

### Acid Base Answers

- 1A)  $K_{sp} = [\text{Ca}^{2+}][\text{OH}^-]^2$   
1B) 0.407g  
1C) 12.3  
1D)  $1.38 \times 10^{-6}$   
2) 0.50M  
3)  $\text{HNO}_2$  and  $\text{NaNO}_2$   
4)  $K_a = 6.7 \times 10^{-14}$   
5)  $\text{H}_2\text{O}$   
6) Basic or Alkali  
7)  $\text{OH}^-$   
8) Neutralization  
9) 0.0824M  
10A)  $[\text{H}^+] = 0.0393$ , pH=1.41  
10B)  $[\text{OH}^-] = 2.54 \times 10^{-13}$   
11A) Base  
11B) Acid  
12A) pH= 4.63  
12B) pH= 4.39  
12C) pH=10.98  
13A)  $1.0 \times 10^{-7}\text{M}$   
13B) 0.00562M  
13C)  $1.58 \times 10^{-12}$   
14A) 9.25  
14B) 9.46  
14C) 9.88  
14D) 9.25  
15)  $8.20 \times 10^{-19}$   
16)  $9.3 \times 10^{-9}$   
17) Average score = 2.87  
a) two points  
 $\text{SrSO}_{4(s)} \rightleftharpoons \text{Sr}_{(aq)}^{2+} + \text{SO}_{4(aq)}^{2-}$   
at equilibrium:  $[\text{SO}_4^{2-}] = x = [\text{Sr}^{2+}]$   
 $(x)(x) = K_{sp} = 7.6 \times 10^{-7}$   
 $(x) = 8.7 \times 10^{-4} \text{ mol / liter} = \text{solubility of SrSO}_4$   
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17b) three points  
 $\text{SrF}_{2(s)} \rightleftharpoons \text{Sr}_{(aq)}^{2+} + 2 \text{F}_{(aq)}^-$   
at equilibrium:  $[\text{Sr}^{2+}] = x$ ,  $[\text{F}^-] = 2x$   
 $K_{sp} = [\text{Sr}^{2+}][\text{F}^-]^2 = (x)(2x)^2 = 7.9 \times 10^{-10}$   
 $x = 5.8 \times 10^{-4} \text{ mol / liter} = \text{solubility of SrF}_2$   
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17c) two points  
Solve for  $[\text{Sr}^{2+}]$  required for precipitation of each salt.  
 $K_{sp} = [\text{Sr}^{2+}][\text{F}^-]^2 = 7.9 \times 10^{-10}$

$$= (x)(0.020 \text{ mole} / 1.0 \text{ L})^2 = 7.9 \times 10^{-10}$$
$$x = 2.0 \times 10^{-6} \text{ M}$$
$$K_{sp} = [\text{Sr}^{2+}][\text{SO}_4^{2-}] = 7.6 \times 10^{-7}$$
$$= (y)(0.10 \text{ mole} / 1.0 \text{ liter}) = 7.6 \times 10^{-7}$$
$$y = 7.6 \times 10^{-6} \text{ M}$$

Since  $2.0 \times 10^{-6} \text{ M} < 7.6 \times 10^{-6} \text{ M}$ ,  $\text{SrF}_2$  must precipitate first.  
When  $\text{SrF}_2$  precipitates,  $[\text{Sr}^{2+}] = 2.0 \times 10^{-6} \text{ M}$

