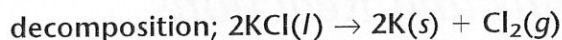


CHAPTER 8 REVIEW*Chemical Equations and Reactions***MIXED REVIEW****SHORT ANSWER** Answer the following questions in the space provided.

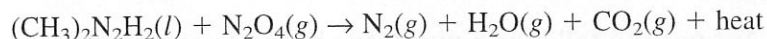
1. b A balanced chemical equation represents all the following *except*
- (a) experimentally established facts.
 - (b) the mechanism by which reactants combine to form products.
 - (c) identities of reactants and products in a chemical reaction.
 - (d) relative quantities of reactants and products in a chemical reaction.
2. d According to the law of conservation of mass, the total mass of the reacting substances is
- (a) always more than the total mass of the products.
 - (b) always less than the total mass of the products.
 - (c) sometimes more and sometimes less than the total mass of the products.
 - (d) always equal to the total mass of the products.
3. Predict whether each of the following chemical reactions will occur. For each reaction that will occur, identify the reaction type and complete the chemical equation by writing in the products formed and balancing the final equation. General solubility rules are in **Table 1** on page 437 of the text.
- a. $\text{Ba}(\text{NO}_3)_2(\text{aq}) + \text{Na}_3\text{PO}_4(\text{aq}) \rightarrow$
double-displacement; $3\text{Ba}(\text{NO}_3)_2(\text{aq}) + 2\text{Na}_3\text{PO}_4(\text{aq}) \rightarrow$
 $\text{Ba}_3(\text{PO}_4)_2(\text{s}) + 6\text{NaNO}_3(\text{aq})$
- b. $\text{Al}(\text{s}) + \text{O}_2(\text{g}) \rightarrow$
synthesis; $4\text{Al}(\text{s}) + 3\text{O}_2(\text{g}) \rightarrow 2\text{Al}_2\text{O}_3(\text{s})$
- c. $\text{I}_2(\text{s}) + \text{NaBr}(\text{aq}) \rightarrow$
no reaction
- d. $\text{C}_3\text{H}_4(\text{g}) + \text{O}_2(\text{g}) \rightarrow$
combustion; $\text{C}_3\text{H}_4(\text{g}) + 4\text{O}_2(\text{g}) \rightarrow 3\text{CO}_2(\text{g}) + 2\text{H}_2\text{O}(\text{g})$

MIXED REVIEW continued

- e. electrolysis of molten potassium chloride



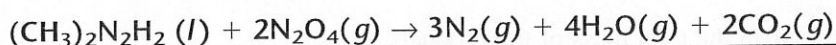
4. Some small rockets are powered by the reaction represented by the following unbalanced equation:



- a. Translate this chemical equation into a sentence. (Hint: The name for $(\text{CH}_3)_2\text{N}_2\text{H}_2$ is dimethylhydrazine.)

When liquid dimethylhydrazine is mixed with dinitrogen tetroxide gas, the products are nitrogen gas, water vapor, and gaseous carbon dioxide, along with energy in the form of heat.

- b. Balance the formula equation.



5. In the laboratory, you are given two small chips of each of the unknown metals X, Y, and Z, along with dropper bottles containing solutions of $\text{XCl}_2(aq)$ and $\text{ZCl}_2(aq)$. Describe an experimental strategy you could use to determine the relative activities of X, Y, and Z.

Wording and strategies will vary. First, place one chip of Y into $\text{XCl}_2(aq)$ and another into $\text{ZCl}_2(aq)$. If Y reacts with one solution but not the other, the activity series can be established. If Y replaces X but not Z, the series is $Z > Y > X$. If Y replaces Z but not X, the series is $X > Y > Z$. If Y reacts with neither solution, Y is at the bottom of the series. Next, put one chip of X into $\text{ZCl}_2(aq)$. If it reacts, the series is $X > Z > Y$. If it does not react, the series is $Z > X > Y$. If Y reacts with both solutions, Y is the most reactive. Last, put a chip of X into $\text{ZCl}_2(aq)$. If it reacts, the series is $Y > X > Z$. If it does not react, the series is $Y > Z > X$.

