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 _____.

$$C_8H_{18} + O_2 \rightarrow CO_2 + H_2O$$

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) $C + O_2 \rightarrow CO_2$
B) $2Mg + O_2 \rightarrow 2MgO$
C) $2N_2 + 3H_2 \rightarrow 2NH_3$
D) $CaO + H_2O \rightarrow Ca(OH)_2$
E) $2CH_4 + 4O_2 \rightarrow 2CO_2 + 4H_2O$
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) $NH_4Cl \rightarrow NH_3 + HCl$
B) $2Mg + O_2 \rightarrow 2MgO$
C) $2N_2 + 3\,H_2 \rightarrow 2NH_3$
D) $2CH_4 + 4O_2 \rightarrow 2CO_2 + 4H_2O$
E) $Cd(NO_3)O_2 + Na_2S \rightarrow CdS + 2NaNO_3$
Answer: A
Diff: 3 Page Ref: Sec. 3.2

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

$$Al\,(s) + I_2\,(s) \rightarrow \_\_\_\_\_$$

A) AlI_2
B) AlI
C) AlI_3
D) Al_2I_3
E) Al_3I_2
Answer: C
Diff: 2 Page Ref: Sec. 3.2

7) Which one of the following is <u>not</u> 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?
1) CH_4 (g) + O_2 (g) → CO_2 (g) + H_2O (l)
2) CaO (s) + CO_2 (g) → $CaCO_3$ (s)
3) Mg (s) + O_2 (g) → MgO (s)
4) $PbCO_3$ (s) → PbO (s) + CO_2 (g)
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?
1) CH_4 (g) + O_2 (g) → CO_2 (g) + H_2O (l)
2) CaO (s) + CO_2 (g) → $CaCO_3$ (s)
3) $PbCO_3$ (s) → PbO (s) + CO_2 (g)
4) CH_3OH (l) + O_2 (g) → CO_2 (g) + H_2O (l)
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?
1) CH_4 (g) + O_2 (g) → CO_2 (g) + H_2O (l)
2) CaO (s) + CO_2 (g) → $CaCO_3$ (s)
3) Mg (s) + O_2 (g) → MgO (s)
4) $PbCO_3$ (s) → PbO (s) + CO_2 (g)
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 $C_6H_5N\,O_2$. 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 (Ag_2CrO_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 ($(NH_4)O_2SO_4$), 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 (CH_3CO_2H), 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 (C_2H_5OH), 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 ($C_6H_{12}O_6$), 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 (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 ($Pb(NO_3)_2$) 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 (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 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 $PtCl_2(NH_3)_2$.
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 $Pb(NO_3)_2$.
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 $Pb(NO_3)_2$.
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 $PbCO_3$.
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 $Pb(NO_3)_2$.
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 $PtCl_2(NH_3)_2$.
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 $PtCl_2(N H_3)_2$
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) S_8
B) $C_{10}H_8$
C) $Al_2(SO_4)_3$
D) Na_3PO_4
E) Cl_2
Answer: B
Diff: 2 Page Ref: Sec. 3.4

39) One mole of _____ contains the smallest number of atoms.
A) S_8
B) $C_{10}H_8$
C) $Al_2(SO_4)_3$
D) Na_3PO_4
E) 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) 1.7×10^{-18}
C) 6.0×10^{23}
D) 1.0×10^{-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 CH_3CO_2H.
A) 300
B) 600
C) 3.01×10^{24}
D) 3.61×10^{26}
E) 1.80×10^{26}
Answer: B
Diff: 2 Page Ref: Sec. 3.4

42) How many molecules of CH_4 are in 48.2 g of this compound?

A) 5.00×10^{24}
B) 3.00
C) 2.90×10^{25}
D) 1.81×10^{24}
E) 4.00
Answer: D
Diff: 3 Page Ref: Sec. 3.4

43) A 30.5 gram sample of glucose ($C_6H_{12}O_6$) 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 ($C_6H_{12}O_6$) contains _____ atoms of carbon.

