Answer on Question #63387 - Chemistry - General Chemistry

Question:

Part 1) A solution containing 240 g of silver nitrate is combined with a solution containing 200 g of sodium chloride. predict the reaction and provide a balance equation and net ionic equation?

Part 2) If a chemist filters the resulting mixture described above and collects 150 g sample of precipitate, what is her % yield.

(SOLVE USING STOICHIOMETRY)

Solution:

1) We know that the silver chloride is insoluble in water, so it will form the precipitate. The balanced equation will look like this:
   $NaCl(aq) + AgNO_3(aq) = AgCl(s) + NaNO_3(aq)$
   The net ionic equation includes only reacting species. In our case Na^+ and NO_3^- ions remain unchanged in solution. So the net ionic equation will look like this:
   $Cl^-(aq) + Ag^+(aq) \rightarrow AgCl(s)$

2) From the balanced equation we can see that silver nitrate and sodium chloride react in ratio 1 mol to 1 mol and give 1 mol of silver chloride. Convert to mass units: Molar mass $M(AgNO_3) = 108 + 14 + 16*3 = 170$ g/mol; $M(NaCl) = 23 + 35 = 58$ g/mol; $M(AgCl) = 108 + 35 = 143$ g/mol.
   So 170 g of silver nitrate reacts with 58 g of sodium chloride giving 143 g of silver chloride. In case of non-stoichiometric amount of reactants the product amount is defined by the component which is in shortage. It is pretty obvious from the task that silver nitrate is in shortage, but let's check:
   If 58 g of sodium chloride requires 170 g of silver nitrate, than 200 g of sodium chloride would require (200 * 170) / 58 = 586 g of silver nitrate, but we have only 240 g of it. Yes, silver nitrate is in shortage.
   The % yield of reaction is actual mass of product / theoretical mass of product) * 100%.
   170 g of silver nitrate give 143 g of silver chloride, so 240 of silver nitrate theoretically would give (240* 143) / 170 = 202 g of silver chloride. The actual mass of silver chloride is 150 g.
   So the % yield is (150 g / 202 g) *100% = 74%.

Answer:

1) The balanced equation:
   $NaCl(aq) + AgNO_3(aq) = AgCl(s) + NaNO_3(aq)$.
   The net ionic equation:
   $Cl^-(aq) + Ag^+(aq) \rightarrow AgCl(s)$.

2) The % yield is 74%.