

CHEMISTRY I – CH-1211

EXTRA PRACTICE

Department of Chemistry
University of Georgia

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Exam 2 Review: Mole and Percent Composition

1. Which one of the samples contains the most particles?
 - A. 1 mol $\text{CO}_2(\text{g})$
 - B. 1 mol $\text{UF}_6(\text{g})$
 - C. 1 mol $\text{CH}_3\text{COCH}_3(\text{l})$
 - D. 1 mol $\text{He}(\text{g})$
 - E. all contain the same number of particles

2. Which one of the samples has the largest mass?
 - A. 1 mol $\text{CO}_2(\text{g})$
 - B. 1 mol $\text{UF}_6(\text{g})$
 - C. 1 mol $\text{CH}_3\text{COCH}_3(\text{l})$
 - D. 1 mol $\text{He}(\text{g})$
 - E. all have the same mass

3. What is the molar mass (in g mol^{-1} to four significant figures) of $\text{Al}_2(\text{SO}_4)_3 \cdot 18 \text{H}_2\text{O}$?

4. What is the molar mass (in g mmol^{-1} to three significant figures) of $(\text{NH}_4)_2\text{HPO}_4$?

5. How many atoms are present in a 0.268 mol sample of CH_3OH ?

6. How many aluminum atoms are there in a 3.50 g sample of Al_2O_3 ?

7. Which one of the samples contains the most atoms?

- A. 1 mol $\text{CO}_2(\text{g})$
- B. 1 mol $\text{UF}_6(\text{g})$
- C. 1 mol $\text{CH}_3\text{COCH}_3(\text{l})$
- D. 1 mol $\text{He}(\text{g})$
- E. all contain the same number of atoms

8. Guanidine, $\text{HNC}(\text{NH}_2)_2$, is a fertilizer. What is the percent by mass (to one decimal place) of nitrogen in the fertilizer?

9. Determine the percent by mass (to one decimal place) of Mg in chlorophyll ($\text{C}_{55}\text{H}_{72}\text{MgN}_4\text{O}_5$), the green pigment in plant cells.

10. The mineral spodumene has the formula $\text{LiAlSi}_2\text{O}_6$. What is the mass (in g to two decimal places) of lithium in a 438 g sample?

11. Analysis of a sample of a covalent compound showed that it contained 14.4 % hydrogen and 85.6 % carbon by mass. What is the empirical formula for the compound?

12. How many moles (in normalized scientific notation) of Cs are contained in 595 kg of Cs?

13. What is the mass (in g) of 2.6×10^{22} chlorine atoms?

14. How many iron atoms are contained in 354 g of iron?

15. What is the mass (in ng) of 2.33×10^{20} oxygen atoms?

16. What is the mass (in g) of 2.0×10^{24} Hg atoms?

17. A sample of a compound containing only carbon and oxygen decomposes and produces 24.5 g of carbon and 32.59 g of oxygen. Determine the sample by considering percent composition by mass.
- A. CO
 - B. CO₂
 - C. CO₃
 - D. C₃O₂
 - E. C₂O

18. The mineral spodumene has the formula $\text{LiAlSi}_2\text{O}_6$. How many lithium atoms are present in a 105 g sample?

19. Which of the following statements are correct for sorbic acid, $\text{C}_6\text{H}_8\text{O}_2$, an inhibitor of mold and yeast?

- I. It has a C:H:O mass ratio of 3:4:1
- II. It has the same mass percent composition as $\text{C}_3\text{H}_4\text{O}$
- III. It has the same empirical formula as $\text{C}_{12}\text{H}_{16}\text{O}_4$
- IV. The highest percentage, by mass, is that of H
- V. It is an alcohol

- A. III and IV
- B. II and III
- C. I, II, III, IV, and V
- D. II, III, and V
- E. II, III, IV, and V

20. Find the mass (in g) of 500 atoms of iron.

21. How much Fe (in mol and number of atoms) are in 125.0 g of Fe?

22. Freon-12 (CCl_2F_2) is used as a refrigerant in air conditioners and as a propellant in aerosol cans. What is the number of freon-12 molecules and what is the mass (in mg) of Cl in a 5.56 mg sample of freon-12?

