**Quantitative Study of a Reaction: Copper & Silver Nitrate**

* **Question:** How does the law of conservation of mass relate to writing and balancing chemical equations?

**Data Table**

*(Copy into your lab notebook before lab day.)*

|  |  |
| --- | --- |
|  | Mass (g) |
| empty beaker |  |
| beaker with silver nitrate, AgNO3 |  |
| copper (before reaction) |  |
| copper (after reaction) |  |
| beaker with silver crystals |  |

* **Safety:** Goggles, gloves and aprons are required. Be careful with the silver nitrate. Silver nitrate is caustic and will burn your skin. After cleaning up your lab station including sponging your entire lab bench, wash your hands before leaving the lab.
* **Procedure*:****(🗹 each of the steps as you complete them.)*

Day One

* 1. Label your beaker with your name, your partner’s name and class period.
* 2. Using your lab balance, measure the mass of your beaker. Record the mass on your data table.
* 3. Into your beaker, add all of your silver nitrate, AgNO3.
* 4. Using your lab balance, measure the mass of your beaker with the silver nitrate. Record this mass on your data table.
* 5. Fill the beaker about ¾ full with distilled water and then using a glass stirring rod, stir to dissolve the silver nitrate.
* 6. If your piece of copper wire is not already coiled, wrap your copper wire around a pencil to coil.
* 7. Using your lab balance, measure the mass of just your copper wire. Record the mass of your data table.
* 8. Place the copper wire into your beaker containing the silver nitrate solution and then store overnight in the area indicated by your teacher.

Day Two

* 1. Lift the copper wire and shake into the beaker any residue which has formed. Rinse any remaining residue from the copper coil into your beaker with distilled water from a wash bottle.
* 2. Dip the rinsed copper coil into a beaker of acetone supplied by your teacher. Place the wire on a paper towel to dry. When dry, measure and record the mass of the wire.
* 3. Obtain another beaker – this is your waste beaker. Decant the liquid from your beaker into the waste beaker. Your goal is to have your beaker emptied of as much liquid as possible without sacrificing any of the silver crystals.
* 4. To the crystals in your beaker, add 4mL of silver nitrate solution (to react with any remaining particles of copper). Stir *gently* – try to keep the silver crystals as whole and large as possible*.*
* 5. Stop stirring and let the crystals settle. Decant the liquid into your waste beaker.
* 6. Rinse your crystals by adding 10mL of distilled water to your beaker, stirring gently and then decanting the liquid into your waste beaker.
* 7. Add 10mL of distilled water again and to this, add a drop of ammonia (NH3) (Go to the fume hood with your beaker.)
* 8. Did the liquid turn bright blue?

No: The **lack** of blue color shows that all the copper has been removed and so you can decant the liquid into your waste beaker and then place your beaker in the drying oven

Yes: If blue is **noticeable**, repeat steps #4 – 8.

* 9. Pour the liquid in the waste beaker down the sink and rinse the beaker.

Day Three

* 1. Measure and record the mass of your beaker with the silver crystals. Return beaker to your teacher.
* 2. Observe the crystals under the stereomicroscope.
* **Calculations:**

1. **Mass of (reacted) copper**

Subtract the mass of the copper wire *after* the reaction from the mass of the copper wire *before* the reaction.

*Mass of copper wire before reaction – Mass of copper wire after reaction = Mass of reacted copper*

1. **Moles of (reacted) copper**

Divide the mass of the reacted copper by the atomic mass of copper.

*Mass of (reacted) copper / Atomic mass of copper (from periodic table) = Moles of reacted copper*

1. **Mass of silver nitrate**

Subtract the mass of the empty beaker from the mass of the beaker *with* the silver nitrate.

*Mass of the beaker with the silver nitrate – Mass of empty beaker = Mass of silver nitrate*

1. **Molar mass of silver nitrate**

Using the periodic table, calculate the molar mass of silver nitrate.

1. **Moles of silver nitrate**

Divide the mass of the silver nitrate by the molar mass of silver nitrate.

*Mass of silver nitrate ÷ Molar mass of silver nitrate = Moles of silver nitrate*

1. **Mass of silver**

Subtract the mass of the empty beaker from the mass of the beaker with the silver crystals.

*Mass of the beaker with the silver crystals – Mass of empty beaker = Mass of silver*

1. **Moles of silver**

Divide the mass of the silver by the atomic mass of silver

*Mass of the silver ÷ Atomic mass of silver (from periodic table) = Moles of silver*

1. **Coefficients**
2. Write the ratio of moles of Cu : moles of AgNO3 : moles of Ag
3. Reduce the ratio of moles to the lowest whole number by dividing all three by the smallest of the three. These are your coefficients.

* **Conclusion: Balanced Equation**

Use your calculated coefficients to balance the equation:

Cu + AgNO3 🡪 Ag + Cu(NO3)2. (The coefficient of Cu(NO3)2 is 1.)

EXTRA CREDIT: Using your mass of reacted copper, calculate the mass of the Cu(NO3)2 produced. (The Cu(NO3)2 was not weighed but discarded.) You will need to use gram to gram stoichiometry to calculate this.