Chapter 3 Test Bank
Stoichiometry of Formulas and Equations

1. Calcium fluoride, CaF_2, is a source of fluorine and is used to fluoridate drinking water. Calculate its molar mass.
A. 118.15 g/mol
B. 99.15 g/mol
C. 78.07 g/mol
D. 59.08 g/mol
E. 50.01 g/mol

Accessibility: Keyboard Navigation
Bloom's: 3. Apply
Difficulty: Easy
Gradable: automatic
Subtopic: Molar Mass
Topic: Stoichiometry and Chemical Reactions

2. Calculate the molar mass of tetraphosphorus decaoxide, P_4O_{10}, a corrosive substance which can be used as a drying agent.
A. 469.73 g/mol
B. 283.89 g/mol
C. 190.97 g/mol
D. 139.88 g/mol
E. 94.97 g/mol

Accessibility: Keyboard Navigation
Bloom's: 3. Apply
Difficulty: Easy
Gradable: automatic
Subtopic: Molar Mass
Topic: Stoichiometry and Chemical Reactions

3. Calculate the molar mass of rubidium carbonate, Rb_2CO_3.
A. 340.43 g/mol
B. 255.00 g/mol
C. 230.94 g/mol
D. 145.47 g/mol
E. 113.48 g/mol

Accessibility: Keyboard Navigation
Bloom's: 3. Apply
Difficulty: Easy
Gradable: automatic
Subtopic: Molar Mass
Topic: Stoichiometry and Chemical Reactions

4. Calculate the molar mass of $(NH_4)_3AsO_4$.
A. 417.80 g/mol
B. 193.03 g/mol
C. 165.02 g/mol
D. 156.96 g/mol
E. 108.96 g/mol

Accessibility: Keyboard Navigation
Bloom's: 3. Apply
Difficulty: Easy
Gradable: automatic
Subtopic: Molar Mass
Topic: Stoichiometry and Chemical Reactions

5. Aluminum sulfate, $Al_2(SO_4)_3$, is used in tanning leather, purifying water, and manufacture of antiperspirants. Calculate its molar mass.
A. 450.06 g/mol
B. 342.15 g/mol
C. 315.15 g/mol
D. 278.02 g/mol
E. 74.98 g/mol

Accessibility: Keyboard Navigation

Bloom's: 3. Apply
Difficulty: Easy
Gradable: automatic
Subtopic: Molar Mass
Topic: Stoichiometry and Chemical Reactions

6. Calculate the molar mass of $Ca(BO_2)_2 \cdot 6H_2O$.
A. 273.87 g/mol
B. 233.79 g/mol
C. 183.79 g/mol
D. 174.89 g/mol
E. 143.71 g/mol

Accessibility: Keyboard Navigation
Bloom's: 3. Apply
Difficulty: Medium
Gradable: automatic
Subtopic: Molar Mass
Topic: Stoichiometry and Chemical Reactions

7. Magnesium fluoride is used in the ceramics and glass industry. What is the mass of 1.72 mol of magnesium fluoride?
A. 43.3 g
B. 62.3 g
C. 74.5 g
D. 92.9 g
E. 107 g

Accessibility: Keyboard Navigation
Bloom's: 3. Apply
Difficulty: Medium
Gradable: automatic
Subtopic: Mole Conversions
Topic: Stoichiometry and Chemical Reactions

8. Sodium bromate is used in a mixture which dissolves gold from its ores. Calculate the mass in grams of 4.68 mol of sodium bromate.
A. 706 g
B. 482 g
C. 383 g
D. 32.2 g
E. 0.0310 g

Accessibility: Keyboard Navigation
Bloom's: 3. Apply
Difficulty: Medium
Gradable: automatic
Subtopic: Mole Conversions
Topic: Stoichiometry and Chemical Reactions

9. What is the mass in grams of 0.250 mol of the common antacid calcium carbonate?
A. 4.00×10^2 g
B. 25.0 g
C. 17.0 g
D. 4.00×10^{-2} g
E. 2.50×10^{-3} g

Accessibility: Keyboard Navigation
Bloom's: 3. Apply
Difficulty: Medium
Gradable: automatic
Subtopic: Mole Conversions
Topic: Stoichiometry and Chemical Reactions

10. Calculate the number of moles in 17.8 g of the antacid magnesium hydroxide, $Mg(OH)_2$.
A. 3.28 mol
B. 2.32 mol
C. 0.431 mol
D. 0.305 mol
E. 0.200 mol

Accessibility: Keyboard Navigation
Bloom's: 3. Apply
Difficulty: Easy
Gradable: automatic
Subtopic: Mole Conversions
Topic: Stoichiometry and Chemical Reactions

11. Phosphorus pentachloride, PCl_5, a white solid that has a pungent, unpleasant odor, is used as a catalyst for certain organic reactions. Calculate the number of moles in 38.7 g of PCl_5.
A. 5.38 mol
B. 3.55 mol
C. 0.583 mol
D. 0.282 mol
E. 0.186 mol

Accessibility: Keyboard Navigation
Bloom's: 3. Apply
Difficulty: Easy
Gradable: automatic
Subtopic: Mole Conversions
Topic: Stoichiometry and Chemical Reactions

12. Aluminum oxide, Al_2O_3, is used as a filler for paints and varnishes as well as in the manufacture of electrical insulators. Calculate the number of moles in 47.51 g of Al_2O_3.
A. 2.377 mol
B. 2.146 mol
C. 1.105 mol
D. 0.4660 mol
E. 0.4207 mol

Accessibility: Keyboard Navigation
Bloom's: 3. Apply
Difficulty: Easy
Gradable: automatic
Subtopic: Mole Conversions
Topic: Stoichiometry and Chemical Reactions

