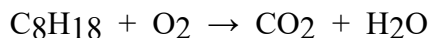


*Chemistry: The Central Science, 12e* (Brown et al.)

## Chapter 3 Stoichiometry: Calculations with Chemical Formulas and Equations

## 3.1 Multiple-Choice Questions

1) When the following equation is balanced, the coefficients are \_\_\_\_\_.



- A) 2, 3, 4, 4
- B) 1, 4, 8, 9
- C) 2, 12, 8, 9
- D) 4, 4, 32, 36
- E) 2, 25, 16, 18

Answer: E

Diff: 2 Page Ref: Sec. 3.1

2) Of the reactions below, which one is not a combination reaction?

- A)  $\text{C} + \text{O}_2 \rightarrow \text{CO}_2$
- B)  $2\text{Mg} + \text{O}_2 \rightarrow 2\text{MgO}$
- C)  $2\text{N}_2 + 3\text{H}_2 \rightarrow 2\text{NH}_3$
- D)  $\text{CaO} + \text{H}_2\text{O} \rightarrow \text{Ca}(\text{OH})_2$
- E)  $2\text{CH}_4 + 4\text{O}_2 \rightarrow 2\text{CO}_2 + 4\text{H}_2\text{O}$

Answer: E

Diff: 2 Page Ref: Sec. 3.2

3) When a hydrocarbon burns in air, what component of air reacts?

- A) oxygen
- B) nitrogen
- C) carbon dioxide
- D) water
- E) argon

Answer: A

Diff: 2 Page Ref: Sec. 3.2

4) When a hydrocarbon burns in air, a component produced is?

- A) oxygen
- B) nitrogen
- C) carbon
- D) water
- E) argon

Answer: D

Diff: 2 Page Ref: Sec. 3.2

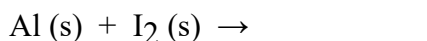
5) Of the reactions below, which one is a decomposition reaction?

- A)  $\text{NH}_4\text{Cl} \rightarrow \text{NH}_3 + \text{HCl}$
- B)  $2\text{Mg} + \text{O}_2 \rightarrow 2\text{MgO}$
- C)  $2\text{N}_2 + 3\text{H}_2 \rightarrow 2\text{NH}_3$
- D)  $2\text{CH}_4 + 4\text{O}_2 \rightarrow 2\text{CO}_2 + 4\text{H}_2\text{O}$
- E)  $\text{Cd}(\text{NO}_3)_2 + \text{Na}_2\text{S} \rightarrow \text{CdS} + 2\text{NaNO}_3$

Answer: A

Diff: 3 Page Ref: Sec. 3.2

6) Which one of the following substances is the product of this combination reaction?



- A)  $\text{AlI}_2$
- B)  $\text{AlI}$
- C)  $\text{AlI}_3$
- D)  $\text{Al}_2\text{I}_3$
- E)  $\text{Al}_3\text{I}_2$

Answer: C

Diff: 2 Page Ref: Sec. 3.2

7) Which one of the following is not true concerning automotive air bags?

- A) They are inflated as a result of a decomposition reaction
- B) They are loaded with sodium azide initially
- C) The gas used for inflating them is oxygen
- D) The two products of the decomposition reaction are sodium and nitrogen
- E) A gas is produced when the air bag activates.

Answer: C

Diff: 2 Page Ref: Sec. 3.2

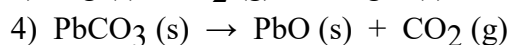
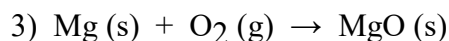
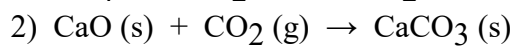
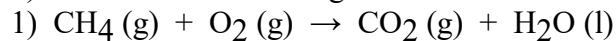
8) The reaction used to inflate automobile airbags \_\_\_\_\_.

- A) produces sodium gas
- B) is a combustion reaction
- C) is a combination reaction
- D) violates the law of conservation of mass
- E) is a decomposition reaction

Answer: E

Diff: 2 Page Ref: Sec. 3.2

9) Which of the following are combination reactions?



A) 1, 2, and 3

B) 2 and 3

C) 1, 2, 3, and 4

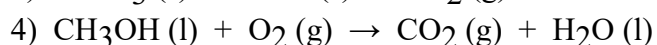
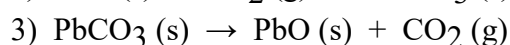
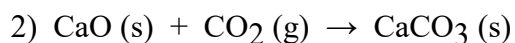
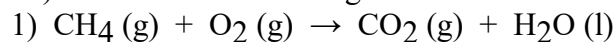
D) 4 only

E) 2, 3, and 4

Answer: B

Diff: 3 Page Ref: Sec. 3.2

10) Which of the following are combustion reactions?



A) 1 and 4

B) 1, 2, 3, and 4

C) 1, 3, and 4

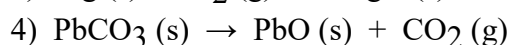
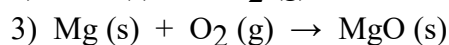
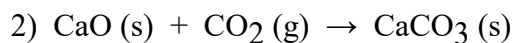
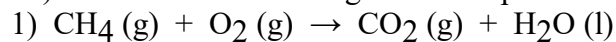
D) 2, 3, and 4

E) 3 and 4

Answer: A

Diff: 2 Page Ref: Sec. 3.2

11) Which of the following are decomposition reactions?



A) 1, 2, and 3

B) 4 only

C) 1, 2, 3, and 4

D) 2 and 3

E) 2, 3, and 4

Answer: B

Diff: 3 Page Ref: Sec. 3.2

12) The formula of nitrobenzene is  $C_6H_5NO_2$ . The molecular weight of this compound is \_\_\_\_\_ amu.

- A) 107.11
- B) 43.03
- C) 109.10
- D) 123.11
- E) 3.06

Answer: D

Diff: 2 Page Ref: Sec. 3.3

13) The formula weight of potassium dichromate ( $K_2Cr_2O_7$ ) is \_\_\_\_\_ amu.

- A) 107.09
- B) 255.08
- C) 242.18
- D) 294.18
- E) 333.08

Answer: D

Diff: 2 Page Ref: Sec. 3.3

14) The formula weight of lead (II) carbonate ( $PbCO_3$ ) is \_\_\_\_\_ amu.

- A) 207.2
- B) 219.2
- C) 235.2
- D) 267.2
- E) 273.2

Answer: D

Diff: 2 Page Ref: Sec. 3.3

15) The formula weight of potassium phosphate ( $K_3PO_4$ ) is \_\_\_\_\_ amu.

- A) 173.17
- B) 251.37
- C) 212.27
- D) 196.27
- E) 86.07

Answer: C

Diff: 2 Page Ref: Sec. 3.3

16) The formula weight of aluminum sulfate ( $Al_2(SO_4)_3$ ) is \_\_\_\_\_ amu.

- A) 342.15
- B) 123.04
- C) 59.04
- D) 150.14
- E) 273.06

Answer: A

Diff: 2 Page Ref: Sec. 3.3

17) The formula weight of silver chromate ( $\text{Ag}_2\text{CrO}_4$ ) is \_\_\_\_\_ amu.

- A) 159.87
- B) 223.87
- C) 331.73
- D) 339.86
- E) 175.87

Answer: C

Diff: 2 Page Ref: Sec. 3.3

18) The formula weight of ammonium sulfate ( $(\text{NH}_4)_2\text{SO}_4$ ), rounded to the nearest integer, is \_\_\_\_\_ amu.

- A) 100
- B) 118
- C) 116
- D) 132
- E) 264

Answer: D

Diff: 2 Page Ref: Sec. 3.3

19) The molecular weight of the acetic acid ( $\text{CH}_3\text{CO}_2\text{H}$ ), rounded to the nearest integer, is \_\_\_\_\_ amu.

- A) 60
- B) 48
- C) 44
- D) 32

Answer: A

Diff: 1 Page Ref: Sec. 3.3

20) The molecular weight of the ethanol ( $\text{C}_2\text{H}_5\text{OH}$ ), rounded to the nearest integer, is \_\_\_\_\_ amu.

- A) 34
- B) 41
- C) 30
- D) 46
- E) 92

Answer: D

Diff: 1 Page Ref: Sec. 3.3

21) The molecular weight of glucose ( $\text{C}_6\text{H}_{12}\text{O}_6$ ), rounded to the nearest integer, is \_\_\_\_\_ amu.

