trace elements

(b)  $O_2$  at  $0^\circ C$

(c)  $I_2(g)$

(d)  $O_2(g)$  at 0.1 bar pressure

(4) (a)  $NaCl(aq)$  (b)  $H_2S$  (c)  $C_2H_4(g)$  (d)  $H_2SO_4(aq)$

$$(5) (a) \Delta S^\ominus = S^\ominus [KOH(aq)] - S^\ominus [KOH(s)]$$

$$= (91.6 - 78.9) J K^{-1} = \underline{\underline{12.7 J K^{-1}}}$$

$\Delta S^\ominus > 0$  since the solid has less entropy than the solution.

$$(b) \Delta S^\ominus = S^\ominus [\text{Na}(s)] - S^\ominus [\text{Na}(g)]$$

$$= (51.21 - 153.765) \text{ J K}^{-1} = \underline{\underline{-102.56 \text{ J K}^{-1}}}$$

< 0 because Na(g) has more entropy.

$$(c) \Delta S^\ominus = S^\ominus [\text{Br}_2(g)] - S^\ominus [\text{Br}_2(l)]$$

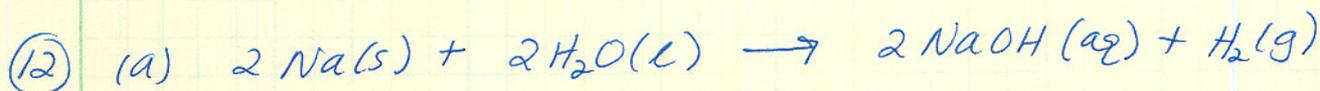
$$= (245.474 - 152.2) \text{ J K}^{-1} = \underline{\underline{93.3 \text{ J K}^{-1}}}$$

> 0 since the gas phase has more entropy.

$$(d) \Delta S^\ominus = S^\ominus [\text{HCl}(aq)] - S^\ominus [\text{HCl}(g)]$$

$$= (56.5 - 186.2) \text{ J K}^{-1} = \underline{\underline{-129.7 \text{ J K}^{-1}}}$$

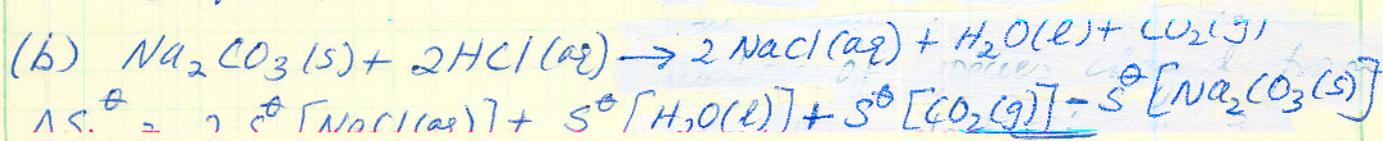
< 0 since the aqueous phase has less entropy than gas phase.



$$\Delta S_{\text{rxn}}^\ominus = 2 S^\ominus [\text{NaOH}(aq)] + S^\ominus [\text{H}_2(g)] - 2 S^\ominus [\text{Na}(s)] - 2 S^\ominus [\text{H}_2\text{O}(l)]$$

$$= [2(48.1) + 130.7 - 2(51.21) - 2(69.95)] \text{ J K}^{-1}$$

$$= -15.42 \text{ J K}^{-1}$$

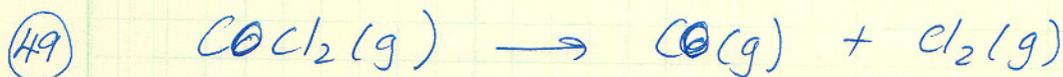


(17) (a)  $\Delta H < 0$      $\Delta S < 0$

spontaneous at low temperatures.

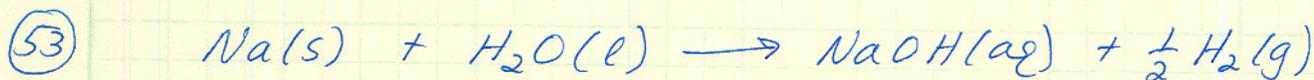
(b)  $\Delta H > 0$      $\Delta S < 0$  not spontaneous under any condition.

~~(c)~~



$\Delta S > 0$

$\therefore$  have to raise the temperature.