23. *Prevacid* ($C_{16}H_{14}F_3N_3O_2S$) is used to treat gastroesophageal reflux disease (GERD). Determine each of the following:
- A. the molar mass (in $g\ mol^{-1}$) of *Prevacid*
 - B. the mass (in g) of fluorine in a 0.75 mol sample of *Prevacid*
 - C. the number of C atoms in a 0.75 mol sample of *Prevacid*
 - D. the mass (in g) of 4.25×10^{21} molecules of *Prevacid*

24. Find the percent composition by mass (to one decimal place) of each element in $\text{YBa}_2\text{Cu}_3\text{O}_7$.

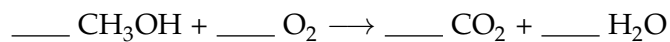
25. Hemoglobin is a protein that transports oxygen in mammals. Hemoglobin is 0.347 % Fe (by mass). Each hemoglobin molecule contains 4 Fe atoms. What is the molar mass (in g mol^{-1} in standard notation) of hemoglobin?

26. A compound that only contains carbon, hydrogen, and oxygen is 48.64 % C and 8.16 % H (by mass). What is the empirical formula of this substance?

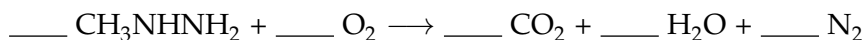
27. Consider four individual samples of phosphine (PH_3), water, hydrogen sulfide, and hydrogen fluoride, each with a mass of 121 g. Rank the compounds from the least to the greatest number of hydrogen atoms contained in each sample.

Exam 2 Review: Balancing Equations and Solubility

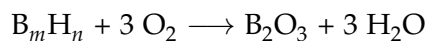
1. Write a balanced equation for the following reaction by placing appropriate stoichiometric coefficients.



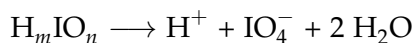
2. Write a balanced equation for the following reaction by placing appropriate stoichiometric coefficients.



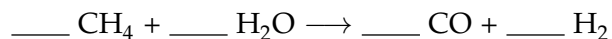
3. What values for m and n are required to balance the equation with the given stoichiometric coefficients?



4. What values for m and n are required to balance the equation with the given stoichiometric coefficients?



5. Write a balanced equation for the following reaction by placing appropriate stoichiometric coefficients. Include a coefficient of "1" where appropriate for the purpose of this exercise.



6. Solid silver oxide decomposes at high temperatures to yield metallic silver and oxygen gas. Balance the following reaction. Include a coefficient of "1" where appropriate for the purpose of this exercise.



7. Chemical equations must be balanced because the resulting coefficients allow us to predict (select all that apply).

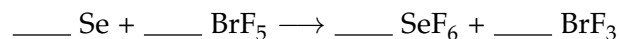
- A. the amount of product that can form from a given amount of reactant.
- B. whether the reaction requires a catalyst or not
- C. how much of one reactant is required to react with a given amount of another
- D. how much reactants are required to form a given amount of products
- E. whether the given reaction is possible or not

8. Select the appropriately balanced equation for the following reaction.

aqueous silver sulfate + aqueous barium iodide \longrightarrow solid barium sulfate + solid silver iodide

- A. $\text{Ag}_2\text{SO}_4 + \text{BaI}_2 \longrightarrow \text{BaSO}_4 + \text{AgI}$
- B. $\text{Ag}_2\text{SO}_4(\text{l}) + \text{BaI}_2(\text{l}) \longrightarrow \text{BaSO}_4(\text{s}) + 2 \text{AgI}(\text{s})$
- C. $\text{Ag}_2\text{SO}_4(\text{aq}) + \text{BaI}_2(\text{aq}) \longrightarrow \text{BaSO}_4(\text{s}) + 2 \text{AgI}(\text{s})$
- D. $\text{AgSO}_4(\text{aq}) + \text{BaI}(\text{aq}) \longrightarrow \text{BaSO}_4(\text{s}) + 2 \text{AgI}(\text{s})$
- E. $\text{AgSO}_4(\text{l}) + 2 \text{BaI}(\text{l}) \longrightarrow \text{Ba}_2\text{SO}_4(\text{s}) + 2 \text{AgI}_2(\text{s})$

9. Write a balanced equation for the following reaction by placing appropriate stoichiometric coefficients. Include a coefficient of "1" where appropriate for the purpose of this exercise.