- A) 24
- B) 96
- C) 136
- D) 180
- E) 224

Answer: D

Diff: 1 Page Ref: Sec. 3.3

22) What is the mass % of carbon in dimethylsulfoxide ( $C_2H_6SO$ ) rounded to three significant figures?

- A) 60.0
- B) 20.6
- C) 30.7
- D) 7.74
- E) 79.8

Answer: C

Diff: 3 Page Ref: Sec. 3.3

23) The mass % of H in methane ( $CH_4$ ) is \_\_\_\_\_.

- A) 25.13
- B) 4.032
- C) 74.87
- D) 92.26
- E) 7.743

Answer: A

Diff: 2 Page Ref: Sec. 3.3

24) The mass % of Al in aluminum sulfate ( $Al_2(SO_4)_3$ ) is \_\_\_\_\_.

- A) 7.886
- B) 15.77
- C) 21.93
- D) 45.70
- E) 35.94

Answer: B

Diff: 3 Page Ref: Sec. 3.3

25) The formula weight of a substance is \_\_\_\_\_.

- A) identical to the molar mass
- B) the same as the percent by mass weight
- C) determined by combustion analysis
- D) the sum of the atomic weights of each atom in its chemical formula
- E) the weight of a sample of the substance

Answer: D

Diff: 1 Page Ref: Sec. 3.3

26) The formula weight of calcium nitrate ( $Ca(NO_3)_2$ ), rounded to one decimal place, is \_\_\_\_\_  
amu.

- A) 102.1
- B) 164.0
- C) 204.2
- D) 150.1
- E) 116.1

Answer: B

Diff: 2 Page Ref: Sec. 3.3

27) The formula weight of magnesium fluoride ( $\text{MgF}_2$ ), rounded to one decimal place, is \_\_\_\_\_ amu.

- A) 86.6
- B) 43.3
- C) 62.3
- D) 67.6
- E) 92.9

Answer: C

Diff: 2 Page Ref: Sec. 3.3

28) The formula weight of lead nitrate ( $\text{Pb}(\text{NO}_3)_2$ ) is \_\_\_\_\_ amu.

- A) 269.2
- B) 285.2
- C) 317.2
- D) 331.2
- E) 538.4

Answer: D

Diff: 2 Page Ref: Sec. 3.3

29) The mass % of C in methane ( $\text{CH}_4$ ) is \_\_\_\_\_.

- A) 25.13
- B) 133.6
- C) 74.87
- D) 92.26
- E) 7.743

Answer: C

Diff: 2 Page Ref: Sec. 3.4

30) The mass % of F in the binary compound  $\text{KrF}_2$  is \_\_\_\_\_.

- A) 18.48
- B) 45.38
- C) 68.80
- D) 81.52
- E) 31.20

Answer: E

Diff: 2 Page Ref: Sec. 3.4

31) Calculate the percentage by mass of nitrogen in  $\text{PtCl}_2(\text{NH}_3)_2$ .

- A) 4.67
- B) 9.34
- C) 9.90
- D) 4.95
- E) 12.67

Answer: B

Diff: 2 Page Ref: Sec. 3.4

32) Calculate the percentage by mass of lead in  $\text{Pb}(\text{NO}_3)_2$ .

- A) 38.6
- B) 44.5
- C) 62.6
- D) 65.3
- E) 71.2

Answer: C

Diff: 2 Page Ref: Sec. 3.4

33) Calculate the percentage by mass of nitrogen in  $\text{Pb}(\text{NO}_3)_2$ .

- A) 4.2
- B) 5.2
- C) 8.5
- D) 10.4
- E) 12.6

Answer: C

Diff: 2 Page Ref: Sec. 3.4

34) Calculate the percentage by mass of lead in  $\text{PbCO}_3$ .

- A) 17.96
- B) 22.46
- C) 73.05
- D) 77.54
- E) 89.22

Answer: D

Diff: 2 Page Ref: Sec. 3.4

35) Calculate the percentage by mass of oxygen in  $\text{Pb}(\text{NO}_3)_2$ .

- A) 9.7
- B) 14.5
- C) 19.3
- D) 29.0
- E) 33.4

Answer: D

Diff: 2 Page Ref: Sec 3.4

36) Calculate the percentage by mass of chlorine in  $\text{PtCl}_2(\text{NH}_3)_2$ .

- A) 23.63
- B) 11.82
- C) 25.05
- D) 12.53
- E) 18.09

Answer: A

Diff: 3 Page Ref: Sec. 3.4



37) Calculate the percentage by mass of hydrogen in  $\text{PtCl}_2(\text{NH}_3)_2$

- A) 1.558
- B) 1.008
- C) 0.672
- D) 0.034
- E) 2.016

Answer: E

Diff: 3 Page Ref: Sec. 3.4

38) One mole of \_\_\_\_\_ contains the largest number of atoms.

- A)  $\text{S}_8$
- B)  $\text{C}_{10}\text{H}_8$
- C)  $\text{Al}_2(\text{SO}_4)_3$
- D)  $\text{Na}_3\text{PO}_4$
- E)  $\text{Cl}_2$

Answer: B

Diff: 2 Page Ref: Sec. 3.4

39) One mole of \_\_\_\_\_ contains the smallest number of atoms.

- A)  $\text{S}_8$
- B)  $\text{C}_{10}\text{H}_8$
- C)  $\text{Al}_2(\text{SO}_4)_3$
- D)  $\text{Na}_3\text{PO}_4$
- E)  $\text{NaCl}$

Answer: E

Diff: 1 Page Ref: Sec. 3.4

40) One million argon atoms is \_\_\_\_\_ mol (rounded to two significant figures) of argon atoms.

- A) 3.0
- B)  $1.7 \times 10^{-18}$
- C)  $6.0 \times 10^{23}$
- D)  $1.0 \times 10^{-6}$
- E)  $1.0 \times 10^{+6}$

Answer: B

Diff: 2 Page Ref: Sec. 3.4

41) There are \_\_\_\_\_ atoms of oxygen are in 300 molecules of  $\text{CH}_3\text{CO}_2\text{H}$ .

- A) 300
- B) 600
- C)  $3.01 \times 10^{24}$
- D)  $3.61 \times 10^{26}$
- E)  $1.80 \times 10^{26}$

Answer: B

Diff: 2 Page Ref: Sec. 3.4

42) How many molecules of  $\text{CH}_4$  are in 48.2 g of this compound?

- A)  $5.00 \times 10^{24}$
- B) 3.00
- C)  $2.90 \times 10^{25}$
- D)  $1.81 \times 10^{24}$
- E) 4.00

Answer: D

Diff: 3 Page Ref: Sec. 3.4

43) A 30.5 gram sample of glucose ( $\text{C}_6\text{H}_{12}\text{O}_6$ ) contains \_\_\_\_\_ mol of glucose.

- A) 0.424
- B) 0.169
- C) 5.90
- D) 2.36
- E) 0.136

Answer: B

Diff: 2 Page Ref: Sec. 3.4

44) A 30.5 gram sample of glucose ( $\text{C}_6\text{H}_{12}\text{O}_6$ ) contains \_\_\_\_\_ atoms of carbon.

- A)  $1.02 \times 10^{23}$
- B)  $6.12 \times 10^{23}$
- C)  $6.02 \times 10^{23}$
- D)  $2.04 \times 10^{23}$
- E)  $1.22 \times 10^{24}$

Answer: B

Diff: 3 Page Ref: Sec 3.4

45) A sample of  $\text{CH}_2\text{F}_2$  with a mass of 19 g contains \_\_\_\_\_ atoms of F.

- A)  $2.2 \times 10^{23}$
- B) 38
- C)  $3.3 \times 10^{24}$
- D)  $4.4 \times 10^{23}$
- E) 9.5

Answer: D

Diff: 3 Page Ref: Sec. 3.4

46) A sample of  $\text{CH}_4\text{O}$  with a mass of 32.0 g contains \_\_\_\_\_ molecules of  $\text{CH}_4\text{O}$ .

- A)  $5.32 \times 10^{-23}$
- B) 1.00
- C)  $1.88 \times 10^{22}$
- D)  $6.02 \times 10^{23}$
- E) 32.0

Answer: D

Diff: 2 Page Ref: Sec. 3.4

47) How many atoms of nitrogen are in 10 g of  $\text{NH}_4\text{NO}_3$ ?

