MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

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

\[ \text{NH}_3 (g) + \text{O}_2 (g) \rightarrow \text{NO}_2 (g) + \text{H}_2\text{O} (g) \]

A) 4, 7, 4, 6 \hspace{1cm} B) 1, 3, 1, 2 \hspace{1cm} C) 4, 3, 4, 3 \hspace{1cm} D) 2, 3, 2, 3 \hspace{1cm} E) 1, 1, 1, 1

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

\[ \text{Al(NO}_3)_3 + \text{Na}_2\text{S} \rightarrow \text{Al}_2\text{S}_3 + \text{NaN}_3 \]

A) 1, 1, 1, 1 \hspace{1cm} B) 2, 3, 2, 3 \hspace{1cm} C) 2, 1, 3, 2 \hspace{1cm} D) 4, 6, 3, 2 \hspace{1cm} E) 2, 3, 1, 6

3) When the following equation is balanced, the coefficient of \text{H}_2\text{O} is ________.

\[ \text{K (s)} + \text{H}_2\text{O} (l) \rightarrow \text{KOH} (aq) + \text{H}_2 (g) \]

A) 4 \hspace{1cm} B) 5 \hspace{1cm} C) 1 \hspace{1cm} D) 2 \hspace{1cm} E) 3

4) When the following equation is balanced, the coefficient of \text{Al} is ________.

\[ \text{Al (s)} + \text{H}_2\text{O} (l) \rightarrow \text{Al(OH)}_3 (s) + \text{H}_2 (g) \]

A) 1 \hspace{1cm} B) 5 \hspace{1cm} C) 2 \hspace{1cm} D) 3 \hspace{1cm} E) 4

5) When the following equation is balanced, the coefficient of \text{H}_2\text{O} is ________.

\[ \text{Ca (s)} + \text{H}_2\text{O} (l) \rightarrow \text{Ca(OH)}_2 (aq) + \text{H}_2 (g) \]

A) 4 \hspace{1cm} B) 2 \hspace{1cm} C) 1 \hspace{1cm} D) 5 \hspace{1cm} E) 3
6) When the following equation is balanced, the coefficient of $\text{Al}_2\text{O}_3$ is ________.

$$\text{Al}_2\text{O}_3 (s) + \text{C} (s) + \text{Cl}_2 (g) \rightarrow \text{AlCl}_3 (s) + \text{CO} (g)$$

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

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

$$\text{FeCl}_3 (aq) + \text{H}_2\text{S} (g) \rightarrow \text{Fe}_2\text{S}_3 (s) + \text{HCl} (aq)$$

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

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

$$\text{CaCO}_3 (s) + \text{HCl} (aq) \rightarrow \text{CaCl}_2 (aq) + \text{CO}_2 (g) + \text{H}_2\text{O} (l)$$

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

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

$$\text{HNO}_3 (aq) + \text{CaCO}_3 (s) \rightarrow \text{Ca(NO}_3)_2 (aq) + \text{CO}_2 (g) + \text{H}_2\text{O} (l)$$

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

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

$$\text{H}_3\text{PO}_4 (aq) + \text{NaOH} (aq) \rightarrow \text{Na}_3\text{PO}_4 (aq) + \text{H}_2\text{O} (l)$$

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

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

$$\text{C}_3\text{H}_8\text{O}_3 (g) + \text{O}_2 (g) \rightarrow \text{CO}_2 (g) + \text{H}_2\text{O} (g)$$

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

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

$$\text{C}_2\text{H}_4\text{O} (g) + \text{O}_2 (g) \rightarrow \text{CO}_2 (g) + \text{H}_2\text{O} (g)$$

A) 5  B) 3  C) 2  D) 1  E) 4
13) When the following equation is balanced, the coefficient of H\(_2\) is _______.

\[ \text{CO (g)} + \text{H}_2\text{(g)} \rightarrow \text{H}_2\text{O (g)} + \text{CH}_4 \text{(g)} \]

