

Chemistry 12 Solubility Equil'm Practice Test

Name: Key
Date:
Block:

Multiple Choice:

C 1. The relationship between the solubility of SrF_2 and its K_{sp} is:

A. solubility = $\sqrt[3]{\frac{K_{sp}}{4}}$

B. solubility = $\sqrt{\frac{K_{sp}}{2}}$

C. solubility = $\sqrt[3]{\frac{K_{sp}}{4}}$

D. solubility = $\sqrt{K_{sp}}$



$$K_{sp} = [\text{Sr}^{2+}][\text{F}^-]^2$$

$$= (s)(2s)^2$$

$$= 4s^3 \rightarrow s = \sqrt[3]{\frac{K_{sp}}{4}}$$

D 2. Which of the following compounds will form a saturated solution with the greatest concentration of Ag^+ ?

- A. AgI
B. AgBr

- C. AgIO_3
D. AgBrO_3

3. Explain your answer to the question above:

- All salts are 1:1 ratio
- $K_{sp} = s^2$
- Greatest K_{sp} value = highest solubility
↳ greatest $[\text{Ag}^+]$

D 4. Which of the following compounds is the least soluble in water?

- A. H_2S
B. KNO_3

- C. ZnSO_4
D. Ca(OH)_2
(low solubility)

A 5. When Ca(OH)_2 attains solubility equilibrium, the:

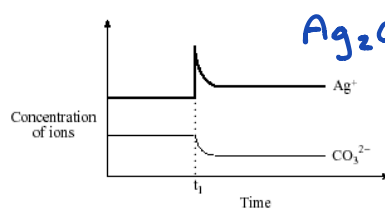
- A. solution is saturated.
B. solution will be acidic
C. Trial K_{sp} is less than the K_{sp} .
D. concentrations of the ions are equal.

_____ 6. When equal volumes of 0.2 M NH_4Cl and 0.2 M CuSO_4 are combined:

- A. a precipitate does not form.
B. a precipitate of $(\text{NH}_4)_2\text{SO}_4$ forms.
C. a precipitate of CuCl_2 forms.
D. a precipitate of both $(\text{NH}_4)_2\text{SO}_4$ and CuCl_2

$\text{NH}_4\text{SO}_4 = \text{soluble}$
 $\text{CuCl}_2 = \text{soluble}$
($\text{CuCl} = \text{ppt}$)

B 7. Consider the following graph for a saturated Ag_2CO_3 solution:



What change occurred at time t_1 ?

- B. AgNO_3 was added.
A. Water was added.
C. Na_2CO_3 was added.
D. The temperature was increased

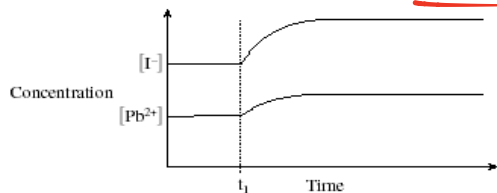
8. Explain your answer to the question above:

- $[\text{Ag}^+]$ spike means Ag^+ was added
↳ shift left, $\downarrow [\text{CO}_3^{2-}]$

B 9. From the list of salts below, how many are considered soluble at 25°C?

- B. zero
A. CuCl_2
B. CaSO_4
C. PbS
D. Ag_3PO_4

B 10. A saturated solution of PbI_2 was subjected to a stress and the following graph was obtained.

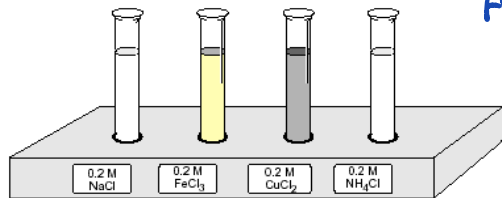


Which stress was applied at time t_1 ?

- A. the addition of PbI_2 C. an increase in volume
B. a temperature change D. the evaporation of water

(no spikes)

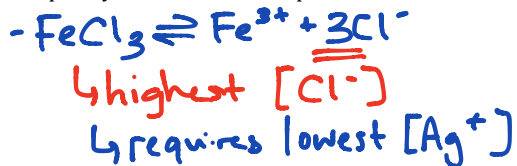
B 11. A dilute solution of $AgNO_3$ is added dropwise to each of the following test tubes until a precipitate forms in each tube.



Which solution requires the lowest $[Ag^+]$ to form a saturated solution?

- A. $NaCl$ C. $CuCl_2$
B. $FeCl_3$ D. NH_4Cl

12. Explain your answer to the question above:



D 13. Which of the following solutions would have $[Fe^{3+}] = 0.020M$?