10. Classify each of the following (all that apply) as a

- I. strong electrolyte
- II. weak electrolyte
- III. nonelectrolyte
- IV. strong acid
- V. strong base

- VI. weak acid
- VII. weak base
- VIII. ionic compound
- IX. organic compound

- A. HBr
- B. ammonium carbonate
- C. NaClO₄
- D. ethanol
- E. acetic acid
- F. NH₃

11. Which of the following compounds are insoluble in water? Select all that apply.

- A. CoCO₃
- B. Cu₃(PO₄)₂
- C. AgNO₃
- D. Na₂S
- E. AgI

12. Which of the following combinations will form a precipitate? Select all that apply.

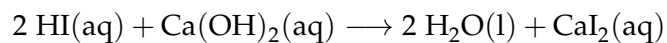
- A. $\text{SrCl}_2(\text{aq}) + \text{Na}_2\text{S}(\text{aq})$
- B. $\text{KCl}(\text{aq}) + \text{CaS}(\text{aq})$
- C. $\text{Hg}(\text{NO}_3)_2(\text{aq}) + \text{Na}_3\text{PO}_4(\text{aq})$
- D. $\text{Ba}(\text{NO}_3)_2(\text{aq}) + \text{KOH}(\text{aq})$
- E. $\text{NaOH}(\text{aq}) + \text{FeCl}_3(\text{aq})$

13. Lead(II) nitrate reacts with sodium chloride. Choose the net ionic equation for the reaction.

- A. $\text{Pb}^{2+}(\text{aq}) + \text{Cl}^{-}(\text{aq}) \longrightarrow \text{PbCl}(\text{s})$
- B. $\text{Pb}^{2+}(\text{aq}) + \text{NO}_3^{-}(\text{aq}) + \text{Na}^{+}(\text{aq}) + \text{Cl}^{-}(\text{aq}) \longrightarrow \text{PbCl}(\text{s}) + \text{NaNO}_3(\text{aq})$
- C. $\text{PbNO}_3(\text{aq}) + \text{NaCl}(\text{aq}) \longrightarrow \text{PbCl}(\text{s}) + \text{NaNO}_3(\text{aq})$
- D. $\text{Pb}^{2+}(\text{aq}) + 2 \text{Cl}^{-}(\text{aq}) \longrightarrow \text{PbCl}_2(\text{s})$

14. Aqueous solutions of sodium sulfate and barium chloride react. What is the sum of the coefficients from the balanced net ionic equation?

15. Answer the questions for the following reaction.

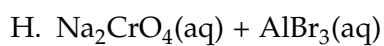
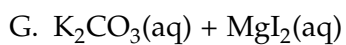
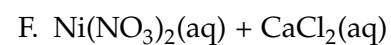
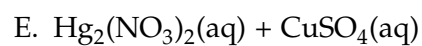
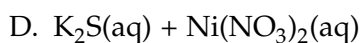
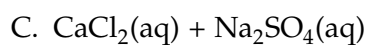
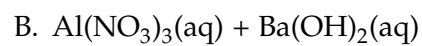
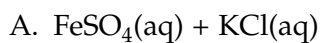


- A. Is the acid strong or weak?
- B. Is the base strong or weak?
- C. What is the net ionic equation for the reaction?