13. Which of the following samples has the most moles of the compound?
A. 50.0 g of Li_2O
B. 75.0 g of CaO
C. 200.0 g of Fe_2O_3
D. 50.0 g of CO_2
E. 100.0 g of SO_3

Accessibility: Keyboard Navigation
Bloom's: 3. Apply
Difficulty: Medium
Gradable: automatic
Subtopic: Mole Conversions
Topic: Stoichiometry and Chemical Reactions

14. Calculate the number of oxygen atoms in 29.34 g of sodium sulfate, Na_2SO_4.
A. 1.244×10^{23} O atoms
B. 4.976×10^{23} O atoms
C. 2.409×10^{24} O atoms
D. 2.915×10^{24} O atoms
E. 1.166×10^{25} O atoms

Accessibility: Keyboard Navigation
Bloom's: 3. Apply
Difficulty: Hard
Gradable: automatic
Subtopic: Mole Conversions
Topic: Stoichiometry and Chemical Reactions

15. A normal breath takes in about 1.0 L of air. Assuming that air has an average molar mass of 28.8g, and that its density is 0.97 g/L, how many molecules of air do you take in with each breath?
A. 2.0×10^{22}
B. 2.2×10^{22}

C. 5.8×10^{23}
D. 1.7×10^{25}
E. 1.8×10^{25}

Accessibility: Keyboard Navigation
Bloom's: 3. Apply
Difficulty: Medium
Gradable: automatic
Subtopic: Mole Conversions
Topic: Stoichiometry and Chemical Reactions

16. Which of the following samples contains the greatest total number atoms?
A. 50.0 g of Li_2O
B. 75.0 g of CaO
C. 200.0 g of Fe_2O_3
D. 50.0 g of CO_2
E. 100.0 g of SO_3

Accessibility: Keyboard Navigation
Bloom's: 3. Apply
Difficulty: Medium
Gradable: automatic
Subtopic: Mole Conversions
Topic: Stoichiometry and Chemical Reactions

17. A single atom of hydrogen has a mass of 1.0 amu, while a mole of hydrogen atoms has a mass of 1.0 g. Select the correct conversion factor between atomic mass units and grams.
A. 1 amu = 1 g exactly
B. 1 amu = 6.0×10^{23} g
C. 1 g = 6.0×10^{23} amu
D. 1 g = 1.7×10^{-24} amu
E. None of these choices are correct.

Accessibility: Keyboard Navigation
Bloom's: 2. Understand
Difficulty: Medium
Gradable: automatic
Subtopic: Mole Conversions
Topic: Stoichiometry and Chemical Reactions

18. How many atoms are in a drop of mercury that has a diameter of 1.0 mm? (Volume of a sphere is $4\pi r^3/3$; density of mercury = 13.6 g/cm^3)
A. 2.1×10^{19}
B. 1.7×10^{20}
C. 2.1×10^{22}
D. 1.7×10^{23}
E. None of these choices are correct.

Accessibility: Keyboard Navigation
Bloom's: 3. Apply
Difficulty: Medium
Gradable: automatic
Subtopic: Mole Conversions
Topic: Stoichiometry and Chemical Reactions

19. Potassium dichromate, $K_2Cr_2O_7$, is used in tanning leather, decorating porcelain, and water proofing fabrics. Calculate the number of chromium atoms in 78.82 g of $K_2Cr_2O_7$.
A. 9.490×10^{25} Cr atoms
B. 2.248×10^{24} Cr atoms
C. 1.124×10^{24} Cr atoms
D. 3.227×10^{23} Cr atoms
E. 1.613×10^{23} Cr atoms

Accessibility: Keyboard Navigation
Bloom's: 3. Apply
Difficulty: Hard
Gradable: automatic
Subtopic: Mole Conversions
Topic: Stoichiometry and Chemical Reactions

20. Sulfur trioxide can react with atmospheric water vapor to form sulfuric acid that falls as acid rain. Calculate the mass in grams of 3.65×10^{20} molecules of SO_3.
A. 6.06×10^{-4} g
B. 2.91×10^{-2} g
C. 4.85×10^{-2} g
D. 20.6 g
E. 1650 g

Accessibility: Keyboard Navigation
Bloom's: 3. Apply
Difficulty: Medium
Gradable: automatic
Subtopic: Mole Conversions
Topic: Stoichiometry and Chemical Reactions

21. Calculate the mass in grams of 8.35×10^{22} molecules of CBr_4.
A. 0.0217 g
B. 0.139 g
C. 7.21 g
D. 12.7 g
E. 46.0 g

Accessibility: Keyboard Navigation
Bloom's: 3. Apply
Difficulty: Medium
Gradable: automatic
Subtopic: Mole Conversions
Topic: Stoichiometry and Chemical Reactions

22. The number of hydrogen atoms in 0.050 mol of $C_3H_8O_3$ is
A. 3.0×10^{22} H atoms.
B. 1.2×10^{23} H atoms.
C. 2.4×10^{23} H atoms.
D. 4.8×10^{23} H atoms.
E. None of these choices are correct.