- A) 3.5
- B)  $1.5 \times 10^{23}$
- C)  $3.0 \times 10^{23}$
- D) 1.8
- E) 2

Answer: B

Diff: 3 Page Ref: Sec. 3.4

48) Gaseous argon has a density of 1.40 g/L at standard conditions. How many argon atoms are in 1.00 L of argon gas at standard conditions?

- A)  $4.76 \times 10^{22}$
- B)  $3.43 \times 10^{26}$
- C)  $2.11 \times 10^{22}$
- D)  $1.59 \times 10^{25}$
- E)  $6.02 \times 10^{23}$

Answer: C

Diff: 4 Page Ref: Sec. 3.4

49) What is the mass in grams of  $9.76 \times 10^{12}$  atoms of naturally occurring sodium?

- A) 22.99
- B)  $1.62 \times 10^{-11}$
- C)  $3.73 \times 10^{-10}$
- D)  $7.05 \times 10^{-13}$
- E)  $2.24 \times 10^{14}$

Answer: C

Diff: 3 Page Ref: Sec. 3.4

50) How many moles of pyridine ( $\text{C}_5\text{H}_5\text{N}$ ) are contained in 3.13 g of pyridine?

- A) 0.0396
- B) 25.3
- C) 0.319
- D) 0.00404
- E)  $4.04 \times 10^3$

Answer: A

Diff: 3 Page Ref: Sec. 3.4

51) How many oxygen atoms are contained in 2.74 g of  $\text{Al}_2(\text{SO}_4)_3$ ?

- A) 12
- B)  $6.02 \times 10^{23}$
- C)  $7.22 \times 10^{24}$
- D)  $5.79 \times 10^{22}$
- E)  $8.01 \times 10^{-3}$

Answer: D

Diff: 3 Page Ref: Sec. 3.4

52) The total number of atoms in 0.111 mol of  $\text{Fe}(\text{CO})_3(\text{PH}_3)_2$  is \_\_\_\_\_.

- A) 15.0
- B)  $1.00 \times 10^{24}$
- C)  $4.46 \times 10^{21}$
- D) 1.67
- E)  $2.76 \times 10^{-24}$

Answer: B

Diff: 3 Page Ref: Sec. 3.4

53) How many sulfur dioxide molecules are there in 1.80 mol of sulfur dioxide?

- A)  $1.08 \times 10^{23}$
- B)  $6.02 \times 10^{24}$
- C)  $1.80 \times 10^{24}$
- D)  $1.08 \times 10^{24}$
- E)  $6.02 \times 10^{23}$

Answer: D

Diff: 2 Page Ref: Sec. 3.4

54) How many sulfur dioxide molecules are there in 0.180 mol of sulfur dioxide?

- A)  $1.80 \times 10^{23}$
- B)  $6.02 \times 10^{24}$
- C)  $6.02 \times 10^{23}$
- D)  $1.08 \times 10^{24}$
- E)  $1.08 \times 10^{23}$

Answer: E

Diff: 2 Page Ref: Sec. 3.4

55) How many carbon atoms are there in 52.06 g of carbon dioxide?

- A)  $5.206 \times 10^{24}$
- B)  $3.134 \times 10^{25}$
- C)  $7.122 \times 10^{23}$
- D)  $8.648 \times 10^{-23}$
- E)  $1.424 \times 10^{24}$

Answer: C

Diff: 3 Page Ref: Sec. 3.4

56) How many oxygen atoms are there in 52.06 g of carbon dioxide?

A)  $1.424 \times 10^{24}$

B)  $6.022 \times 10^{23}$

C)  $1.204 \times 10^{24}$

D)  $5.088 \times 10^{23}$

E)  $1.018 \times 10^{24}$

Answer: A

Diff: 3 Page Ref: Sec. 3.4

57) How many moles of sodium carbonate contain  $1.773 \times 10^{17}$  carbon atoms?

A)  $5.890 \times 10^{-7}$

B)  $2.945 \times 10^{-7}$

C)  $1.473 \times 10^{-7}$

D)  $8.836 \times 10^{-7}$

E)  $9.817 \times 10^{-8}$

Answer: B

Diff: 2 Page Ref: Sec. 3.4

58) How many grams of sodium carbonate contain  $1.773 \times 10^{17}$  carbon atoms?

A)  $3.121 \times 10^{-5}$

B)  $1.011 \times 10^{-5}$

C)  $1.517 \times 10^{-5}$

D)  $9.100 \times 10^{-5}$

E)  $6.066 \times 10^{-5}$

Answer: A

Diff: 2 Page Ref: Sec. 3.4

59) The compound responsible for the characteristic smell of garlic is allicin,  $C_6H_{10}OS_2$ . The mass of 1.00 mol of allicin, rounded to the nearest integer, is \_\_\_\_\_ g.

A) 34

B) 162

C) 86

D) 61

E) 19

Answer: B

Diff: 1 Page Ref: Sec. 3.4

60) The molecular formula of aspartame, the generic name of NutraSweet<sup>®</sup>, is  $C_{14}H_{18}N_2O_5$ . The molar mass of aspartame, rounded to the nearest integer, is \_\_\_\_\_ g.

- A) 24
- B) 156
- C) 294
- D) 43
- E) 39

Answer: C

Diff: 1 Page Ref: Sec. 3.4

61) There are \_\_\_\_\_ oxygen atoms in 30 molecules of  $C_{20}H_{42}S_3O_2$ .

- A)  $6.0 \times 10^{23}$
- B)  $1.8 \times 10^{25}$
- C)  $3.6 \times 10^{25}$
- D)  $1.2 \times 10^{24}$
- E) 60

Answer: E

Diff: 2 Page Ref: Sec. 3.4

62) A nitrogen oxide is 63.65% by mass nitrogen. The molecular formula could be \_\_\_\_\_.

- A) NO
- B)  $NO_2$
- C)  $N_2O$
- D)  $N_2O_4$
- E) either  $NO_2$  or  $N_2O_4$

Answer: C

Diff: 3 Page Ref: Sec. 3.5

63) A sulfur oxide is 50.0% by mass sulfur. This molecular formula could be \_\_\_\_\_.

- A) SO
- B)  $SO_2$
- C)  $S_2O$
- D)  $S_2O_4$
- E) either  $SO_2$  or  $S_2O_4$

Answer: E

Diff: 3 Page Ref: Sec. 3.5

64) Which hydrocarbon pair below have identical mass percentage of C?

- A)  $C_3H_4$  and  $C_3H_6$
- B)  $C_2H_4$  and  $C_3H_4$
- C)  $C_2H_4$  and  $C_4H_2$
- D)  $C_2H_4$  and  $C_3H_6$
- E) none of the above

Answer: D

Diff: 3 Page Ref: Sec. 3.5

65) Sulfur and oxygen react to produce sulfur trioxide. In a particular experiment, 7.9 grams of SO<sub>3</sub> are produced by the reaction of 5.0 grams of O<sub>2</sub> with 6.0 grams of S. What is the % yield of SO<sub>3</sub> in this experiment?



- A) 32
- B) 63
- C) 75
- D) 95
- E) 99

Answer: D

Diff: 4 Page Ref: Sec. 3.7

66) Propane (C<sub>3</sub>H<sub>8</sub>) reacts with oxygen in the air to produce carbon dioxide and water. In a particular experiment, 38.0 grams of carbon dioxide are produced from the reaction of 22.05 grams of propane with excess oxygen. What is the % yield in this reaction?

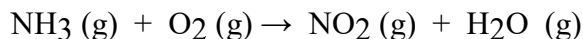
- A) 38.0
- B) 57.6
- C) 66.0
- D) 86.4
- E) 94.5

Answer: B

Diff: 5 Page Ref: Sec 3.7

### 3.2 Bimodal Questions

1) When the following equation is balanced, the coefficients are \_\_\_\_\_.

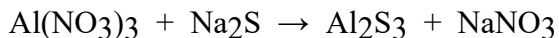


- A) 1, 1, 1, 1
- B) 4, 7, 4, 6
- C) 2, 3, 2, 3
- D) 1, 3, 1, 2
- E) 4, 3, 4, 3

Answer: B

Diff: 1 Page Ref: Sec. 3.1

2) When the following equation is balanced, the coefficients are \_\_\_\_\_.

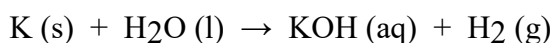


- A) 2, 3, 1, 6
- B) 2, 1, 3, 2
- C) 1, 1, 1, 1
- D) 4, 6, 3, 2
- E) 2, 3, 2, 3

Answer: A

Diff: 1 Page Ref: Sec. 3.1

3) When the following equation is balanced, the coefficient of H<sub>2</sub> is \_\_\_\_\_.