6. List the observations that would indicate that a reaction had occurred.

Signs of a reaction include generation of energy as heat or light, formation of a precipitate, formation of a gas, and change in color.

CHAPTER 9 REVIEW*Stoichiometry***MIXED REVIEW****SHORT ANSWER** Answer the following questions in the space provided.

1. Given the following equation:
- $C_3H_4(g) + xO_2(g) \rightarrow 3CO_2(g) + 2H_2O(g)$

4 a. What is the value of the coefficient x in this equation?40.07 g/mol b. What is the molar mass of C_3H_4 ?2 mol O_2 :1 mol H_2O c. What is the mole ratio of O_2 to H_2O in the above equation?0.20 mol d. How many moles are in an 8.0 g sample of C_3H_4 ?3z e. If z mol of C_3H_4 react, how many moles of CO_2 are produced, in terms of z ?

2. a. What is meant by
- ideal conditions*
- relative to stoichiometric calculations?

The limiting reactant is completely converted to product with no losses, as dictated by the ratio of coefficients.

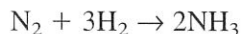
- b. What function do ideal stoichiometric calculations serve?

They determine the theoretical yield of the products of the reaction.

- c. Are actual yields typically larger or smaller than theoretical yields?

smaller**PROBLEMS** Write the answer on the line to the left. Show all your work in the space provided.

3. Assume the reaction represented by the following equation goes all the way to completion:

4 mol a. If 6 mol of H_2 are consumed, how many moles of NH_3 are produced?8.5 g b. How many grams are in a sample of NH_3 that contains 3.0×10^{23} molecules?

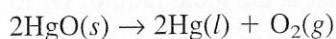
MIXED REVIEW continued

- c. If 0.1 mol of N_2 combine with H_2 , what must be true about the quantity of H_2 for N_2 to be the limiting reactant?

At least 0.3 mol of H_2 must be provided.

4. 75% If a reaction's theoretical yield is 8.0 g and the actual yield is 6.0 g, what is the percentage yield?

5. Joseph Priestley generated oxygen gas by strongly heating mercury(II) oxide according to the following equation:



0.0693 mol

- a. If 15.0 g HgO decompose, how many moles of HgO does this represent?

0.0346 mol

- b. How many moles of O_2 are theoretically produced?

1.11 g

- c. How many grams of O_2 is this?

0.786 L

- d. If the density of O_2 gas is 1.41 g/L, how many liters of O_2 are produced?

1.05 g

- e. If the percentage yield is 95.0%, how many grams of O_2 are actually collected?

CHAPTER 10 REVIEW*States of Matter***MIXED REVIEW****SHORT ANSWER** Answer the following questions in the space provided.

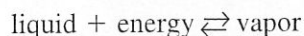
1. c The average speed of a gas molecule is most directly related to the
- (a) polarity of the molecule.
 - (b) pressure of the gas.
 - (c) temperature of the gas.
 - (d) number of moles in the sample.
2. Use the kinetic-molecular theory to explain the following phenomena:
- a. When 1 mol of a real gas is condensed to a liquid, the volume shrinks by a factor of about 1000.
Molecules in a gas are far apart. They are much closer together in a liquid.
Molecules in a gas are easily squeezed closer together as the gas is compressed.
- b. When a gas in a rigid container is warmed, the pressure on the walls of the container increases.
As the temperature increases, the molecules speed up. Thus, they collide with the walls more frequently than before and with a greater force per impact. For both of these reasons, the total force per unit area increases and the pressure increases.
3. b Which of the following statements about liquids and gases is *not* true?
- (a) Molecules in a liquid are much more closely packed than molecules in a gas.
 - (b) Molecules in a liquid can vibrate and rotate, but they are bound in fixed positions.
 - (c) Liquids are much more difficult to compress into a smaller volume than are gases.
 - (d) Liquids diffuse more slowly than gases.
4. Answer *solid* or *liquid* to the following questions:
- solid a. Which is less compressible?
- liquid b. Which is quicker to diffuse into neighboring media?
- solid c. Which has a definite volume and shape?
- solid d. Which has molecules that are rotating or vibrating primarily in place?

