Chemistry Review
Unit 3 – Moles / Stoichiometry

Formula Writing, Naming & Writing Chemical Compound Formulas, Chemical Equations, Mole Interpretation, Stoichiometry

Moles and Stoichiometry

1. A compound is a substance composed of two or more different elements that are chemically combined in a fixed proportion. A chemical compound can only be broken down by chemical means.

2. Chemical compounds can be represented by a specific formula and assigned a name based on the IUPAC system.

3. Types of chemical formulas include empirical, molecular, and structural.

- ✓ Empirical formulas show elements in their simplest whole number ratios. This may or may not be the same as the molecular formula.
- ✓ Molecular formulas show the actual number of atoms per element in a single molecule.
- ✓ Structural formulas show the number of each type of atom as well as their physical arrangement.

4. All chemical reactions show a conservation of mass, energy and charge.

5. A balanced chemical equation represents conservation of atoms.

6. The coefficients in a balanced chemical equation can be used to determine mole ratios in the reaction.

7. The formula mass of a substance is the sum of the atomic masses of its atoms. The molar mass (gram formula mass) equals the mass of one mole of that substance.

8. The percent composition by mass of each element in a compound can be calculated mathematically.

9. Types of chemical reactions include synthesis, decomposition single replacement, and double replacement.

54 Write the empirical formula for the compound C_8H_{18}. [1]

Base your answers to questions 77 through 79 on the information below.

Some dry chemicals can be used to put out forest fires. One of these chemicals is $NaHCO_3$. When $NaHCO_3(s)$ is heated, one of the products is $CO_2(g)$, as shown in the balanced equation below.

$$2NaHCO_3(s) + \text{heat} \rightarrow Na_2CO_3(s) + H_2O(g) + CO_2(g)$$

77 In the space *in your answer booklet*, show a correct numerical setup for calculating the percent composition by mass of carbon in the product Na_2CO_3. [1]

78 Identify the type of chemical reaction represented by this equation. [1]

79 Determine the total number of moles of $CO_2(g)$ produced when 7.0 moles of $NaHCO_3(s)$ is completely reacted. [1]

August 2007

10 Given the balanced equation representing a reaction:

$$2CO(g) + O_2(g) \rightarrow 2CO_2(g)$$

What is the mole ratio of $CO(g)$ to $CO_2(g)$ in this reaction?

(1) 1:1
(2) 1:2
(3) 2:1
(4) 3:2

12 Which polyatomic ion contains the greatest number of oxygen atoms?

(1) acetate
(2) carbonate
(3) hydroxide
(4) peroxide

17 What is the total number of different elements present in NH_4NO_3?

(1) 7
(2) 9
(3) 3
(4) 4

35 A compound has a molar mass of 90. grams per mole and the empirical formula CH_2O. What is the molecular formula of this compound?

(1) CH_2O
(2) $C_2H_4O_2$
(3) $C_3H_6O_3$
(4) $C_4H_8O_4$

51 What is the oxidation number of nitrogen in $NO(g)$? [1] **51** _____

Base your answers to questions 70 through 72 on the information below.

Rust on an automobile door contains $Fe_2O_3(s)$. The balanced equation representing one of the reactions between iron in the door of the automobile and oxygen in the atmosphere is given below.

$$4Fe(s) + 3O_2(g) \rightarrow 2Fe_2O_3(s)$$

70 Identify the type of chemical reaction represented by this equation. [1]

71 Determine the gram-formula mass of the product of this reaction. [1]

72 Write the IUPAC name for Fe_2O_3. [1]

70 _____

71 _____ **g/mol**

72 _____

June 2007

7 Which substance can be decomposed by chemical means?

(1) ammonia (3) phosphorus
(2) oxygen (4) silicon

9 What is the name of the polyatomic ion in the compound Na_2O_2?

(1) hydroxide (3) oxide
(2) oxalate (4) peroxide

36 Which formula represents lead(II) chromate?

(1) $PbCrO_4$ (3) Pb_2CrO_4
(2) $Pb(CrO_4)_2$ (4) $Pb_2(CrO_4)_3$

38 Which pair consists of a molecular formula and its corresponding empirical formula?

(1) C_2H_2 and CH_3CH_3 (3) P_4O_{10} and P_2O_5
(2) C_6H_6 and C_2H_2 (4) SO_2 and SO_3

55 Determine the percent composition by mass of oxygen in the compound $C_6H_{12}O_6$. [1] **55** _____ %

Base your answers to questions 59 and 60 on the information below.

