Multiple Choice

1. 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.

Chapter menu Resources

Multiple Choice

2. To balance a chemical equation, you may adjust the

   A. coefficients.

   B. subscripts.

   C. formulas of the products.

   D. either the coefficients or the subscripts.

Chapter menu Resources

Multiple Choice

3. Which is the correct chemical equation for the following formula equation:
   $(NH_4)_2S \longrightarrow NH_3 + H_2S$?

   A. $2(NH_4)_2S \longrightarrow 2NH_3 + H_2S_2$

   B. $2(NH_4)_2S \longrightarrow 2NH_3 + H_2S$

   C. $(NH_4)_2S \longrightarrow 2NH_3 + H_2S$

   D. None of the above

Chapter menu Resources

Multiple Choice

4. Select the missing reactant(s) for the double-displacement reaction that produces PF_5 and $AsCl_3$.

   A. PCl_5 and AsF_3

   B. PCl_3 and AsF_5

   C. PCl_3 and AsF_3

   D. None of the above

Chapter menu Resources

Multiple Choice

5. Select the missing reactant for the following combustion reaction: 2_____ + $15O_2 \longrightarrow$ $14CO_2 + 6H_2O$.

   A. $C_{14}H_{12}$

   B. $C_{14}H_{12}O_4$

   C. C_7H_6

   D. $C_7H_6O_2$

Chapter menu Resources

Multiple Choice

6. A mixture consists of Ag, Pb, and Fe metals. Which of these metals will react with $ZnCl_2$?

   A. Ag(s)

   B. Pb(s)

   C. Fe(s)

   D. None of these metals

Chapter menu Resources

Multiple Choice

7. Which of the following statements is true about the reaction $2F_2 + 2H_2O \longrightarrow 4HF + O_2$?

   A. Two grams of O_2 are produced when 2 g F_2 reacts with 2 g H_2O.
   B. Two moles of HF are produced when 1 mol F_2 reacts with 1 mol H_2O.
   C. For every 2 mol O_2 produced, 6 mol HF are produced.
   D. For every 1 mol H_2O that reacts, 2 mol O_2 are produced.

Short Answer

8. Determine the products and write a balanced equation for the reaction of solid magnesium and water.

Short Answer

9. A precipitation of iron(III) hydroxide is produced by reacting an aqueous solution of iron(III) chloride with an aqueous solution of sodium hydroxide. Write a balanced chemical equation.

Extended Response

10. List the hypothetical metals A, E, M, and R in increasing order of reactivity by using the reaction data in the table below. The reaction of interest is of the form $C + ZX \longrightarrow CX + Z$. Explain your reasoning.

	AX	EX	MX	RX
A	_____	no reaction	reaction	no reaction
E	reaction	_____	reaction	reaction
M	no reaction	no reaction	_____	no reaction
R	reaction	no reaction	reaction	_____

Extended Response

11. Calcium hypochlorite, $Ca(OCl)_2$, is a bleaching agent produced from sodium hydroxide, calcium hydroxide, and chlorine. Sodium chloride and water are also produced in the reaction. Write the balanced chemical equation. If 2 mol NaOH react, how many moles of calcium hypochlorite can be produced?

Multiple Choice

1. In stoichiometry, chemists are mainly concerned with

A. the types of bonds found in compounds.
B. mass relationships in chemical reactions.
C. energy changes occurring in chemical reactions.
D. the speed with which chemical reactions occur.

Multiple Choice

2. Assume ideal stoichiometry in the reaction $CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$. If you know the mass of CH_4, you can calculate

A. only the mass of CO_2 produced.
B. only the mass of O_2 reacting.
C. only the mass of $CO_2 + H_2O$ produced.
D. the mass of O_2 reacting and $CO_2 + H_2O$ produced.