16. A reaction between hydrobromic acid and potassium hydroxide occurs. What is the sum of the coefficients from the balanced net ionic equation?
17. Which is the spectator ion in the reaction between potassium carbonate and calcium iodide? Select all that apply.
- A. $\text{K}^+(\text{aq})$
 - B. $\text{CO}_3^{2-}(\text{aq})$
 - C. $\text{Ca}^{2+}(\text{aq})$
 - D. $\text{I}^-(\text{aq})$

18. What is the sum of the coefficients of the net ionic equation for aqueous sodium hydroxide neutralized by aqueous acetic acid?

19. Balance each reaction complete with phase labels.



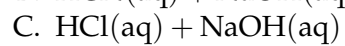
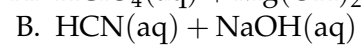
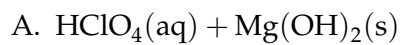
20. Which of the following substances are soluble in water? Select all that apply.

- A. aluminum nitrate
- B. magnesium chloride
- C. rubidium sulfate
- D. nickel(II) hydroxide
- E. lead(II) sulfide
- F. barium hydroxide
- G. iron(III) phosphate

21. Write the net ionic equations for the following reactions:

- A. ammonium sulfate and barium nitrate
- B. lead(II) nitrate and sodium chloride
- C. sodium phosphate and potassium nitrate
- D. sodium bromide and rubidium chloride
- E. copper(II) chloride and sodium hydroxide

22. Write the balanced molecular equation, complete ionic equation, and net ionic equation for the following acid-base reactions.



23. Write a balanced chemical equation between an acid and a base that would have the following salt appear as a product.
- A. potassium perchlorate
 - B. cesium nitrate
 - C. calcium iodide

Exam 2 Review: Oxidation-Reduction

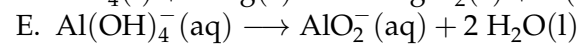
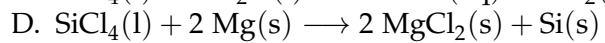
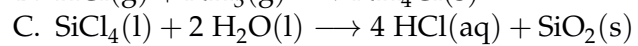
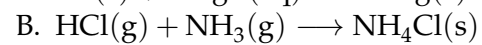
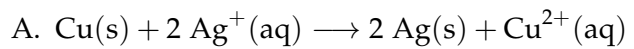
1. Assign oxidation states for all atoms in each of the following compounds.

- A. KMnO_4
- B. NiO_2
- C. $\text{Na}_4\text{Fe}(\text{OH})_6$
- D. $(\text{NH}_4)_2\text{HPO}_4$
- E. P_4O_6

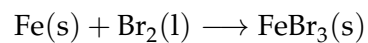
2. Assign oxidation states for all atoms in each of the following compounds.

- A. Fe_3O_4
- B. XeOF_4
- C. SF_4
- D. CO
- E. $\text{C}_6\text{H}_{12}\text{O}_6$

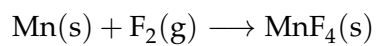
3. Specify which reactions are redox reactions and identify the oxidizing agent, reducing agent, the substance being oxidized, and the substance being reduced.



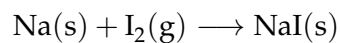
4. Determine the half-reactions, the amount (in mol) of electrons transferred, and the overall balanced reaction (with phase labels) for the following redox reaction.



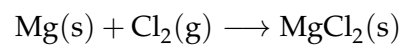
5. Determine the half-reactions, the amount (in mol) of electrons transferred, and the overall balanced reaction (with phase labels) for the following redox reaction.



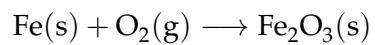
6. Determine the half-reactions, the amount (in mol) of electrons transferred, and the overall balanced reaction (with phase labels) for the following redox reaction.



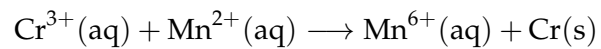
7. Determine the half-reactions, the amount (in mol) of electrons transferred, and the overall balanced reaction (with phase labels) for the following redox reaction.



8. Determine the half-reactions, the amount (in mol) of electrons transferred, and the overall balanced reaction (with phase labels) for the following redox reaction.



9. Determine the half-reactions, the amount (in mol) of electrons transferred, and the overall balanced reaction (with phase labels) for the following redox reaction.