- A) 1
- B) 2
- C) 3
- D) 4
- E) 5

Answer: A

Diff: 1 Page Ref: Sec. 3.1

4) When the following equation is balanced, the coefficient of Al is \_\_\_\_\_.

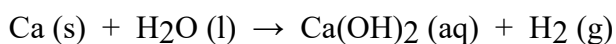


- A) 1
- B) 2
- C) 3
- D) 5
- E) 4

Answer: B

Diff: 1 Page Ref: Sec. 3.1

5) When the following equation is balanced, the coefficient of H<sub>2</sub>O is \_\_\_\_\_.



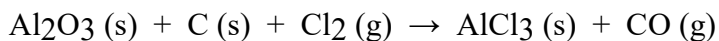
- A) 1
- B) 2
- C) 3
- D) 5
- E) 4

Answer: B

Diff: 1 Page Ref: Sec. 3.1



6) When the following equation is balanced, the coefficient of  $\text{Al}_2\text{O}_3$  is \_\_\_\_\_.

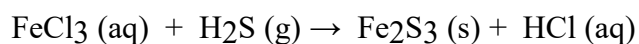


- A) 1
- B) 2
- C) 3
- D) 4
- E) 5

Answer: A

Diff: 1 Page Ref: Sec. 3.1

7) When the following equation is balanced, the coefficient of  $\text{H}_2\text{S}$  is \_\_\_\_\_.



- A) 1
- B) 2
- C) 3
- D) 5
- E) 4

Answer: C

Diff: 1 Page Ref: Sec. 3.1

8) When the following equation is balanced, the coefficient of  $\text{HCl}$  is \_\_\_\_\_.

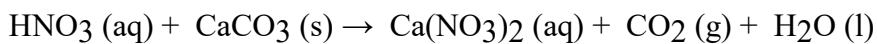


- A) 1
- B) 2
- C) 3
- D) 4
- E) 0

Answer: B

Diff: 1 Page Ref: Sec. 3.1

9) When the following equation is balanced, the coefficient of  $\text{HNO}_3$  is \_\_\_\_\_.

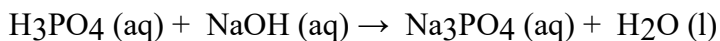


- A) 1
- B) 2
- C) 3
- D) 5
- E) 4

Answer: B

Diff: 1 Page Ref: Sec. 3.1

10) When the following equation is balanced, the coefficient of  $\text{H}_3\text{PO}_4$  is \_\_\_\_\_.

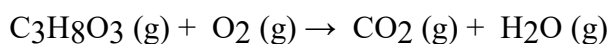


- A) 1
- B) 2
- C) 3
- D) 4
- E) 0

Answer: A

Diff: 1 Page Ref: Sec. 3.1

11) When the following equation is balanced, the coefficient of  $\text{C}_3\text{H}_8\text{O}_3$  is \_\_\_\_\_.

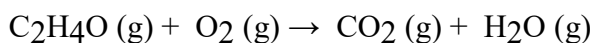


- A) 1
- B) 2
- C) 3
- D) 7
- E) 5

Answer: B

Diff: 1 Page Ref: Sec. 3.1

12) When the following equation is balanced, the coefficient of  $\text{O}_2$  is \_\_\_\_\_.

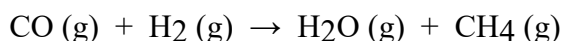


- A) 2
- B) 3
- C) 4
- D) 5
- E) 1

Answer: D

Diff: 1 Page Ref: Sec. 3.1

13) When the following equation is balanced, the coefficient of  $\text{H}_2$  is \_\_\_\_\_.

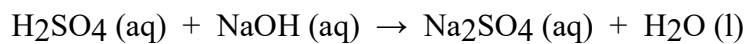


- A) 1
- B) 2
- C) 3
- D) 4
- E) 0

Answer: C

Diff: 1 Page Ref: Sec. 3.1

14) When the following equation is balanced, the coefficient of  $\text{H}_2\text{SO}_4$  is \_\_\_\_\_.

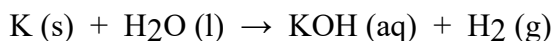


- A) 1
- B) 2
- C) 3
- D) 4
- E) 0.5

Answer: A

Diff: 1 Page Ref: Sec. 3.1

15) When the following equation is balanced, the coefficient of water is \_\_\_\_\_.

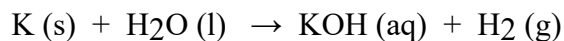


- A) 1
- B) 2
- C) 3
- D) 4
- E) 5

Answer: B

Diff: 1 Page Ref: Sec. 3.1

16) When the following equation is balanced, the coefficient of hydrogen is \_\_\_\_\_.

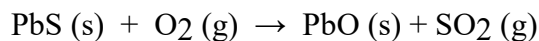


- A) 1
- B) 2
- C) 3
- D) 4
- E) 5

Answer: A

Diff: 1 Page Ref: Sec. 3.1

17) When the following equation is balanced, the coefficient of oxygen is \_\_\_\_\_.

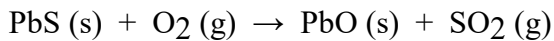


- A) 1
- B) 3
- C) 2
- D) 4
- E) 5

Answer: B

Diff: 1 Page Ref: Sec. 3.1

18) When the following equation is balanced, the coefficient of sulfur dioxide is \_\_\_\_\_.

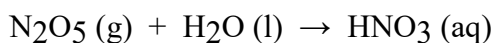


- A) 5
- B) 1
- C) 3
- D) 2
- E) 4

Answer: D

Diff: 1 Page Ref: Sec. 3.1

19) When the following equation is balanced, the coefficient of dinitrogen pentoxide is \_\_\_\_\_.

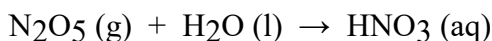


- A) 1
- B) 2
- C) 3
- D) 4
- E) 5

Answer: A

Diff: 1 Page Ref: Sec. 3.1

20) When the following equation is balanced, the coefficient of water is \_\_\_\_\_.

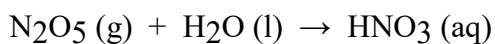


- A) 5
- B) 2
- C) 3
- D) 4
- E) 1

Answer: E

Diff: 1 Page Ref: Sec. 3.1

21) When the following equation is balanced, the coefficient of nitric acid is \_\_\_\_\_.



- A) 5
- B) 2
- C) 3
- D) 4
- E) 1

Answer: B

Diff: 1 Page Ref: Sec. 3.1

22) Write the balanced equation for the reaction that occurs when methanol, CH<sub>3</sub>OH (l), is burned in air. What is the coefficient of methanol in the balanced equation?

- A) 1
- B) 2
- C) 3
- D) 4
- E) 3/2

Answer: B

Diff: 2 Page Ref: Sec. 3.2

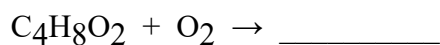
23) Write the balanced equation for the reaction that occurs when methanol, CH<sub>3</sub>OH (l), is burned in air. What is the coefficient of oxygen in the balanced equation?

- A) 1
- B) 2
- C) 3
- D) 4
- E) 3/2

Answer: C

Diff: 2 Page Ref: Sec. 3.2

24) What is the coefficient of O<sub>2</sub> when the following equation is completed and balanced?

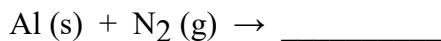


- A) 2
- B) 3
- C) 5
- D) 6
- E) 1

Answer: C

Diff: 3 Page Ref: Sec. 3.2

25) Predict the product in the combination reaction below.



- A) AlN
- B) Al<sub>3</sub>N
- C) Al N<sub>2</sub>
- D) Al<sub>3</sub>N<sub>2</sub>
- E) AlN<sub>3</sub>

Answer: A

Diff: 3 Page Ref: Sec. 3.2

26) The balanced equation for the decomposition of sodium azide is \_\_\_\_\_.

