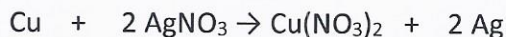


Stoichiometry Class notes

4 types of questions

1. According to the equation below, adding copper (Cu) to silver nitrate (AgNO_3) allows a chemical reaction to occur that produces silver (Ag) and copper nitrate ($\text{Cu}(\text{NO}_3)_2$).



a- Gram to gram question (steps 1-4)

You need 2.0 g of silver (Ag) for an experiment. What mass of the silver nitrate will you require to obtain the 2.0 g of silver that you need?

$$2.0 \text{ g Ag} \times \frac{1 \text{ mol Ag}}{107.87 \text{ g Ag}} \times \frac{2 \text{ mol AgNO}_3}{2 \text{ mol Ag}} \times \frac{169.88 \text{ g AgNO}_3}{1 \text{ mol AgNO}_3} = 3.1 \text{ g AgNO}_3$$

b- Gram to moles question (steps 1-3)

You need 2.0 g of silver (Ag) for an experiment. How many moles of the Cu will you require to obtain the 2.0 g of silver that you need?

$$2.0 \text{ g Ag} \times \frac{1 \text{ mol Ag}}{107.87 \text{ g Ag}} \times \frac{1 \text{ mol Cu}}{2 \text{ mol Ag}} = 0.0093 \text{ mol Cu}$$

c- Moles to gram question (steps 1, 3 and 4)

You have 1.5 moles of $\text{Cu}(\text{NO}_3)_2$, what mass of AgNO_3 was needed for the reaction to occur?

$$1.5 \text{ mol Cu}(\text{NO}_3)_2 \times \frac{2 \text{ mol AgNO}_3}{1 \text{ mol Cu}(\text{NO}_3)_2} \times \frac{169.88 \text{ g AgNO}_3}{1 \text{ mol AgNO}_3} = 510 \text{ g AgNO}_3$$

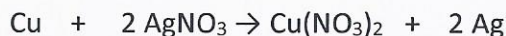
d- Moles to moles question (steps 1 and 3)

You have 3.0 moles of $\text{Cu}(\text{NO}_3)_2$, how many moles of AgNO_3 was needed for the reaction to occur?

$$3.0 \text{ mol Cu}(\text{NO}_3)_2 \times \frac{2 \text{ mol AgNO}_3}{1 \text{ mol Cu}(\text{NO}_3)_2} = 6 \text{ mol AgNO}_3$$

Atoms and molecules questions – 4 types

2. According to the equation below, adding copper (Cu) to silver nitrate (AgNO₃) allows a chemical reaction to occur that produces silver (Ag) and copper nitrate (Cu(NO₃)₂).



A- Atom (or molecules) to grams (Steps 1-4)

If 3.33×10^7 atoms of Cu are available, how many grams of silver nitrate AgNO₃ would react with it?

$$3.33 \times 10^7 \text{ Cu atoms} \times \frac{1 \text{ mol Cu}}{(6.02 \times 10^{23}) \text{ Cu atoms}} \times \frac{2 \text{ mol AgNO}_3}{1 \text{ mol Cu}} \times \frac{169.88 \text{ g AgNO}_3}{1 \text{ mol AgNO}_3} = 1.88 \times 10^{-14} \text{ g AgNO}_3$$

B- Grams to atoms (or molecule) (Steps 1-4)

If 400.0 g of copper nitrate Cu(NO₃)₂ was produced, how many Cu atoms must have reacted with the copper nitrate?

$$400.0 \text{ g Cu(NO}_3)_2 \times \frac{1 \text{ mol Cu(NO}_3)_2}{187.5 \text{ g Cu(NO}_3)_2} \times \frac{1 \text{ mol Cu}}{1 \text{ mol Cu(NO}_3)_2} \times \frac{6.02 \times 10^{23} \text{ Cu atoms}}{1 \text{ mol Cu}} = 1.284 \times 10^{24} \text{ Cu atoms}$$

C- Atoms (or molecules) to moles (Steps 1-3)

If 7.5×10^4 Ag atoms are available, how many moles of silver nitrate AgNO₃ would react with it?

$$7.5 \times 10^4 \text{ Ag atoms} \times \frac{1 \text{ mol Ag}}{(6.02 \times 10^{23}) \text{ Ag atoms}} \times \frac{2 \text{ mol AgNO}_3}{2 \text{ mol Ag}} = 1.2 \times 10^{-19} \text{ mol AgNO}_3$$

D- Moles to molecules (or atoms) (steps 1, 3 and 4)

If 3.0 moles of Cu were used in the reaction, how many molecules of Cu(NO₃)₂ would be produced?

$$3.0 \text{ mol Cu} \times \frac{1 \text{ mol Cu(NO}_3)_2}{1 \text{ mol Cu}} \times \frac{6.02 \times 10^{23} \text{ molec Cu(NO}_3)_2}{1 \text{ mol Cu(NO}_3)_2} = 1.8 \times 10^{24} \text{ molecules Cu(NO}_3)_2$$

Mole and stoichiometry combination questions

3. 'Given' not in problem, must find given to solve question

200.0 mL of NaI whose concentration is 2.0 M are reacted with $\text{Pb}(\text{NO}_3)_2$ in order to obtain the precipitate PbI_2 . Calculate the mass of PbI_2 obtained.