Accessibility: Keyboard Navigation
Bloom's: 3. Apply
Difficulty: Easy
Gradable: automatic
Subtopic: Mole Conversions
Topic: Stoichiometry and Chemical Reactions

23. How many protons are there in a molecule of adrenaline ($C_9H_{13}NO_3$), a neurotransmitter and hormone?
A. 22
B. 26
C. 43
D. 98
E. 183

Accessibility: Keyboard Navigation
Bloom's: 3. Apply
Difficulty: Medium
Gradable: automatic
Subtopic: Mole Conversions
Topic: Stoichiometry and Chemical Reactions

24. Copper(II) sulfate pentahydrate, $CuSO_4 \cdot 5H_2O$, is used as a fungicide and algicide. Calculate the mass of oxygen in 1.000 mol of $CuSO_4 \cdot 5H_2O$.
A. 249.7 g
B. 144.0 g
C. 96.00 g
D. 80.00 g
E. 64.00 g

Accessibility: Keyboard Navigation
Bloom's: 3. Apply
Difficulty: Easy
Gradable: automatic
Subtopic: Mole Conversions

Topic: Stoichiometry and Chemical Reactions

25. Lead (II) nitrate is a poisonous substance which has been used in the manufacture of special explosives and as a sensitizer in photography. Calculate the mass of lead in 139 g of $Pb(NO_3)_2$.
A. 107 g
B. 90.8 g
C. 87.0 g
D. 83.4 g
E. 62.6 g

Accessibility: Keyboard Navigation
Bloom's: 3. Apply
Difficulty: Medium
Gradable: automatic
Subtopic: Mole Conversions
Topic: Stoichiometry and Chemical Reactions

26. Household sugar, sucrose, has the molecular formula $C_{12}H_{22}O_{11}$. What is the percent of carbon in sucrose, by mass?
A. 26.7%
B. 33.3%
C. 41.4%
D. 42.1%
E. 52.8%

Accessibility: Keyboard Navigation
Bloom's: 3. Apply
Difficulty: Medium
Gradable: automatic
Subtopic: Mass Percent Composition
Topic: Stoichiometry and Chemical Reactions

27. Determine the percent composition of potassium dichromate, $K_2Cr_2O_7$.
A. 17.5% K, 46.6% Cr, 35.9% O
B. 29.8% K, 39.7% Cr, 30.5% O
C. 36.5% K, 48.6% Cr, 14.9% O
D. 37.2% K, 24.7% Cr, 38.1% O
E. None of these choices are correct.

Accessibility: Keyboard Navigation
Bloom's: 3. Apply
Difficulty: Medium
Gradable: automatic
Subtopic: Mass Percent Composition
Topic: Stoichiometry and Chemical Reactions

28. Gadolinium oxide, a colorless powder which absorbs carbon dioxide from the air, contains 86.76 mass % Gd. Determine its empirical formula.
A. Gd_2O_3
B. Gd_3O_2
C. Gd_3O_4
D. Gd_4O_3
E. GdO

Accessibility: Keyboard Navigation
Bloom's: 3. Apply
Difficulty: Medium
Gradable: automatic
Subtopic: Formula Determination of Unknown Compounds (Empirical and Molecular Formulas)
Topic: Stoichiometry and Chemical Reactions

29. Hydroxylamine nitrate contains 29.17 mass % N, 4.20 mass % H, and 66.63 mass % O. Determine its empirical formula.
A. HNO
B. H_2NO_2
C. HN_6O_{16}
D. $HN_{16}O_7$
E. H_2NO_3

Accessibility: Keyboard Navigation
Bloom's: 3. Apply

Difficulty: Medium
Gradable: automatic
Subtopic: Formula Determination of Unknown Compounds (Empirical and Molecular Formulas)
Topic: Stoichiometry and Chemical Reactions

30. Hydroxylamine nitrate contains 29.17 mass % N, 4.20 mass % H, and 66.63 mass O. If its molar mass is between 94 and 98 g/mol, what is its molecular formula?
A. NH_2O_5
B. $N_2H_4O_4$
C. $N_3H_3O_3$
D. $N_4H_8O_2$
E. $N_2H_2O_4$

Accessibility: Keyboard Navigation
Bloom's: 3. Apply
Difficulty: Hard
Gradable: automatic
Subtopic: Formula Determination of Unknown Compounds (Empirical and Molecular Formulas)
Topic: Stoichiometry and Chemical Reactions

31. Analysis of a carbohydrate showed that it consisted of 40.0 % C, 6.71 % H, and 53.3 % O by mass. Its molecular mass was found to be between 140 and 160 amu. What is the molecular formula of this compound?
A. $C_4H_8O_6$
B. $C_5H_{10}O_5$
C. $C_5H_{12}O_5$
D. $C_6H_{12}O_4$
E. None of these choices are correct.

Accessibility: Keyboard Navigation
Bloom's: 3. Apply
Difficulty: Hard
Gradable: automatic
Subtopic: Formula Determination of Unknown Compounds (Empirical and Molecular Formulas)
Topic: Stoichiometry and Chemical Reactions

32. A compound of bromine and fluorine is used to make UF_6, which is an important chemical in processing and reprocessing of nuclear fuel. The compound contains 58.37 mass percent bromine. Determine its empirical formula.
A. BrF
B. BrF_2
C. Br_2F_3
D. Br_3F
E. BrF_3

Accessibility: Keyboard Navigation
Bloom's: 3. Apply
Difficulty: Medium
Gradable: automatic
Subtopic: Formula Determination of Unknown Compounds (Empirical and Molecular Formulas)
Topic: Stoichiometry and Chemical Reactions

33. A compound containing chromium and silicon contains 73.52 mass percent chromium. Determine its empirical formula.
A. $CrSi_3$
B. Cr_2Si_3
C. Cr_3Si
D. Cr_3Si_2
E. Cr_2S

Accessibility: Keyboard Navigation
Bloom's: 3. Apply
Difficulty: Medium
Gradable: automatic
Subtopic: Formula Determination of Unknown Compounds (Empirical and Molecular Formulas)
Topic: Stoichiometry and Chemical Reactions

34. Alkanes are compounds of carbon and hydrogen with the general formula C_nH_{2n+2}. An alkane component of gasoline has a molar mass of between 125 and 130 g/mol. What is the value of *n* for this alkane?
A. 4
B. 9
C. 10