- A. $0.050M Fe(NO_3)_3$
 B. $0.020M Fe_2(SO_4)_3$

- C. $0.040M FeC_6H_5O_7$
 D. $0.010M Fe_2(C_2O_4)_3$

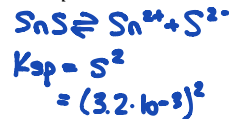


B 14. In a saturated solution, the rate of dissolving is:

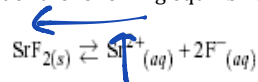
- A. Equal to zero
B. Equal to the rate of recrystallization
 C. Less than the rate of recrystallization
 D. Greater than the rate of recrystallization

A 15. The solubility of SnS is $3.2 \times 10^{-3} M$. The value of K_{sp} is:

- A.** 1.0×10^{-5} C. 6.4×10^{-3}
 B. 3.2×10^{-3} D. 5.7×10^{-2}



C 16. Consider the following equilibrium:



The equilibrium will shift left upon the addition of:

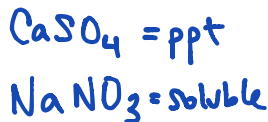
- A. H_2O **C.** $SrCl_2$
 B. KCl D. $NaNO_3$

17. Explain your answer to the question above:

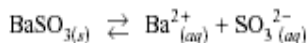
- Shift left achieved by $\uparrow [Sr^{2+}]$
 or $\uparrow [F^-]$

A 18. When equal volumes of calcium nitrate and sodium sulphate are combined,

- A. a precipitate of CaSO_4 could form
- B. a precipitate of NaNO_3 could form
- C. a precipitate of CaSO_4 or NaNO_3 could form
- D. no precipitate would form



B 19. Consider the following solubility equilibrium:



Which of the following will result in an increase of $[\text{Ba}^{2+}]$?

- A. adding water
- B. adding BaS
- C. adding BaSO_3
- D. adding Na_2SO_3

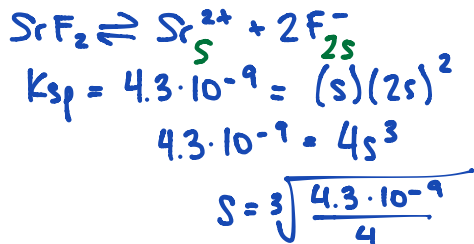
C 20. Which of the following will **not** produce a precipitate when equal volumes of solutions are combined?

- A. KOH and CaCl_2
- C. $\text{Sr}(\text{OH})_2$ and $(\text{NH}_4)_2\text{S}$
- B. $\text{Zn}(\text{NO}_3)_2$ and K_3PO_4
- D. Na_2SO_4 and $\text{Pb}(\text{NO}_3)_2$

C 21. The solubility of strontium fluoride is:

- A. $4.3 \times 10^{-9} \text{ M}$
- C. $1.0 \times 10^{-3} \text{ M}$
- B. $6.6 \times 10^{-5} \text{ M}$
- D. $1.6 \times 10^{-3} \text{ M}$

22. Show your calculation for the question above:



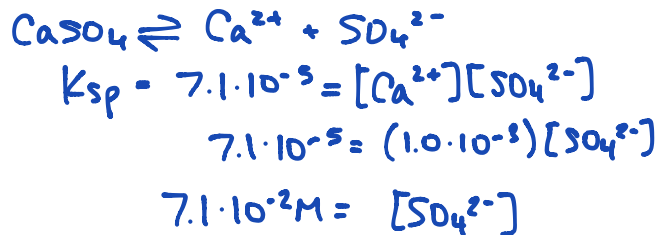
D 23. A solution contains two cations, each having a concentration of 0.20M . When an equal volume of 0.20M hydroxide ions are added, these cations are removed from the solution by precipitation. These ions are:

- A. Ba^{2+} and K^+
- B. Sr^{2+} and Na^+
- C. Mg^{2+} and Sr^{2+}
- D. Mg^{2+} and Ca^{2+}

D 24. The maximum $[\text{SO}_4^{2-}]$ that can exist in $1.0 \times 10^{-3}\text{M}$ $\text{Ca}(\text{NO}_3)_2$ without a precipitate forming is:

- A. $7.1 \times 10^{-5} \text{ M}$
- C. $8.4 \times 10^{-3} \text{ M}$
- B. $1.0 \times 10^{-3} \text{ M}$
- D. $7.1 \times 10^{-2} \text{ M}$