Multiple Choice

3. Which mole ratio for the equation $6Li + N_2 \rightarrow 2Li_3N$ is incorrect?

A. $\frac{6 \text{ mol Li}}{2 \text{ mol } N_2}$

B. $\frac{1 \text{ mol } N_2}{6 \text{ mol Li}}$

C. $\frac{2 \text{ mol } Li_3N}{1 \text{ mol } N_2}$

D. $\frac{2 \text{ mol } Li_3N}{6 \text{ mol Li}}$

Multiple Choice

4. For the reaction below, how many moles of N_2 are required to produce 18 mol NH_3?

$$N_2 + 3H_2 \rightarrow 2NH_3$$

A. 4.5
B. 9.0
C. 18
D. 36

Multiple Choice

5. What mass of NaCl can be produced by the reaction of 0.75 mol Cl_2?

$$2Na + Cl_2 \rightarrow 2NaCl$$

A. 0.75 g
B. 1.5 g
C. 44 g
D. 88 g

Multiple Choice

6. What mass of CO_2 can be produced from 25.0 g $CaCO_3$ given the decomposition reaction

$$CaCO_3 \rightarrow CaO + CO_2$$

A. 11.0 g
B. 22.0 g
C. 25.0 g
D. 56.0 g

Multiple Choice

7. If a chemical reaction involving substances A and B stops when B is completely used up, then B is referred to as the

A. excess reactant.
B. primary reactant.
C. limiting reactant.
D. primary product.

Multiple Choice

8. If a chemist calculates the maximum amount of product that could be obtained in a chemical reaction, he or she is calculating the

A. percentage yield.
B. mole ratio.
C. theoretical yield.
D. actual yield.

Multiple Choice

9. What is the maximum number of moles of $AlCl_3$ that can be produced from 5.0 mol Al and 6.0 mol Cl_2?

$$2Al + 3Cl_2 \rightarrow 2AlCl_3$$

A. 2.0 mol $AlCl_3$
B. 4.0 mol $AlCl_3$
C. 5.0 mol $AlCl_3$
D. 6.0 mol $AlCl_3$

Short Answer

10. Why is a balanced equation necessary to solve a mass-mass stoichiometry problem?

Extended Response

12. A student makes a compound in the laboratory and reports an actual yield of 120%. Is this result possible? Assuming that all masses were measured correctly, give an explanation.

Extended Response

13. Benzene, C_6H_6, is reacted with bromine, Br_2, to produce bromobenzene, C_6H_5Br, and hydrogen bromide, HBr, as shown below. When 40.0 g of benzene are reacted with 95.0 g of bromine, 65.0 g of bromobenzene is produced.

$$C_6H_6 + Br_2 \rightarrow C_6H_5Br + HBr$$

a. Which compound is the limiting reactant?
b. What is the theoretical yield of bromobenzene?
c. What is the reactant in excess, and how much remains after the reaction is completed?
d. What is the percentage yield?

Multiple Choice

1. Surface tension is

   A. skin on the surface of a liquid.

   B. the tendency of the surface of liquids to decrease the area.

   C. the spontaneous mixing of two substances.

   D. the same as vapor pressure.

Multiple Choice

2. Pure liquids boil at higher temperatures under high pressures than they do under low pressures, because

   A. the molecules of liquid are closer together under higher pressures.

   B. it takes a higher temperature for the vapor pressure to equal the higher external pressure.

   C. the molecules of vapor are farther apart under higher pressures.

   D. the vapor diffuses more rapidly at higher pressures.

Multiple Choice

3. The formation of frost is an example of

   A. condensation.

   B. evaporation.

   C. deposition.

   D. melting point.

Multiple Choice

4. The graph that shows the pressure and temperature conditions under which the phases of a substance exist is called

   A. a phase diagram.

   B. a vapor pressure curve.

   C. a unit cell.

   D. the kinetic-molecular theory of matter.

Multiple Choice

5. Water boils at 100°C. Ethanol boils at 78.5°C. Which of the following statements is true?

   A. Water has the higher vapor pressure at 78.5°C.

   B. Ethanol has the higher vapor pressure at 78.5°C.

   C. Both have the same vapor pressure at 78.5°C.

   D. Vapor pressure is not related to boiling point.

Multiple Choice

6. Which of the following is not a property of typical solids?

   A. definite melting point

   B. high density

   C. easily compressible

   D. low rate of diffusion

Multiple Choice

7. The kinetic-molecular theory states that ideal gas molecules

   A. are in constant, rapid, random motion.

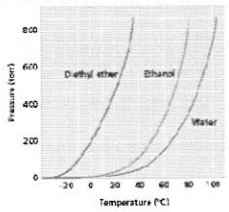
   B. have mass and take up space.

   C. exert forces of attraction and repulsion on each other.

   D. have high densities compared with liquids and solids.

Short Answer

8. Using this graph of vapor pressures of substances at various temperatures, estimate the boiling point of ethanol at an applied (external) pressure of 300 torr.



