

Problem Set #3
CHEM101A: General College Chemistry

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1 Topic B Problem 13

For each of the mixtures below, do the following:

- 1) Identify the actual species that are present in the mixture (before any reaction occurs).
- 2) Write the formula of any product that forms. If no product will form, write “no reaction” and skip Step 3.
- 3) Write the net ionic equation for the reaction that occurs, including the state of each substance (s, l, g, or aq).

Example: Mixing 0.1 M NaCl and 0.1 M Pb(NO₃)₂ (a) The actual species are Na⁺, Cl⁻, Pb²⁺, and NO₃⁻ (b) PbCl₂ will form (because it is insoluble in water) (c) The net ionic equation is Pb²⁺ (aq) + 2 Cl⁻ (aq) → PbCl₂ (s)

- a) Mixing 0.1 M MgCl₂ and 0.1 M Na₃PO₄
- b) Mixing 0.1 M HNO₃ and 0.1 M NaOH
- c) Mixing 0.1 M Fe(NO₃)₃ and 0.1 M KOH
- d) Mixing 0.1 M ZnBr₂ and 0.1 M CuSO₄
- e) Mixing 0.1 M HCl and 0.1 M NaHCO₃
- f) Mixing 0.1 M AgNO₃ and 0.1 M K₂CO₃
- g) Mixing 0.1 M Ba(OH)₂ and 0.1 M Na₂SO₄
- h) Mixing 0.1 M HC₂H₃O₂ and 0.1 M Ba(OH)₂
- i) Mixing 0.1 M HC₆H₅O and 0.1 M NaOH
- j) Mixing 0.1 M H₂C₄H₄O₄ (succinic acid) and excess 0.1 M NaOH. (Hint: You should write two equations for this.)

1.1 Solution

2 Topic B Problem 14

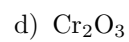
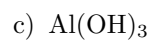
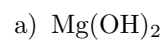
Write balanced net ionic equations that explain the following observations.

- a) When solutions of BaCl_2 and K_2CrO_4 are mixed, a bright yellow precipitate forms.
- b) When solutions of $\text{NaC}_2\text{H}_3\text{O}_2$ and $\text{Ca}(\text{NO}_3)_2$ are mixed, a white precipitate forms.

2.1 Solution

3 Topic B Problem 15

Write the net ionic equation for the reaction that occurs when each of the following insoluble compounds is mixed with excess 6 M HCl. Be sure to include the state of each substance.



3.1 Solution

4 Topic B Problem 16

If you put some solid CaCO_3 into a beaker of water and slowly add HCl solution, stirring vigorously the whole time, the CaCO_3 gradually dissolves. As the last of the CaCO_3 dissolves, bubbles begin to form, and if you continue to add HCl , you observe steady bubble formation.

- a) Write a net ionic equation that shows why the CaCO_3 dissolves.
- b) Write a net ionic equation that shows why the mixture bubbles.

4.1 Solution

5 Topic B Problem 17

Both MgO and PbO are insoluble in water. When solid MgO is added to 3 M H_2SO_4 , the solid dissolves completely. When solid PbO is added to 3 M H_2SO_4 , the solid changes color slightly, but does not dissolve. Explain this difference.

5.1 Solution

6 Topic B Problem 18

A solution contains one or more of the following anions: I^- , PO_4^{3-} , and NO_3^- . A chemist carries out the following experiments on this solution:

- Experiment 1: The chemist adds 0.1 M $\text{Ba}(\text{NO}_3)_2$ to a small portion of this solution, and no precipitate forms.
- Experiment 2: The chemist adds 0.1 M AgNO_3 to the solution from Experiment 1, and a precipitate forms.

Based on these results, tell which anions are definitely present in the original solution, which anions are definitely absent from the original solution, and which anions cannot be determined from the information given here. Explain your answer.

6.1 Solution

7 Topic B Problem 19

Complete the following ICE table:

mol	$3\text{Ca}^{2+} + 3\text{PO}_4^{3-} \rightarrow \text{Ca}_3(\text{PO}_4)_2$		
I	0.0685	0.0505	0
C			
E			

7.1 Solution

8 Topic B Problem 20

Complete the following ICE table, assuming Ca^{2+} is the limiting reactant:

mol	$3\text{Ca}^{2+} + 3\text{PO}_4^{3-} \rightarrow \text{Ca}_3(\text{PO}_4)_2$		
I	x	y	0
C			
E			

8.1 Solution

9 Topic B Problem 21

Repeat Problem 20, but now assume that PO_4^{3-} is the limiting reactant.

9.1 Solution

10 Topic B Problem 22

A chemist prepares a mixture that contains 0.0200 mol of CuCl_2 and 0.0300 mol of KOH dissolved in water.

- Write the balanced net ionic equation for the reaction that occurs.
- What are the spectator ions in this reaction?
- What is the limiting reactant in this reaction? (Hint: it's an ion.)
- Construct an ICE table for this reaction, using the net ionic equation.

10.1 Solution

11 Topic B Problem 23

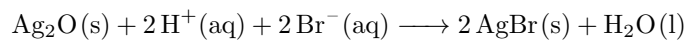
A chemist mixes 5.00 mL of 0.240 M KI with 4.00 mL of 0.200 M $\text{Pb}(\text{NO}_3)_2$.

- Write the balanced net ionic equation for the reaction that occurs.
- Construct an ICE table for this reaction, using the net ionic equation.
- What mass of solid product is formed?
- What is the concentration of the excess reactant in the final mixture?
- What is the concentration of nitrate ions in the final mixture?

11.1 Solution

12 Topic B Problem 24

A chemist adds 1.35 g of solid Ag_2O to 25.0 mL of 2.00 M HBr , causing this reaction:



- a) What mass of solid AgBr is formed?
- b) What is the concentration of H^+ ions in the final mixture? (You may assume that the final solution volume is 25.0 mL.)

12.1 Solution

13 Topic B Problem 25

You have 50.0 mL of a 0.138 M $\text{Ba}(\text{NO}_3)_2$ solution. What is the minimum volume of 0.131 M Na_3PO_4 solution that you must add in order to remove all of the barium ions from the solution?

13.1 Solution

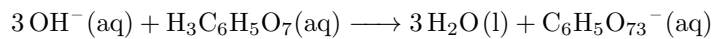
14 Topic B Problem 26

A solution contains an unknown concentration of sulfate ions. When 20.00 mL of this solution is mixed with excess aqueous $\text{Ba}(\text{NO}_3)_2$, 0.877 g of BaSO_4 is formed. Calculate the molarity of sulfate ions in the original solution.

14.1 Solution

15 Topic B Problem 27

A solution contains an unknown concentration of citric acid, $\text{H}_3\text{C}_6\text{H}_5\text{O}_7$. A 15.73 mL portion of this solution is placed in a flask and titrated with 0.321 M NaOH. The endpoint is reached when 23.44 mL of the NaOH solution has been added. Calculate the molarity of the original citric acid solution. The net ionic equation for the reaction that occurs is:



15.1 Solution

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