

### Acid Base Answers

- 1A)  $K_{sp} = [Ca^{2+}][OH^-]^2$   
 1B) 0.407g  
 1C) 12.3  
 1D) 1.38e-6  
 2) 0.50M  
 3)  $HNO_2$  and  $NaNO_2$   
 4)  $k_a = 6.7 \cdot 10^{-14}$   
 5)  $H_2O$   
 6) Basic or Alkali  
 7)  $OH^-$   
 8) Neutralization  
 9) 0.0824M  
 10A)  $[H^+] = 0.0393$ , pH=1.41  
 10B)  $[OH^-] = 2.54 \cdot 10^{-13}$   
 11A) Base  
 11B) Acid  
 12A) pH= 4.63  
 12B) pH= 4.39  
 12C) pH=10.98  
 13A)  $1.0 \cdot 10^{-7}M$   
 13B) 0.00562M  
 13C)  $1.58 \cdot 10^{-12}$   
 14A) 9.25  
 14B) 9.46  
 14C) 9.88  
 14D) 9.25  
 15)  $8.20 \cdot 10^{-19}$   
 16)  $9.3 \cdot 10^{-9}$   
 17) Average score = 2.87  
 a) two points  
 $SrSO_{4(s)} \rightleftharpoons Sr_{(aq)}^{2+} + SO_{4(aq)}^{2-}$   
 at equilibrium:  $[SO_4^{2-}] = x = [Sr^{2+}]$   
 $(x)(x) = K_{sp} = 7.6 \times 10^{-7}$   
 $(x) = 8.7 \times 10^{-4} \text{ mol / liter} = \text{solubility of } SrSO_4$
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- 17b) three points  
 $SrF_{2(s)} \rightleftharpoons Sr_{(aq)}^{2+} + 2 F_{(aq)}^-$   
 at equilibrium:  $[Sr^{2+}] = x$ ,  $[F^-] = 2x$   
 $K_{sp} = [Sr^{2+}][F^-]^2 = (x)(2x)^2 = 7.9 \times 10^{-10}$   
 $x = 5.8 \times 10^{-4} \text{ mol / liter} = \text{solubility of } SrF_2$
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- 17c) two points  
 Solve for  $[Sr^{2+}]$  required for precipitation of each salt.  
 $K_{sp} = [Sr^{2+}][F^-]^2 = 7.9 \times 10^{-10}$

$$= (x)(0.020 \text{ mole} / 1.0 \text{ L})^2 = 7.9 \times 10^{-10}$$

$$x = 2.0 \times 10^{-6} \text{ M}$$

$$K_{sp} = [Sr^{2+}][SO_4^{2-}] = 7.6 \times 10^{-7}$$

$$= (y)(0.10 \text{ mole} / 1.0 \text{ liter}) = 7.6 \times 10^{-7}$$

$$y = 7.6 \times 10^{-6} \text{ M}$$

Since  $2.0 \times 10^{-6} \text{ M} < 7.6 \times 10^{-6} \text{ M}$ ,  $SrF_2$  must precipitate first.  
 When  $SrF_2$  precipitates,  $[Sr^{2+}] = 2.0 \times 10^{-6} \text{ M}$

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17d) two points  
 The second precipitate to form is  $SrSO_4$ , which appears when  $[Sr^{2+}] = 7.6 \times 10^{-6} \text{ M}$  (Based on calculation in Part c.)  
 When  $[Sr^{2+}] = 7.6 \times 10^{-6} \text{ M}$ ,  $[F^-]$  is determined as follows:  
 $K_{sp} = [Sr^{2+}][F^-]^2 = 7.9 \times 10^{-10}$   
 $= (7.6 \times 10^{-6})(z)^2 = 7.9 \times 10^{-10}$   
 $z = 1.0 \times 10^{-2} \text{ M}$   
 $\% F^- \text{ still in solution} = 1.0 \times 10^{-2} / 2.0 \times 10^{-2} \times 100 = 50.\%$

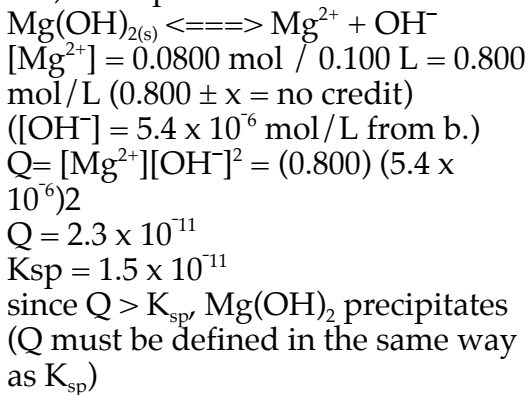
18a) three points  
 $[NH_4^+] = [OH^-] = x$   
 $[NH_3] = 0.150 \text{ mol/L} - x$   
 $K_b = ([NH_4^+][OH^-]) \div [NH_3]$   
 $1.8 \times 10^{-5} = [(x)(x)] \div (0.150 - x)$   
 approximately equals  $x^2 \div 0.150$   
 $x = [OH^-] = 1.6 \times 10^{-3} \text{ mol/L}$   
 $\% \text{ diss} = [(1.6 \times 10^{-3}) / (0.150)] \times 100\%$   
 $= 1.1\%$

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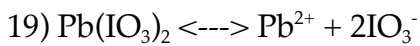
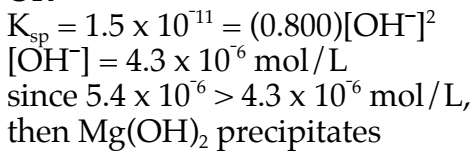
18b) three points  
 $[NH_4^+] = 0.0500 \text{ mol} / 0.100 \text{ L} = 0.500 \text{ mol/L } NH_4^+$   
 $[NH_3] = 0.150 \text{ mol/L}$   
 OR  
 $\text{mol } NH_4^+ = 0.0500 \text{ mol } NH_4^+$   
 $\text{mol } NH_3 = 0.150 \text{ mol/L} \times 0.100 \text{ L} = 0.0150 \text{ mol}$   
 THEN  
 $1.8 \times 10^{-5} = [(0.500)(x)] \div (0.150)$   
 OR  
 $pOH = 4.74 + \log(0.500 / 0.150)$   
 THEN  
 $x = [OH^-] = 5.4 \times 10^{-6} \text{ mol/L}$   
 $pOH = 5.27$   
 $pH = 14.00 - 5.27 = 8.73$

- 24) B  
25) D  
26) A

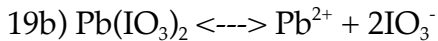
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18c) three points



OR



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

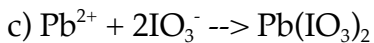


I	/	0.10	0
C	-x	+x	+2x
E	-x	+x	+2x

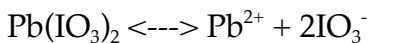
$$2.56 \cdot 10^{-13} = [0.10+x][2x]^2$$

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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

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

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

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

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

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