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

14) When the following equation is balanced, the coefficient of H\(_2\)SO\(_4\) is _______.

\[ \text{H}_2\text{SO}_4 \text{(aq)} + \text{NaOH (aq)} \rightarrow \text{Na}_2\text{SO}_4 \text{(aq)} + \text{H}_2\text{O (l)} \]

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

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

\[ \text{K (s)} + \text{H}_2\text{O (l)} \rightarrow \text{KOH (aq)} + \text{H}_2 \text{(g)} \]

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

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

\[ \text{K (s)} + \text{H}_2\text{O (l)} \rightarrow \text{KOH (aq)} + \text{H}_2 \text{(g)} \]

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

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

\[ \text{PbS (s)} + \text{O}_2 \text{(g)} \rightarrow \text{PbO (s)} + \text{SO}_2 \text{(g)} \]

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

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

\[ \text{PbS (s)} + \text{O}_2 \text{(g)} \rightarrow \text{PbO (s)} + \text{SO}_2 \text{(g)} \]

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

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

\[ \text{N}_2\text{O}_5 \text{(g)} + \text{H}_2\text{O (l)} \rightarrow \text{HNO}_3 \text{(aq)} \]

A) 4        B) 2        C) 5        D) 1        E) 3
20) When the following equation is balanced, the coefficient of water is ________.

\[
\text{N}_2\text{O}_5 \text{ (g) + H}_2\text{O (l) \rightarrow HNO}_3 \text{ (aq)}
\]

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

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

\[
\text{N}_2\text{O}_5 \text{ (g) + H}_2\text{O (l) \rightarrow HNO}_3 \text{ (aq)}
\]

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

22) Write the balanced equation for the reaction that occurs when methanol, \( \text{CH}_3\text{OH} \text{ (l)} \), 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

23) Write the balanced equation for the reaction that occurs when methanol, \( \text{CH}_3\text{OH} \text{ (l)} \), 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

24) What is the coefficient of \( \text{O}_2 \) when the following equation is completed and balanced?

\[
\text{C}_4\text{H}_8\text{O}_2 + \text{O}_2 \rightarrow _________
\]

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

25) Predict the product in the combination reaction below.

\[
\text{Al (s) + N}_2 \text{ (g) \rightarrow _________}
\]

A) AlN  
B) Al_3N  
C) AlN_3  
D) Al_3N_2  
E) AlN_2

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

A) \( \text{NaN}_3 \text{ (s) \rightarrow Na (s) + N}_2 \text{ (g)} \)

B) \( \text{NaN}_3 \text{ (s) \rightarrow Na (s) + N}_2 \text{ (g) + N (g)} \)

C) \( 2\text{NaN}_3 \text{ (s) \rightarrow Na}_2 \text{ (s) + 3N}_2 \text{ (g)} \)

D) \( 2\text{NaN}_3 \text{ (s) \rightarrow 2Na (s) + 2N}_2 \text{ (g)} \)

E) \( 2\text{NaN}_3 \text{ (s) \rightarrow 2Na (s) + 3N}_2 \text{ (g)} \)
27) There are _______ mol of carbon atoms in 4 mol of dimethylsulfoxide (C₂H₆SO).
A) 3  B) 6  C) 2  D) 8  E) 4

28) There are _______ sulfur atoms in 25 molecules of C₄H₄S₂.
A) 4.8 \times 10^{25}  
B) 1.5 \times 10^{25}  
C) 3.0 \times 10^{25}  
D) 6.02 \times 10^{23}  
E) 50

29) There are _______ hydrogen atoms in 25 molecules of C₄H₄S₂.
A) 3.8 \times 10^{24}  
B) 25  
C) 6.0 \times 10^{25}  
D) 1.5 \times 10^{25}  
E) 100

30) A sample of C₃H₈O that contains 200 molecules contains _______ carbon atoms.
A) 3.61 \times 10^{26}  
B) 600  
C) 4.01 \times 10^{25}  
D) 200  
E) 1.20 \times 10^{26}