A) 1.02 x 10^{23}
B) 6.12 x 10^{23}
C) 6.02 x 10^{23}
D) 2.04 x 10^{23}
E) 1.22 x 10^{24}
Answer: B
Diff: 3 Page Ref: Sec 3.4

45) A sample of CH_2F_2 with a mass of 19 g contains _____ atoms of F.

A) 2.2×10^{23}
B) 38
C) 3.3×10^{24}
D) 4.4×10^{23}
E) 9.5
Answer: D
Diff: 3 Page Ref: Sec. 3.4

46) A sample of CH_4O with a mass of 32.0 g contains _____ molecules of CH_4O.

A) 5.32×10^{-23}
B) 1.00
C) 1.88×10^{22}
D) 6.02×10^{23}
E) 32.0
Answer: D
Diff: 2 Page Ref: Sec. 3.4

47) How many atoms of nitrogen are in 10 g of NH_4NO_3?
A) 3.5
B) 1.5×10^{23}
C) 3.0×10^{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) 4.76×10^{22}
B) 3.43×10^{26}
C) 2.11×10^{22}
D) 1.59×10^{25}
E) 6.02×10^{23}
Answer: C
Diff: 4 Page Ref: Sec. 3.4

49) What is the mass in grams of 9.76×10^{12} atoms of naturally occurring sodium?
A) 22.99
B) 1.62×10^{-11}
C) 3.73×10^{-10}
D) 7.05×10^{-13}
E) 2.24×10^{14}
Answer: C
Diff: 3 Page Ref: Sec. 3.4

50) How many moles of pyridine (C_5H_5N) are contained in 3.13 g of pyridine?
A) 0.0396
B) 25.3
C) 0.319
D) 0.00404
E) 4.04×10^{3}
Answer: A
Diff: 3 Page Ref: Sec. 3.4

51) How many oxygen atoms are contained in 2.74 g of $Al_2(SO_4)_3$?
A) 12
B) 6.02×10^{23}
C) 7.22×10^{24}
D) 5.79×10^{22}
E) 8.01×10^{-3}
Answer: D
Diff: 3 Page Ref: Sec. 3.4

52) The total number of atoms in 0.111 mol of $Fe(CO)_3(PH_3)_2$ is _____.
A) 15.0
B) 1.00×10^{24}
C) 4.46×10^{21}
D) 1.67
E) 2.76×10^{-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) 1.08×10^{23}
B) 6.02×10^{24}
C) 1.80×10^{24}
D) 1.08×10^{24}
E) 6.02×10^{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) 1.80×10^{23}
B) 6.02×10^{24}
C) 6.02×10^{23}
D) 1.08×10^{24}
E) 1.08×10^{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) 5.206×10^{24}
B) 3.134×10^{25}
C) 7.122×10^{23}
D) 8.648×10^{-23}
E) 1.424×10^{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) 1.424×10^{24}
B) 6.022×10^{23}
C) 1.204×10^{24}
D) 5.088×10^{23}
E) 1.018×10^{24}
Answer: A
Diff: 3 Page Ref: Sec. 3.4

57) How many moles of sodium carbonate contain 1.773×10^{17} carbon atoms?
A) 5.890×10^{-7}
B) 2.945×10^{-7}
C) 1.473×10^{-7}
D) 8.836×10^{-7}
E) 9.817×10^{-8}
Answer: B
Diff: 2 Page Ref: Sec. 3.4

58) How many grams of sodium carbonate contain 1.773×10^{17} carbon atoms?
A) 3.121×10^{-5}
B) 1.011×10^{-5}
C) 1.517×10^{-5}
D) 9.100×10^{-5}
E) 6.066×10^{-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®, 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) 6.0×10^{23}
B) 1.8×10^{25}
C) 3.6×10^{25}
D) 1.2×10^{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_3 are produced by the reaction of 5.0 grams of O_2 with 6.0 grams of S. What is the % yield of SO_3 in this experiment?

$$S\ (s)\ +\ O_2\ (g)\ \rightarrow\ SO_3\ (g)\ \text{(not balanced)}$$

A) 32
B) 63
C) 75
D) 95
E) 99
Answer: D
Diff: 4 Page Ref: Sec. 3.7

66) Propane (C_3H_8) 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 _____.