The unbalanced equation below represents the decomposition of potassium chlorate.

$$KClO_3(s) \rightarrow KCl(s) + O_2(g)$$

59 Balance the equation *in your answer booklet*, using the smallest whole-number coefficients. [1]

60 Determine the oxidation number of chlorine in the reactant. [1]

59 _____ $KClO_3(s)$ → _____ $KCl(s)$ + _____ $O_2(g)$

60 _____

January 2007

Unit 3 – Moles / Stoichiometry

10 Given the balanced equation representing the reaction between propane and oxygen:

$$C_3H_8 + 5O_2 \rightarrow 3CO_2 + 4H_2O$$

According to this equation, which ratio of oxygen to propane is correct?

(1) $\frac{5 \text{ grams } O_2}{1 \text{ gram } C_3H_8}$ (3) $\frac{10 \text{ grams } O_2}{11 \text{ grams } C_3H_8}$

(2) $\frac{5 \text{ moles } O_2}{1 \text{ mole } C_3H_8}$ (4) $\frac{10 \text{ moles } O_2}{11 \text{ moles } C_3H_8}$

17 Which substance can be decomposed by chemical means?

(1) tungsten (3) krypton
(2) antimony (4) methane

18 Bronze contains 90 to 95 percent copper and 5 to 10 percent tin. Because these percentages can vary, bronze is classified as

(1) a compound (3) a mixture
(2) an element (4) a substance

35 The molar mass of $Ba(OH)_2$ is

(1) 154.3 g (3) 171.3 g
(2) 155.3 g (4) 308.6 g

36 Given the balanced equation representing a reaction:

$$4NH_3 + 5O_2 \rightarrow 4NO + 6H_2O$$

What is the *minimum* number of moles of O_2 that are needed to completely react with 16 moles of NH_3?

(1) 16 mol (3) 64 mol
(2) 20. mol (4) 80. mol

54

54 A hydrated compound contains water molecules within its crystal structure. The percent composition by mass of water in the hydrated compound $CaSO_4 \cdot 2H_2O$ has an accepted value of 20.9%. A student did an experiment and determined that the percent composition by mass of water in $CaSO_4 \cdot 2H_2O$ was 21.4%.

In the space *in your answer booklet*, calculate the percent error of the student's experimental result. Your response must include *both* a correct numerical setup and the calculated result. [2]

_____ %

August 2006

6 A compound is made up of iron and oxygen, only. The ratio of iron ions to oxide ions is 2:3 in this compound. The IUPAC name for this compound is

(1) triiron dioxide (3) iron(III) oxide
(2) iron(II) oxide (4) iron trioxide

9 What is the total number of pairs of electrons shared in a molecule of N_2?

(1) one pair (3) three pairs
(2) two pairs (4) four pairs

37 The percent composition by mass of magnesium in $MgBr_2$ (gram-formula mass = 184 grams/mole) is equal to

(1) $\frac{24}{184} \times 100$ (3) $\frac{184}{24} \times 100$

(2) $\frac{160.}{184} \times 100$ (4) $\frac{184}{160.} \times 100$

38 Given the balanced equation:

$$CaCO_3(s) + 2HCl(aq) \rightarrow CaCl_2(aq) + H_2O(\ell) + CO_2(g)$$

What is the total number of moles of CO_2 formed when 20. moles of HCl is completely consumed?