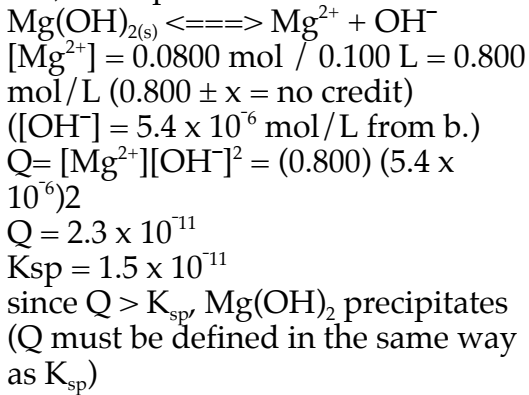
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17d) two points  
The second precipitate to form is  $\text{SrSO}_4$ , which appears when  $[\text{Sr}^{2+}] = 7.6 \times 10^{-6} \text{ M}$  (Based on calculation in Part c.)  
When  $[\text{Sr}^{2+}] = 7.6 \times 10^{-6} \text{ M}$ ,  $[\text{F}^-]$  is determined as follows:  
 $K_{sp} = [\text{Sr}^{2+}][\text{F}^-]^2 = 7.9 \times 10^{-10}$   
 $= (7.6 \times 10^{-6})(z)^2 = 7.9 \times 10^{-10}$   
 $z = 1.0 \times 10^{-2} \text{ M}$   
%  $\text{F}^-$  still in solution =  $1.0 \times 10^{-2} / 2.0 \times 10^{-2} \times 100 = 50.0\%$

18a) three points  
 $[\text{NH}_4^+] = [\text{OH}^-] = x$   
 $[\text{NH}_3] = 0.150 \text{ mol/L} - x$   
 $K_b = ([\text{NH}_4^+][\text{OH}^-]) \div [\text{NH}_3]$   
 $1.8 \times 10^{-5} = [(x)(x)] \div (0.150 - x)$   
approximately equals  $x^2 \div 0.150$   
 $x = [\text{OH}^-] = 1.6 \times 10^{-3} \text{ mol/L}$   
% diss =  $[(1.6 \times 10^{-3}) / (0.150)] \times 100\%$   
 $= 1.1\%$

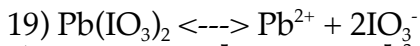
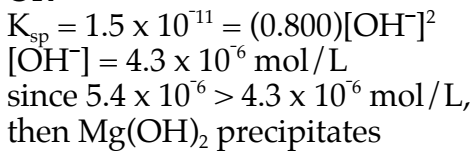
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18b) three points  
 $[\text{NH}_4^+] = 0.0500 \text{ mol} / 0.100 \text{ L} = 0.500 \text{ mol/L}$   
 $[\text{NH}_3] = 0.150 \text{ mol/L}$   
OR  
 $\text{mol NH}_4^+ = 0.0500 \text{ mol NH}_4^+$   
 $\text{mol NH}_3 = 0.150 \text{ mol/L} \times 0.100 \text{ L} = 0.0150 \text{ mol}$   
THEN  
 $1.8 \times 10^{-5} = [(0.500)(x)] \div (0.150)$   
OR  
pOH =  $4.74 + \log(0.500 / 0.150)$   
THEN  
 $x = [\text{OH}^-] = 5.4 \times 10^{-6} \text{ mol/L}$   
pOH = 5.27  
pH =  $14.00 - 5.27 = 8.73$

- 24) B  
25) D  
26) A

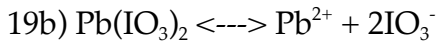
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18c) three points



OR



a)  $K_{sp} = [4.0 \cdot 10^{-5}][2 \cdot 4.0 \cdot 10^{-5}]^2$   
 $K_{sp} = 2.56 \cdot 10^{-19}$

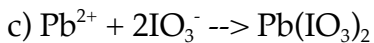


I	/	0.10	0
C	-x	+x	+2x
E	-x	+x	+2x

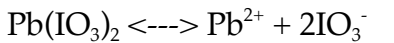
$$2.56 \cdot 10^{-13} = [0.10+x][2x]^2$$

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$$2.56 \cdot 10^{-12} = 4x^2 \quad x = 8.0 \cdot 10^{-7} \text{ mol L}^{-1}$$



0.0400	0.290	/
-0.0400	-0.0400	
0	0.210	



/	0	0.210
	+x	+2x

$$2.56 \cdot 10^{-13} = [x][0.210+2x]^2$$

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$$x = 5.80 \cdot 10^{-12} \text{ M Pb}^{2+}$$

$$0.210 \text{ M IO}_3^-$$

- 20) B  
21) D  
22) C  
23) C