Short Answer

9. It is found that 60.0 J of energy are required to melt 15 g of a substance. The molar mass of the substance is 120 g/mol. Calculate the enthalpy of fusion of the substance in kilojoules per mole.

Extended Response

10. Describe how a pressure cooker works.

Extended Response

11. What is meant by the statement that a liquid and its vapor in a closed container are in a state of dynamic equilibrium?

Multiple Choice

1. Pressure can be measured in

   A. grams.

   B. meters.

   C. pascals.

   D. liters.

Multiple Choice

2. A sample of oxygen gas has a volume of 150 mL when its pressure is 0.923 atm. If the pressure is increased to 0.987 atm and the temperature remains constant, what will the new volume be?

   A. 140 mL

   B. 160 mL

   C. 200 mL

   D. 240 mL

Multiple Choice

3. What is the pressure exerted by a 0.500 mol sample of nitrogen in a 10.0 L container at 20°C?

   A. 1.2 kPa

   B. 10 kPa

   C. 0.10 kPa

   D. 120 kPa

Multiple Choice

4. A sample of gas in a closed container at a temperature of 100.0°C and 3.0 atm is heated to 300.0°C. What is the pressure of the gas at the higher temperature?

   A. 35 atm

   B. 4.6 atm

   C. 59 atm

   D. 9.0 atm

Multiple Choice

5. An unknown gas effuses twice as fast as CH_4. What is the molar mass of the gas?

   A. 64 g/mol

   B. 32 g/mol

   C. 8 g/mol

   D. 4 g/mol

Multiple Choice

6. If 3 L N_2 and 3 L H_2 are mixed and react according to the equation below, how many liters of unreacted gas remain? Assume temperature and pressure remain constant.

$$N_2(g) + 3H_2(g) \rightarrow 2NH_3(g)$$

   A. 4 L

   B. 3 L

   C. 2 L

   D. 1 L

Multiple Choice

7. Avogadro's law states that
   - **A.** equal numbers of moles of gases at the same conditions occupy equal volumes, regardless of the identity of the gases.
   - **B.** at constant pressure, gas volume is directly proportional to absolute temperature.
   - **C.** the volume of a gas is inversely proportional to its amount in moles.
   - **D.** at constant temperature, gas volume is inversely proportional to pressure.

Short Answer

8. Give a molecular explanation for the observation that the pressure of a gas increases when the gas volume is decreased.

Short Answer

9. The graph on the next slide shows a plot of volume versus pressure for a particular gas sample at constant pressure. Answer the following questions by referring to the graph. No calculation is necessary.

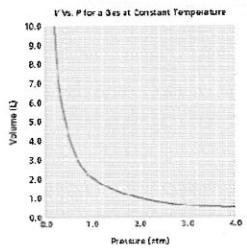
a. What is the volume of this gas sample at standard pressure?

b. What is the volume of this gas sample at 4.0 atm pressure?

c. At what pressure would this gas sample occupy a volume of 5.0 L?

Short Answer

9. *continued*



Extended Response

10. Refer to the plot in question 9. Suppose the same gas sample were heated to a higher temperature and a new graph of *V* versus *P* were plotted. Would the new plot be identical to this one? If not, how would it differ?

Multiple Choice

1. Water is an excellent solvent because

A. it is a covalent compound.
B. it is a nonconductor of electricity.
C. its molecules are quite polar.
D. it is a clear, colorless liquid.

Multiple Choice

2. Two liquids are likely to be immiscible if

A. both have polar molecules.
B. both have nonpolar molecules.
C. one is polar and the other is nonpolar.
D. one is water and the other is methyl alcohol, CH_3OH.

Multiple Choice

3. The solubility of a gas in a liquid would be increased by an

A. addition of an electrolyte.
B. addition of an emulsifier.
C. agitation of the solution.
D. increase in its partial pressure.

Multiple Choice

4. Which of the following types of compounds is most likely to be a strong electrolyte?

A. a polar compound
B. a nonpolar compound
C. a covalent compound
D. an ionic compound

Multiple Choice

5. A saturated solution can become supersaturated under which of the following conditions?

A. It contains electrolytes.
B. The solution is heated and then allowed to cool.
C. More solvent is added.
D. More solute is added.

Multiple Choice

6. Molarity is expressed in units of

A. moles of solute per liter of solution.
B. liters of solution per mole of solute.
C. moles of solute per liter of solvent.
D. liters of solvent per mole of solute.