$\Delta H < 0$  (since the reaction is <sup>(violent)</sup> exothermic)

$\Delta S > 0$  (gas evolved), but

$$\Delta H_m^\ominus = \Delta H_f^\ominus [\text{NaOH}(\text{aq})] + \frac{1}{2} \Delta H_f^\ominus [\text{H}_2(\text{g})] - \Delta H_f^\ominus [\text{Na}(\text{s})] - \Delta H_f^\ominus [\text{H}_2\text{O}(\text{l})]$$

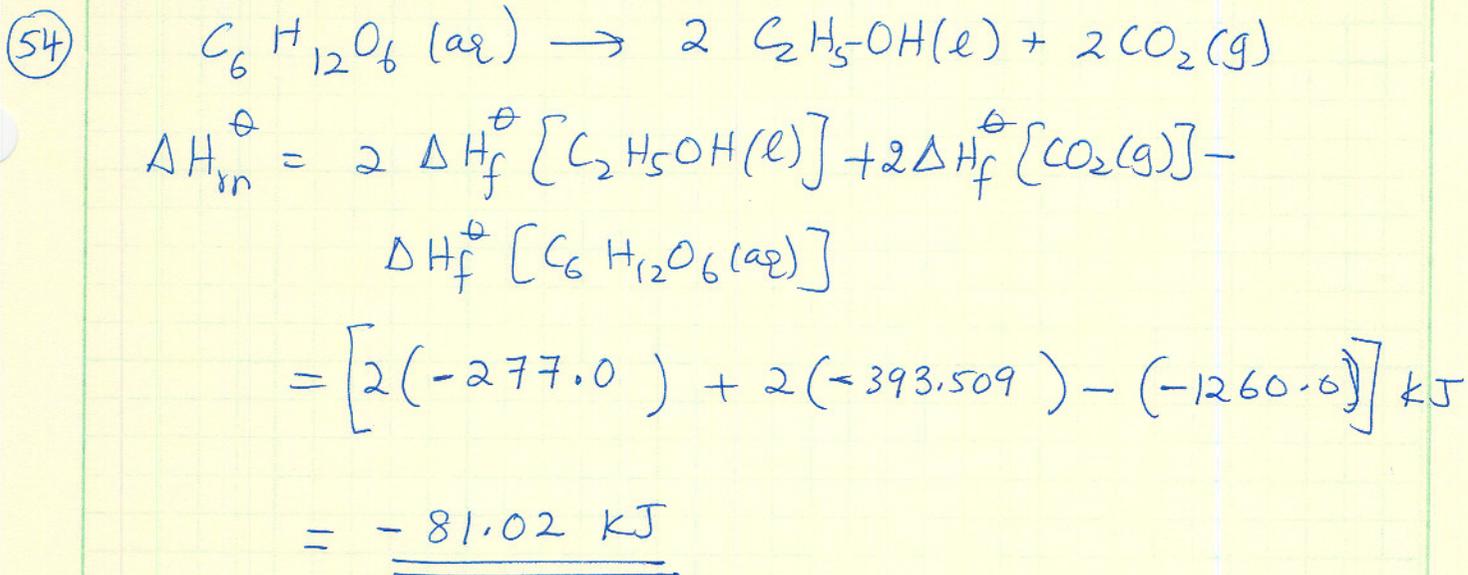
$$= [-469.15 + \frac{1}{2}(0) - (0) - (-285.83)] \text{ kJ mol}^{-1}$$

$$= \underline{\underline{-183.32 \text{ kJ} < 0}}$$

$$\Delta S_m^\ominus = S^\ominus [\text{NaOH}(\text{aq})] + \frac{1}{2} S^\ominus [\text{H}_2(\text{g})] - S^\ominus [\text{Na}(\text{s})] - S^\ominus [\text{H}_2\text{O}(\text{l})]$$

$$= [48.1 + \frac{1}{2}(130.7) - (51.21) - (69.95)] \text{ J K}^{-1}$$

$$= -7.68 < 0 \text{ perhaps because number of species is decreasing. Also } \text{NaOH} \text{ is being dissolved}$$



$$\Delta S_m^{\ominus} = 2 S_f^{\ominus} [C_2H_5OH(l)] + 2 S^{\ominus} [CO_2(g)] - S^{\ominus} [C_6H_{12}O_6(aq)]$$

$$= [2(160.7) + 2(213.74) - 289] \text{ JK}^{-1}$$

$$= \underline{\underline{459.88 \text{ JK}^{-1}}}$$

$$\Delta G_m^{\ominus} = 2 \Delta G_f^{\ominus} [C_2H_5OH(l)] + 2 \Delta G_f^{\ominus} [CO_2(g)] - \Delta G_f^{\ominus} [C_6H_{12}O_6(aq)]$$

$$= 2(-174.7) + 2(-394.359) - (-918.8) \text{ kJ}$$

$$= \underline{\underline{-219.32 \text{ kJ}}} \quad \text{Product favored reaction.}$$