MIXED REVIEW continued

5. Explain why almost all solids are denser than their liquid states by describing what is occurring at the molecular level.

In solids, particles are more closely packed than in liquids, due to stronger attractive forces between the particles of the solid.

6. A general equilibrium equation for boiling is



Indicate whether the forward or reverse reaction is favored in each of the following cases:

forward reaction a. The temperature of the system is increased.

reverse reaction b. More molecules of the vapor are added to the system.

reverse reaction c. The pressure on the system is increased.

7. 181 kJ Freon-11, CCl_3F has been commonly used in air conditioners. It has a molar mass of 137.35 g/mol and its enthalpy of vaporization is 24.8 kJ/mol at its normal boiling point of 24°C . Ideally how much energy in the form of heat is removed from a room by an air conditioner that evaporates 1.00 kg of freon-11?

8. Use the data table below to answer the following:

Composition	Molar mass (g/mol)	Enthalpy vaporization (kJ/mol)	Normal boiling point ($^\circ\text{C}$)	Critical temperature ($^\circ\text{C}$)
He	4	0.08	-269	-268
Ne	20	1.8	-246	-229
Ar	40	6.5	-186	-122
Xe	131	12.6	-107	+17
H_2O	18	40.8	+100	+374
HF	20	25.2	+20	+188
CH_4	16	8.9	-161	-82
C_2H_6	30	15.7	-89	+32

higher a. Among *nonpolar* liquids, those with higher molar masses tend to have normal boiling points that are (higher, lower, or about the same).

higher b. Among compounds of approximately the same molar mass, those with greater polarities tend to have enthalpies of vaporization that are (higher, lower, or about the same).

- c. Which is the only noble gas listed that is stable as a liquid at 0°C ? Explain your answer using the concept of critical temperature.

Xe; a substance can exist only as a gas at temperatures above its critical temperature.

Of the noble gases listed, only Xe has a critical temperature above 0°C .

CHAPTER 11 REVIEW*Gases***MIXED REVIEW****SHORT ANSWER** Answer the following questions in the space provided.

1. Consider the following data table:

Approximate pressure (kPa)	Altitude above sea level (km)
100	0 (sea level)
50	5.5 (peak of Mt. Kilimanjaro)
25	11 (jet cruising altitude)
< 0.1	22 (ozone layer)

- a. Explain briefly why the pressure decreases as the altitude increases.

As the altitude increases, there are fewer gas molecules above; therefore, there are fewer gas molecules to exert their pressure.

- b. A few places on Earth are below sea level (the Dead Sea, for example). What would be true about the average atmospheric pressure there?

It would exceed 100 kPa at places below sea level.

2. Explain how the ideal gas law can be simplified to give Avogadro's law, expressed as
- $\frac{V}{n} = k$
- , when the pressure and temperature of a gas are held constant.

Rearrange $PV = nRT$ to obtain $\frac{V}{n} = \frac{RT}{P}$. Because every value for $\frac{RT}{P}$ is the same, its overall value is constant; therefore, $\frac{V}{n} = k$.

PROBLEMS Write the answer on the line to the left. Show all your work in the space provided.

3. Convert a pressure of 0.400 atm to the following units:

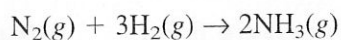
304 a. torr

4.05×10^4 b. Pa

MIXED REVIEW continued

4. 226 mL A 250. mL sample of gas is collected at 57°C. What volume will the gas sample occupy at 25°C?

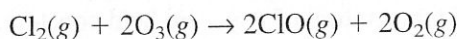
5. 0.7 L H₂ reacts according to the following equation representing the synthesis of ammonia gas:



If 1 L of H₂ is consumed, what volume of ammonia will be produced at constant temperature and pressure, based on Gay-Lussac's law of combining volumes?

6. 3.15×10^3 kPa A 7.00 L sample of argon gas at 420. K exerts a pressure of 625 kPa. If the gas is compressed to 1.25 L and the temperature is lowered to 350. K, what will be its new pressure?

7. 2.1×10^3 L Chlorine in the upper atmosphere can destroy ozone molecules, O₃. The reaction can be represented by the following equation:



How many liters of ozone can be destroyed at 220. K and 5.0 kPa if 200.0 g of chlorine gas react with it?