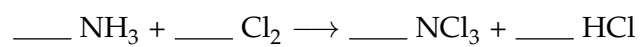
Exam 2 Review: Stoichiometry and Molarity

1. Balance the following equation.



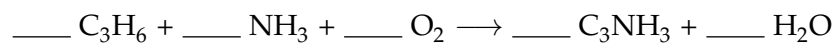
Additionally, consider a 4.260×10^3 mg sample of impure silver oxide that, when completely decomposes, yields 283 mg of $\text{O}_2\text{(g)}$. Assuming that the silver oxide is the only source of oxygen, what is the mass percent of silver oxide in the sample?

2. Balance the following equation.



Additionally, what mass (in g) of HCl is produced if 1.27 g of NH₃ reacts with 4.53 g of Cl₂?

3. Balance the following equation.



Additionally, determine the following:

- A. What is the limiting reactant if 4.25 g of C_3H_6 reacts with 3.14 g of NH_3 and 6.12 g of O_2 ?
- B. What mass (in g) of C_3NH_3 can theoretically be produced given the information in A?
- C. What mass (in g) of C_3NH_3 , NH_3 , and O_2 would theoretically be leftover given the information in A?
- D. If 1.94 g of C_3NH_3 was produced in an experiment, what is the percent yield?

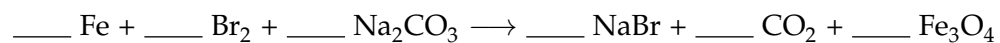
4. Balance the following reaction.



Additionally, determine the following:

- A. What volume (in mL) of $\text{C}_6\text{H}_5\text{NO}_2$ ($\rho = 1.20 \text{ g mL}^{-1}$) must be allowed to react with an excess of $\text{C}_6\text{H}_{14}\text{O}_4$ to produce 6.21 g of $(\text{C}_6\text{H}_5\text{N})_2$ if the percent yield is 83.7 %?
- B. If 0.17 L of $\text{C}_6\text{H}_5\text{NO}_2$ ($\rho = 1.20 \text{ g mL}^{-1}$) and 0.52 L $\text{C}_6\text{H}_{14}\text{O}_4$ ($\rho = 1.12 \text{ g mL}^{-1}$) react to yield 64.4 g of $(\text{C}_6\text{H}_5\text{N})_2$, what is the limiting reactant and what is the percent yield of the reaction?

5. Balance the following reaction.



Additionally, an alloy contains 84.2 % Fe and 15.8 % Ni (by mass). A 6.41 g sample of the alloy reacts with 8.30 g Na_2CO_3 with excess Br_2 .

- A. What mass (in g) of Fe_3O_4 can be produced?
- B. What mass (in g) of Fe_3O_4 is produced if the percent yield of the reaction is 94.3 %?

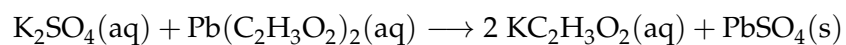
6. A mixture contained no fluorine compound except methyl fluoroacetate, $\text{FCH}_2\text{COOCH}_3$ ($M(\text{FCH}_2\text{COOCH}_3) = 92.08 \text{ g mol}^{-1}$). When chemically treated, all the fluorine was converted to CaF_2 ($M(\text{CaF}_2) = 78.08 \text{ g mol}^{-1}$). The mass of CaF_2 obtained was 20.1 g. Find the mass (in g) of methyl fluoroacetate in the original mixture.
7. A 1.62 g sample of a metal chloride, MCl_2 , is dissolved in water and treated with excess aqueous silver nitrate. The silver chloride that formed weighed 3.46 g. Calculate the molar mass (in g mol^{-1}) of the metal, M, and identify the metal.

8. Which solution has the greatest molar concentration of SO_4^{2-} ?

- A. 0.060 M H_2SO_4
- B. 0.27 M MgSO_4
- C. 0.17 M Na_2SO_4
- D. 0.098 M $\text{Al}_2(\text{SO}_4)_3$
- E. 0.22 M CuSO_4

9. A solution is prepared by dissolving 4.25 g NaCl, 0.175 g KCl, and 0.183 g CaCl₂ in water. The volume of the solution is 500.0 mL. What is the molar concentration (in mol L⁻¹) of Cl⁻ in the solution?