31) How many grams of hydrogen are in 46 g of CH₄O?
A) 1.5  
B) 2.8  
C) 184  
D) 5.8  
E) 0.36

32) How many grams of oxygen are in 65 g of C₂H₂O₂?
A) 29  
B) 9.0  
C) 36  
D) 18  
E) 130

33) How many moles of carbon dioxide are there in 52.06 g of carbon dioxide?
A) 6.022 \times 10^{23}  
B) 3.134 \times 10^{25}  
C) 8.648 \times 10^{23}  
D) 1.183  
E) 0.8452

TEST MATERIAL ENDS HERE
34) There are _______ molecules of methane in 0.123 mol of methane (CH₄).

A) 2.46 x 10⁻²  
B) 2.04 x 10⁻²⁵  
C) 0.615  
D) 7.40 x 10²²  
E) 5

35) A 2.25-g sample of magnesium nitrate, Mg(NO₃)₂, contains _______ mol of this compound.

A) 0.0152  
B) 38.4  
C) 148.3  
D) 0.0261  
E) 65.8

36) A 22.5-g sample of ammonium carbonate contains _______ mol of ammonium ions.

A) 3.47  
B) 0.234  
C) 2.14  
D) 0.288  
E) 0.468

37) 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) SO₂Cl  
C) SOCl₂  
D) ClSO₄  
E) S₂OCl

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

A) Na₂S₂O₆  
B) Na₂S₂O₃  
C) NaSO₂  
D) NaSO  
E) NaSO₃

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

A) K₂SO₃  
B) K₂SO₄  
C) KSO₃  
D) KSO₄  
E) KSO₂

40) 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) C₂H₃O₄  
B) CH₂O  
C) CHO₂  
D) C₂H₂O₄  
E) C₂H₄O₂

41) 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) C₅H₆O₂  
B) C₈H₄O  
C) C₉H₁₂O  
D) C₈H₈O₂  
E) C₄H₄O

42) 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) C₂H₄  
B) CH₄  
C) C₄H₈  
D) CH₂  
E) C₈₆H₁₄
43) 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) C₂₀H₆₀   B) CH₃   C) C₇H₂₀   D) CH₄   E) C₂H₆

44) A compound contains 38.7% K, 13.9% N, and 47.4% O by mass. What is the empirical formula of the compound?
   A) K₄NO₅   B) KNO₃   C) KNO₂   D) K₂NO₃   E) K₂N₂O₃

45) 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 CO₂ and 0.255 g of H₂O. What is the empirical formula of the compound?
   A) C₆H₆O   B) C₃H₃O   C) CH₃O   D) C₂H₆O₂   E) C₂H₆O₅

46) Combustion of a 1.031-g sample of a compound containing only carbon, hydrogen, and oxygen produced 2.265 g of CO₂ and 1.236 g of H₂O. What is the empirical formula of the compound?
   A) C₃H₅O   B) C₆H₁₆O₂   C) C₃H₉O₃   D) C₃H₆O₃   E) C₃H₈O

47) Combustion of a 0.9835-g sample of a compound containing only carbon, hydrogen, and oxygen produced 1.900 g of CO₂ and 1.070 g of H₂O. What is the empirical formula of the compound?
   A) C₄H₁₀O   B) C₂H₅O₂   C) C₄H₁₀O₂   D) C₄H₁₁O₂   E) C₂H₅O

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

   \[ 3 \text{ Mg} + \text{ N}_2 \rightarrow \text{ Mg}_3\text{N}_2 \]

In a particular experiment, a 9.27-g sample of N₂ reacts completely. The mass of Mg consumed is _______ g.
   A) 13.9   B) 24.1   C) 0.92   D) 16.1   E) 8.04

49) The combustion of ammonia in the presence of excess oxygen yields NO₂ and H₂O:

   \[ 4 \text{ NH}_3 (g) + 7 \text{ O}_2 (g) \rightarrow 4 \text{ NO}_2 (g) + 6 \text{ H}_2\text{O} (g) \]