D. 13
E. 14

Accessibility: Keyboard Navigation
Bloom's: 2. Understand
Difficulty: Medium
Gradable: automatic
Subtopic: Formula Determination of Unknown Compounds (Empirical and Molecular Formulas)
Topic: Stoichiometry and Chemical Reactions

35. Terephthalic acid, used in the production of polyester fibers and films, is composed of carbon, hydrogen, and oxygen. When 0.6943 g of terephthalic acid was subjected to combustion analysis it produced 1.471 g CO_2 and 0.226 g H_2O. What is its empirical formula?
A. $C_2H_3O_4$
B. $C_3H_4O_2$
C. $C_4H_3O_2$
D. $C_5H_{12}O_4$
E. C_2H_2O

Accessibility: Keyboard Navigation
Bloom's: 3. Apply
Difficulty: Hard
Gradable: automatic
Subtopic: Formula Determination of Unknown Compounds (Empirical and Molecular Formulas)
Topic: Stoichiometry and Chemical Reactions

36. Terephthalic acid, used in the production of polyester fibers and films, is composed of carbon, hydrogen, and oxygen. When 0.6943 g of terephthalic acid was subjected to combustion analysis it produced 1.471 g CO_2 and 0.226 g H_2O. If its molar mass is between 158 and 167 g/mol, what is its molecular formula?
A. $C_4H_6O_7$
B. $C_6H_8O_5$
C. $C_7H_{12}O_4$
D. $C_4H_3O_2$
E. $C_8H_6O_4$

Accessibility: Keyboard Navigation
Bloom's: 3. Apply
Difficulty: Hard
Gradable: automatic
Subtopic: Formula Determination of Unknown Compounds (Empirical and Molecular Formulas)
Topic: Stoichiometry and Chemical Reactions

37. Hydroxylamine hydrochloride is a powerful reducing agent which is used as a polymerization catalyst. It contains 5.80 mass % H, 20.16 mass % N, 23.02 mass % O, and 51.02 mass % Cl. What is its empirical formula?
A. $H_2N_7O_8Cl_{18}$
B. $H_2N_2O_2Cl$
C. $HN_3O_4Cl_9$
D. H_4NOCl
E. H_4NOCl_2

Accessibility: Keyboard Navigation
Bloom's: 3. Apply
Difficulty: Medium
Gradable: automatic
Subtopic: Formula Determination of Unknown Compounds (Empirical and Molecular Formulas)
Topic: Stoichiometry and Chemical Reactions

38. In the combustion analysis of 0.1127 g of glucose ($C_6H_{12}O_6$), what mass, in grams, of CO_2 would be produced?
A. 0.0451 g
B. 0.0825 g
C. 0.1652 g
D. 0.4132 g
E. 1.466 g

Accessibility: Keyboard Navigation
Bloom's: 3. Apply
Difficulty: Medium
Gradable: automatic
Subtopic: Formula Determination of Unknown Compounds (Empirical and Molecular Formulas)
Topic: Stoichiometry and Chemical Reactions

39. Balance the following equation:
$B_2O_3(s) + HF(l) \rightarrow BF_3(g) + H_2O(l)$
A. $B_2O_3(s) + 6HF(l) \rightarrow 2BF_3(g) + 3H_2O(l)$
B. $B_2O_3(s) + H_6F_6(l) \rightarrow B_2F_6(g) + H_6O_3(l)$
C. $B_2O_3(s) + 2HF(l) \rightarrow 2BF_3(g) + H_2O(l)$
D. $B_2O_3(s) + 3HF(l) \rightarrow 2BF_3(g) + 3H_2O(l)$
E. $B_2O_3(s) + 6HF(l) \rightarrow 2BF_3(g) + 6H_2O(l)$

Accessibility: Keyboard Navigation
Bloom's: 3. Apply
Difficulty: Easy
Gradable: automatic
Subtopic: Writing and Balancing Chemical Equations
Topic: Stoichiometry and Chemical Reactions

40. Balance the following equation:
$UO_2(s) + HF(l) \rightarrow UF_4(s) + H_2O(l)$
A. $UO_2(s) + 2HF(l) \rightarrow UF_4(s) + H_2O(l)$
B. $UO_2(s) + 4HF(l) \rightarrow UF_4(s) + 2H_2O(l)$
C. $UO_2(s) + H_4F_4(l) \rightarrow UF_4(s) + H_4O_2(l)$
D. $UO_2(s) + 4HF(l) \rightarrow UF_4(s) + 4H_2O(l)$
E. $UO_2(s) + 8HF(l) \rightarrow 2UF_4(s) + 4H_2O(l)$

Accessibility: Keyboard Navigation
Bloom's: 3. Apply
Difficulty: Easy
Gradable: automatic
Subtopic: Writing and Balancing Chemical Equations
Topic: Stoichiometry and Chemical Reactions

41. Balance the following equation for the combustion of benzene:
$C_6H_6(l) + O_2(g) \rightarrow H_2O(g) + CO_2(g)$
A. $C_6H_6(l) + 9O_2(g) \rightarrow 3H_2O(g) + 6CO_2(g)$
B. $C_6H_6(l) + 9O_2(g) \rightarrow 6H_2O(g) + 6CO_2(g)$
C. $2C_6H_6(l) + 15O_2(g) \rightarrow 6H_2O(g) + 12CO_2(g)$
D. $C_6H_6(l) + 15O_2(g) \rightarrow 3H_2O(g) + 6CO_2(g)$
E. $2C_6H_6(l) + 9O_2(g) \rightarrow 6H_2O(g) + 12CO_2(g)$

Accessibility: Keyboard Navigation
Bloom's: 3. Apply
Difficulty: Easy
Gradable: automatic
Subtopic: Writing and Balancing Chemical Equations
Topic: Stoichiometry and Chemical Reactions

