

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

1. \_\_\_\_\_ 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. \_\_\_\_\_ 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.  $\text{Ba}(\text{NO}_3)_2(\text{aq}) + \text{Na}_3\text{PO}_4(\text{aq}) \rightarrow$
- \_\_\_\_\_
- \_\_\_\_\_
- b.  $\text{Al}(\text{s}) + \text{O}_2(\text{g}) \rightarrow$
- \_\_\_\_\_
- \_\_\_\_\_
- c.  $\text{I}_2(\text{s}) + \text{NaBr}(\text{aq}) \rightarrow$
- \_\_\_\_\_
- \_\_\_\_\_
- d.  $\text{C}_3\text{H}_4(\text{g}) + \text{O}_2(\text{g}) \rightarrow$
- \_\_\_\_\_
- \_\_\_\_\_



**CHAPTER 9 REVIEW*****Stoichiometry*****MIXED REVIEW****SHORT ANSWER** Answer the following questions in the space provided.**1.** Given the following equation:  $C_3H_4(g) + xO_2(g) \rightarrow 3CO_2(g) + 2H_2O(g)$ 

- \_\_\_\_\_ a. What is the value of the coefficient  $x$  in this equation?
- \_\_\_\_\_ b. What is the molar mass of  $C_3H_4$ ?
- \_\_\_\_\_ c. What is the mole ratio of  $O_2$  to  $H_2O$  in the above equation?
- \_\_\_\_\_ d. How many moles are in an 8.0 g sample of  $C_3H_4$ ?
- \_\_\_\_\_ 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?

\_\_\_\_\_

\_\_\_\_\_

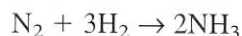
**b.** What function do ideal stoichiometric calculations serve?

\_\_\_\_\_

\_\_\_\_\_

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

\_\_\_\_\_

**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:

- \_\_\_\_\_ a. If 6 mol of  $H_2$  are consumed, how many moles of  $NH_3$  are produced?
- \_\_\_\_\_ b. How many grams are in a sample of  $NH_3$  that contains  $3.0 \times 10^{23}$  molecules?

**MIXED REVIEW** continued

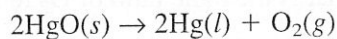
- c. If 0.1 mol of  $N_2$  combine with  $H_2$ , what must be true about the quantity of  $H_2$  for  $N_2$  to be the limiting reactant?

---

---

4. \_\_\_\_\_ 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:



- \_\_\_\_\_ a. If 15.0 g  $\text{HgO}$  decompose, how many moles of  $\text{HgO}$  does this represent?

- \_\_\_\_\_ b. How many moles of  $\text{O}_2$  are theoretically produced?

- \_\_\_\_\_ c. How many grams of  $\text{O}_2$  is this?

- \_\_\_\_\_ d. If the density of  $\text{O}_2$  gas is 1.41 g/L, how many liters of  $\text{O}_2$  are produced?

- \_\_\_\_\_ e. If the percentage yield is 95.0%, how many grams of  $\text{O}_2$  are actually collected?

## CHAPTER 10 REVIEW

### *States of Matter*

#### MIXED REVIEW

**SHORT ANSWER** Answer the following questions in the space provided.

- \_\_\_\_\_ The average speed of a gas molecule is most directly related to the
  - polarity of the molecule.
  - pressure of the gas.
  - temperature of the gas.
  - number of moles in the sample.
  
- Use the kinetic-molecular theory to explain the following phenomena:
  - When 1 mol of a real gas is condensed to a liquid, the volume shrinks by a factor of about 1000.  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_
  - When a gas in a rigid container is warmed, the pressure on the walls of the container increases.  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_
  
- \_\_\_\_\_ Which of the following statements about liquids and gases is *not* true?
  - Molecules in a liquid are much more closely packed than molecules in a gas.
  - Molecules in a liquid can vibrate and rotate, but they are bound in fixed positions.
  - Liquids are much more difficult to compress into a smaller volume than are gases.
  - Liquids diffuse more slowly than gases.
  