- A)  $2\text{NaN}_3(\text{s}) \rightarrow 2\text{Na}(\text{s}) + 3\text{N}_2(\text{g})$
- B)  $2\text{NaN}_3(\text{s}) \rightarrow \text{Na}_2(\text{s}) + 3\text{N}_2(\text{g})$
- C)  $\text{NaN}_3(\text{s}) \rightarrow \text{Na}(\text{s}) + \text{N}_2(\text{g})$
- D)  $\text{NaN}_3(\text{s}) \rightarrow \text{Na}(\text{s}) + \text{N}_2(\text{g}) + \text{N}(\text{g})$
- E)  $2\text{NaN}_3(\text{s}) \rightarrow 2\text{Na}(\text{s}) + 2\text{N}_2(\text{g})$

Answer: A

Diff: 2 Page Ref: Sec. 3.2

27) There are \_\_\_\_\_ mol of carbon atoms in 4 mol  $\text{C}_4\text{H}_8\text{O}_2$ .

- A) 4
- B) 8
- C) 16
- D) 20
- E) 32

Answer: C

Diff: 1 Page Ref: Sec. 3.4

28) There are \_\_\_\_\_ sulfur atoms in 25 molecules of  $\text{C}_4\text{H}_4\text{S}_2$ .

- A)  $1.5 \times 10^{25}$
- B)  $4.8 \times 10^{25}$
- C)  $3.0 \times 10^{25}$
- D) 50
- E)  $6.02 \times 10^{23}$

Answer: D

Diff: 2 Page Ref: Sec. 3.4

29) There are \_\_\_\_\_ hydrogen atoms in 25 molecules of  $\text{C}_4\text{H}_4\text{S}_2$ .

- A) 25
- B)  $3.8 \times 10^{24}$
- C)  $6.0 \times 10^{25}$
- D) 100
- E)  $1.5 \times 10^{25}$

Answer: D

Diff: 2 Page Ref: Sec. 3.4

30) A sample of  $\text{C}_3\text{H}_8\text{O}$  that contains 200 molecules contains \_\_\_\_\_ carbon atoms.

- A) 600
- B) 200
- C)  $3.61 \times 10^{26}$
- D)  $1.20 \times 10^{26}$
- E)  $4.01 \times 10^{25}$

Answer: A

Diff: 2 Page Ref: Sec. 3.4

31) How many moles of carbon monoxide are there in 36.55 g of carbon monoxide?

A) 0.8452

B) 1.305

C) 0.9291

D) 2.589

E) 3.046

Answer: B

Diff: 2 Page Ref: Sec. 3.4

32) How many moles of carbon dioxide are there in 52.06 g of carbon dioxide?

A) 0.8452

B) 1.183

C)  $6.022 \times 10^{23}$

D)  $8.648 \times 10^{23}$

E)  $3.134 \times 10^{25}$

Answer: B

Diff: 2 Page Ref: Sec. 3.4

33) There are \_\_\_\_\_ molecules of methane in 0.123 mol of methane (CH<sub>4</sub>).

A) 5

B)  $2.46 \times 10^{-2}$

C)  $2.04 \times 10^{-25}$

D)  $7.40 \times 10^{22}$

E) 0.615

Answer: D

Diff: 2 Page Ref: Sec. 3.4

34) What is the empirical formula of a compound that contains 27.0% S, 13.4% O, and 59.6% Cl by mass?

A) SOCl

B) SOCl<sub>2</sub>

C) S<sub>2</sub>OCl

D) SO<sub>2</sub>Cl

E) ClSO<sub>4</sub>

Answer: B

Diff: 3 Page Ref: Sec. 3.5

35) What is the empirical formula of a compound that contains 29% Na, 41% S, and 30% O by mass?

A) Na<sub>2</sub>S<sub>2</sub>O<sub>3</sub>

B) NaSO<sub>2</sub>

C) NaSO

D) NaSO<sub>3</sub>

E) Na<sub>2</sub>S<sub>2</sub>O<sub>6</sub>

Answer: A

Diff: 3 Page Ref: Sec. 3.5

36) What is the empirical formula of a compound that contains 49.4% K, 20.3% S, and 30.3% O by mass?

- A)  $\text{KSO}_2$
- B)  $\text{KSO}_3$
- C)  $\text{K}_2\text{SO}_4$
- D)  $\text{K}_2\text{O}_3$
- E)  $\text{KSO}_4$

Answer: D

Diff: 3 Page Ref: Sec. 3.5

37) A compound contains 40.0% C, 6.71% H, and 53.29% O by mass. The molecular weight of the compound is 60.05 amu. The molecular formula of this compound is \_\_\_\_\_.

- A)  $\text{C}_2\text{H}_4\text{O}_2$
- B)  $\text{C H}_2\text{O}$
- C)  $\text{C}_2\text{H}_3\text{O}_4$
- D)  $\text{C}_2\text{H}_2\text{O}_4$
- E)  $\text{CHO}_2$

Answer: A

Diff: 3 Page Ref: Sec. 3.5

38) A compound that is composed of carbon, hydrogen, and oxygen contains 70.6% C, 5.9% H, and 23.5% O by mass. The molecular weight of the compound is 136 amu. What is the molecular formula?

- A)  $\text{C}_8\text{H}_8\text{O}_2$
- B)  $\text{C}_8\text{H}_4\text{O}$
- C)  $\text{C}_4\text{H}_4\text{O}$
- D)  $\text{C}_9\text{H}_{12}\text{O}$
- E)  $\text{C}_5\text{H}_6\text{O}_2$

Answer: A

Diff: 3 Page Ref: Sec. 3.5

39) A compound that is composed of only carbon and hydrogen contains 85.7% C and 14.3% H by mass. What is the empirical formula of the compound?

- A)  $\text{CH}_2$
- B)  $\text{C}_2\text{H}_4$
- C)  $\text{C H}_4$
- D)  $\text{C}_4\text{H}_8$
- E)  $\text{C}_{86}\text{H}_{14}$

Answer: A

Diff: 3 Page Ref: Sec. 3.5



40) A compound that is composed of only carbon and hydrogen contains 80.0% C and 20.0% H by mass. What is the empirical formula of the compound?

- A)  $C_{20}H_{60}$
- B)  $C_7H_{20}$
- C)  $CH_3$
- D)  $C_2H_6$
- E)  $CH_4$

Answer: C

Diff: 3 Page Ref: Sec. 3.5

41) A compound contains 38.7% K, 13.9% N, and 47.4% O by mass. What is the empirical formula of the compound?

- A)  $KNO_3$
- B)  $K_2N_2O_3$
- C)  $KNO_2$
- D)  $K_2NO_3$
- E)  $K_4NO_5$

Answer: A

Diff: 3 Page Ref: Sec. 3.5

42) A compound is composed of only C, H, and O. The combustion of a 0.519-g sample of the compound yields 1.24 g of  $CO_2$  and 0.255 g of  $H_2O$ . What is the empirical formula of the compound?

- A)  $C_6H_6O$
- B)  $C_3H_3O$
- C)  $CH_3O$
- D)  $C_2H_6O_5$
- E)  $C_2H_6O_2$

Answer: B

Diff: 4 Page Ref: Sec. 3.5

43) Combustion of a 1.031-g sample of a compound containing only carbon, hydrogen, and oxygen produced 2.265 g of  $CO_2$  and 1.236 g of  $H_2O$ . What is the empirical formula of the compound?

- A)  $C_3H_8O$
- B)  $C_3H_5O$
- C)  $C_6H_{16}O_2$
- D)  $C_3H_9O_3$
- E)  $C_3H_6O_3$

Answer: A

Diff: 4 Page Ref: Sec. 3.5

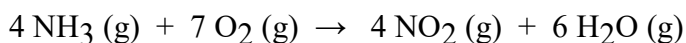
44) Combustion of a 0.9835-g sample of a compound containing only carbon, hydrogen, and oxygen produced 1.900 g of CO<sub>2</sub> and 1.070 g of H<sub>2</sub>O. What is the empirical formula of the compound?

- A) C<sub>2</sub> H<sub>5</sub>O
- B) C<sub>4</sub> H<sub>10</sub>O<sub>2</sub>
- C) C<sub>4</sub> H<sub>11</sub>O<sub>2</sub>
- D) C<sub>4</sub> H<sub>10</sub>O
- E) C<sub>2</sub> H<sub>5</sub>O<sub>2</sub>

Answer: C

Diff: 4 Page Ref: Sec. 3.5

45) The combustion of ammonia in the presence of excess oxygen yields NO<sub>2</sub> and H<sub>2</sub>O:



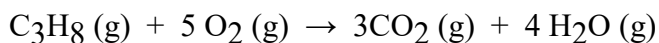
The combustion of 43.9 g of ammonia produces \_\_\_\_\_ g of NO<sub>2</sub>.