(1) 5.0 mol
(2) 10. mol
(3) 20. mol
(4) 40. mol

44 Given the balanced equation representing a reaction:

$$CH_4(g) + 2O_2(g) \rightarrow 2H_2O(g) + CO_2(g) + \text{heat}$$

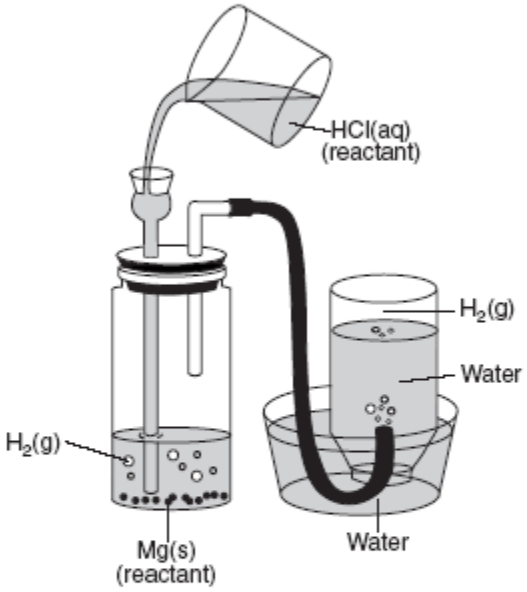
Which statement is true about energy in this reaction?

(1) The reaction is exothermic because it releases heat.
(2) The reaction is exothermic because it absorbs heat.
(3) The reaction is endothermic because it releases heat.
(4) The reaction is endothermic because it absorbs heat.

51 In the space *in your answer booklet*, draw a Lewis electron-dot diagram for a sulfur atom in the ground state. [1]

Base your answers to questions 82 through 85 on the information below.

A student places a 2.50-gram sample of magnesium metal in a bottle and fits the bottle with a 2-hole stopper as shown in the diagram. Hydrochloric acid is added to the bottle, causing a reaction. As the reaction proceeds, hydrogen gas travels through the tubing to an inverted bottle filled with water, displacing some of the water in the bottle.



82 Balance the equation *in your answer booklet* for the reaction of magnesium and hydrochloric acid, using the smallest whole-number coefficients. [1]

83 Identify the type of chemical reaction that occurs when magnesium reacts with hydrochloric acid. [1]

84 In the space *in your answer booklet*, show a correct numerical setup for calculating the number of moles of magnesium used in the experiment. [1]

85 Based on Reference Table *J*, explain why Ag(s) will *not* react with HCl(aq) to generate $H_2(g)$. [1]

82 _____ $Mg(s)$ + _____ $HCl(aq) \rightarrow$ _____ $MgCl_2(aq)$ + _____ $H_2(g)$

83 _____

84

85 _____

_____

_____

June 2006

6 What is the IUPAC name for the compound FeS?

(1) iron(II) sulfate
(2) iron(III) sulfate
(3) iron(II) sulfide
(4) iron(III) sulfide

7 Given the balanced equation representing a reaction:

$$F_2(g) + H_2(g) \rightarrow 2HF(g)$$

What is the mole ratio of $H_2(g)$ to $HF(g)$ in this reaction?

(1) 1:1
(2) 1:2
(3) 2:1
(4) 2:3

33 A substance has an empirical formula of CH_2 and a molar mass of 56 grams per mole. The molecular formula for this compound is

(1) CH_2
(2) C_4H_6
(3) C_4H_8
(4) C_8H_4

35 In which compound is the percent composition by mass of chlorine equal to 42%?

(1) HClO (gram-formula mass = 52 g/mol)
(2) $HClO_2$ (gram-formula mass = 68 g/mol)
(3) $HClO_3$ (gram-formula mass = 84 g/mol)
(4) $HClO_4$ (gram-formula mass = 100. g/mol)

Base your answers to questions 51 and 52 on the balanced equation below.

$$Fe(s) + 2HNO_3(aq) \rightarrow Fe(NO_3)_2(aq) + H_2(g)$$

51 What is the total number of oxygen atoms represented in the formula of the iron compound produced? [1]

52 Explain, using information from Reference Table *J*, why this reaction is spontaneous. [1]

51 _____

52 _____

_____

_____

56 What is the mass of 4.76 moles of Na_3PO_4 (gram-formula mass = 164 grams/mole)? [1] 56 _____ g

Base your answers to questions 69 and 70 on the information below.