10. In the following reaction, 55.2 mL of potassium sulfate solution was added to excess lead acetate. What is the concentration of K^+ in the potassium sulfate solution if 1.23 g of $PbSO_4$ was produced?



11. You mix 285.0 mL of 1.20 M aqueous lead(II) nitrate with 300.0 mL of 1.55 M aqueous potassium iodide. Determine the following.
- A. the molecular equation for this reaction
 - B. the limiting reactant
 - C. the final molar concentration (in mol L⁻¹) of Pb²⁺
 - D. the mass (in g) of lead(II) iodide formed
 - E. the final molar concentration (in mol L⁻¹) of K⁺
 - F. the final molar concentration (in mol L⁻¹) of NO₃⁻

12. If all of the chloride in a 4.106 g sample of an unknown metal chloride is precipitated as AgCl with 70.90 mL of 0.2010 M AgNO₃, what is the percentage of chloride in the sample?

13. A mixture of BaCl₂ and NaCl is analyzed by precipitating all of the barium as BaSO₄. After the addition of excess Na₂SO₄ to a 3.988 g sample of the mixture, the mass of precipitate collected is 2.113 g. What is the mass percentage of barium chloride in the mixture?

14. A 3.00 g sample of an alloy containing only Pb and Sn was dissolved in nitric acid. Sulfuric acid was added to this solution, which precipitated 1.90 g of PbSO_4 . Assuming that all of the lead was precipitated, what is the percentage of Sn in the sample? ($M(\text{PbSO}_4) = 303.26 \text{ g mol}^{-1}$)

15. You have 76.0 mL of a 2.50 M aqueous solution of Na_2CrO_4 and 125 mL of a 2.16 M aqueous solution of AgNO_3 . Calculate the molar concentration (in mol L^{-1}) of CrO_4^{2-} after the two solutions are mixed together.

16. You have a 75.0 mL 2.50 M aqueous Na_2CrO_4 solution and 125 mL 2.29 M aqueous AgNO_3 solution. What is the molar concentration (in mol L^{-1}) of Ag^+ after the two solutions are mixed together?

17. You have 75.0 mL of a 2.50 M aqueous solution of Na_2CrO_4 and 125 mL of a 2.24 M aqueous solution of AgNO_3 . Calculate the molar concentration (in mol L^{-1}) of NO_3^- after the two solutions are mixed together.

18. Combine a 55 mL 1.00 *M* aqueous silver nitrate solution with a 25 mL 0.55 *M* silver chloride solution. What mass (in g) of silver chloride is produced?

19. A 0.307 g sample of an unknown triprotic acid is completely neutralized using a 35.2 mL 0.106 M aqueous NaOH solution. What is the molar mass (in g mol^{-1}) of the acid?

20. A 0.685 g sample of an unknown diprotic acid requires a 42.57 mL 0.111 M aqueous NaOH solution to be completely neutralized. What is the molar mass (in g mol^{-1}) of the acid?

21. What mass (in g) of NaOH is required to completely react with a 25.0 mL 2.2 M aqueous H_2SO_4 solution?
22. What volume (in mL) of a 5.00 M hydrofluoric acid solution will completely react with 4.05 g of calcium hydroxide?

23. Sulfamic acid (HSO_3NH_2) is a strong monoprotic acid that can be used to standardize a strong base. A 0.179 g sample of HSO_3NH_2 is required to completely neutralize a 19.4 mL aqueous KOH solution. What is the molar concentration (in mol L^{-1}) of the KOH solution?

24. A student weighs out 0.556 g of KHP ($M(\text{KHP}) = 204.22 \text{ g mol}^{-1}$) and puts it into 36.78 mL of a stock NaOH solution. If that was enough to neutralize the NaOH, what is the concentration of the stock NaOH solution? KHP is a monoprotic acid.