- A) 2.58
- B) 178
- C) 119
- D) 0.954
- E) 43.9

Answer: C

Diff: 3 Page Ref: Sec. 3.6

46) The combustion of propane (C<sub>3</sub>H<sub>8</sub>) in the presence of excess oxygen yields CO<sub>2</sub> and H<sub>2</sub>O:



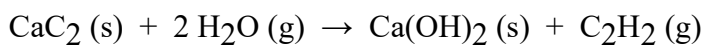
When 2.5 mol of O<sub>2</sub> are consumed in their reaction, \_\_\_\_\_ mol of CO<sub>2</sub> are produced.

- A) 1.5
- B) 3.0
- C) 5.0
- D) 6.0
- E) 2.5

Answer: A

Diff: 2 Page Ref: Sec. 3.6

47) Calcium carbide ( $\text{CaC}_2$ ) reacts with water to produce acetylene ( $\text{C}_2\text{H}_2$ ):



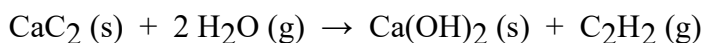
Production of 13 g of  $\text{C}_2\text{H}_2$  requires consumption of \_\_\_\_\_ g of  $\text{H}_2\text{O}$ .

- A) 4.5
- B) 9.0
- C) 18
- D)  $4.8 \times 10^2$
- E)  $4.8 \times 10^{-2}$

Answer: C

Diff: 3 Page Ref: Sec. 3.6

48) Calcium carbide ( $\text{CaC}_2$ ) reacts with water to produce acetylene ( $\text{C}_2\text{H}_2$ ):



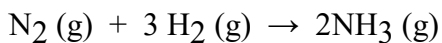
The complete reaction of 57.4 g of  $\text{CaC}_2$  requires consumption of \_\_\_\_\_ g of  $\text{H}_2\text{O}$ .

- A) 0.895
- B) 64.1
- C) 32.3
- D) 1.79
- E) 18.0

Answer: C

Diff: 4 Page Ref: Sec. 3.6

49) Under appropriate conditions, nitrogen and hydrogen undergo a combination reaction to yield ammonia:



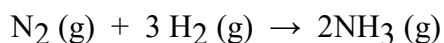
A 7.1-g sample of  $\text{N}_2$  requires \_\_\_\_\_ g of  $\text{H}_2$  for complete reaction.

- A) 0.51
- B) 0.76
- C) 1.2
- D) 1.5
- E) 17.2

Answer: D

Diff: 3 Page Ref: Sec. 3.6

50) Under appropriate conditions, nitrogen and hydrogen undergo a combination reaction to yield ammonia:



A \_\_\_\_\_ g sample of  $\text{N}_2$  requires 3.0 g of  $\text{H}_2$  for complete reaction.

- A) 0.51
- B) 0.76
- C) 1.2
- D) 14.0
- E) 17.2

Answer: D

Diff: 3 Page Ref: Sec. 3.6

51) Lead (II) carbonate decomposes to give lead (II) oxide and carbon dioxide:



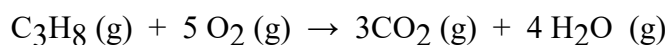
How many grams of lead (II) oxide will be produced by the decomposition of 2.50 g of lead (II) carbonate?

- A) 0.41
- B) 2.50
- C) 0.00936
- D) 2.09
- E) 2.61

Answer: D

Diff: 3 Page Ref: Sec. 3.6

52) The combustion of propane ( $\text{C}_3\text{H}_8$ ) produces  $\text{CO}_2$  and  $\text{H}_2\text{O}$ :



The reaction of 2.5 mol of  $\text{O}_2$  with 4.6 mol of  $\text{C}_3\text{H}_8$  will produce \_\_\_\_\_ mol of  $\text{H}_2\text{O}$ .

- A) 4.0
- B) 3.0
- C) 2.5
- D) 2.0
- E) 1.0

Answer: D

Diff: 2 Page Ref: Sec. 3.7

53)  $\text{GeF}_3\text{H}$  is formed from  $\text{GeH}_4$  and  $\text{GeF}_4$  in the combination reaction:



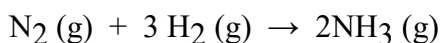
If the reaction yield is 92.6%, how many moles of  $\text{GeF}_4$  are needed to produce 8.00 mol of  $\text{GeF}_3\text{H}$ ?

- A) 3.24
- B) 5.56
- C) 6.48
- D) 2.78
- E) 2.16

Answer: C

Diff: 4 Page Ref: Sec. 3.7

54) Under appropriate conditions, nitrogen and hydrogen undergo a combination reaction to yield ammonia:



If the reaction yield is 87.5%, how many moles of  $\text{N}_2$  are needed to produce 3.00 mol of  $\text{NH}_3$ ?

- A) 0.166
- B) 1.00
- C) 1.5
- D) 1.71
- E) 2.32

Answer: D

Diff: 4 Page Ref: Sec. 3.7

55) Lead (II) carbonate decomposes to give lead (II) oxide and carbon dioxide:



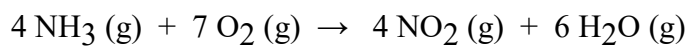
If the reaction yield is 95.7%, how many grams of lead (II) oxide will be produced by the decomposition of 2.50 g of lead (II) carbonate?

- A) 1.04
- B) 1.55
- C) 2.09
- D) 4.00
- E) 5.55

Answer: C

Diff: 4 Page Ref: Sec. 3.7

56) The combustion of ammonia in the presence of oxygen yields  $\text{NO}_2$  and  $\text{H}_2\text{O}$ :



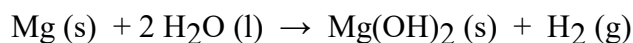
The combustion of 43.9 g of ammonia with 258 g of oxygen produces \_\_\_\_\_ g of  $\text{NO}_2$ .

- A) 212
- B) 178
- C) 119
- D) 0.954
- E) 43.9

Answer: C

Diff: 4 Page Ref: Sec. 3.7

57) What mass in grams of hydrogen is produced by the reaction of 4.73 g of magnesium with 1.83 g of water?

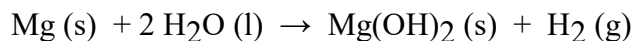


- A) 0.102
- B) 0.0162
- C) 0.0485
- D) 0.219
- E) 0.204

Answer: A

Diff: 4 Page Ref: Sec. 3.7

58) If the reaction yield is 94.4%, what mass in grams of hydrogen is produced by the reaction of 4.73 g of magnesium with 1.83 g of water?

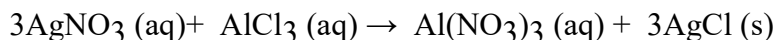


- A) 0.0962
- B) 0.0162
- C) 0.0485
- D) 0.219
- E) 0.204

Answer: A

Diff: 4 Page Ref: Sec. 3.7

59) Silver nitrate and aluminum chloride react with each other by exchanging anions:



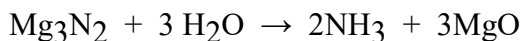
What mass in grams of AgCl is produced when 4.22 g of AgNO<sub>3</sub> react with 7.73 g of AlCl<sub>3</sub>?

- A) 17.6
- B) 4.22
- C) 24.9
- D) 3.56
- E) 11.9

Answer: D

Diff: 4 Page Ref: Sec. 3.7

60) How many moles of magnesium oxide are produced by the reaction of 3.82 g of magnesium nitride with 7.73 g of water?

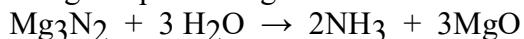


- A) 0.114
- B) 0.0378
- C) 0.429
- D) 0.0756
- E) 4.57

Answer: A

Diff: 4 Page Ref: Sec. 3.7

61) A 3.82-g sample of magnesium nitride is reacted with 7.73 g of water.



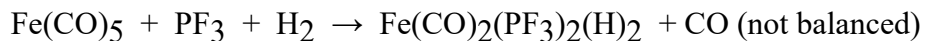
The yield of MgO is 3.60 g. What is the percent yield in the reaction?

- A) 94.5
- B) 78.4
- C) 46.6
- D) 49.4
- E) 99.9

Answer: B

Diff: 4 Page Ref: Sec. 3.7

62) Pentacarbonyliron ( $\text{Fe}(\text{CO})_5$ ) reacts with phosphorous trifluoride ( $\text{PF}_3$ ) and hydrogen, releasing carbon monoxide:



The reaction of 5.0 mol of  $\text{Fe}(\text{CO})_5$ , 8.0 mol of  $\text{PF}_3$  and 6.0 mol of  $\text{H}_2$  will release \_\_\_\_\_ mol of CO.