Air bags are an important safety feature in modern automobiles. An air bag is inflated in milliseconds by the explosive decomposition of $NaN_3(s)$. The decomposition reaction produces $N_2(g)$, as well as $Na(s)$, according to the unbalanced equation below.

$$NaN_3(s) \rightarrow Na(s) + N_2(g)$$

69 Balance the equation *in your answer booklet* for the decomposition of NaN_3, using the smallest whole-number coefficients. [1]

70 When the air bag inflates, the nitrogen gas is at a pressure of 1.30 atmospheres, a temperature of 301 K, and has a volume of 40.0 liters. In the space *in your answer booklet*, calculate the volume of the nitrogen gas at STP. Your response must include *both* a correct numerical setup and the calculated volume. [2]

69 ____ $NaN_3(s) \rightarrow$ ____ $Na(s)$ + ____ $N_2(g)$

70

_____ L

January 2006

8 What is the chemical formula for sodium sulfate?

(1) Na_2SO_3 (3) $NaSO_3$
(2) Na_2SO_4 (4) $NaSO_4$

10 Which chemical equation is correctly balanced?

(1) $H_2(g) + O_2(g) \rightarrow H_2O(g)$
(2) $N_2(g) + H_2(g) \rightarrow NH_3(g)$
(3) $2NaCl(s) \rightarrow Na(s) + Cl_2(g)$
(4) $2KCl(s) \rightarrow 2K(s) + Cl_2(g)$

33 What is the percent composition by mass of nitrogen in NH_4NO_3 (gram-formula mass = 80.0 grams/mole)?

(1) 17.5% (3) 52.5%
(2) 35.0% (4) 60.0%

36 Given the balanced equation:

$$2C + 3H_2 \rightarrow C_2H_6$$

What is the total number of moles of C that must completely react to produce 2.0 moles of C_2H_6?

(1) 1.0 mol (3) 3.0 mol
(2) 2.0 mol (4) 4.0 mol

57 What is the total number of moles in 80.0 grams of C_2H_5Cl (gram-formula mass = 64.5 grams/mole)? [1]

57 _____ mol

Base your answers to questions 75 through 77 on the information below.

A student is instructed to make 0.250 liter of a 0.200 M aqueous solution of $Ca(NO_3)_2$.

75 What is the gram-formula mass of $Ca(NO_3)_2$? [1]

76 In the space *in your answer booklet*, show a correct numerical setup for calculating the total number of moles of $Ca(NO_3)_2$ needed to make 0.250 liter of the 0.200 M calcium nitrate solution. [1]

77 In order to prepare the described solution in the laboratory, two quantities must be measured accurately. One of these quantities is the volume of the solution. What other quantity must be measured to prepare this solution? [1]

75 _____ g/mol

76

77 _____

9 The correct chemical formula for iron(II) sulfide is

(1) FeS (3) $FeSO_4$
(2) Fe_2S_3 (4) $Fe_2(SO_4)_3$

31 The percentage by mass of Br in the compound $AlBr_3$ is closest to

(1) 10.% (3) 75%
(2) 25% (4) 90.%

36 A sample of a compound contains 65.4 grams of zinc, 12.0 grams of carbon, and 48.0 grams of oxygen. What is the mole ratio of zinc to carbon to oxygen in this compound?

(1) 1:1:2 (3) 1:4:6
(2) 1:1:3 (4) 5:1:4

38 Given the balanced equation:

$AgNO_3(aq) + NaCl(aq) \rightarrow NaNO_3(aq) + AgCl(s)$

This reaction is classified as

(1) synthesis
(2) decomposition
(3) single replacement
(4) double replacement

48 Given the incomplete equation:

$$4Fe + 3O_2 \rightarrow 2X$$

Which compound is represented by *X*?

(1) FeO (3) Fe_3O_2
(2) Fe_2O_3 (4) Fe_3O_4

51 In the space *in your answer booklet*, show a correct numerical setup for calculating the formula mass of glucose, $C_6H_{12}O_6$. [1]

51

52 Write the empirical formula for the compound $C_6H_{12}O_6$. [1] **52** _____

Base your answers to questions 68 through 70 on the information below.