8. 32 g/mol A gas of unknown molar mass is observed to effuse through a small hole at one-fourth the effusion rate of hydrogen. Estimate the molar mass of this gas. (Round the molar mass of hydrogen to two significant figures.)

CHAPTER 12 REVIEW*Solutions***MIXED REVIEW**

SHORT ANSWER Answer the following questions in the space provided.

1. Solid CaCl_2 does not conduct electricity. Explain why it is considered to be an electrolyte.

CaCl_2 is an ionic solid. In the crystal form, its ions are locked in position. Dissolving the crystal in water releases the ions to move freely, allowing them to conduct electricity.

2. Explain the following statements at the molecular level:

a. Generally, a polar liquid and a nonpolar liquid are immiscible.

Polar molecules tend to attract one another, forcing the nonpolar molecules to remain in a separate layer.

b. Carbonated soft drinks taste flat when they warm up.

The solubility of gases usually decreases as the temperature of the solution increases.

At higher temperatures, more CO_2 molecules escape through the liquid's surface,

leaving fewer molecules in solution to effervesce.

3. An unknown compound is observed to mix with toluene, $\text{C}_6\text{H}_5\text{CH}_3$, but not with water.

a. Is the unknown compound ionic, polar covalent, or nonpolar covalent? Explain your answer.

nonpolar covalent, because it mixes with nonpolar toluene and not with polar water

b. Suppose the unknown compound is also a liquid. Will it be able to dissolve table salt? Explain why or why not.

No; being nonpolar, the solvent molecules are unable to remove ions from sodium chloride's crystal surfaces.

MIXED REVIEW continued

PROBLEMS Write the answer on the line to the left. Show all your work in the space provided.

4. Consider 500. mL of a 0.30 M CuSO_4 solution.

0.15 mol

- a. How many moles of solute are present in this solution?

24 g

- b. How many grams of solute were used to prepare this solution?

5. a. If a solution is electrically neutral, can all of its ions have the same type of charge? Explain your answer.

No; to be neutral the total positive charge must equal the total negative charge.

6.0×10^{13} ions

- b. The concentration of the OH^- ions in pure water is known to be 1.0×10^{-7} M. How many OH^- ions are present in each milliliter of pure water?

6. 90. g of CaBr_2 are dissolved in 900. g of water.

900. mL

- a. What volume does the 900. g of water occupy if its density is 1.00 g/mL?

0.50 m

- b. What is the molality of this solution?

CHAPTER 13 REVIEW*Ions in Aqueous Solutions and Colligative Properties***MIXED REVIEW****SHORT ANSWER** Answer the following questions in the space provided.

1. Match the four compounds on the right to their descriptions on the left.

<u> b </u> an ionic compound that is quite soluble in water	(a) HCl
<u> c </u> an ionic compound that is not very soluble in water	(b) NaNO ₃
<u> a </u> a molecular compound that ionizes in water	(c) AgCl
<u> d </u> a molecular compound that does not ionize in water	(d) C ₂ H ₅ OH

2. Consider nonvolatile nonelectrolytes dissolved in various liquid solvents to complete the following statements:

<u> solute </u>	a. The change in the boiling point does <i>not</i> vary with the identity of the ____ (solute, solvent), assuming all other factors remain constant.
<u> solvent </u>	b. The change in the boiling point varies with the identity of the ____ (solute, solvent), assuming all other factors remain constant.
<u> increases </u>	c. The change in the boiling point becomes greater as the concentration of the solute in solution ____ (increases, decreases).

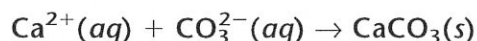
3. a. Name two compounds in solution that could be combined to cause the formation of a calcium carbonate precipitate.

Answers will vary; any soluble calcium salt mixed with any soluble carbonate will form the precipitate. One example is calcium nitrate with sodium carbonate.

- b. Identify any spectator ions in the system you described in part a.

In the example given, sodium and nitrate ions are spectator ions.

- c. Write the net ionic equation for the formation of calcium carbonate.