42. Balance the following equation:
$C_8H_{18}O_3(l) + O_2(g) \rightarrow H_2O(g) + CO_2(g)$
A. $C_8H_{18}O_3(l) + 8O_2(g) \rightarrow 9H_2O(g) + 8CO_2(g)$
B. $C_8H_{18}O_3(l) + 11O_2(g) \rightarrow 9H_2O(g) + 8CO_2(g)$
C. $2C_8H_{18}O_3(l) + 22O_2(g) \rightarrow 9H_2O(g) + 16CO_2(g)$
D. $C_8H_{18}O_3(l) + 13O_2(g) \rightarrow 18H_2O(g) + 8CO_2(g)$
E. $2C_8H_{18}O_3(l) + 17O_2(g) \rightarrow 18H_2O(g) + 16CO_2(g)$

Accessibility: Keyboard Navigation
Bloom's: 3. Apply
Difficulty: Medium
Gradable: automatic
Subtopic: Writing and Balancing Chemical Equations
Topic: Stoichiometry and Chemical Reactions

43. Balance the following equation:
$Ca_3(PO_4)_2(s) + SiO_2(s) + C(s) \rightarrow CaSiO_3(s) + CO(g) + P_4(s)$
A. $Ca_3(PO_4)_2(s) + 3SiO_2(s) + 8C(s) \rightarrow 3CaSiO_3(s) + 8CO(g) + P_4(s)$
B. $Ca_3(PO_4)_2(s) + 3SiO_2(s) + 14C(s) \rightarrow 3CaSiO_3(s) + 14CO(g) + P_4(s)$
C. $Ca_3(PO_4)_2(s) + 3SiO_2(s) + 8C(s) \rightarrow 3CaSiO_3(s) + 8CO(g) + 2P_4(s)$
D. $2Ca_3(PO_4)_2(s) + 6SiO_2(s) + 10C(s) \rightarrow 6CaSiO_3(s) + 10CO(g) + P_4(s)$
E. $2Ca_3(PO_4)_2(s) + 6SiO_2(s) + 10C(s) \rightarrow 6CaSiO_3(s) + 10CO(g) + 4P_4(s)$

Accessibility: Keyboard Navigation

Bloom's: 3. Apply
Difficulty: Medium
Gradable: automatic
Subtopic: Writing and Balancing Chemical Equations
Topic: Stoichiometry and Chemical Reactions

44. How many molecules of molecular oxygen react with four molecules of NH_3 to form four molecules of nitrogen monoxide and six molecules of water?
A. 2
B. 10
C. 3
D. 4
E. 5

Accessibility: Keyboard Navigation
Bloom's: 3. Apply
Difficulty: Medium
Gradable: automatic
Subtopic: Writing and Balancing Chemical Equations
Topic: Stoichiometry and Chemical Reactions

45. Sulfur dioxide reacts with chlorine to produce thionyl chloride (used as a drying agent for inorganic halides) and dichlorine oxide (used as a bleach for wood, pulp, and textiles).
$SO_2(g) + 2Cl_2(g) \rightarrow SOCl_2(g) + Cl_2O(g)$
If 0.400 mol of Cl_2 reacts with excess SO_2, how many moles of Cl_2O are formed?
A. 0.800 mol
B. 0.400 mol
C. 0.200 mol
D. 0.100 mol
E. 0.0500 mol

Accessibility: Keyboard Navigation
Bloom's: 3. Apply
Difficulty: Easy
Gradable: automatic
Subtopic: Calculating Amounts of Reactant and Product (including solutions)
Topic: Stoichiometry and Chemical Reactions

46. Aluminum will react with bromine to form aluminum bromide (used as an acid catalyst in organic synthesis).
$Al(s) + Br_2(l) \rightarrow Al_2Br_6(s)$ [unbalanced]
How many moles of Al are needed to form 2.43 mol of Al_2Br_6?
A. 7.29 mol
B. 4.86 mol
C. 2.43 mol
D. 1.62 mol
E. 1.22 mol

Accessibility: Keyboard Navigation
Bloom's: 3. Apply
Difficulty: Easy
Gradable: automatic
Subtopic: Calculating Amounts of Reactant and Product (including solutions)
Topic: Stoichiometry and Chemical Reactions

47. Ammonia will react with fluorine to produce dinitrogen tetrafluoride and hydrogen fluoride (used in production of aluminum, in uranium processing, and in frosting of light bulbs).
$2NH_3(g) + 5F_2(g) \rightarrow N_2F_4(g) + 6HF(g)$
How many moles of NH_3 are needed to react completely with 13.6 mol of F_2?
A. 34.0 mol
B. 27.2 mol
C. 6.80 mol
D. 5.44 mol
E. 2.27 mol

Accessibility: Keyboard Navigation
Bloom's: 3. Apply
Difficulty: Easy
Gradable: automatic
Subtopic: Calculating Amounts of Reactant and Product (including solutions)

Topic: Stoichiometry and Chemical Reactions

48. Ammonia, an important source of fixed nitrogen that can be metabolized by plants, is produced using the Haber process in which nitrogen and hydrogen combine.
$N_2(g) + 3H_2(g) \rightarrow 2NH_3(g)$
How many grams of nitrogen are needed to produce 325 grams of ammonia?
A. 1070 g
B. 535 g
C. 267 g
D. 178 g
E. 108 g

Accessibility: Keyboard Navigation
Bloom's: 3. Apply
Difficulty: Medium
Gradable: automatic
Subtopic: Calculating Amounts of Reactant and Product (including solutions)
Topic: Stoichiometry and Chemical Reactions