The decomposition of sodium azide, $NaN_3(s)$, is used to inflate airbags. On impact, the $NaN_3(s)$ is ignited by an electrical spark, producing $N_2(g)$ and Na(s). The $N_2(g)$ inflates the airbag.

68 Balance the equation *in your answer booklet*, using the smallest whole-number coefficients. [1]

69 What is the total number of moles present in a 52.0-gram sample of $NaN_3(s)$ (gram-formula mass = 65.0 gram/mole)? [1]

70 An inflated airbag has a volume of 5.00×10^4 cm^3 at STP. The density of $N_2(g)$ at STP is 0.00125 g/cm^3. What is the total number of grams of $N_2(g)$ in the airbag? [1]

68 _____ $NaN_3(s) \rightarrow$ _____ Na(s) + _____ $N_2(g)$

69 _____ **mol**

70 _____ **g**

June 2005

9 What is the formula of titanium(II) oxide?

(1) TiO (3) Ti_2O
(2) TiO_2 (4) Ti_2O_3

36 Which substance has a chemical formula with the same ratio of metal ions to nonmetal ions as in potassium sulfide?

(1) sodium oxide
(2) sodium chloride
(3) magnesium oxide
(4) magnesium chloride

37 The molecular formula of glucose is $C_6H_{12}O_6$. What is the empirical formula of glucose?

(1) CHO (3) $C_6H_{12}O_6$
(2) CH_2O (4) $C_{12}H_{24}O_{12}$

39 A sample of a substance containing only magnesium and chlorine was tested in the laboratory and was found to be composed of 74.5% chlorine by mass. If the total mass of the sample was 190.2 grams, what was the mass of the magnesium?

(1) 24.3 g (3) 70.9 g
(2) 48.5 g (4) 142 g

54 Given the balanced equation:

$$4Al(s) + 3O_2(g) \rightarrow 2Al_2O_3(s)$$

What is the total number of moles of $O_2(g)$ that must react completely with 8.0 moles of Al(s) in order to form $Al_2O_3(s)$? [1]

54 _____ mol

January 2005

8 What is the chemical formula for copper(II) hydroxide?

(1) CuOH (3) $Cu_2(OH)$
(2) $CuOH_2$ (4) $Cu(OH)_2$

9 What is the percent composition by mass of aluminum in $Al_2(SO_4)_3$ (gram-formula mass = 342 grams/mole)?

(1) 7.89% (3) 20.8%
(2) 15.8% (4) 36.0%

19 At STP, 4 liters of O_2 contains the same total number of molecules as

(1) 1 L of NH_3 (3) 8 L of He
(2) 2 L of Cl_2 (4) 4 L of CO_2

34 Which pair of compounds has the same empirical formula?

(1) C_2H_2 and C_6H_6
(2) C_2H_6 and C_3H_8
(3) CH_3OH and C_2H_5OH
(4) CH_3CHO and CH_3COOH

35 Which equation shows a conservation of mass?

(1) $Na + Cl_2 \rightarrow NaCl$
(2) $Al + Br_2 \rightarrow AlBr_3$
(3) $H_2O \rightarrow H_2 + O_2$
(4) $PCl_5 \rightarrow PCl_3 + Cl_2$

Unit 3 – Moles / Stoichiometry

Base your answers to questions 68 and 69 on the information below.

A scientist in a chemistry laboratory determined the molecular formulas for two compounds containing nitrogen and oxygen to be NO_2 and N_2O_5.