Multiple Choice

7. What mass of NaOH is contained in 2.5 L of a 0.010 M solution?

A. 0.010 g

B. 1.0 g

C. 2.5 g

D. 0.40 g

Multiple Choice

8. Which one of the following statements is false?

A. Gases are generally more soluble in water under high pressures than under low pressures.

B. As temperature increases, the solubilities of some solids in water increase and the solubilities of other solids in water decrease.

C. Water dissolves many ionic solutes because of its ability to hydrate ions in solution.

D. Many solids dissolve more quickly in a cold solvent than in a warm solvent.

Short Answer

9. Several experiments are carried out to determine the solubility of cadmium iodide, CdI_2, in water. In each experiment, a measured mass of CdI_2 is added to 100 g of water at 25°C and the mixture is stirred. Any undissolved CdI_2 is then filtered off and dried, and its mass is determined. Results for several such experiments are shown in the table on the next slide. What is the solubility of CdI_2 in water at this temperature?

Short Answer

9. *continued*

Mass of CdI_2 added, g	Mass of undissolved CdI_2 recovered, g
17.9	0.0
38.2	0.0
53.6	0.0
79.3	0.0
93.6	7.4
104.3	18.1

Extended Response

10. Explain why oil and water do not mix.

Extended Response

11. Write a set of instructions on how to prepare a solution that is 0.100 M KBr, using solid KBr (molar mass 119 g/mol) as the solute. Your instructions should include a list of all materials and equipment needed.

Multiple Choice

1. Acetic acid is a weak electrolyte because it

   A. is miscible with water.

   B. forms hydronium and hydroxide ions in aqueous solution.

   C. lowers the freezing point of water.

   D. ionizes only slightly in aqueous solution.

Multiple Choice

2. Which of the following solutions would contain the highest concentration of hydronium ions, H_3O^+?

   A. 0.10 M HCl
   B. 0.10 M HF
   C. 0.10 M CH_3COOH
   D. 0.10 M NaCl

Multiple Choice

3. Which of the following is the best representation of the precipitation reaction that occurs when aqueous solutions of sodium carbonate and calcium chloride are mixed?

   A. $Na^+(aq) + Cl^-(aq) \longrightarrow 2NaCl(s)$
   B.
   C.
   D. No precipitation reaction occurs.

Multiple Choice

4. Which of the following is *not* a colligative property?

   A. molality

   B. vapor-pressure lowering

   C. boiling-point elevation

   D. osmotic pressure

Multiple Choice

5. Solution A contains 0.1 mol of sucrose, $C_{12}H_{22}O_{11}$, dissolved in 500 g of water. Solution B contains 0.1 mol of sodium chloride, NaCl, in 500 g of water. Which of the following statements about these solutions is true?

   A. Both solutions have the same vapor pressure.
   B. Solution A would boil at a higher temperature than solution B would.
   C. Solution A would freeze at a higher temperature than solution B would.
   D. Both solutions would boil at the same temperature.

Multiple Choice

The table below shows the freezing points of solutions of three nonvolatile solutes, X,Y, and Z, in water. Refer to the table to answer items 6 and 7. The K_f for water is –1.86°C/*m*.

Solute	Solute (mol)	Water (g)	Freezing point (°C)
X	1.00	1000	–5.58
Y	1.00	1000	–1.86
Z	1.00	1000	–3.72

Multiple Choice

6. Which of the following statements is *not* true?

   A. All three solutes are nonelectrolytes.

   B. Solute X could be $Ca(NO_3)_2$.

   C. Solute Y could be sucrose.

   D. Solute Z could be KCl.

Multiple Choice

7. Which of the solutions described in the table would have the highest boiling point?

   A. the solution of solute X

   B. the solution of solute Y

   C. the solution of solute Z

   D. All three solutions would have the same boiling point.

Short Answer

8. An aqueous solution of an unknown quantity of a nonelectrolyte solute is found to have a freezing point of –0.58°C. What is the molal concentration of the solution?

Short Answer

9. Give the names and formulas of two strong electrolytes.

Short Answer

10. Write the formula equation, the overall ionic equation, and the net ionic equation for the precipitation reaction that occurs when solutions of zinc chloride, $ZnCl_2$, and sodium sulfide, Na_2S, are mixed.

Short Answer

11. Distinguish between dissociation and ionization. Write one chemical equation to illustrate each of these terms.

Multiple Choice

1. Which of the following is not a characteristic of an acid?

A. An acid changes the color of an indicator.
B. An acid has a bitter taste.
C. An acid ionizes in water.
D. An acid produces hydronium ions in water.