25. A 2.80 g sample of phosphoric acid is added to a 150.0 mL 1.00 M sodium hydroxide solution to give a 151.489 mL mixture and the acid is completely neutralized. Determine the following:
- A. $[\text{Na}^+]$ (in mol L^{-1})
 - B. $[\text{PO}_4^{3-}]$ (in mol L^{-1})
 - C. $[\text{OH}^-]$ (in mol L^{-1})

26. A stock solution with a total volume of 1000.0 mL contains 37.1 g $\text{Mg}(\text{NO}_3)_2$. If you take a 20.0 mL aliquot and then dilute it with water to a total volume of 500.0 mL, what is the molar concentration (in mol L^{-1}) of Mg^{2+} and NO_3^{2-} in the final solution?

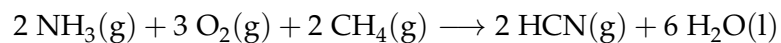
27. Determine the molar concentrations (in g mol^{-1}) the ions present in a solution created from mixing equal volumes of 1.0 *M* aqueous lead(II) nitrate and 1.0 *M* aqueous sodium chloride solutions? Assume that the volumes are precise to one decimal place in normalized scientific notation.

28. Determine the molar concentrations (in g mol^{-1}) the ions present in a solution created from mixing equal volumes of 1.0 *M* aqueous ammonium carbonate and 1.0 *M* aqueous potassium perchlorate. Assume that the volumes are precise to one decimal place in normalized scientific notation.

29. Determine the molar concentration (in g mol^{-1}) of the salt produced by a reaction between a 200. mL 0.100 *M* aqueous HCl solution with a 100. mL 0.50 *M* aqueous KOH solution.

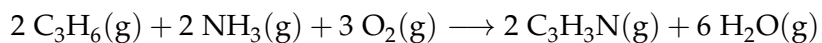
30. What volume (in mL) of a 0.100 M aqueous HNO_3 solution is required to neutralize a 50.0 mL 0.150 M aqueous $\text{Ba}(\text{OH})_2$ solution?

31. Hydrogen cyanide is produced industrially from a reaction between gaseous ammonia, oxygen, and methane.



If 5.00×10^3 kg of each reactant react, what mass (in kg) of each product would be produced (assuming a 100 % yield)?

32. Acrylonitrile ($\text{C}_3\text{H}_3\text{N}$) is the starting material for many synthetic carpets and fabrics and is produced by the following reaction.



If 15.0 g C_3H_6 , 5.00 g NH_3 , and 8.00 g O_2 react, what mass (in g) of acrylonitrile can be produced (assuming a 100 % yield)?

33. Calcium chloride is a strong electrolyte and is used to “salt” streets in the winter to melt ice and snow. Write a net ionic reaction to show how this substance breaks apart when it dissolves in water.
34. A solution of ethanol in water is prepared by dissolving 75.0 mL of ethanol ($\rho = 0.79 \text{ g cm}^{-3}$) in enough water to make a 250.0 mL solution. What is the molar concentration (in mol L^{-1}) of the ethanol in this solution?

35. Which of the following aqueous solutions contains the largest number of ions?

- A. 100.0 mL of 0.100 M NaOH
- B. 50.0 mL of 0.200 M BaCl₂
- C. 75.0 mL of 0.150 M Na₃PO₄

36. If 12.0 g of AgNO_3 is available, what volume (in L) of 0.25 M AgNO_3 can be prepared?

37. A solution is prepared by dissolving 10.8 g ammonium sulfate in enough water to make 100.0 mL of stock solution. A 10.00 mL aliquot is taken and 50.00 mL of water is added. What is the molar concentration (in mol L⁻¹) of ammonium ions and sulfate ions in the final solution?

38. What mass (in g) of Na_2CrO_4 is required to precipitate all of the silver ions from a 75.0 mL 0.100 M aqueous solution of AgNO_3 ?