68 Write an IUPAC name for the compound N_2O_5. [1]

69 In the space provided *in your answer booklet*, show a correct numerical setup for calculating the percent composition by mass of oxygen in NO_2. [1]

68 _____

69

August 2004

8 All chemical reactions have a conservation of

(1) mass, only
(2) mass and charge, only
(3) charge and energy, only
(4) mass, charge, and energy

29 Which process uses a volume of solution of known concentration to determine the concentration of another solution?

(1) distillation
(2) substitution
(3) transmutation
(4) titration

37 Which pair of formulas correctly represents a molecular formula and its corresponding empirical formula?

(1) C_2H_2 and CH
(2) C_3H_4 and CH_2
(3) C_4H_6 and CH
(4) C_5H_8 and C_2H_2

50 A student calculates the density of an unknown solid. The mass is 10.04 grams, and the volume is 8.21 cubic centimeters. How many significant figures should appear in the final answer?

(1) 1
(2) 2
(3) 3
(4) 4

52 Given the equation: $2\ H_2(g) + O_2(g) \rightarrow 2\ H_2O(g)$

If 8.0 moles of O_2 are completely consumed, what is the total number of moles of H_2O produced? [1]

52 _____ **mol**

53

53 In the space provided *in your answer booklet*, show a correct numerical setup for determining how many liters of a 1.2 M solution can be prepared with 0.50 mole of $C_6H_{12}O_6$. [1]

61 What is the gram-formula mass of $(NH_4)_2CO_3$? Use atomic masses rounded to the *nearest whole number*. [1]

61 _____ g/mol

62

62 In the space provided *in your answer booklet*, show a correct numerical setup for calculating the number of moles of CO_2 (gram-formula mass = 44 g/mol) present in 11 grams of CO_2. [1]

Base your answers to questions 66 through 69 on the information below, which describes the smelting of iron ore, and on your knowledge of chemistry.

In the smelting of iron ore, Fe_2O_3 is reduced in a blast furnace at high temperature by a reaction with carbon monoxide. Crushed limestone, $CaCO_3$, is also added to the mixture to remove impurities in the ore. The carbon monoxide is formed by the oxidation of carbon (coke), as shown in the reaction below:

$$2\,C + O_2 \rightarrow 2\,CO + \text{energy}$$

Liquid iron flows from the bottom of the blast furnace and is processed into different alloys of iron.

66 Balance the equation for the reaction of Fe_2O_3 and CO *in your answer booklet*, using the smallest whole-number coefficients. [1]

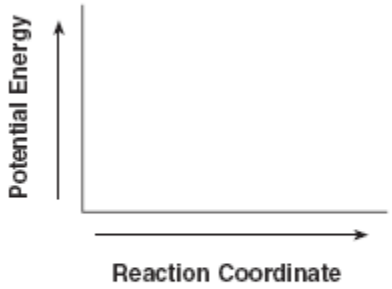
67 Using the set of axes provided *in your answer booklet*, sketch a potential energy diagram for the reaction of carbon and oxygen that produces carbon monoxide. [1]

68 What is the oxidation number of carbon in $CaCO_3$? [1]

69 Convert the melting point of iron metal to degrees Celsius. [1]

66 _____Fe_2O_3 + _____CO → _____Fe + _____CO_2

67



68 _____

69 _____ °C

June 2004

7 Given the reaction:

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

What is the mole-to-mole ratio between nitrogen gas and hydrogen gas?

(1) 1:2 (3) 2:2
(2) 1:3 (4) 2:3

8 What is the percent by mass of oxygen in propanal, CH_3CH_2CHO?

(1) 10.0% (3) 38.1%
(2) 27.6% (4) 62.1%

38 What is the empirical formula for the compound $C_6H_{12}O_6$?

(1) CH_2O (3) $C_3H_6O_3$
(2) $C_2H_4O_2$ (4) $C_6H_{12}O_6$

Base your answers to questions 51 through 53 on the balanced chemical equation below.

$$2\ H_2O \rightarrow 2\ H_2 + O_2$$

51 What type of reaction does this equation represent? [1]

52 How does the balanced chemical equation show the Law of Conservation of Mass? [1]

53 What is the total number of moles of O_2 produced when 8 moles of H_2O is completely consumed? [1]

51 _____

52 _____

_____

53 _____ **mol**

Base your answers to questions 81 through 84 on the information below.

