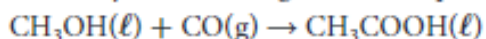


Mathy Bits – Mass Questions

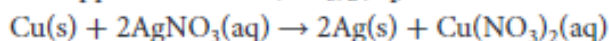
Please do questions.... 22 – 24, 26, 27, and 51-53

21. The production of acetic acid, $\text{CH}_3\text{COOH}(\ell)$, is represented by the following chemical equation:



Calculate the mass of acetic acid that is produced by the reaction of 6.0×10^4 g of carbon monoxide with sufficient methanol, $\text{CH}_3\text{OH}(\ell)$.

22. Calculate the mass of silver nitrate, $\text{AgNO}_3(\text{aq})$, that must react with solid copper to provide 475 kg of copper nitrate, $\text{Cu}(\text{NO}_3)_2(\text{aq})$.

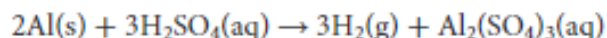


23. What mass of oxygen is produced if 22.7 mol of carbon dioxide is consumed in a controlled photosynthesis reaction?



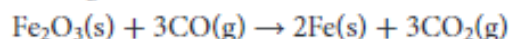
24. Sodium phosphate, $\text{Na}_3\text{PO}_4(\text{aq})$, is an all-purpose cleaner that can be used to clean walls before painting. It is often referred to as trisodium phosphate, or TSP, and it must be handled with care because it is corrosive. It is prepared by the following reaction:
 $3\text{NaOH}(\text{aq}) + \text{H}_3\text{PO}_4(\text{aq}) \rightarrow \text{Na}_3\text{PO}_4(\text{aq}) + 3\text{H}_2\text{O}(\ell)$
What amount in moles of TSP is produced if 14.7 g of sodium hydroxide reacts with phosphoric acid, $\text{H}_3\text{PO}_4(\text{aq})$?

25. What mass of hydrogen is produced when 3.75 g of aluminum reacts with sulfuric acid, $\text{H}_2\text{SO}_4(\text{aq})$?



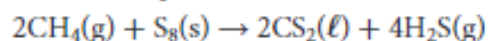
26. Nitrogen monoxide, $\text{NO}(\text{g})$, reacts with oxygen gas to form nitrogen dioxide, $\text{NO}_2(\text{g})$. What mass of nitrogen dioxide is produced from 2.84 g of nitrogen monoxide?

27. Iron(III) oxide, $\text{Fe}_2\text{O}_3(\text{s})$, reacts with carbon monoxide to form solid iron and carbon dioxide in the following reaction:



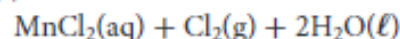
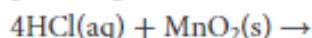
What mass (in grams) of carbon dioxide is produced from 12.4 g of iron(III) oxide?

28. Methane, $\text{CH}_4(\text{g})$, reacts with sulfur, $\text{S}_8(\text{s})$, to produce carbon disulfide, $\text{CS}_2(\ell)$, and hydrogen sulfide, $\text{H}_2\text{S}(\text{g})$. Carbon disulfide is often used in the production of cellophane.



What mass of methane is required if 4.09 g of hydrogen sulfide is produced?

29. The addition of concentrated hydrochloric acid to manganese(IV) oxide, $\text{MnO}_2(\text{s})$, produces chlorine gas, $\text{Cl}_2(\text{g})$.

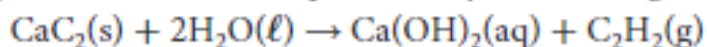


What mass of manganese(IV) oxide is needed to react with 8.65×10^{-2} g of hydrochloric acid?

30. Aluminum carbide, $\text{Al}_4\text{C}_3(\text{s})$, is a yellow powder that reacts with water, $\text{H}_2\text{O}(\ell)$, to produce aluminum hydroxide, $\text{Al}(\text{OH})_3(\text{s})$, and methane, $\text{CH}_4(\text{g})$.

Write a balanced chemical equation for the reaction and determine the mass of water required to react with 14.0 g of aluminum carbide.