49. How many grams of sodium fluoride (used in water fluoridation and manufacture of insecticides) are needed to form 485 g of sulfur tetrafluoride?
$3SCl_2(l) + 4NaF(s) \rightarrow SF_4(g) + S_2Cl_2(l) + 4NaCl(s)$
A. 1940 g
B. 1510 g
C. 754 g
D. 205 g
E. 51.3 g

Accessibility: Keyboard Navigation
Bloom's: 3. Apply
Difficulty: Medium
Gradable: automatic
Subtopic: Calculating Amounts of Reactant and Product (including solutions)
Topic: Stoichiometry and Chemical Reactions

50. How many grams of oxygen are needed to react completely with 200.0 g of ammonia, NH_3?
$4NH_3(g) + 5O_2(g) \rightarrow 4NO(g) + 6H_2O(g)$
A. 469.7 g
B. 300.6 g
C. 250.0 g
D. 3.406 g
E. 2.180 g

Accessibility: Keyboard Navigation
Bloom's: 3. Apply
Difficulty: Medium
Gradable: automatic
Subtopic: Calculating Amounts of Reactant and Product (including solutions)
Topic: Stoichiometry and Chemical Reactions

51. Phosphine, an extremely poisonous and highly reactive gas, will react with oxygen to form tetraphosphorus decaoxide and water.
$PH_3(g) + O_2(g) \rightarrow P_4O_{10}(s) + H_2O(g)$ [unbalanced]
Calculate the mass of $P_4O_{10}(s)$ formed when 225 g of PH_3 reacts with excess oxygen.
A. 1880 g
B. 940. g
C. 900. g
D. 470 g
E. 56.3 g

Accessibility: Keyboard Navigation
Bloom's: 3. Apply
Difficulty: Medium
Gradable: automatic
Subtopic: Calculating Amounts of Reactant and Product (including solutions)
Topic: Stoichiometry and Chemical Reactions

52. Potassium chlorate (used in fireworks, flares, and safety matches) forms oxygen and potassium chloride when heated.
$KClO_3(s) \rightarrow KCl(s) + O_2(g)$ [unbalanced]

How many grams of oxygen are formed when 26.4 g of potassium chlorate is heated?
A. 223 g
B. 99.1 g
C. 10.3 g
D. 6.86 g
E. 4.60 g

Accessibility: Keyboard Navigation
Bloom's: 3. Apply
Difficulty: Medium
Gradable: automatic
Subtopic: Calculating Amounts of Reactant and Product (including solutions)
Topic: Stoichiometry and Chemical Reactions

53. Aluminum metal reacts with chlorine gas to form solid aluminum trichloride, $AlCl_3$. What mass of chlorine gas is needed to react completely with 163 g of aluminum?
A. 214 g
B. 245 g
C. 321 g
D. 489 g
E. 643 g

Accessibility: Keyboard Navigation
Bloom's: 3. Apply
Difficulty: Medium
Gradable: automatic
Subtopic: Calculating Amounts of Reactant and Product (including solutions)
Topic: Stoichiometry and Chemical Reactions

54. Lead(II) sulfide was once used in glazing earthenware. It will also react with hydrogen peroxide to form lead(II) sulfate and water. How many grams of hydrogen peroxide are needed to react completely with 265 g of lead(II) sulfide?
A. 151 g
B. 123 g
C. 50.3 g
D. 37.7 g
E. 9.41 g

Accessibility: Keyboard Navigation
Bloom's: 3. Apply
Difficulty: Medium
Gradable: automatic
Subtopic: Calculating Amounts of Reactant and Product (including solutions)
Topic: Stoichiometry and Chemical Reactions

55. An important reaction sequence in the industrial production of nitric acid is the following:
$N_2(g) + 3H_2(g) \rightarrow 2NH_3(g)$
$4NH_3(g) + 5O_2(g) \rightarrow 4NO(g) + 6H_2O(l)$
Starting from 20.0 mol of nitrogen gas in the first reaction, how many moles of oxygen gas are required in the second one?
A. 12.5 mol O_2
B. 20.0 mol O_2
C. 25.0 mol O_2
D. 50.0 mol O_2
E. 100. mol O_2

Accessibility: Keyboard Navigation
Bloom's: 3. Apply
Difficulty: Easy
Gradable: automatic
Subtopic: Calculating Amounts of Reactant and Product (including solutions)
Topic: Stoichiometry and Chemical Reactions

56. In a blast furnace, elemental iron is produced from a mixture of coke (C), iron ore (Fe_3O_4), and other reactants. An important reaction sequence is
$2C(s) + O_2(g) \rightarrow 2CO(g)$
$Fe_3O_4(s) + 4CO(g) \rightarrow 3Fe(l) + 4CO_2(g)$
How many moles of iron can be formed in this sequence when 1.00 mol of carbon, as coke, is consumed?
A. 6.00 mol Fe
B. 3.00 mol Fe

C. 1.33 mol Fe
D. 1.25 mol Fe
E. 0.750 mol Fe

Accessibility: Keyboard Navigation
Bloom's: 3. Apply
Difficulty: Easy
Gradable: automatic
Subtopic: Calculating Amounts of Reactant and Product (including solutions)
Topic: Stoichiometry and Chemical Reactions