4. Explain why applying rock salt (impure NaCl) to an icy sidewalk hastens the melting process.

The vapor pressure of the NaCl solution that forms is lower than the vapor pressure of pure water at 0°C. The lower vapor pressure of the NaCl solution results in a lower freezing point.

MIXED REVIEW continued

PROBLEMS Write the answer on the line to the left. Show all your work in the space provided.

5. 13.4 m Some insects survive cold winters by generating an antifreeze inside their cells. The antifreeze produced is glycerol, $C_3H_5(OH)_3$, a nonvolatile nonelectrolyte that is quite soluble in water. What must the molality of a glycerol solution be to lower the freezing point of water to -25.0°C ?
6. 2.14 g How many grams of methanol, CH_3OH , should be added to 200. g of acetic acid to lower its freezing point by 1.30°C ? Refer to **Table 2** on page 448 of the text for any necessary data.
7. 0.67 m The boiling point of a solution of glucose, $C_6H_{12}O_6$, and water was recorded to be 100.34°C . Calculate the molality of this solution.
8. $HF(aq)$ is a weak acid. A 0.05 mol sample of HF is added to 1.0 kg of water.
- a. Write the equation for the ionization of HF to form hydronium ions.
- $HF(aq) + H_2O(l) \rightarrow H_3O^+(aq) + F^-(aq)$
- 0.10 mol b. If HF became 100% ionized, how many moles of its ions would be released?
9. c Which solution has the highest osmotic pressure?
- a. 0.1 m glucose
 b. 0.1 m sucrose
 c. 0.5 m glucose
 d. 0.2 m sucrose

CHAPTER 14 REVIEW*Acids and Bases***MIXED REVIEW****SHORT ANSWER** Answer the following questions in the space provided.

1. HClO a. Write the formula for hypochlorous acid.
 hydrofluoric acid b. Write the name for HF(aq).
 H₂C₂O₄ c. If Pb(C₂O₄)₂ is lead(IV) oxalate, what is the formula
for oxalic acid?
 acetic acid d. Name the acid that is present in vinegar.

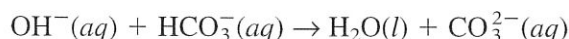
2. Answer the following questions according to the Brønsted-Lowry acid-base theory. Consult **Table 6** on page 485 of the text as needed.

 HS⁻ a. What is the conjugate base of H₂S?

 PO₄³⁻ b. What is the conjugate base of HPO₄²⁻?

 NH₄⁺ c. What is the conjugate acid of NH₃?

3. Consider the reaction represented by the following equation:



If OH⁻ is considered base 1, what are acid 1, acid 2, and base 2?

 H₂O a. acid 1

 HCO₃⁻ b. acid 2

 CO₃²⁻ c. base 2

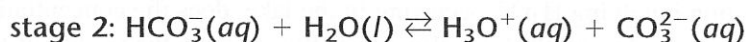
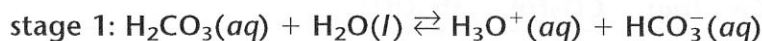
4. Write the formula for the salt that is produced in each of the following neutralization reactions:

 K₂SO₃ a. sulfurous acid combined with potassium hydroxide

 Ca₃(PO₄)₂ b. calcium hydroxide combined with phosphoric acid

5. Carbonic acid releases H₃O⁺ ions into water in two stages.

a. Write equations representing each stage.



 stage 1 b. Which stage releases more ions into solution?

MIXED REVIEW continued

6. Glacial acetic acid is a highly viscous liquid that is close to 100% CH_3COOH . When it mixes with water, it forms dilute acetic acid.

- a. When making a dilute acid solution, should you add acid to water or water to acid? Explain your answer.

Add acid to water to achieve a thorough mixing of a denser acid with a slow release of heat and to avoid splashing concentrated acid.

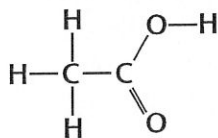
- b. Glacial acetic acid does not conduct electricity, but dilute acetic acid does. Explain this statement.

Glacial acetic acid exists as neutral molecules. In the presence of water, some of those molecules ionize into H^+ and CH_3COO^- , which cause the solution to conduct electricity.