A safe level of fluoride ions is added to many public drinking water supplies. Fluoride ions have been found to help prevent tooth decay. Another common source of fluoride ions is toothpaste. One of the fluoride compounds used in toothpaste is tin(II) fluoride.

A town located downstream from a chemical plant was concerned about fluoride ions from the plant leaking into its drinking water. According to the Environmental Protection Agency, the fluoride ion concentration in drinking water cannot exceed 4 ppm. The town hired a chemist to analyze its water. The chemist determined that a 175-gram sample of the town's water contains 0.000 250 gram of fluoride ions.

81 In the box provided *in your answer booklet,* draw a Lewis electron-dot diagram for a fluoride ion. [1]

82 What is the chemical formula for tin(II) fluoride? [1]

83 How many parts per million of fluoride ions are present in the analyzed sample? [1]

84 Is the town's drinking water safe to drink? Support your decision using information in the passage and your calculated fluoride level in question 83. [1]

81

82 _____

83 _____ ppm

84 _____

_____

_____

January 2004

6 What is the correct formula for iron (III) phosphate?

(1) FeP (3) $FePO_4$

(2) Fe_3P_2 (4) $Fe_3(PO_4)_2$

36 What is the empirical formula of a compound with the molecular formula N_2O_4?

(1) NO (3) N_2O

(2) NO_2 (4) N_2O_3

39 Which equation shows conservation of both mass and charge?

(1) $Cl_2 + Br^- \rightarrow Cl^- + Br_2$

(2) $Cu + 2\,Ag^+ \rightarrow Cu^{2+} + Ag$

(3) $Zn + Cr^{3+} \rightarrow Zn^{2+} + Cr$

(4) $Ni + Pb^{2+} \rightarrow Ni^{2+} + Pb$

Base your answers to questions 51 and 52 on the unbalanced equation provided *in your answer booklet*.

51 Balance the equation *in your answer booklet*, using the smallest whole-number coefficients. [1]

52 *a* Using your balanced equation, show a correct numerical setup for calculating the total number of moles of $H_2O(g)$ produced when 5.0 moles of $O_2(g)$ are completely consumed. Use the space provided *in your answer booklet*. [1]

b Record your answer. [1]

51 _____ $C_5H_{12}(g)$ + _____ $O_2(g)$ → _____ $CO_2(g)$ + _____ $H_2O(g)$

52 *a*

b _____ mol H_2O

Unit 3 – Moles / Stoichiometry

Base your answers to questions 75 and 76 on the information below.

Gypsum is a mineral that is used in the construction industry to make drywall (sheetrock). The chemical formula for this hydrated compound is $CaSO_4 \bullet 2\ H_2O$. A hydrated compound contains water molecules within its crystalline structure. Gypsum contains 2 moles of water for each 1 mole of calcium sulfate.

75 What is the gram formula mass of $CaSO_4 \bullet 2\ H_2O$? [1]

76 *a* In the space provided *in your answer booklet,* show a correct numerical setup for calculating the percent composition by mass of water in this compound. [1]

b Record your answer. [1]

75 _____ **g/mol**

76 ***a***

b _____ %

August 2003

6 What is the correct IUPAC name for the compound NH_4Cl?

(1) nitrogen chloride
(2) nitrogen chlorate
(3) ammonium chloride
(4) ammonium chlorate

8 In which compound is the percent by mass of oxygen greatest?

(1) BeO (3) CaO
(2) MgO (4) SrO

10 What is conserved during a chemical reaction?

(1) mass, only
(2) charge, only
(3) both mass and charge
(4) neither mass nor charge

39 Given the balanced equation:

$$2\ C_4H_{10}(g) + 13\ O_2(g) \rightarrow 8\ CO_2(g) + 10\ H_2O(g)$$

What is the total number of moles of $O_2(g)$ that must react completely with 5.00 moles of $C_4H_{10}(g)$?