$$NH_3\ (g)\ +\ O_2\ (g) \rightarrow\ NO_2\ (g)\ +\ H_2O\ (g)$$

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 _____.

$$Al(NO_3)_3 + Na_2S \rightarrow Al_2S_3 + NaNO_3$$

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_2 is _____.

$$K\,(s) + H_2O\,(l) \rightarrow KOH\,(aq) + H_2\,(g)$$

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 _____.

$$Al\,(s) + H_2O\,(l) \rightarrow Al(OH)_3\,(s) + H_2\,(g)$$

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_2O is _____.

$$Ca\,(s) + H_2O\,(l) \rightarrow Ca(OH)_2\,(aq) + H_2\,(g)$$

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 Al_2O_3 is _____.

$$Al_2O_3\ (s)\ +\ C\ (s)\ +\ Cl_2\ (g)\ \rightarrow\ AlCl_3\ (s)\ +\ CO\ (g)$$

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 H_2S is _____.

$$FeCl_3\ (aq)\ +\ H_2S\ (g) \rightarrow\ Fe_2S_3\ (s) +\ HCl\ (aq)$$

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 HCl is _____.

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

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 HNO_3 is _____.

$$HNO_3\ (aq) +\ CaCO_3\ (s) \rightarrow\ Ca(NO_3)_2\ (aq) +\ CO_2\ (g) +\ H_2O\ (l)$$

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 H_3PO_4 is _____.

$$H_3PO_4\ (aq) + NaOH\ (aq) \rightarrow Na_3PO_4\ (aq) + H_2O\ (l)$$

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 $C_3H_8O_3$ is _____.

$$C_3H_8O_3\ (g) + O_2\ (g) \rightarrow CO_2\ (g) + H_2O\ (g)$$

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 O_2 is _____.

$$C_2H_4O\ (g) + O_2\ (g) \rightarrow CO_2\ (g) + H_2O\ (g)$$

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 H_2 is _____.

$$CO\ (g) + H_2\ (g) \rightarrow H_2O\ (g) + CH_4\ (g)$$

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 H_2SO_4 is _____.

H_2SO_4 (aq) + NaOH (aq) → Na_2SO_4 (aq) + H_2O (l)

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 _____.

K (s) + H_2O (l) → KOH (aq) + H_2 (g)

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 _____.

K (s) + H_2O (l) → KOH (aq) + H_2 (g)

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 _____.

PbS (s) + O_2 (g) → PbO (s) + SO_2 (g)

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 _____.

$$PbS\ (s)\ +\ O_2\ (g)\ \rightarrow\ PbO\ (s)\ +\ SO_2\ (g)$$

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 _____.

$$N_2O_5\ (g)\ +\ H_2O\ (l)\ \rightarrow\ HNO_3\ (aq)$$

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 _____.

$$N_2O_5\ (g)\ +\ H_2O\ (l)\ \rightarrow\ HNO_3\ (aq)$$

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 _____.

$$N_2O_5\ (g)\ +\ H_2O\ (l)\ \rightarrow\ HNO_3\ (aq)$$

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_3OH (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_3OH (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_2 when the following equation is completed and balanced?

$$C_4H_8O_2 + O_2 \rightarrow \_\_\_\_\_$$

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.

$$Al\,(s) + N_2\,(g) \rightarrow \_\_\_\_\_$$

A) AlN
B) Al_3N
C) $Al\,N_2$
D) Al_3N_2
E) AlN_3
Answer: A
Diff: 3 Page Ref: Sec. 3.2

26) The balanced equation for the decomposition of sodium azide is _____.
A) $2NaN_3\ (s) \rightarrow 2Na\ (s) + 3\ N_2\ (g)$
B) $2NaN_3\ (s) \rightarrow Na_2\ (s) + 3\ N_2\ (g)$
C) $NaN_3\ (s) \rightarrow Na\ (s) + N_2\ (g)$
D) $NaN_3\ (s) \rightarrow Na\ (s) + N_2\ (g) + N\ (g)$
E) $2NaN_3\ (s) \rightarrow 2Na\ (s) + 2\ N_2\ (g)$
Answer: A
Diff: 2 Page Ref: Sec. 3.2