- A) 15
- B) 5.0
- C) 24
- D) 6.0
- E) 12

Answer: E

Diff: 3 Page Ref: Sec. 3.7

63) What is the maximum mass in grams of  $\text{NH}_3$  that can be produced by the reaction of 1.0 g of  $\text{N}_2$  with 3.0 g of  $\text{H}_2$  via the equation below?



- A) 2.0
- B) 1.2
- C) 0.61
- D) 17
- E) 4.0

Answer: B

Diff: 3 Page Ref: Sec. 3.7

64) What is the maximum amount in grams of  $\text{SO}_3$  that can be produced by the reaction of 1.0 g of S with 1.0 g of  $\text{O}_2$  via the equation below?



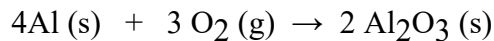
- A) 0.27
- B) 1.7
- C) 2.5
- D) 3.8
- E) 2.0

Answer: B

Diff: 3 Page Ref: Sec. 3.7



65) Solid aluminum and gaseous oxygen react in a combination reaction to produce aluminum oxide:



The maximum amount of  $\text{Al}_2\text{O}_3$  that can be produced from 2.5 g of Al and 2.5 g of  $\text{O}_2$  is \_\_\_\_\_

g.

A) 9.4

B) 7.4

C) 4.7

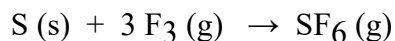
D) 5.3

E) 5.0

Answer: C

Diff: 3 Page Ref: Sec. 3.7

66) Sulfur and fluorine react in a combination reaction to produce sulfur hexafluoride:



The maximum amount of  $\text{SF}_6$  that can be produced from the reaction of 3.5 g of sulfur with 4.5 g of fluorine is \_\_\_\_\_ g.

A) 12

B) 3.2

C) 5.8

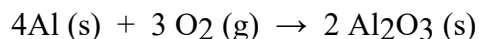
D) 16

E) 8.0

Answer: C

Diff: 3 Page Ref: Sec. 3.7

67) Solid aluminum and gaseous oxygen react in a combination reaction to produce aluminum oxide:



In a particular experiment, the reaction of 2.5 g of Al with 2.5 g of  $\text{O}_2$  produced 3.5 g of  $\text{Al}_2\text{O}_3$ . The % yield of the reaction is \_\_\_\_\_.

A) 74

B) 37

C) 47

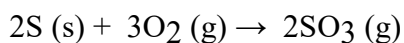
D) 66

E) 26

Answer: A

Diff: 4 Page Ref: Sec. 3.7

68) Sulfur and oxygen react in a combination reaction to produce sulfur trioxide, an environmental pollutant:



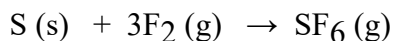
In a particular experiment, the reaction of 1.0 g S with 1.0 g O<sub>2</sub> produced 0.80 g of SO<sub>3</sub>. The % yield in this experiment is \_\_\_\_\_.

- A) 30
- B) 29
- C) 21
- D) 88
- E) 48

Answer: E

Diff: 4 Page Ref: Sec. 3.7

69) Sulfur and fluorine react in a combination reaction to produce sulfur hexafluoride:



In a particular experiment, the percent yield is 79.0%. This means that in this experiment, a 7.90-g sample of fluorine yields \_\_\_\_\_ g of SF<sub>6</sub>.

- A) 30.3
- B) 10.1
- C) 7.99
- D) 24.0
- E) 0.110

Answer: C

Diff: 4 Page Ref: Sec. 3.7

### 3.3 Algorithmic Questions

1) The molecular weight of acetic acid (HC<sub>2</sub>H<sub>3</sub>O<sub>2</sub>), the acid in vinegar, is \_\_\_\_\_ amu (rounded to one decimal place).

- A) 59.0
- B) 29.0
- C) 60.1
- D) 8.0
- E) 32.0

Answer: C

Diff: 1 Page Ref: Sec. 3.3

2) Determine the mass percent (to the hundredths place) of Na in sodium bicarbonate (NaHCO<sub>3</sub>).

Answer: 27.36

Diff: 2 Page Ref: Sec. 3.3

3) There are \_\_\_\_\_ mol of carbon atoms in 3 mol of dimethylsulfoxide ( $C_2H_6SO$ ).

- A) 2
- B) 4
- C) 6
- D) 8
- E) 10

Answer: C

Diff: 1 Page Ref: Sec. 3.4

4) How many grams of hydrogen are in 23 g of  $CH_4O$ ?

- A) 2.9
- B) 4.6
- C) 2.3
- D) 4.0
- E) 5.8

Answer: A

Diff: 3 Page Ref: Sec. 3.4

5) How many grams of oxygen are in 45 g of  $C_2H_2O_2$ ?

- A) 8.3
- B) 9.3
- C) 17
- D) 25
- E) 31

Answer: D

Diff: 3 Page Ref: Sec. 3.4

6) A 3.92-g sample of magnesium nitrate,  $Mg(NO_3)_2$ , contains \_\_\_\_\_ mol of this compound.

- A) 2.32
- B) 1.65
- C) 0.111
- D) 0.0529
- E) 0.0264

Answer: E

Diff: 2 Page Ref: Sec. 3.4

7) A 17.6-g sample of ammonium carbonate contains \_\_\_\_\_ mol of ammonium ions.

- A) 0.366
- B) 0.183
- C) 0.176
- D) 2.14
- E) 3.47

Answer: A

Diff: 4 Page Ref: Sec. 3.4

8) What is the empirical formula of a compound that is 52.1% C, 13.1% H, and 34.7% O by mass?

- A) C<sub>2</sub>HO
- B) C<sub>2</sub>HO<sub>3</sub>
- C) C<sub>4</sub>H<sub>12</sub>O<sub>2</sub>
- D) C<sub>4</sub>H<sub>13</sub>O<sub>2</sub>
- E) C<sub>2</sub>H<sub>6</sub>O

Answer: E

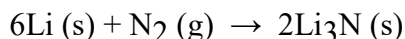
Diff: 4 Page Ref: Sec. 3.5

9) A certain alcohol contains only three elements, carbon, hydrogen, and oxygen. Combustion of a 30.00 gram sample of the alcohol produced 57.30 grams of CO<sub>2</sub> and 35.22 grams of H<sub>2</sub>O. What is the empirical formula of the alcohol?

Answer: C<sub>2</sub>H<sub>6</sub>O

Diff: 4 Page Ref: Sec. 3.5

10) Lithium and nitrogen react to produce lithium nitride:



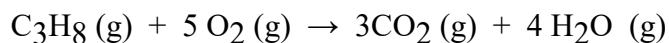
How many moles of N<sub>2</sub> are needed to react with 0.710 mol of lithium?

- A) 4.26
- B) 0.710
- C) 0.237
- D) 2.13
- E) 0.118

Answer: E

Diff: 2 Page Ref: Sec. 3.6

11) The combustion of propane (C<sub>3</sub>H<sub>8</sub>) produces CO<sub>2</sub> and H<sub>2</sub>O:



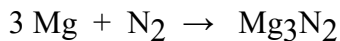
The reaction of 5.5 mol of O<sub>2</sub> will produce \_\_\_\_\_ mol of H<sub>2</sub>O.

- A) 5.5
- B) 5.0
- C) 2.0
- D) 4.4
- E) 1.0

Answer: D

Diff: 2 Page Ref: Sec. 3.6

12) Magnesium and nitrogen react in a combination reaction to produce magnesium nitride:



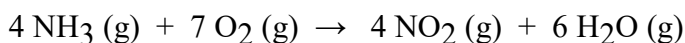
In a particular experiment, a 10.1-g sample of  $\text{N}_2$  reacts completely. The mass of Mg consumed is \_\_\_\_\_ g.

- A) 8.76
- B) 26.3
- C) 35.1
- D) 0.92
- E) 13.9

Answer: B

Diff: 3 Page Ref: Sec. 3.6

13) The combustion of ammonia in the presence of excess oxygen yields  $\text{NO}_2$  and  $\text{H}_2\text{O}$ :



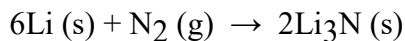
The combustion of 57.6 g of ammonia consumes \_\_\_\_\_ g of oxygen.