- Answer *solid* or *liquid* to the following questions:
  - \_\_\_\_\_ a. Which is less compressible?
  - \_\_\_\_\_ b. Which is quicker to diffuse into neighboring media?
  - \_\_\_\_\_ c. Which has a definite volume and shape?
  - \_\_\_\_\_ d. Which has molecules that are rotating or vibrating primarily in place?

**MIXED REVIEW** continued

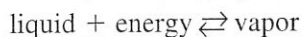
5. Explain why almost all solids are denser than their liquid states by describing what is occurring at the molecular level.

---



---

6. A general equilibrium equation for boiling is



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

- \_\_\_\_\_ a. The temperature of the system is increased.
- \_\_\_\_\_ b. More molecules of the vapor are added to the system.
- \_\_\_\_\_ c. The pressure on the system is increased.
7. \_\_\_\_\_ Freon-11,  $\text{CCl}_3\text{F}$  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  $24^\circ\text{C}$ . 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
$\text{H}_2\text{O}$	18	40.8	+100	+374
HF	20	25.2	+20	+188
$\text{CH}_4$	16	8.9	-161	-82
$\text{C}_2\text{H}_6$	30	15.7	-89	+32

- \_\_\_\_\_ a. Among *nonpolar* liquids, those with higher molar masses tend to have normal boiling points that are (higher, lower, or about the same).
- \_\_\_\_\_ 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  $0^\circ\text{C}$ ? Explain your answer using the concept of critical temperature.

---



---

**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.

---

---

- 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?

---

---

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.

---

---

---

**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:

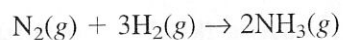
\_\_\_\_\_ a. torr

\_\_\_\_\_ b. Pa

**MIXED REVIEW** continued

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

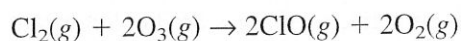
5. \_\_\_\_\_ H<sub>2</sub> reacts according to the following equation representing the synthesis of ammonia gas:



If 1 L of H<sub>2</sub> is consumed, what volume of ammonia will be produced at constant temperature and pressure, based on Gay-Lussac's law of combining volumes?

6. \_\_\_\_\_ 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. \_\_\_\_\_ Chlorine in the upper atmosphere can destroy ozone molecules, O<sub>3</sub>. 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. \_\_\_\_\_ 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  $\text{CaCl}_2$  does not conduct electricity. Explain why it is considered to be an electrolyte.

---

---

---

2. Explain the following statements at the molecular level:

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

---

---

---

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

---

---

---

---

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.

---

---

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

---

---

---

**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  $\text{CuSO}_4$  solution.

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

\_\_\_\_\_ 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.

\_\_\_\_\_  
\_\_\_\_\_

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

6. 90. g of  $\text{CaBr}_2$  are dissolved in 900. g of water.

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

\_\_\_\_\_ 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.

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

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

\_\_\_\_\_ a. The change in the boiling point does *not* vary with the identity of the \_\_\_\_\_ (solute, solvent), assuming all other factors remain constant.

\_\_\_\_\_ b. The change in the boiling point varies with the identity of the \_\_\_\_\_ (solute, solvent), assuming all other factors remain constant.

\_\_\_\_\_ 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.

\_\_\_\_\_

\_\_\_\_\_

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

\_\_\_\_\_

\_\_\_\_\_

- 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.

\_\_\_\_\_

\_\_\_\_\_

**MIXED REVIEW** continued

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

5. \_\_\_\_\_ 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  $-25.0^\circ C$ ?
6. \_\_\_\_\_ How many grams of methanol,  $CH_3OH$ , should be added to 200. g of acetic acid to lower its freezing point by  $1.30^\circ C$ ? Refer to **Table 2** on page 448 of the text for any necessary data.
7. \_\_\_\_\_ The boiling point of a solution of glucose,  $C_6H_{12}O_6$ , and water was recorded to be  $100.34^\circ C$ . 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.
- \_\_\_\_\_
- \_\_\_\_\_ b. If HF became 100% ionized, how many moles of its ions would be released?
9. \_\_\_\_\_ 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

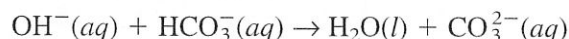
**CHAPTER 14 REVIEW***Acids and Bases***MIXED REVIEW****SHORT ANSWER** Answer the following questions in the space provided.

