

Solubility product determination assignment



Solubility Product Determination Purpose ??? To determine the solubility product constant, K_{sp} , of an ionic compound. Introduction The solubility product constant, K_{sp} , is a particular type of equilibrium constant. The equilibrium is formed when an ionic solid dissolves in water to form a saturated solution. The equilibrium exists between the aqueous ions and the undissolved solid. A saturated solution contains the maximum concentration of ions of the substance that can dissolve at the solution's temperature. The equilibrium equation showing the ionic solid lead chloride dissolving in water is:

$PbCl_2(s) \rightleftharpoons Pb^{2+}(aq) + 2Cl^{-}(aq)$ The solubility product expression is: $K_{sp} = [Pb^{2+}][Cl^{-}]^2$ A knowledge of the K_{sp} of a salt is useful, since it allows us to determine the concentration of ions of the compound in a saturated solution. This allows us to control a solution so that precipitation of a compound will not occur, or to find the concentration needed to cause a precipitate to form. This experiment will determine the solubility product constant for the strong base, calcium hydroxide, $Ca(OH)_2$. A microscale technique will be used so care must be made to accurately deliver and count drops.

Hold pipets vertically and be sure there are no air bubbles in the capillary tubes. Procedure Part I K_{sp} by dilution of calcium ions 1. Arrange the 96-well microplate so that you have 12 wells across from left to right. Put 5 drops of 0.10 M calcium nitrate in well #1 in the first row. 2. Place 5 drops of water in each of the wells #2 through #12 in the first row. 3. Add 5 drops of 0.10 M calcium nitrate to well #2. Use an empty Beral pipet to mix the solution thoroughly by drawing the solution into the pipet and then squirting it back several times. 4.

Use the empty pipet to remove the solution from well #2 and put 5 drops of this solution into well #3. Put the remaining solution back in well #2. Mix the solution in well #3 as before. 5. Continue this serial dilution procedure, adding 5 drops of the previous solution to the 5 drops of water in each well down the row until you fill the last one, #12. Mix the solution in well #12 and discard 5 drops. 6. Place 5 drops of 0.10 M sodium hydroxide in each of the wells #1 through #12. Stir thoroughly with a toothpick. 7. Allow three or four minutes for the precipitates to form.

Observe the pattern of precipitation. Record. Part II K_{sp} by dilution of hydroxide ions. 1. Repeat the procedure in Part I, but use a serial dilution of NaOH followed by 5 drops of calcium nitrate in each well. Data Analysis Part I 1. Determine the concentration of the calcium ion in each well after the serial dilution but before the sodium hydroxide has been added. 2. Determine the concentration of the calcium ion in each well after the sodium hydroxide has been added. 3. Determine the concentration of the hydroxide ion in each well. 4.

Assume that the first well with no precipitate contains a saturated solution. Calculate the solubility product of calcium hydroxide using the concentrations in this well. Part II 1. Determine the concentration of the hydroxide ion in each well after the serial dilution but before the calcium nitrate has been added. 2. Determine the concentration of the hydroxide ion in each well after the calcium nitrate has been added. 3. Determine the concentration of the calcium ion in each well. 3. Again calculate the solubility product of calcium hydroxide using the concentrations in the first well that has no precipitate. . Average the two values of K_{sp} determined in Parts I and <https://assignbuster.com/solubility-product-determination-assignment/>

II. 5. Look up the accepted value for the K_{sp} of calcium hydroxide and

calculate percent error. Data and Results Part I | Well # | $[Ca^{2+}]$ | $[Ca^{2+}]$ |

$[OH^-]$ | Precipitate? | | before NaOH | after NaOH | | 1 | | | | | | | | | | 3 | | |

| | 4 | | | | | 5 | | | | | 6 | | | | | 7 | | | | | 8 | | | | | 9 | | | | | 10 | | | | | 11 | | | |

| | 12 | | | | | Part II | Well # | $[OH^-]$ | $[OH^-]$ | $[Ca^{2+}]$ | Precipitate? | | before

$Ca(NO_3)_2$ | after $Ca(NO_3)_2$ | | | | | | 2 | | | | | 3 | | | | | 4 | | | | | 5 | | | | |

6 | | | | | 7 | | | | | 8 | | | | | 9 | | | | | 10 | | | | | 11 | | | | | 12 | | | | |

Part I K_{sp} of $Ca(OH)_2$ _____ Part II K_{sp} of

$Ca(OH)_2$ _____ Average K_{sp}

_____ Percent error _____

Questions 1. Why was the first well with no precipitate used to calculate the solubility product? Would it be better to use the first cell with a precipitate?

Would it be better to use an average of the two cells? Explain your

reasoning. 2. Calculate the K_{sp} the two ways suggested in question 2. Were the results better?