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SOLUTION STOICHIOMETRY

Recall: Stoichiometric problems involve the following steps …

1.

2. a)

   b)

3.

4.

As one can see, the only difference is in step 2, where instead of mass data, a solution question will have givens in molarities and volumes.

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Ex: *Aqueous magnesium chloride will react with aqueous silver nitrate in a double displacement reaction. You are given 60 mL of 0.3 M silver nitrate. What volume of 0.25 M magnesium chloride does one need to completely react with the silver nitrate?*

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Ex: *Suppose that 25 mL of 0.085 M aqueous sodium sulfide is added to 56.5 mL of 0.10 M mercury(II)nitrate. What mass of mercury(II)sulfide precipitates. (**Limiting Reagent**)*

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Ex: *Silver chromate, Ag_2CrO_4, is insoluble. Calculate the mass of silver chromate that forms when 50.0 mL of 0.100 M silver nitrate reacts with 25.0 mL of 0.150 M sodium chromate. If the percent yield for this reaction is 91%, what is the actual yield?*

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Practice Problems

11. If 8.5 g of pure ammonium phosphate, $(NH_4)_3PO_4(s)$, is dissolved in distilled water to make 400 mL of solution, what are the concentrations (in moles per litre) of the ions in the solution?

12. A strip of zinc metal was placed in a beaker that contained 120 mL of a solution of copper(II) nitrate, $Cu(NO_3)_2(aq)$. The mass of the copper produced was 0.813 g. Find the initial concentration of the solution of copper(II) nitrate.

13. When 75.0 mL of silver nitrate, $AgNO_3(aq)$, was treated with excess ammonium carbonate, $(NH_4)_2CO_3(aq)$, 2.47 g of dry precipitate was recovered. Write the net ionic equation for the reaction, and calculate the concentration of the original silver nitrate solution.

14. When an excess of sodium sulfide, $Na_2S(aq)$, was added to 125 mL of 0.100 mol/L iron(II) nitrate, $Fe(NO_3)_2(aq)$, a black precipitate formed. Identify the precipitate, and calculate the maximum mass of precipitate that can be collected from the reaction.

15. What mass of silver chloride, $AgCl(s)$, can be precipitated from 75 mL of 0.25 mol/L silver nitrate, $AgNO_3(aq)$, by adding excess magnesium chloride, $MgCl_2(aq)$?

16. What mass of bromine gas can be collected by bubbling excess chlorine gas through 850 mL of a 0.350 mol/L solution of sodium bromide, $NaBr(aq)$?

17. What mass of strontium carbonate, $SrCO_3(s)$, can be precipitated from 50.0 mL of 0.165 mol/L strontium nitrate, $Sr(NO_3)_2(aq)$, by adding excess sodium carbonate, $NaCO_3(aq)$?

18. Before it was banned in the 1970s due to its non-selective toxicity, thallium(I) sulfate, $Tl_2SO_4(s)$, was the active ingredient in some pesticides. A chemist measured 100.0 mL of a solution of thallium(I) sulfate and added excess aqueous potassium iodide to precipitate yellow thallium(I) iodide, $TlI(s)$. The mass of the dry precipitate was 2.45 g. Find the molar concentration of the thallium(I) sulfate solution.

19. A sample of a substance known to contain chloride ions was dissolved in distilled water in a 1 L volumetric flask. Then 25.00 mL of this solution was treated with excess silver nitrate, $AgNO_3(aq)$. The precipitate of silver chloride, $AgCl(s)$, was filtered and dried. The mass of the dry precipitate was 0.765 g.
  a. Calculate the concentration of chloride ions.
  b. If the original substance was sodium chloride, $NaCl(s)$, what mass of it was dissolved in the volumetric flask?

20. Food manufacturers sometimes add calcium acetate, $Ca(CH_3COO)_2(s)$, to sauces as a thickening agent. When analyzed, a 250 mL solution of calcium acetate was found to contain 0.200 mol of acetate ions.
  a. Find the molar concentration of the calcium acetate solution.
  b. What mass of calcium acetate was dissolved to make the solution?

11. $NH_4^+(aq) = 0.4$ mol/L; $PO_4^{3-}(aq) = 0.1$ mol/L
12. 0.11 mol/L
13. $2Ag^+(aq) + CO_3^{2-}(aq) \rightarrow Ag_2CO_3(s)$; 0.239 mol/L
14. 1.10 g FeS(s)
15. 2.7 g
16. 24 g
17. 1.22 g
18. 0.0370 mol/L
19. a. 0.214 mol/L
  b. 12.5 g
20. a. 0.40 mol/L
  b. 16 g