57. The iodine "clock reaction" involves the following sequence of reactions occurring in a reaction mixture in a single beaker.
1. $IO_3(aq) + 5I–(aq) + 6H+(aq) \rightarrow 3I_2(aq) + 3H_2O(l)$
2. $I_2(aq) + 2S_2O_32–(aq) \rightarrow 2I–(aq) + S_4O_62–(aq)$
The molecular iodine (I_2) formed in reaction 1 is immediately used up in reaction 2, so that no iodine accumulates. What is the overall reaction occurring in this experiment?
A. $IO_3^-(aq) + 3I^-(aq) + 2S_2O_3^{2-}(aq) + 6H^+(aq) \rightarrow 2I_2(aq) + S_4O_6^{2-}(aq) + 3H_2O(l)$
B. $IO_3(aq) + 4S_2O_3^{2-}(aq) + 6H^+(aq) \rightarrow I^-(aq) + 2S_4O_6^{2-}(aq) + 3H_2O(l)$
C. $IO_3^-(aq) + 6S_2O_3^{2-}(aq) + 6H^+(aq) \rightarrow I^-(aq) + 3S_4O_6^{2-}(aq) + 3H_2O(l)$
D. $IO_3^-(aq) + I_2(aq) + 8S_2O_3^{2-}(aq) + 6H^+(aq) \rightarrow 3I^-(aq) + 4S_4O_6^{2-}(aq) + 3H_2O(l)$
E. $IO_3(aq) + 2I_2(aq) + 6S_2O_3^{2-}(aq) + 6H^+(aq) \rightarrow 5I^-(aq) + 3S_4O_6^{2-}(aq) + 3H_2O(l)$

Accessibility: Keyboard Navigation
Bloom's: 3. Apply
Difficulty: Medium
Gradable: automatic
Subtopic: Writing and Balancing Chemical Equations
Topic: Stoichiometry and Chemical Reactions

58. The iodine "clock reaction" involves the following sequence of reactions occurring in a reaction mixture in a single beaker.
1. $IO_3(aq) + 5I–(aq) + 6H+(aq) \rightarrow 3I_2(aq) + 3H_2O(l)$
2. $I_2(aq) + 2S_2O_3^{2-}(aq) \rightarrow 2I^-(aq) + S_4O_6^{2-}(aq)$
The molecular iodine (I_2) formed in reaction 1 is immediately used up in reaction 2, so that no iodine accumulates. In one experiment, a student made up a reaction mixture which initially contained 0.0020 mol of iodate ions (IO_3^-). If the iodate ions reacted completely, how many moles of thiosulfate ions ($S_2O_3^{2-}$) were needed in reaction 2, in order to react completely with the iodine (I_2) produced in reaction 1?
A. 0.0020 mol
B. 0.012 mol
C. 0.0040 mol
D. 0.0010 mol
E. 0.0060 mol

Accessibility: Keyboard Navigation
Bloom's: 3. Apply
Difficulty: Medium
Gradable: automatic
Subtopic: Calculating Amounts of Reactant and Product (including solutions)
Topic: Stoichiometry and Chemical Reactions

59. Aluminum oxide (used as an adsorbent or a catalyst for organic reactions) forms when aluminum reacts with oxygen.
$4Al(s) + 3O_2(g) \rightarrow 2Al_2O_3(s)$
A mixture of 82.49 g of aluminum ($\mathcal{M}$ = 26.98 g/mol) and 117.65 g of oxygen ($\mathcal{M}$ = 32.00g/mol) is allowed to react. What mass of aluminum oxide ($\mathcal{M}$ = 101.96 g/mol) can be formed?
A. 155.8 g
B. 200.2 g
C. 249.9 g
D. 311.7 g
E. 374.9 g

Bloom's: 3. Apply
Difficulty: Hard
Gradable: automatic
Subtopic: Limiting Reactant
Topic: Stoichiometry and Chemical Reactions

60. Aluminum reacts with oxygen to produce aluminum oxide which can be used as an adsorbent, desiccant, or catalyst for organic reactions.

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

A mixture of 82.49 g of aluminum ($\mathcal{M}$ = 26.98 g/mol) and 117.65 g of oxygen ($\mathcal{M}$ = 32.00 g/mol) is allowed to react. Identify the limiting reactant and determine the mass of the excess reactant present in the vessel when the reaction is complete.
A. Oxygen is the limiting reactant; 19.81 g of aluminum remain.
B. Oxygen is the limiting reactant; 35.16 g of aluminum remain.
C. Aluminum is the limiting reactant; 16.70 g of oxygen remain.
D. Aluminum is the limiting reactant; 35.16 g of oxygen remain.
E. Aluminum is the limiting reactant; 44.24 g of oxygen remain.

Bloom's: 3. Apply
Difficulty: Hard
Gradable: automatic
Subtopic: Limiting Reactant
Topic: Stoichiometry and Chemical Reactions

61. Magnesium reacts with iron(III) chloride to form magnesium chloride (which can be used in fireproofing wood and in disinfectants) and iron.
$3Mg(s) + 2FeCl_3(s) \rightarrow 3MgCl_2(s) + 2Fe(s)$

A mixture of 41.0 g of magnesium ($\mathcal{M}$ = 24.31 g/mol) and 175 g of iron(III) chloride ($\mathcal{M}$ = 162.2 g/mol) is allowed to react. What mass of magnesium chloride = 95.21 g/mol) is formed?
A. 68.5 g $MgCl_2$
B. 77.0 g $MgCl_2$
C. 71.4 g $MgCl_2$
D. 107 g $MgCl_2$
E. 154 g $MgCl_2$

Bloom's: 3. Apply
Difficulty: Hard
Gradable: automatic
Subtopic: Limiting Reactant
Topic: Stoichiometry and Chemical Reactions

62. Magnesium (used in the manufacture of light alloys) reacts with iron(III) chloride to form magnesium chloride and iron.
$3Mg(s) + 2FeCl_3(s) \rightarrow 3MgCl_2(s) + 2Fe(s)$

A mixture of 41.0 g of magnesium ($\mathcal{M}$ = 24.31 g/mol) and 175 g of iron(III) chloride ($\mathcal{M}$ = 162.2 g/mol) is allowed to react. Identify the limiting reactant and determine the mass of the excess reactant present in the vessel when the reaction is complete.
A. Limiting reactant is Mg; 67 g of $FeCl_3$ remain.
B. Limiting reactant is Mg; 134 g of $FeCl_3$ remain.
C. Limiting reactant is Mg; 104 g of $FeCl_3$ remain.
D. Limiting reactant is $FeCl_3$; 2 g of Mg remain.
E. Limiting reactant is $FeCl_3$; 87 g of Mg remain.