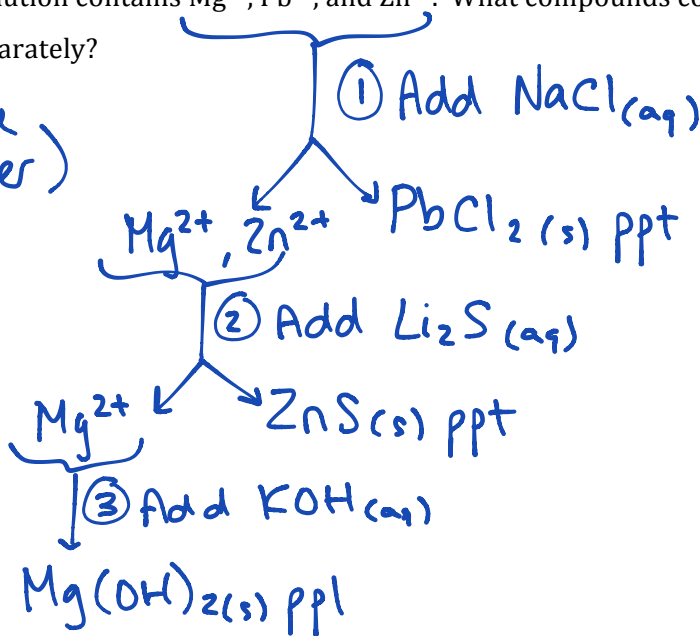
25. Show your calculation for the question above:



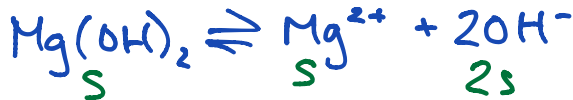
Problems:

1) A solution contains Mg^{2+} , Pb^{2+} , and Zn^{2+} . What compounds could be added, and in what order, to ppt. out each ion separately? (3 marks)

(Possible answer)



2) Milk of magnesia, which contains $Mg(OH)_2$, has a solubility of $7.05 \times 10^{-3} g/L$. Calculate the K_{sp} for magnesium hydroxide. (2 marks)



$$s = \frac{7.05 \cdot 10^{-3} g}{L} \times \frac{1 \text{ mol } Mg(OH)_2}{58.3 g} = 1.21 \cdot 10^{-4} M$$

$$K_{sp} = [Mg^{2+}][OH^-]^2 = (s)(2s)^2 = 4s^3$$
$$K_{sp} = 4(1.21 \cdot 10^{-4})^3 = \boxed{7.09 \cdot 10^{-12}}$$

3) What mass of Pb^{2+} is present in 5.0L of saturated $Pb(IO_3)_2$? (3 marks)



$$K_{sp} = 3.7 \cdot 10^{-13} = (s)(2s)^2$$
$$3.7 \cdot 10^{-13} = 4s^3$$

$$s = \sqrt[3]{\frac{3.7 \cdot 10^{-13}}{4}}$$
$$= 4.52 \cdot 10^{-5} = [Pb^{2+}]$$

$$\frac{4.52 \cdot 10^{-5} \text{ mol}}{L} \times \frac{5.0 L}{1} \times \frac{207.2 g Pb}{1 \text{ mol}} = \boxed{0.047 g Pb^{2+}}$$

4) Predict whether a ppt. form when 20.0mL of $5.0 \times 10^{-5}M$ $Ca(NO_3)_2$ is added to 35.0mL of $2.5 \times 10^{-4}M$ $Li_2C_2O_4$.



(4 marks)



$$C_1V_1 = C_2V_2$$

$$(5.0 \cdot 10^{-5})(20.0) = C_2(55.0)$$

$$C_2 = 1.8 \cdot 10^{-5}M$$



$$1.8 \cdot 10^{-5} \quad 1.8 \cdot 10^{-5}M$$

1:1



$$C_1V_1 = C_2V_2$$

$$(2.5 \cdot 10^{-4})(35.0) = C_2(55.0)$$

$$C_2 = 1.6 \cdot 10^{-4}M$$



$$1.6 \cdot 10^{-4} \quad 1.6 \cdot 10^{-4}M$$

1:1

$$\begin{aligned} TIP &= [Ca^{2+}][C_2O_4^{2-}] \\ &= (1.8 \cdot 10^{-5})(1.6 \cdot 10^{-4}) \\ &= 2.9 \cdot 10^{-9} \end{aligned}$$

$$K_{sp} = 2.3 \cdot 10^{-9}$$

TIP > K_{sp}
∴ ppt will form

5) A saturated solution of silver bromate is prepared by adding 5.00g of silver nitrate to a $2.5 \times 10^{-2}M$ solution

$NaBrO_3(aq)$. What is the maximum volume of solution produced? (5 marks)



$$2.5 \cdot 10^{-2}M$$

$$2.5 \cdot 10^{-2}M$$

1:1

$$K_{sp} = 5.3 \cdot 10^{-5} = [Ag^+][BrO_3^-]$$

$$5.3 \cdot 10^{-5} = [Ag^+](2.5 \cdot 10^{-2})$$

$$2.1 \cdot 10^{-3}M = [Ag^+]$$



$$2.1 \cdot 10^{-3}M \quad 2.1 \cdot 10^{-3}M$$

$$5.00g \cancel{AgNO_3} \times \frac{1 \cancel{mol}}{169.9g \cancel{AgNO_3}} \times \frac{1L}{2.1 \cdot 10^{-3}mol} = 14L$$