27) There are _____ mol of carbon atoms in 4 mol $C_4H_8O_2$.
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 $C_4H_4S_2$.
A) 1.5×10^{25}
B) 4.8×10^{25}
C) 3.0×10^{25}
D) 50
E) 6.02×10^{23}
Answer: D
Diff: 2 Page Ref: Sec. 3.4

29) There are _____ hydrogen atoms in 25 molecules of $C_4H_4S_2$.
A) 25
B) 3.8×10^{24}
C) 6.0×10^{25}
D) 100
E) 1.5×10^{25}
Answer: D
Diff: 2 Page Ref: Sec. 3.4

30) A sample of C_3H_8O that contains 200 molecules contains _____ carbon atoms.
A) 600
B) 200
C) 3.61×10^{26}
D) 1.20×10^{26}
E) 4.01×10^{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) 6.022×10^{23}
D) 8.648×10^{23}
E) 3.134×10^{25}
Answer: B
Diff: 2 Page Ref: Sec. 3.4

33) There are _____ molecules of methane in 0.123 mol of methane (CH_4).
A) 5
B) 2.46×10^{-2}
C) 2.04×10^{-25}
D) 7.40×10^{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) $SOCl_2$
C) S_2OCl
D) SO_2Cl
E) $ClSO_4$
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) $Na_2S_2O_3$
B) $NaSO_2$
C) NaSO
D) $NaSO3_4$
E) $Na_2S_2O_6$
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) KSO_2
B) KSO_3
C) K_2SO_4
D) K_2O_3
E) 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) $C_2H_4O_2$
B) C H_2O
C) $C_2H_3O_4$
D) $C_2H_2O_4$
E) 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) $C_8H_8O_2$
B) C_8H_4O
C) C_4H_4O
D) $C_9H_{12}O$
E) $C_5H_6O_2$
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) CH_2
B) C_2H_4
C) C $H4_2$
D) C_4H_8
E) $C_{86}H_{14}$
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) C H_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_2 and 1.070 g of H_2O. What is the empirical formula of the compound?

A) C_2H_5O

B) $C_4H_{10}O_2$

C) $C_4H_{11}O_2$

D) $C_4H_{10}O$

E) $C_2H_5O_2$

Answer: C

Diff: 4 Page Ref: Sec. 3.5

45) The combustion of ammonia in the presence of excess oxygen yields NO_2 and H_2O:

$$4\ NH_3\ (g)\ +\ 7\ O_2\ (g)\ \rightarrow\ 4\ NO_2\ (g)\ +\ 6\ H_2O\ (g)$$

The combustion of 43.9 g of ammonia produces _____ g of NO_2.

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_3H_8) in the presence of excess oxygen yields CO_2 and H_2O:

$$C_3H_8\ (g)\ +\ 5\ O_2\ (g)\ \rightarrow\ 3CO_2\ (g)\ +\ 4\ H_2O\ (g)$$

When 2.5 mol of O_2 are consumed in their reaction, _____ mol of CO_2 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 (CaC_2) reacts with water to produce acetylene (C_2H_2):

$$CaC_2\ (s)\ +\ 2\ H_2O\ (g)\ \rightarrow\ Ca(OH)_2\ (s)\ +\ C_2H_2\ (g)$$

Production of 13 g of C_2H_2 requires consumption of _____ g of H_2O.
A) 4.5
B) 9.0
C) 18
D) 4.8×10^2
E) 4.8×10^{-2}
Answer: C
Diff: 3 Page Ref: Sec. 3.6

48) Calcium carbide (CaC_2) reacts with water to produce acetylene (C_2H_2):

$$CaC_2\ (s)\ +\ 2\ H_2O\ (g)\ \rightarrow\ Ca(OH)_2\ (s)\ +\ C_2H_2\ (g)$$

The complete reaction of 57.4 g of CaC_2 requires consumption of _____ g of H_2O.
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:

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

A 7.1-g sample of N_2 requires _____ g of 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:

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

A _____ g sample of N_2 requires 3.0 g of 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:

$$PbCO_3\,(s) \rightarrow PbO\,(s) + CO_2\,(g)$$

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 (C_3H_8) produces CO_2 and H_2O:

$$C_3H_8\,(g) + 5\,O_2\,(g) \rightarrow 3CO_2\,(g) + 4\,H_2O\,(g)$$

The reaction of 2.5 mol of O_2 with 4.6 mol of C_3H_8 will produce _____ mol of H_2O.
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) GeF_3H is formed from GeH_4 and GeF_4 in the combination reaction:

$$GeH_4 + 3Ge\,F_4 \rightarrow 4GeF_3H$$

If the reaction yield is 92.6%, how many moles of GeF_4 are needed to produce 8.00 mol of GeF_3H?
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:

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

If the reaction yield is 87.5%, how many moles of N_2 are needed to produce 3.00 mol of 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:

$$PbCO_3\,(s) \rightarrow PbO\,(s) + CO_2\,(g)$$

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 NO_2 and H_2O:

$$4\ NH_3\ (g)\ +\ 7\ O_2\ (g)\ \rightarrow\ 4\ NO_2\ (g)\ +\ 6\ H_2O\ (g)$$

The combustion of 43.9 g of ammonia with 258 g of oxygen produces _____ g of 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?

$$Mg\ (s)\ +2\ H_2O\ (l)\ \rightarrow\ Mg(OH)_2\ (s)\ +\ H_2\ (g)$$

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?

$$Mg\ (s)\ +2\ H_2O\ (l)\ \rightarrow\ Mg(OH)_2\ (s)\ +\ H_2\ (g)$$

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:

$$3AgNO_3\,(aq) + AlCl_3\,(aq) \rightarrow Al(NO_3)_3\,(aq) + 3AgCl\,(s)$$

What mass in grams of AgCl is produced when 4.22 g of $AgNO_3$ react with 7.73 g of $AlCl_3$?
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?

$$Mg_3N_2 + 3\,H_2O \rightarrow 2NH_3 + 3MgO$$

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.

$$Mg_3N_2 + 3\,H_2O \rightarrow 2NH_3 + 3MgO$$

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 ($Fe(CO)_5$) reacts with phosphorous trifluoride (PF_3) and hydrogen, releasing carbon monoxide:

$$Fe(CO)_5 + PF_3 + H_2 \rightarrow Fe(CO)_2(PF_3)_2(H)_2 + CO \text{ (not balanced)}$$

The reaction of 5.0 mol of $Fe(CO)_5$, 8.0 mol of $PF_3$and 6.0 mol of 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 NH3 that can be produced by the reaction of 1.0 g of N_2 with 3.0 g of H_2 via the equation below?

$$N_2 (g) + H_2 (g) \rightarrow NH_3 (g) \text{ (not balanced)}$$

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 SO_3 that can be produced by the reaction of 1.0 g of S with 1.0 g of O_2 via the equation below?

$$S (s) + O_2 (g) \rightarrow SO_3 (g) \text{ (not balanced)}$$

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:

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

The maximum amount of Al_2O_3 that can be produced from 2.5 g of Al and 2.5 g of 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:

$$S\,(s) + 3\,F_3\,(g) \rightarrow SF_6\,(g)$$

The maximum amount of 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:

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

In a particular experiment, the reaction of 2.5 g of Al with 2.5 g of O_2 produced 3.5 g of Al_2O_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:

$$2S\ (s) + 3O_2\ (g) \rightarrow 2SO_3\ (g)$$

In a particular experiment, the reaction of 1.0 g S with 1.0 g O_2 produced 0.80 g of SO_3. 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:

$$S\ (s) + 3F_2\ (g) \rightarrow SF_6\ (g)$$

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_6.
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 ($HC_2H_3O_2$), 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 ($NaHCO_3$).
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_2HO
B) C_2HO_3
C) $C_4H_{12}O_2$
D) $C_4H_{13}O_2$
E) C_2H_6O
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_2 and 35.22 grams of H_2O. What is the empirical formula of the alcohol?
Answer: C_2H_6O
Diff: 4 Page Ref: Sec. 3.5