Bloom's: 3. Apply
Difficulty: Hard
Gradable: automatic
Subtopic: Limiting Reactant
Topic: Stoichiometry and Chemical Reactions

63. Potassium chloride is used as a substitute for sodium chloride for individuals with high blood pressure. Identify the limiting reactant and determine the mass of the excess reactant remaining when 7.00 g of chlorine gas reacts with 5.00 g of potassium to form potassium chloride.
A. Potassium is the limiting reactant; 2.47 g of chlorine remain.
B. Potassium is the limiting reactant; 7.23 g of chlorine remain.
C. Chlorine is the limiting reactant; 4.64 g of potassium remain.
D. Chlorine is the limiting reactant; 2.70 g of potassium remain.
E. No limiting reagent: the reactants are present in the correct stoichiometric ratio.

Accessibility: Keyboard Navigation
Bloom's: 3. Apply
Difficulty: Hard
Gradable: automatic
Subtopic: Limiting Reactant
Topic: Stoichiometry and Chemical Reactions

64. Tetraphosphorus hexaoxide ($\mathcal{M}$ = 219.9 g/mol) is formed by the reaction of phosphorus with oxygen gas.
$P_4(s) + 3O_2(g) \rightarrow P_4O_6(s)$

If a mixture of 75.3 g of phosphorus and 38.7 g of oxygen produce 43.3 g of P_4O_6, what is the percent yield for the reaction?
A. 57.5%
B. 48.8%
C. 38.0%
D. 32.4%
E. 16.3%

Bloom's: 3. Apply
Difficulty: Hard
Gradable: automatic
Subtopic: Reaction Yield
Topic: Stoichiometry and Chemical Reactions

65. What is the percent yield for the reaction
$PCl_3(g) + Cl_2(g) \rightarrow PCl_5(g)$

If 119.3 g of PCl_5 (M = 208.2 g/mol) are formed when 61.3 g of Cl_2 ($\mathcal{M}$ = 70.91 g/mol) react with excess PCl3?
A. 195%
B. 85.0%
C. 66.3%
D. 51.4%
E. 43.7%

Bloom's: 3. Apply
Difficulty: Medium
Gradable: automatic
Subtopic: Reaction Yield
Topic: Stoichiometry and Chemical Reactions

66. Methanol (CH_4O) is converted to bromomethane (CH_3Br) as follows:
$CH_4O + HBr \rightarrow CH_3Br + H_2O$
If 12.23 g of bromomethane are produced when 5.00 g of methanol is reacted with excess HBr, what is the percentage yield?
A. 40.9%
B. 82.6%
C. 100%
D. 121%
E. 245%

Accessibility: Keyboard Navigation
Bloom's: 3. Apply
Difficulty: Medium
Gradable: automatic
Subtopic: Reaction Yield
Topic: Stoichiometry and Chemical Reactions

67. One mole of O_2 has a mass of 16.0 g.
FALSE

Accessibility: Keyboard Navigation
Bloom's: 2. Understand
Difficulty: Easy
Gradable: automatic
Subtopic: Molar Mass
Topic: Stoichiometry and Chemical Reactions

68. One mole of methane (CH_4) contains a total of 3×10^{24} atoms.
TRUE

Accessibility: Keyboard Navigation
Bloom's: 2. Understand
Difficulty: Easy
Gradable: automatic
Subtopic: Mole Conversions
Topic: Stoichiometry and Chemical Reactions

69. The formula $CH_3O_{0.5}$ is an example of an empirical formula.
FALSE

Accessibility: Keyboard Navigation
Bloom's: 2. Understand
Difficulty: Easy

Gradable: automatic
Subtopic: Chemical Formulas
Topic: Components of Matter

70. In combustion analysis, the carbon and hydrogen contents of a substance are determined from the CO_2 and H_2O, respectively, which are collected in the absorbers.
TRUE

Accessibility: Keyboard Navigation
Bloom's: 1. Remember
Difficulty: Easy
Gradable: automatic
Subtopic: Formula Determination of Unknown Compounds (Empirical and Molecular Formulas)
Topic: Stoichiometry and Chemical Reactions

71. In combustion analysis, the oxygen content of a substance is equal to the total oxygen in the CO_2 and H_2O collected in the absorbers.
FALSE

Accessibility: Keyboard Navigation
Bloom's: 1. Remember
Difficulty: Medium
Gradable: automatic
Subtopic: Formula Determination of Unknown Compounds (Empirical and Molecular Formulas)
Topic: Stoichiometry and Chemical Reactions

72. Constitutional (structural) isomers have the same empirical formula but different molecular formulas.
FALSE

Accessibility: Keyboard Navigation
Bloom's: 1. Remember
Difficulty: Medium
Gradable: automatic
Subtopic: Chemical Formulas
Topic: Components of Matter

73. Constitutional (structural) isomers have the same molecular formula but different structural formulas.
TRUE

Accessibility: Keyboard Navigation
Bloom's: 1. Remember
Difficulty: Medium
Gradable: automatic
Subtopic: Chemical Formulas
Topic: Components of Matter

74. In a correctly balanced equation, the number of reactant molecules must equal the number of product molecules.
FALSE

Accessibility: Keyboard Navigation
Bloom's: 1. Remember
Difficulty: Easy
Gradable: automatic
Subtopic: Stoichiometry and Chemical Reactions
Subtopic: Writing and Balancing Chemical Equations

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