- c. Dilute acetic acid does not conduct electricity as well as dilute nitric acid at the same concentration. Is acetic acid a strong or weak acid?

weak

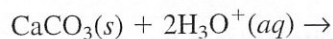
- d. Although there are four H atoms per molecule, acetic acid is monoprotic. Show the structural formula for CH_3COOH , and indicate the H atom that ionizes.



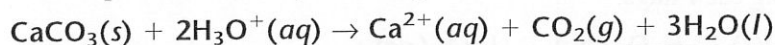
The H bonded to the O ionizes.

- e. 30. g How many grams of glacial acetic acid should be used to make 250 mL of 2.00 M acetic acid? Show all your work.

7. The overall effect of acid rain on lakes and ponds is partially determined by the geology of the lake bed. In some cases, the rock is limestone, which is rich in calcium carbonate. Calcium carbonate reacts with the acid in lake water according to the following (incomplete) ionic equation:



- a. Complete the ionic equation begun above.



- b. If this reaction is the only reaction involving H_3O^+ occurring in the lake, does the concentration of H_3O^+ in the lake water increase or decrease? What effect does this have on the acidity of the lake water?

It decreases, making the lake water less acidic.

CHAPTER 15 REVIEW*Acid-Base Titration and pH***MIXED REVIEW****SHORT ANSWER** Answer the following questions in the space provided.

1. Calculate the following values without using a calculator.

4.0 a. The $[\text{H}_3\text{O}^+]$ in a solution is 1×10^{-4} M. Calculate the pH. 1×10^{-13} M b. The pH of a solution is 13.0. Calculate the $[\text{H}_3\text{O}^+]$. 1×10^{-9} M c. The $[\text{OH}^-]$ in a solution is 1×10^{-5} M. Calculate the $[\text{H}_3\text{O}^+]$.9.28 d. The pH of a solution is 4.72. Calculate the pOH.14.00 e. The $[\text{OH}^-]$ in a solution is 1.0 M. Calculate the pH.

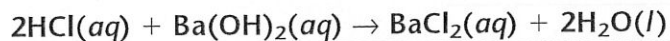
2. Calculate the following values.

8.204 a. The $[\text{H}_3\text{O}^+]$ in a solution is 6.25×10^{-9} M. Calculate the pH. 4.6×10^{-3} M b. The pOH of a solution is 2.34. Calculate the $[\text{OH}^-]$. 3×10^{-4} M c. The pH of milk of magnesia is approximately 10.5. Calculate the $[\text{OH}^-]$.**PROBLEMS** Write the answer on the line to the left. Show all your work in the space provided.3. A 0.0012 M solution of H_2SO_4 is 100% ionized.0.0024 M a. What is the $[\text{H}_3\text{O}^+]$ in the H_2SO_4 solution? 4.2×10^{-12} M b. What is the $[\text{OH}^-]$ in this solution?2.62 c. What is the pH of this solution?

MIXED REVIEW continued

4. In a titration, a 25.0 mL sample of 0.150 M HCl is neutralized with 44.45 mL of Ba(OH)₂.

a. Write the balanced molecular equation for this reaction.



0.0422 M

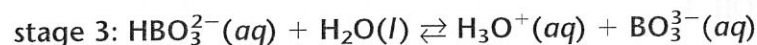
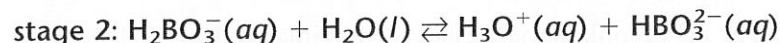
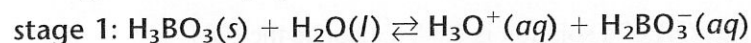
b. What is the molarity of the base solution?

5. 3.09 g of boric acid, H₃BO₃, are dissolved in 200 mL of solution.

0.250 M

a. Calculate the molarity of the solution.

b. H₃BO₃ ionizes in solution in three stages. Write the equation showing the ionization for each stage. Which stage proceeds furthest to completion?



Stage 1 proceeds furthest to completion.

$1.3 \times 10^{-5} \text{ M}$

c. What is the [H₃O⁺] in this boric acid solution if the pH = 4.90?

less than 1%

d. Is the percentage ionization of this H₃BO₃ solution more than or less than 1%?