51. During an investigation, calcium carbide, $\text{CaC}_2(\text{s})$, reacted with excess water to make calcium hydroxide, $\text{Ca}(\text{OH})_2(\text{aq})$, and acetylene, $\text{C}_2\text{H}_2(\text{g})$.



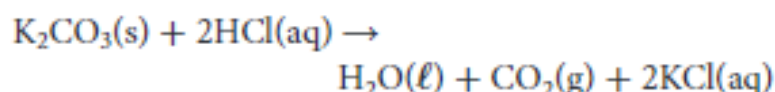
The data table for this investigation is given below.

Data Table

Mass of Calcium Carbide That Reacted	2.38 g
Mass of Acetylene That Was Produced	0.77 g

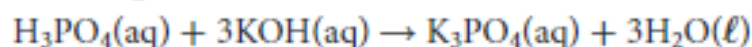
What was the theoretical yield and actual yield of acetylene?

52. Suppose that 0.250 mol of potassium carbonate, $\text{K}_2\text{CO}_3(\text{s})$, reacts with excess hydrochloric acid as follows:



- Calculate the theoretical yield of potassium chloride.
- Calculate the percentage yield of water if 0.189 mol of water is produced.

53. Phosphoric acid, $\text{H}_3\text{PO}_4(\text{aq})$, is neutralized by potassium hydroxide, $\text{KOH}(\text{aq})$, according to the following reaction:



If 49.0 g of potassium phosphate, $\text{K}_3\text{PO}_4(\text{aq})$, is recovered after 49.0 g of phosphoric acid reacts with 49.0 g of potassium hydroxide, what is the percentage yield of the reaction?

Lab: Determining the Percentage Yield of a Reaction

Note: You will not actually be doing this experiment – sample data will be provided for you.

Do only the highlighted parts!

Introduction

It is relatively easy to calculate the mass of the product that should be produced from a known mass of a reactant. This is the theoretical yield. However, the mass of the product actually obtained, the experimental yield, is usually less than the theoretical yield. The relationship between these two yields is expressed in a quantity called the percentage yield.

Purpose

Determine the percentage yield of a precipitate.

Material

Chemicals: lead(II) nitrate, potassium iodide

Apparatus: pipette (5 mL), pipette, beaker (250 mL), Erlenmeyer flask (250 mL), funnel, filter paper, electronic balance, wash bottle with distilled water

Procedure – see this video for how this all works - <https://youtu.be/faO9m9JzIgM>

1. Dissolve 3.31 g of lead(II) nitrate in 100 mL of distilled water. Label the container as solution A.
2. Dissolve 2 g of potassium iodide in 100 mL of distilled water. Label the container as solution B.
3. Use a pipette to measure 5 mL of each of the two solutions and add to the beaker. Use a different pipette for each solution to avoid contaminating your stock solutions.
4. Swirl gently.
5. Determine the mass of the filter paper. An accurate measurement is very important.
6. Fold the filter paper in four and place it in the funnel supported by a flask.
7. Slowly pour the mixture into the funnel. Be careful not to overflow the filter paper. Use a wash bottle of distilled water to wash any remaining solid out of the beaker and onto the filter paper.
8. After filtering, let the paper dry overnight.
9. When it is completely dry, determine its mass. Once again, accuracy is important. Be careful not to remove any of the solid product on the filter paper.
10. If time permits, repeat the entire procedure for a second time for accuracy.

Sample Results

Record your observations for each reaction in a table like the one below.

Item	Mass (g)	
	Trial 1	Trial 2
Filter paper	1.36	1.29
Filter paper + PbI_2	5.35	5.50
PbI_2		

Questions

1. What was your average yield of precipitate?
2. Calculate the percentage yield of your reaction. Use the mass of PbNO_3 to calculate the theoretical yield.
3. Give two reasons why the yield is below 100%.
4. State one way to improve upon the technique and increase the percentage yield.

Conclusion

Briefly and in general terms, state the results for the laboratory. This should be no more than 2 sentences.

21. 1.3×10^5 g

22. 860 kg

23. 726 g

24. 0.123 mol

25. 0.421 g

26. 4.35 g

27. 10.3 g

28. 0.963 g

29. 5.16×10^{-2} g

30. 21.0 g

51. 0.97 g, 0.77 g

52. a. 37.3 g

b. 75.6 %

53. 79.3%