

## Mixing Problems Worksheet

For example, in order to precipitate barium sulfate from a solution of barium chloride at a concentration of 0.50 M the precipitation is done by adding sulfuric acid in small amounts to the solution. **SKETCH** the beakers separately and their contents.

Initially, no precipitation occurs because the small amount of  $\text{SO}_4^{2-}$  is insufficient to make the Ion Product or  $K_{\text{trial}} = [\text{Ba}^{2+}][\text{SO}_4^{2-}]$  equal to the Solubility Product  $K_{\text{sp}}$ .

When we have added a sufficient amount of sulfuric acid so that the ion product exceeds solubility product the barium sulfate would precipitate.

- 1) The concentration of  $\text{Ca}^{2+}$  ions in blood is 0.0025 M.

If an oxalate solution,  $\text{C}_2\text{O}_4^{2-}(\text{aq})$ , with oxalate ion concentration of  $1.0 \times 10^{-7}$  M is added is added to it, does a ppt occur? The  $K_{\text{sp}}$  of calcium oxalate is  $2.3 \times 10^{-9}$ .

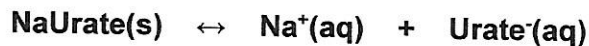
**SKETCH**

- 2) A solution is prepared by mixing equal volumes of 0.010 M  $\text{MgCl}_2$  and 0.020 M  $\text{MgC}_2\text{O}_4$  at 18.0 °C. **SKETCH**

Would  $\text{MgC}_2\text{O}_4$  precipitate out?  $K_{\text{sp}}$  magnesium oxalate is  $8.57 \times 10^{-5}$ .

- 3) The digestion of some foods, such as red meat, releases urate ion  $\text{C}_5\text{H}_3\text{N}_4\text{O}_3^-$  (NaUrate) into the blood stream. An excess of urate in the blood can result in the formation of sodium urate crystals in joints and tissues. This leads to a painful form of arthritis known as gout. (This is the one of the only sodium salts that is insoluble-- another exception in chemistry! It has a  $K_{\text{sp}}$  of  $2.0 \times 10^{-5}$ .)

The equilibrium involved in the process is:



Use Le Chatelier's Principle to explain why eliminating red meat from your diet can reduce the build-up of sodium urate in your joints.

- 4) Gout can be caused by an inborn error of nucleic acid metabolism (The majority of these diseases are due to defects of single genes that code for enzymes that facilitate conversion of various substances (substrates) into others (products).) that leads to a build-up of uric acid in bodily fluids, which is deposited as insoluble sodium urate in the soft tissues of joints.

If the extracellular  $[\text{Na}^+]$  is 0.16 M and the solubility of in water of sodium urate is 0.066 g/100 mL, what is the minimum urate ion concentration (abbreviated  $[\text{Ur}^-]$ ) that will cause a deposit of sodium urate?

- 5) Urine is a complex mixture of many salts in solution. When the concentrations of the ions that comprise these salts rises above their solubility product the urine contains too high a concentration and salt crystals e.g. calcium oxalate precipitate out. These precipitated crystals accumulate to form stones.

Although very small renal stones can pass unnoticed as "gravel" in urine, the passage of larger stones and even movement of stones within the urinary tract is the cause of the most excruciating pain a person is ever likely to experience. Such pain has afflicted humans since antiquity, as evidence of renal stone disease has been found in an Egyptian mummy dating from 7000 BCE.

Write the equation for the equilibrium of calcium oxalate in water:

---

Given the  $K_{sp}$  of calcium oxalate is  $2.7 \times 10^{-9}$  will a ppt (stone) form if 50.0 mL of 0.0050 M calcium chloride is mixed with 75.0 mL of  $4.2 \times 10^{-5}$  M sodium oxalate?

- 6) Barium sulfate is used in medical imaging of the gastrointestinal tract because it is opaque to X-rays. A barium sulfate solution sometimes called a cocktail, is ingested by the patient, whose stomach and intestines can then be visualized via X-ray imaging. If a patient ingests 320. mL of a saturated barium sulfate solution, how much toxic  $\text{Ba}^{2+}$  ion has the patient consumed?
- 7) There was data that suggested zinc lozenges can shorten the duration of a cold (this was a question from 1996). If the solubility of zinc acetate is 43.0 g/L what is the solubility product,  $K_{sp}$ , of this compound?