The combustion of 28.8 g of ammonia consumes ________ g of oxygen.
   A) 54.1   B) 28.8   C) 94.9   D) 15.3   E) 108
50) The combustion of ammonia in the presence of excess oxygen yields NO₂ and H₂O:

\[ 4 \text{NH}_3 (g) + 7 \text{O}_2 (g) \rightarrow 4 \text{NO}_2 (g) + 6 \text{H}_2\text{O} (g) \]

The combustion of 43.9 g of ammonia produces _______ g of NO₂.
A) 43.9  B) 2.58  C) 178  D) 119  E) 0.954

51) The combustion of propane (C₃H₈) produces CO₂ and H₂O:

\[ \text{C}_3\text{H}_8 (g) + 5\text{O}_2 (g) \rightarrow 3\text{CO}_2 (g) + 4\text{H}_2\text{O} (g) \]

The reaction of 2.5 mol of O₂ will produce _______ mol of H₂O.
A) 4.0  B) 3.0  C) 2.5  D) 2.0  E) 1.0

52) The combustion of propane (C₃H₈) in the presence of excess oxygen yields CO₂ and H₂O:

\[ \text{C}_3\text{H}_8 (g) + 5\text{O}_2 (g) \rightarrow 3\text{CO}_2 (g) + 4\text{H}_2\text{O} (g) \]

When 2.5 mol of O₂ are consumed in their reaction, _______ mol of CO₂ are produced.
A) 3.0  B) 5.0  C) 1.5  D) 2.5  E) 6.0

53) Calcium carbide (CaC₂) reacts with water to produce acetylene (C₂H₂):

\[ \text{CaC}_2 (s) + 2\text{H}_2\text{O} (g) \rightarrow \text{Ca(OH)}_2 (s) + \text{C}_2\text{H}_2 (g) \]

Production of 13 g of C₂H₂ requires consumption of _______ g of H₂O.
A) 4.8 \times 10^2  B) 4.5  C) 4.8 \times 10^{-2}  D) 9.0  E) 18

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

\[ \text{N}_2 (g) + 3\text{H}_2 (g) \rightarrow 2\text{NH}_3 (g) \]

A 7.1-g sample of N₂ requires _______ g of H₂ for complete reaction.
A) 0.76  B) 1.2  C) 0.51  D) 1.5  E) 17.2

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

\[ \text{PbCO}_3 (s) \rightarrow \text{PbO} (s) + \text{CO}_2 (g) \]

How many grams of lead (II) oxide will be produced by the decomposition of 2.50 g of lead (II) carbonate?
A) 2.61  B) 2.50  C) 0.41  D) 2.09  E) 0.00936
56) GeF₃H is formed from GeH₄ and GeF₄ in the combination reaction:

\[
\text{GeH}_4 + 3\text{GeF}_4 \rightarrow 4\text{GeF}_3\text{H}
\]

If the reaction yield is 92.6%, how many moles of GeF₄ are needed to produce 8.00 mol of GeF₃H?
A) 2.16  B) 5.56  C) 3.24  D) 6.48  E) 2.78

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

\[
\text{Mg (s)} + 2\text{H}_2\text{O (l)} \rightarrow \text{Mg(OH)}_2\text{(s)} + \text{H}_2\text{(g)}
\]

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

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

\[
3\text{AgNO}_3\text{(aq)} + \text{AlCl}_3\text{(aq)} \rightarrow \text{Al(NO}_3)_3\text{(aq)} + 3\text{AgCl (s)}
\]

What mass in grams of AgCl is produced when 4.22 g of AgNO₃ react with 7.73 g of AlCl₃?
A) 3.56  B) 4.22  C) 17.6  D) 11.9  E) 24.9

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

\[
\text{Mg}_3\text{N}_2 + 3\text{H}_2\text{O} \rightarrow 2\text{NH}_3 + 3\text{MgO}
\]

