Answer on Question #70636- Chemistry – General Chemistry

Question: Theoretically, in a single replacement reaction using 5.000 grams of copper (II) nitrate trihydrate [Cu(NO3)2 · 3 H2O], which has a molar mass of 241.6 g /mole, how much copper [At. Wt. = 63.55 g/mole] in grams would be obtained?

Solution: A single replacement reaction is a reaction in which one element is substituted for another element in a compound. The starting materials are always pure elements plus an aqueous compound. When a replacement reaction occurs, a new aqueous compound and a different pure element will be generated as products. In general, elements that form anions can replace the anion in a compound, and elements that form cations can replace the cation in a compound. The general pattern of a single replacement reaction for $Cu(NO_3)_2$ is shown below:
$Cu(NO_3)_2+Me \rightarrow Cu+MeNO_3$
Only pure salt enters the exchange reaction, so first of all you need to determine the mass of salt without crystallization water.
Mr ($Cu(NO_3)_2 \cdot 3H_2O$) = 241.6 g /mole
Mr ($Cu(NO_3)_2$) = Mr ($Cu(NO_3)_2 \cdot 3H_2O$) – Mr (H_2O) = 241.6 g /mole – (3· 18 g /mole) = 187.6 g /mole
Then solving simple proportion:
Mr ($Cu(NO_3)_2 \cdot 3H_2O$) – m ($Cu(NO_3)_2 \cdot 3H_2O$
Mr ($Cu(NO_3)_2$)- m ($Cu(NO_3)_2$
i.e.
241.6 g /mole – 5.000 g
187.6 g /mole – x g
x = 3.882 g
n ($Cu(NO_3)_2$)= m ($Cu(NO_3)_2$ / Mr ($Cu(NO_3)_2$) = 3.882 g / 187.6 g/mole = 0.0207 mole
n (Cu) = n ($Cu(NO_3)_2$)= 0.0207 mole for single replacement reaction, and
m (Cu) = n (Cu) · At. Wt. (Cu) = 0.0207 mole · 63.55 g/mole = 1.315485 gram

Answer: would be obtained **1.315** gram of copper