8. Collect another 5 mL of the filtrate in step 5 into a test tube and test with $Ba(NO_3)_{2(aq)}$.
9. Repeat the experiment again if time and supplies permit.

Analysis

(e) A white precipitate formed by mixing solutions of $CaCl_{2(aq)}$ and $Na_2SO_{4(aq)}$. White precipitates formed in both diagnostic tests of the filtrate. The same evidence was obtained when the experiment was repeated.

(f) According to the net ionic equation, $Ca^{2+}_{(aq)}$ and $SO_{4(aq)}^{2-}$ combine in a 1:1 ratio. It is logical to assume that if an excess of $Ca^{2+}_{(aq)}$, for example, is used, then $SO_{4(aq)}^{2-}$ should be totally consumed by the reaction. However, a white precipitate of $BaSO_{4(s)}$ was observed in all samples.

Evaluation

(g) The Experimental Design (combining precipitation with diagnostic tests for excess ions) is adequate since clear evidence was obtained to answer the question. Because the experiment required little time, it was repeated. To make the testing complete, at least one diagnostic test for one ion from each reactant is performed. Testing for sodium and chloride ions is not appropriate since these ions are expected to be in the filtrate regardless of the quantitative nature of the reaction.

　　The prediction is falsified since the evidence indicates the presence of both reactants after the reaction was completed. The assumption of a quantitative reaction is judged to be unacceptable for this reaction.

(h) One improvement to the Experimental Design would be to assess the purity of the reagents. An impurity could have caused the unexpected positive diagnostic tests. Furthermore, the precipitate did not form immediately. Perhaps a pair of chemicals that do precipitate immediately would be a more appropriate test of the question.

(i) The use of the terms "limiting" and "excess reagents" does not seem appropriate since $Ca^{2+}_{(aq)}$ and $SO_{4(aq)}^{2-}$ were detected in all samples.

LAB EXERCISE 7.2.1 DEVELOP AN EQUILIBRIUM LAW

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Analysis

(a) The only relationship that gives a constant is #3.

Relationship	Trial 1	Trial 2	Trial 3	Trial 4	Trial 5
1. $[Fe^{3+}_{(aq)}][SCN^-_{(aq)}][FeSCN^{2+}_{(aq)}]$	2.89×10^{-11}	2.34×10^{-9}			
2. $[Fe^{3+}_{(aq)}] + [SCN^-_{(aq)}] + [FeSCN^{2+}_{(aq)}]$	4.01×10^{-2}	1.58×10^{-2}	6.37×10^{-2}		
3. $\dfrac{[FeSCN^{2+}_{(aq)}]}{[Fe^{3+}_{(aq)}][SCN^-_{(aq)}]}$	294	293	288	306	296
4. $\dfrac{[Fe^{3+}_{(aq)}]}{[FeSCN^{2+}_{(aq)}]}$	42.4	17.9	9.23		
5. $\dfrac{[SCN^-_{(aq)}]}{[FeSCN^{2+}_{(aq)}]}$	0.0870	0.231	0.555	1.52	

(b) This relationship is the concentration of the reaction product divided by the concentrations of the reactants multiplied together.

INVESTIGATION 7.3.1 TESTING LE CHÂTELIER'S PRINCIPLE

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Predictions

(a)　I.　According to Le Châtelier's principle,
　　　　(a) placing the flasks into a cold-water mixture will shift the equilibrium to the left.
　　　　(b) placing the flasks into a hot-water mixture will shift the equilibrium to the right.
　　II.　According to Le Châtelier's principle, an increase in pressure will shift the equilibrium to the left.
　　III.　According to Le Châtelier's principle,
　　　　(a) adding water will shift the equilibrium to the right.
　　　　(b) adding saturated silver nitrate will shift the equilibrium to the right.