10) Lithium and nitrogen react to produce lithium nitride:

$$6Li\ (s) + N_2\ (g) \rightarrow 2Li_3N\ (s)$$

How many moles of N_2 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_3H_8) produces CO_2 and H_2O:

$$C_3H_8\ (g) + 5\ O_2\ (g) \rightarrow 3CO_2\ (g) + 4\ H_2O\ (g)$$

The reaction of 5.5 mol of O_2 will produce _____ mol of H_2O.
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:

$$3\ Mg\ +\ N_2\ \rightarrow\ Mg_3N_2$$

In a particular experiment, a 10.1-g sample of 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 NO_2 and H_2O:

$$4\ NH_3\ (g)\ +\ 7\ O_2\ (g)\ \rightarrow\ 4\ NO_2\ (g)\ +\ 6\ H_2O\ (g)$$

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:

$$6Li\ (s) + N_2\ (g)\ \rightarrow\ 2Li_3N\ (s)$$

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:

$$6Li\ (s) + N_2\ (g) \rightarrow 2Li_3N\ (s)$$

How many moles of lithium are needed to produce 0.20 mol of Li_3N 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:

$$2NaN_3\ (s) \rightarrow 2Na\ (s) + 3N_2\ (g)$$

How many moles of 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:

$$2NaN_3\ (s) \rightarrow 2Na\ (s) + 3N_2\ (g)$$

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:

$$2Mg\ (s) + O_2\ (g) \rightarrow 2MgO\ (s)$$

How many moles of 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 (CaC_2) reacts with water to produce acetylene (C_2H_2):

$$CaC_2\ (s) + 2\ H_2O\ (g) \rightarrow Ca(OH)_2\ (s) + C_2H_2\ (g)$$

Production of 3.3 g of C_2H_2 requires consumption of _____ g of H_2O.
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:

$$PbCO_3\ (s) \rightarrow PbO\ (s) + CO_2\ (g)$$

_____ 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:

$$6Li\ (s) + N_2\ (g) \rightarrow 2Li_3N\ (s)$$

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:

$$2Mg\ (s) + O_2\ (g) \rightarrow 2MgO\ (s)$$

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:

$$CaO\ (s) + H_2O\ (l) \rightarrow Ca(OH)_2\ (s)$$

A 4.00-g sample of CaO is reacted with 3.86 g of H_2O. 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_2 is allowed to react with 1408 grams of O_2 according to the following equation, how many grams of Fe_2O_3 are produced?

$$FeS_2 + O_2 \rightarrow Fe_2O_3 + SO_2$$

Answer: 1280
Diff: 4 Page Ref: Sec. 3.7

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

$$CaO\ (s) + H_2O\ (l) \rightarrow Ca(OH)_2\ (s)$$

In a particular experiment, a 1.50-g sample of CaO is reacted with excess water and 1.48 g of $Ca(OH)_2$ 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_2S (s).

$$Na\ (s) + S\ (s) \rightarrow \_\_\_\_\_$$

Answer: $\rightarrow Na_2S\ (s)$
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_3O_4
Diff: 3 Page Ref: Sec. 3.5

3) The combustion of propane (C_3H_8) in the presence of excess oxygen yields CO_2 and H_2O:

$$C_3H_8\ (g) + 5O_2\ (g) \rightarrow 3CO_2\ (g) + 4\ H_2O\ (g)$$

When 7.3 g of C_3H_8 burns in the presence of excess O_2, _____ g of CO_2 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:

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

A 9.3-g sample of hydrogen requires _____ g of 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:

$$2\,H_2\,(g) + O_2\,(g) \rightarrow 2\,H_2O\,(g)$$

A complete reaction of 5.0 g of O_2 with excess hydrogen produces _____ g of H_2O.
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:

$$CS_2\,(g) + 3O_2\,(g) \rightarrow CO_2\,(g) + 2SO_2\,(g)$$

The combustion of 15 g of CS_2 in the presence of excess oxygen yields _____ g of 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