A) 0.113  B) 0.0378  C) 0.0756  D) 4.57  E) 0.429

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

\[
\text{Mg}_3\text{N}_2 + 3\text{H}_2\text{O} \rightarrow 2\text{NH}_3 + 3\text{MgO}
\]

The yield of MgO is 3.60 g. What is the percent yield in the reaction?
A) 46.6  B) 99.9  C) 94.5  D) 78.8  E) 49.4

61) Pentacarbonyliron (Fe(CO)₅) reacts with phosphorous trifluoride (PF₃) and hydrogen, releasing carbon monoxide:

\[
\text{Fe(CO)}_5 + \text{PF}_3 + \text{H}_2 \rightarrow \text{Fe(CO)}_2(\text{PF}_3)_2(\text{H})_2 + \text{CO} \text{ (not balanced)}
\]

The reaction of 5.0 mol of Fe(CO)₅, 8.0 mol of PF₃ and 6.0 mol of H₂ will release ________ mol of CO.
A) 6.0  B) 5.0  C) 15  D) 24  E) 12
62) What is the maximum mass in grams of NH₃ that can be produced by the reaction of 1.0 g of N₂ with 3.0 g of H₂ via the equation below?

\[
\text{N}_2 (\text{g}) + \text{H}_2 (\text{g}) \rightarrow \text{NH}_3 (\text{g}) \quad \text{(not balanced)}
\]

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

63) What is the maximum amount in grams of SO₃ that can be produced by the reaction of 1.0 g of S with 1.0 g of O₂ via the equation below?

\[
\text{S} (\text{s}) + \text{O}_2 (\text{g}) \rightarrow \text{SO}_3 (\text{g}) \quad \text{(not balanced)}
\]

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

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

\[
4\text{Al} (\text{s}) + 3\text{O}_2 (\text{g}) \rightarrow 2\text{Al}_2\text{O}_3 (\text{s})
\]

The maximum amount of Al₂O₃ that can be produced from 2.5 g of Al and 2.5 g of O₂ is

A) 5.3 B) 9.4 C) 4.7 D) 5.0 E) 7.4

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

\[
\text{S} (\text{s}) + 3\text{F}_2 (\text{g}) \rightarrow \text{SF}_6 (\text{g})
\]

The maximum amount of SF₆ that can be produced from the reaction of 3.5 g of sulfur with 4.5 g of fluorine is

A) 12 B) 5.8 C) 8.0 D) 16 E) 3.2

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

\[
4\text{Al} (\text{s}) + 3\text{O}_2 (\text{g}) \rightarrow 2\text{Al}_2\text{O}_3 (\text{s})
\]

In a particular experiment, the reaction of 2.5 g of Al with 2.5 g of O₂ produced 3.5 g of Al₂O₃. The % yield of the reaction is

A) 47 B) 74 C) 26 D) 37 E) 66
67) 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 O₂ produced 0.80 g of SO₃. The % yield in this experiment is \underline{__________}.

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

68) 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 a 7.90-g sample of fluorine yields \underline{__________} g of SF₆ in the presence of excess sulfur.

A) 30.3  B) 10.1  C) 7.99  D) 0.110  E) 24.0
1) A
2) E
3) C
4) C
5) B
6) E
7) D
8) E
9) E
10) A
11) D
12) A
13) C
14) E
15) E
16) D
17) A
18) D
19) D
20) B
21) A
22) B
23) C
24) C
25) A
26) E
27) D
28) E
29) E
30) B
31) D
32) C
33) D
34) D
35) A
36) E
37) C
38) B
39) A
40) E
41) D
42) D
43) B
44) B
45) B
46) E
47) D
48) B
49) C
50) D
51) D
52) C
53) E
54) D
55) D
56) D
57) C
58) A
59) A
60) D
61) E
62) A
63) B
64) C
65) B
66) B
67) C
68) C