Multiple Choice

2. When an acid reacts with an active metal,

A. the hydronium ion concentration increases.
B. the metal forms anions.
C. hydrogen gas is produced.
D. carbon dioxide gas is produced.

Multiple Choice

3. Which of the following is a Brønsted-Lowry base?

A. an electron pair donor
B. an electron pair acceptor
C. a proton donor
D. a proton acceptor

Multiple Choice

4. Which acid is the most commonly produced industrial chemical?

A. hydrochloric acid
B. acetic acid
C. nitric acid
D. sulfuric acid

Multiple Choice

5. Which of the following is a conjugate pair?

A. H^+ and OH^-
B.
C. HCl and Cl^-
D.

Multiple Choice

6. What is the formula for acetic acid?

A. CH_3COOH
B. HNO_3
C. $HClO_4$
D. HCN

Multiple Choice

7. Which of the following species is the conjugate acid of another species in the list?

A.

B. H_3PO_4

C. H_2O

D.

Multiple Choice

8. Identify the salt that forms when a solution of H_2SO_4 is titrated with a solution of $Ca(OH)_2$.

A. calcium sulfate

B. calcium hydroxide

C. calcium oxide

D. calcium phosphate

Multiple Choice

9. Which of the following statements is true for the reaction below?

$$HF(aq) + HPO_4^{2-}(aq) \rightleftharpoons F^-(aq) + H_2PO_4^-(aq)$$

A. HF is the base.

B.

C. F^- is the conjugate base.

D.

Short Answer

10. How does a strong acid differ from a weak acid? Give one example of each.

Short Answer

11. Identify the conjugate acid-base pairs in the following reaction:

$$HClO_2(aq) + NH_3(aq) \rightleftharpoons ClO_2^-(aq) + NH_4^+(aq)$$

Extended Response

13. Write the full equation, ionic equation, and net ionic equation for the neutralization reaction between ammonia and sulfuric acid. Identify the spectator ion(s).

Multiple Choice

1. Distilled water contains

A. H_2O.

B. H_3O^+.

C. OH^-.

D. All of the above

Multiple Choice

2. What is the pH of a 0.0010 M HNO_3?

A. 1.0

B. 3.0

C. 4.0

D. 5.0

Multiple Choice

3. Which of the following solutions would have a pH value greater than 7?

A. $[OH^-] = 2.4 \times 10^{-2}$ M

B. $[H_3O^+] = 1.53 \times 10^{-2}$ M

C. 0.0001 M HCl

D. $[OH^-] = 4.4 \times 10^{-9}$ M

Multiple Choice

4. If the pH of a solution of the strong base NaOH is known, which property of the solution can be calculated?

A. molar concentration

B. $[OH^-]$

C. $[H_3O^+]$

D. All of the above

Multiple Choice

5. A neutral aqueous solution

A. has a 7.0 M H_3O^+ concentration.

B. contains neither hydronium ions nor hydroxide ions.

C. has an equal number of hydronium ions and hydroxide ions.

D. None of the above

Multiple Choice

6. Identify the salt that forms when a solution of H_2SO_4 is titrated with a solution of $Ca(OH)_2$.

A. calcium sulfate

B. calcium hydroxide

C. calcium oxide

D. calcium phosphate

Multiple Choice

7. The pH of a solution is 6.32. What is the pOH?

   A. 6.32

   B. 4.8×10^{-7}

   C. 7.68

   D. 2.1×10^{-8}

Multiple Choice

8. The K_w value for water can be affected by

   A. dissolving a salt in the solution.

   B. changes in temperature.

   C. changes in the hydroxide ion concentration.

   D. the presence of a strong acid

Multiple Choice

9. Which of the pH levels listed below is the most acidic?

   A. pH = 1

   B. pH = 5

   C. pH = 9

   D. pH = 13

Short Answer

10. A solution has a pH of 4.75. What is the hydronium ion concentration? Is the solution acidic or basic?

Extended Response

12. The hydroxide ion concentration in a solution is 1.6×10^{-11} M. What are the $[H_3O^+]$, the pH, and the pOH of the solution?

Extended Response

13. Write the balanced equation and the net ionic equation that represent the reaction that takes place when milk of magnesia (magnesium hydroxide) reacts with hydrochloric acid in your stomach.