(1) 10.0 (3) 26.5
(2) 20.0 (4) 32.5

42 What is the molecular formula of a compound that has a molecular mass of 54 and the empirical formula C_2H_3?

(1) C_2H_3 (3) C_6H_9
(2) C_4H_6 (4) C_8H_{12}

June 2003

8 Which is an empirical formula?

(1) P_2O_5 (3) C_2H_4

(2) P_4O_6 (4) C_3H_6

10 The percent by mass of calcium in the compound calcium sulfate ($CaSO_4$) is approximately

(1) 15% (3) 34%

(2) 29% (4) 47%

19 Which formula correctly represents the composition of iron (III) oxide?

(1) FeO_3 (3) Fe_3O

(2) Fe_2O_3 (4) Fe_3O_2

20 Given the reaction:

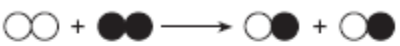
$$PbCl_2(aq) + Na_2CrO_4(aq) \rightarrow PbCrO_4(s) + 2\ NaCl(aq)$$

What is the total number of moles of NaCl formed when 2 moles of Na_2CrO_4 react completely?

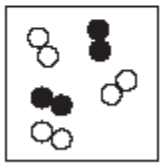
(1) 1 mole (3) 3 moles

(2) 2 moles (4) 4 moles

59 Given the reaction between two different elements in the gaseous state:

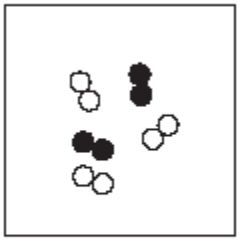


Box *A* below represents a mixture of the two reactants before the reaction occurs. The product of this reaction is a gas. In Box *B* provided *in your answer booklet*, draw the system after the reaction has gone to completion, based on the Law of Conservation of Matter. [2]

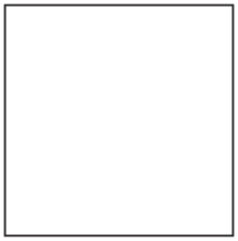


Box A
System Before Reaction

59



Box A
System Before Reaction



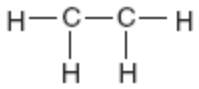
Box B
System After Reaction Has Gone to Completion

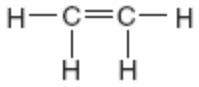
January 2003

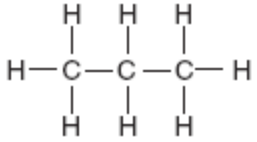
8 What is the percent by mass of oxygen in H_2SO_4? [formula mass = 98]

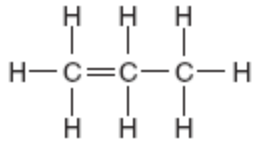
(1) 16%
(2) 33%
(3) 65%
(4) 98%

13 The empirical formula of a compound is CH_2. Which molecular formula is correctly paired with a structural formula for this compound?

(1) C_2H_4 

(2) C_2H_4 

(3) C_3H_8 

(4) C_3H_8 

22 A hydrate is a compound that includes water molecules within its crystal structure. During an experiment to determine the percent by mass of water in a hydrated crystal, a student found the mass of the hydrated crystal to be 4.10 grams. After heating to constant mass, the mass was 3.70 grams. What is the percent by mass of water in this crystal?

(1) 90.%
(2) 11%
(3) 9.8%
(4) 0.40%

42 Given the equation:

$$2\ C_2H_2(g) + 5\ O_2(g) \rightarrow 4\ CO_2(g) + 2\ H_2O(g)$$

How many moles of oxygen are required to react completely with 1.0 mole of C_2H_2?

(1) 2.5
(2) 2.0
(3) 5.0
(4) 10

43 A student intended to make a salt solution with a concentration of 10.0 grams of solute per liter of solution. When the student's solution was analyzed, it was found to contain 8.90 grams of solute per liter of solution. What was the percent error in the concentration of the solution?

(1) 1.10%
(2) 8.90%
(3) 11.0%
(4) 18.9%

48 Given the unbalanced equation:

$$\_\_Fe_2O_3 + \_\_CO \rightarrow \_\_Fe + \_\_CO_2$$

When the equation is correctly balanced using the *smallest* whole-number coefficients, what is the coefficient of CO?

(1) 1
(2) 2
(3) 3
(4) 4