39. What mass (in g) of iron(III) hydroxide precipitate can be produced by reacting a 72.0 mL 0.105 M aqueous iron(III) nitrate solution with a 125 mL 0.150 M aqueous sodium hydroxide solution?

40. A 100.0 mL 0.200 *M* aqueous potassium hydroxide solution is mixed with a 100.0 mL 0.200 *M* aqueous magnesium nitrate solution.
- Write a balanced chemical equation for the reaction that occurs.
 - Determine the precipitate that forms (if any).
 - Determine the mass (in g) of precipitate that forms (if any).
 - Determine the molar concentration (in g mol^{-1}) of each ion in solution after the reaction goes to 100 % completion. Assume the volume change of the solution is negligible.

41. A 1.42 g sample of a pure, metal (M) containing compound (M_2SO_4) was dissolved in water and treated with an excess of aqueous calcium chloride. All the sulfate ions precipitated as calcium sulfate which was collected, dried, and found to be 1.36 g. What is the identity and standard atomic weight of the metal?

42. What volume (in mL) of each of the following bases will completely react with 25.0 mL of 0.200 M HCl?
- A. 0.100 M NaOH
 - B. 0.0500 M Sr(OH)₂
 - C. 0.250 M KOH

43. A 25.0 mL sample of HCl(aq) requires 24.16 mL of 0.106 M NaOH for complete neutralization. What is the molar concentration (in mol L⁻¹) of the original HCl(aq) solution?

44. 5.00 g of barium chloride was added to 225 mL of a 1.40 M solution of sodium sulfide.
- Write the balanced molecular equation and include phase labels.
 - Write the full ionic equation and include phase labels.
 - Write the net ionic equation and include phase labels. If there is no net ionic equation, write "no net ionic equation."
 - Indicate the precipitate (if any).
 - Determine the limiting reactant.

45. A precipitate forms when titanium(IV) chloride is added to water. Two water molecules react and form four HCl molecules. What is the identity of the precipitate?
- A. What is the identity of the precipitate?
 - B. What is the molar concentration (in mol L^{-1}) of H^+ ions if 2.00 g of TiCl_4 was added to enough water to give a 100.0 mL solution?

46. A 123 mL sample of 0.210 M aqueous magnesium chloride forms a precipitate when mixed with 324 mL 0.120 M aqueous sodium hydroxide.
- A. How much (in g) precipitate is formed?
 - B. What is the molar concentration (in mol L⁻¹) of the magnesium(2+) ion?
 - C. What is the molar concentration (in mol L⁻¹) of the sodium(1+) ion?

47. If 275 mL of a 0.125 M aqueous NaCl solution and 375 mL of a 0.575 M aqueous Na₂SO₄ solution are mixed, determine the molar concentrations (in mol L⁻¹) of the following:

- A. chloride ions
- B. sulfate ions
- C. sodium ions

Exam 2 Review: Thermochemistry Basics

1. Sugar is melted in a pot and its temperature is measured as it heats. In this scenario, what is the system?
 - A. the pot and sugar
 - B. the stove
 - C. the entire kitchen
 - D. the rest of the universe

2. Which of the following is not a type of potential energy (select all that apply)?
 - A. Energy held in chemical bonds
 - B. Energy resulting from intramolecular attractions
 - C. Energy from the random motion of molecules
 - D. Energy of a ball dropping from a height

3. Which of the following is true of heat (select all that apply)?
 - A. Heat is a form of thermal energy.
 - B. Heat is the transfer of thermal energy.
 - C. Heat is the action of forces through a distance.
 - D. A negative heat in the system means the surroundings loses energy.
 - E. A negative heat in the system means the system loses energy.

4. Which of the following are false (select all that apply)?
- A. Energy can be converted from one type to another.
 - B. Energy is the capacity to do work.
 - C. Kinetic energy is energy resulting from condition, position, or composition.
 - D. Potential energy is energy transferred between a system and its surroundings as a result of a temperature difference.
5. A block of ice absorbs heat and melts. The value q for the system is:
- A. Positive
 - B. Negative
 - C. Zero
 - D. There is not enough information to determine.

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