Chemical reaction stoichiometry

ASSIGN BUSTER

The objectives of this experiment is to establish and determine the stoichiometry of the precipitation chemical reaction involving calcium nitrate ($Ca(NO_3)_2$) and sodium phosphate (Na_3PO_4) as the reactants that will form the precipitate calcium phosphate ($Ca_3(PO_4)_2$) at the end. The experiment will also determine any physical and chemical changes such as electrical conductivity and temperature that occur in the precipitation of calcium phosphate in an aqueous solution of sodium nitrate ($NaNO_3$). The corresponding volumes and quantities of both reactants and product will also be determined for the purpose of investigating any proportionality and reaction ratios.

Stoichiometry, as we all know, is a branch of chemistry that studies relative quantities of reactants and products (Kotz, Treichel and Townsend, 2011). This branch of chemistry is playing an important role in investigating and determining all the ions (active and spectator) that are involved in a particular chemical reaction (Ebbing and Gammond 2010). For this reason, stoichiometry could determine the proportion and quantity of products and reactants in a particular stoichiometric mixture (calcium phosphate, calcium nitrate) and sodium phosphate with high precision.

Nevertheless, the amount of calcium phosphate (precipitate) formed from this reaction is dependent on the limiting reagent whose reacting molecules are less in number or concentration from the mixture (Ebbing and Gammond 2010). In our experiment, calcium nitrate is the limiting reagent because only 60 ml of 0. 100 M $Ca(NO_3)_2$ therefore it is the only determinant of the amount of product (calcium phosphate) being produced from the

stoichiometric reaction whose unbalanced and balanced equations (1a and 1b) are given below.

Equation 1a: unbalanced equation

Ca(NO3)2 (aq) + &bsp; (Na3PO4)(aq) Ca3(PO4)2 (s) + NaNO3 (aq)

Calcium Nitrate Sodium Phosphate Calcium Phosphate Sodium Nitrate

Equation 1b: balanced equation

3 Ca(NO3)2 (aq) + 2(Na3PO4)(aq) Ca3(PO4)2 (s) + 6NaNO3 (aq)

Calcium Nitrate Sodium Phosphate Calcium Phosphate Sodium Nitrate

Ratio: 3 : 2 1 & : 6

The stoichiometric ration or stoichiometric amount ratio of the above reaction involving (Na3PO4) and Calcium Nitrate [Ca(NO3)2] to precipitate calcium phosphate in an aqueous solution in a sodium nitrate (NaNO3) could be determined only if all particles or ion in the stoichiometric mixture are used up during the reaction. The stoichiometry is based on the principles of the conservation law of mass as observed by Kotz, Treichel and Townsend (2011).

The following apparatus and reagents were required for the purposes of this experiment:

i) 250ml beaker and graduated measuring cylinders.

ii) Calibrator and conductance cell

iii) 60 ml of 0. 100M Na3PO4 (Sodium Phosphate)

iv) 1 liter of 0. 100M NaNO3 (Sodium Nitrate)

v) 250ml Pipette

vi) Retort Stand and clump

vii) Mercury bulb thermometer.

2. 2 Experimental Procedure

a) 60 ml of 0. 100M of Calcium Nitrate solution was stirred in a beaker and then titrated with 0. 100M solution of Sodium Phosphate. The titration of the calcium nitrate with excess sodium phosphate was done at intervals until no further could be observed from the mixture.

b) Temperature of the resultant stoichiometric mixture was measured and recorded at regular time intervals until no further heat change was noticed.

c) The conductivity cell against the 0. 120 M standard solution of sodium nitrate was calibrated at 11, 600uS cm-1. Changes in the electrical conductivity of the titrated solution was gauged and recorded by the use of conductance cell.