- A) 27.0
- B) 28.8
- C) 54.1
- D) 189
- E) 94.6

Answer: D

Diff: 3 Page Ref: Sec. 3.6

14) Lithium and nitrogen react to produce lithium nitride:



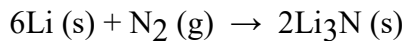
How many moles of lithium nitride are produced when 0.400 mol of lithium react in this fashion?

- A) 0.133
- B) 0.800
- C) 0.0667
- D) 1.20
- E) 0.200

Answer: A

Diff: 2 Page Ref: Sec. 3.6

15) Lithium and nitrogen react in a combination reaction to produce lithium nitride:



How many moles of lithium are needed to produce 0.20 mol of  $\text{Li}_3\text{N}$  when the reaction is carried out in the presence of excess nitrogen?

- A) 0.10
- B) 0.60
- C) 0.067
- D) 0.13
- E) 1.2

Answer: B

Diff: 2 Page Ref: Sec. 3.6

16) Automotive air bags inflate when sodium azide decomposes explosively to its constituent elements:



How many moles of  $\text{H}_2$  are produced by the decomposition of 3.55 mol of sodium azide?

- A) 2.37
- B) 10.7
- C) 5.33
- D) 1.18
- E) 1.78

Answer: C

Diff: 2 Page Ref: Sec. 3.6

17) Automotive air bags inflate when sodium azide decomposes explosively to its constituent elements:



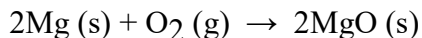
How many grams of sodium azide are required to produce 30.5 g of nitrogen?

- A) 1.63
- B) 0.726
- C) 70.8
- D) 47.2
- E) 106.2

Answer: D

Diff: 3 Page Ref: Sec. 3.6

18) Magnesium burns in air with a dazzling brilliance to produce magnesium oxide:



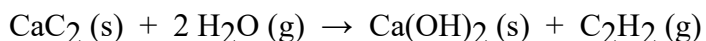
How many moles of  $\text{O}_2$  are consumed when 4.11 mol of magnesium burns?

- A) 0.169
- B) 0.487
- C) 4.11
- D) 8.22
- E) 2.06

Answer: E

Diff: 2      Page Ref: Sec. 3.6

19) Calcium carbide ( $\text{CaC}_2$ ) reacts with water to produce acetylene ( $\text{C}_2\text{H}_2$ ):



Production of 3.3 g of  $\text{C}_2\text{H}_2$  requires consumption of \_\_\_\_\_ g of  $\text{H}_2\text{O}$ .

- A) 1.2
- B) 2.3
- C) 4.6
- D) 480
- E) 0.048

Answer: C

Diff: 3      Page Ref: Sec. 3.6

20) Lead (II) carbonate decomposes to give lead (II) oxide and carbon dioxide:



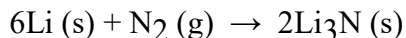
\_\_\_\_\_ grams of lead (II) oxide will be produced by the decomposition of 7.50 g of lead (II) carbonate?

- A) 0.41
- B) 2.50
- C) 0.00936
- D) 6.26
- E) 7.83

Answer: D

Diff: 3      Page Ref: Sec. 3.6

21) Lithium and nitrogen react in a combination reaction to produce lithium nitride:



In a particular experiment, 5.50-g samples of each reagent are reacted. The theoretical yield of lithium nitride is \_\_\_\_\_ g.

A) 5.53

B) 4.60

C) 27.6

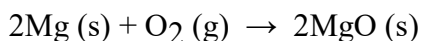
D) 9.20

E) 13.7

Answer: D

Diff: 3      Page Ref: Sec. 3.7

22) Magnesium burns in air with a dazzling brilliance to produce magnesium oxide:



When 2.00 g of magnesium burns, the theoretical yield of magnesium oxide is \_\_\_\_\_ g.

A) 2.00

B) 3.32

C) 0.0823

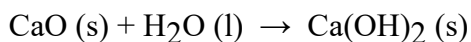
D) 1.66

E) 6.63

Answer: B

Diff: 3      Page Ref: Sec. 3.7

23) Calcium oxide reacts with water in a combination reaction to produce calcium hydroxide:



A 4.00-g sample of CaO is reacted with 3.86 g of H<sub>2</sub>O. How many grams of water remains after completion of reaction?

A) 0.00

B) 0.00793

C) 2.57

D) 1.04

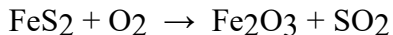
E) 0.143

Answer: C

Diff: 4      Page Ref: Sec. 3.7



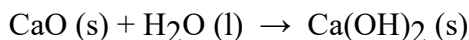
24) If 2352 grams of FeS<sub>2</sub> is allowed to react with 1408 grams of O<sub>2</sub> according to the following equation, how many grams of Fe<sub>2</sub>O<sub>3</sub> are produced?



Answer: 1280

Diff: 4 Page Ref: Sec. 3.7

25) Calcium oxide reacts with water in a combination reaction to produce calcium hydroxide:



In a particular experiment, a 1.50-g sample of CaO is reacted with excess water and 1.48 g of Ca(OH)<sub>2</sub> is recovered. What is the percent yield in this experiment?

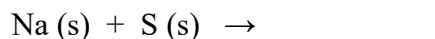
- A) 99
- B) 0.99
- C) 2.16
- D) 74.8
- E) 101.2

Answer: D

Diff: 4 Page Ref: Sec. 3.7

### 3.4 Short Answer Questions

1) Complete and balance the following reaction, given that elemental rubidium reacts with elemental sulfur to form Rb<sub>2</sub>S (s).



Answer:  $\rightarrow \text{Na}_2\text{S (s)}$

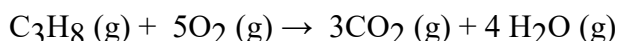
Diff: 3 Page Ref: Sec. 3.2

2) A compound was found to contain 90.6% lead (Pb) and 9.4% oxygen. The empirical formula for this compound is \_\_\_\_\_.

Answer: Pb<sub>3</sub>O<sub>4</sub>

Diff: 3 Page Ref: Sec. 3.5

3) The combustion of propane (C<sub>3</sub>H<sub>8</sub>) in the presence of excess oxygen yields CO<sub>2</sub> and H<sub>2</sub>O:

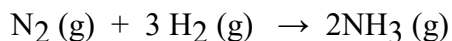


When 7.3 g of C<sub>3</sub>H<sub>8</sub> burns in the presence of excess O<sub>2</sub>, \_\_\_\_\_ g of CO<sub>2</sub> is produced.

Answer: 22

Diff: 3 Page Ref: Sec. 3.6

4) Under appropriate conditions, nitrogen and hydrogen undergo a combination reaction to yield ammonia:

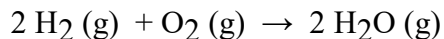


A 9.3-g sample of hydrogen requires \_\_\_\_\_ g of  $\text{N}_2$  for a complete reaction.

Answer: 43

Diff: 3 Page Ref: Sec. 3.6

5) Water can be formed from the stoichiometric reaction of hydrogen with oxygen:

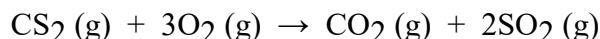


A complete reaction of 5.0 g of  $\text{O}_2$  with excess hydrogen produces \_\_\_\_\_ g of  $\text{H}_2\text{O}$ .

Answer: 5.6

Diff: 3 Page Ref: Sec. 3.6

6) The combustion of carbon disulfide in the presence of excess oxygen yields carbon dioxide and sulfur dioxide:



The combustion of 15 g of  $\text{CS}_2$  in the presence of excess oxygen yields \_\_\_\_\_ g of  $\text{SO}_2$ .

Answer: 25

Diff: 3 Page Ref: Sec. 3.6

### 3.5 True/False Questions

1) The mass of a single atom of an element (in amu) is numerically EQUAL to the mass in grams of 1 mole of that element.

Answer: TRUE

Diff: 2 Page Ref: Sec. 3.4

2) The molecular weight is ALWAYS a whole-number multiple of the empirical formula weight.

Answer: TRUE

Diff: 1 Page Ref: Sec. 3.5

3) A great deal of the carbon dioxide produced by the combustion of fossil fuels is absorbed into the oceans.

Answer: TRUE

Diff: 2 Page Ref: Sec. 3.6

4) The quantity of product that is calculated to form when all of the limiting reagent reacts is called the actual yield.

Answer: FALSE

Diff: 1 Page Ref: Sec. 3.7