1. \_\_\_\_\_ a. Write the formula for hypochlorous acid.  
\_\_\_\_\_ b. Write the name for HF(aq).  
\_\_\_\_\_ c. If Pb(C<sub>2</sub>O<sub>4</sub>)<sub>2</sub> is lead(IV) oxalate, what is the formula for oxalic 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.

- \_\_\_\_\_ a. What is the conjugate base of H<sub>2</sub>S?  
\_\_\_\_\_ b. What is the conjugate base of HPO<sub>4</sub><sup>2-</sup>?  
\_\_\_\_\_ c. What is the conjugate acid of NH<sub>3</sub>?

3. Consider the reaction represented by the following equation:



If OH<sup>-</sup> is considered base 1, what are acid 1, acid 2, and base 2?

- \_\_\_\_\_ a. acid 1  
\_\_\_\_\_ b. acid 2  
\_\_\_\_\_ c. base 2
4. Write the formula for the salt that is produced in each of the following neutralization reactions:
- \_\_\_\_\_ a. sulfurous acid combined with potassium hydroxide  
\_\_\_\_\_ b. calcium hydroxide combined with phosphoric acid
5. Carbonic acid releases H<sub>3</sub>O<sup>+</sup> ions into water in two stages.
- a. Write equations representing each stage.
- \_\_\_\_\_
- \_\_\_\_\_
- \_\_\_\_\_ 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%  $\text{CH}_3\text{COOH}$ . 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.

---

---

---

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

---

---

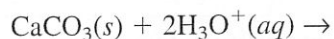
---

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?

d. Although there are four H atoms per molecule, acetic acid is monoprotic. Show the structural formula for  $\text{CH}_3\text{COOH}$ , and indicate the H atom that ionizes.

e. \_\_\_\_\_ 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  $\text{H}_3\text{O}^+$  occurring in the lake, does the concentration of  $\text{H}_3\text{O}^+$  in the lake water increase or decrease? What effect does this have on the acidity of the lake water?

---

**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.\_\_\_\_\_ a. The  $[\text{H}_3\text{O}^+]$  in a solution is  $1 \times 10^{-4}$  M. Calculate the pH.\_\_\_\_\_ b. The pH of a solution is 13.0. Calculate the  $[\text{H}_3\text{O}^+]$ .\_\_\_\_\_ c. The  $[\text{OH}^-]$  in a solution is  $1 \times 10^{-5}$  M. Calculate the  $[\text{H}_3\text{O}^+]$ .

\_\_\_\_\_ d. The pH of a solution is 4.72. Calculate the pOH.

\_\_\_\_\_ e. The  $[\text{OH}^-]$  in a solution is 1.0 M. Calculate the pH.**2.** Calculate the following values.\_\_\_\_\_ a. The  $[\text{H}_3\text{O}^+]$  in a solution is  $6.25 \times 10^{-9}$  M. Calculate the pH.\_\_\_\_\_ b. The pOH of a solution is 2.34. Calculate the  $[\text{OH}^-]$ .\_\_\_\_\_ 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  $\text{H}_2\text{SO}_4$  is 100% ionized.\_\_\_\_\_ a. What is the  $[\text{H}_3\text{O}^+]$  in the  $\text{H}_2\text{SO}_4$  solution?\_\_\_\_\_ b. What is the  $[\text{OH}^-]$  in this solution?

\_\_\_\_\_ 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)<sub>2</sub>.

a. Write the balanced molecular equation for this reaction.

\_\_\_\_\_

\_\_\_\_\_ b. What is the molarity of the base solution?

5. 3.09 g of boric acid, H<sub>3</sub>BO<sub>3</sub>, are dissolved in 200 mL of solution.

\_\_\_\_\_ a. Calculate the molarity of the solution.

b. H<sub>3</sub>BO<sub>3</sub> ionizes in solution in three stages. Write the equation showing the ionization for each stage. Which stage proceeds furthest to completion?

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

\_\_\_\_\_ c. What is the [H<sub>3</sub>O<sup>+</sup>] in this boric acid solution if the pH = 4.90?

\_\_\_\_\_ d. Is the percentage ionization of this H<sub>3</sub>BO<sub>3</sub> solution more than or less than 1%?