$$n = CV \text{ (or Ratio)}$$



$$\frac{2.0 \text{ mol}}{\text{L}} \times 0.200 \text{ L}$$

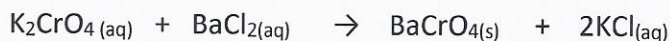
$$= 0.4 \text{ mol}$$

↑
Given

$$0.4 \text{ mol NaI} \times \frac{1 \text{ mol PbI}_2}{2 \text{ mol NaI}} \times \frac{461.00 \text{ g PbI}_2}{1 \text{ mol PbI}_2} = 92 \text{ g PbI}_2$$

4. Looking for molar concentration mol/L

75 mL of BaCl_2 is used to produce BaCrO_4 . If 4.81 g of BaCrO_4 is made, what is the concentration of the BaCl_2 used? The following equation represents the reaction:



$$4.81 \text{ g BaCrO}_4 \times \frac{1 \text{ mol BaCrO}_4}{253.33 \text{ g BaCrO}_4} \times \frac{1 \text{ mol BaCl}_2}{1 \text{ mol BaCrO}_4} = \frac{0.0189... \text{ mol}}{0.075 \text{ L}}$$

$$= 0.25 \text{ mol/L}$$

5. Looking for volume L

What volume of a 6.0 M solution of HCl are needed to react with 4.85 g of NaHCO_3 ? The equation that represents the reaction follows.

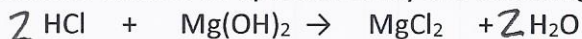


$$4.85 \text{ g NaHCO}_3 \times \frac{1 \text{ mol NaHCO}_3}{84.01 \text{ g NaHCO}_3} \times \frac{1 \text{ mol HCl}}{1 \text{ mol NaHCO}_3} = \frac{0.057727 \text{ mol HCl}}{6 \text{ mol/L}}$$

$$0.0096 \text{ L}$$

Practice Questions

1. To neutralize hydrochloric acid (HCl), magnesium hydroxide (Mg(OH)₂), a base is added. The neutralization reaction is represented by the following equation:



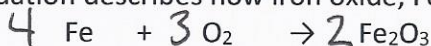
- a- You have 4.0 moles of HCl, what mass of Mg(OH)₂ is required to neutralize the 4.0 moles of HCl?

$$4.0 \text{ mol HCl} \times \frac{1 \text{ mol Mg(OH)}_2}{2 \text{ mol HCl}} \times \frac{58.33 \text{ g Mg(OH)}_2}{1 \text{ mol Mg(OH)}_2} = 120 \text{ g Mg(OH)}_2$$

- b- You have 4.0 moles of HCl, how many moles of H₂O is required to neutralize the 4 moles of HCl?

$$4.0 \text{ mol HCl} \times \frac{2 \text{ mol H}_2\text{O}}{2 \text{ mol HCl}} = 4.0 \text{ mol H}_2\text{O}$$

2. The following equation describes how iron oxide, Fe₂O₃, is produced.



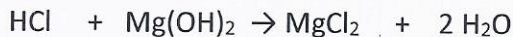
How much Fe₂O₃ is formed by the complete oxidation of 448 g of iron?

$$448 \text{ g Fe} \times \frac{1 \text{ mol Fe}}{55.85 \text{ g Fe}} \times \frac{2 \text{ mol Fe}_2\text{O}_3}{4 \text{ mol Fe}} \times \frac{159.70 \text{ g Fe}_2\text{O}_3}{1 \text{ mol Fe}_2\text{O}_3} = 641 \text{ g Fe}_2\text{O}_3$$

3. Using the formula $3 \text{CuO} + 2 \text{NH}_3 \rightarrow \text{N}_2 + 3 \text{Cu} + 3 \text{H}_2\text{O}$
How many moles of ammonia (NH₃) are needed to obtain 7.00 g of copper (Cu)?

$$7.00 \text{ g Cu} \times \frac{1 \text{ mol Cu}}{63.55 \text{ g Cu}} \times \frac{2 \text{ mol NH}_3}{3 \text{ mol Cu}} = 0.0734 \text{ mol NH}_3$$

4. Use the equation below to solve questions A and B



- a- If 700.0 g of water was produced, how many molecules of magnesium chloride (MgCl₂) must have reacted with the oxygen?

$$700.0 \text{ g H}_2\text{O} \times \frac{1 \text{ mol H}_2\text{O}}{18.02 \text{ g H}_2\text{O}} \times \frac{1 \text{ mol MgCl}_2}{2 \text{ mol H}_2\text{O}} \times \frac{6.02 \times 10^{23} \text{ molecules MgCl}_2}{1 \text{ mol MgCl}_2} = 1.169 \times 10^{25} \text{ molecules MgCl}_2$$

- b- If 3.3×10^9 molecules of HCl are available, how many moles of water react with it?

$$3.3 \times 10^9 \text{ molecules HCl} \times \frac{1 \text{ mol HCl}}{(6.02 \times 10^{23} \text{ molecules HCl})} \times \frac{2 \text{ mol H}_2\text{O}}{2 \text{ mol HCl}} = 5.5 \times 10^{-15} \text{ mol H}_2\text{O}$$