CHEM 110 First Midterm Test Bank

Chapter 1: Chang

1. The SI prefixes *giga* and *micro* represent, respectively:
   A. 10^{-9} and 10^{-6}.
   B. 10^6 and 10^{-3}.
   C. 10^3 and 10^{-3}.
   D. 10^9 and 10^{-6}.
   E. 10^{-9} and 10^{-3}.

2. The SI prefixes *milli* and *mega* represent, respectively:
   A. 10^6 and 10^{-6}.
   B. 10^{-3} and 10^6.
   C. 10^3 and 10^{-6}.
   D. 10^{-3} and 10^9.
   E. 10^{-6} and 10^{-3}.

3. The SI prefixes *kilo* and *centi* represent, respectively:
   A. 10^3 and 10^{-2}.
   B. 10^6 and 10^{-1}.
   C. 10^{-3} and 10^{-2}.
   D. 10^{-6} and 10^2.
   E. 10^2 and 10^{-3}.

4. The diameter of an atom is approximately 1×10^{-8} cm. What is this diameter when expressed in nanometers?
   A. 1×10^{-19} nm
   B. 1×10^{-15} nm
   C. 1×10^1 nm
   D. 1×10^{-10} nm
   E. 1×10^{-1} nm

5. 6.0 km is how many micrometers?
   A. 6.0×10^6 µm
   B. 1.7×10^{-7} µm
   C. 6.0×10^9 µm
   D. 1.7×10^{-4} µm
   E. 6.0×10^3 µm

6. 2.4 km is how many millimeters?
   A.   2,400 mm
   B. 2.4×10^4 mm
   C. 2.4×10^5 mm
   D. 2.4×10^6 mm
   E. 2.4×10^{-5} mm

7. How many milliliters is 0.005 L?
   A.   0.5 mL

  B. 5 mL
  C. 0.50 mL
  D. 0.000005 mL
  E. 200 mL

8. Express 7,500 nm as picometers.
  A. 7.50 pm
  B. 75.0 pm
  C. 750 pm
  D. 7.5×10^6 pm
  E. 7.5×10^{12} pm

9. Which of these quantities represents the largest mass?
  A. 2.0×10^2 mg
  B. 0.0010 kg
  C. 1.0×10^5 µg
  D. 2.0×10^2 cg
  E. 10.0 dg

10. The density of lead is 11.4 g/cm^3 at 25°C. Calculate the volume occupied by 25.0 g of lead.
  A. 2.19 cm^3
  B. 0.456 cm^3
  C. 285 cm^3
  D. 1.24 cm^3
  E. 6.05 cm^3

11. Iron has a density of 7.86 g/cm^3. The volume occupied by 55.85 g of iron is
  A. 0.141 cm^3
  B. 7.11 cm^3
  C. 2.8 cm^3
  D. 439 cm^3
  E. 50.6 cm^3

12. The diameter of Earth is 12.7 Mm. Express this diameter in centimeters.
  A. 1.27×10^5 cm
  B. 1.27×10^6 cm
  C. 1.27×10^7 cm
  D. 1.27×10^8 cm
  E. 1.27×10^9 cm

Chapter 2: Chang

13. What is the mass number of an iron atom that has 28 neutrons?
    A) 54
    B) 28
    C) 56
    D) 26

14. Calculate the number of neutrons of ^{239}Pu.
    A) 94
    B) 145
    C) 120
    D) 239

15. What is the number of protons and the number of neutrons in the nucleus of $^{25}_{12}$Mg ?
    A) 25 protons, 12 neutrons
    B) 13 protons, 12 neutrons
    C) 12 protons, 25 neutrons
    D) 12 protons, 13 neutrons

16. What is the number of protons, neutrons, and electrons in $^{63}_{29}$Cu ?
    A) 29 protons, 34 neutrons, 34 electrons
    B) 29 protons, 34 neutrons, 29 electrons
    C) 34 protons, 29 neutrons, 34 electrons
    D) 29 protons, 63 neutrons, 29 electrons

17. What is the appropriate symbol for the isotope $Z = 11$, $A = 23$?
    A) $^{34}_{23}$V
    B) $^{23}_{12}$Mg
    C) $^{23}_{11}$Na
    D) $^{23}_{11}$V

18. What is the appropriate symbol for the isotope $Z = 28$, $A = 64$?
    A) $^{28}_{64}$Ni
    B) $^{64}_{28}$Kr
    C) $^{64}_{28}$Gd
    D) $^{64}_{28}$Ni

19. What is the appropriate symbol for the isotope $Z = 74$, $A = 186$?
    A) $^{186}_{74}$W
    B) $^{186}_{74}$Sg
    C) $^{186}_{112}$W
    D) the element does not exist

20. What is the appropriate symbol for the isotope $Z = 80$, $A = 201$?
    A) $^{201}_{121}\text{Hg}$
    B) $^{201}_{80}\text{Hg}$
    C) $^{80}_{21}\text{Sc}$
    D) the element does not exist

21. Which of the following is a difference between metals and nonmetals?
    A) Metals contain electrons, nonmetals do not.
    B) Metals are good conductors of electricity; nonmetals are not.
    C) Nonmetals are all gases while metals are all solids.
    D) none of the above

22. Sodium (Na) and cesium (Cs) are members of which of the following categories?
    A) alkali metals
    B) alkaline earth metals
    C) halogens
    D) noble gases

23. Helium (He) and radon (Rn) are members of which of the following categories?
    A) alkali metals
    B) alkaline earth metals
    C) halogens
    D) noble gases

24. Elements whose names end with ium are usually metals; sodium is one example.
    Identify a nonmetal whose name also ends with ium.
    A) potassium
    B) magnesium
    C) helium
    D) barium

25. The elements near the bottom of the periodic table are more likely to be members of
    what category?
    A) metals
    B) nonmetals
    C) halogens
    D) noble gases

26. Group the following elements in pairs that you would expect to show similar chemical
    properties: K, F, P, Na, Cl, and N.
    A) K/N; F/Na; Cl/N
    B) K/Na; F/Cl; P/N
    C) K/F; P/Na; Cl/N
    D) K/P; F/Na; Cl/N

27. What is the difference between an atom and a molecule?
    A)   A molecule has more electrons than an atom.
    B)   An atom is charged while a molecule is not.
    C)   A molecule is an aggregate of atoms, while an atom, by definition, is a single particle.
    D)   A molecule is bigger than an atom.

28. NH_4^+ is an example of which of the following?
    A) a monatomic cation
    B) a monatomic anion
    C) a polyatomic cation
    D) a polyatomic anion

29. Which of the following is an element?
    A) N_2
    B) NH_3
    C) NO
    D) CO

30. Which of the following is a compound?
    A) N_2
    B) H_2
    C) O_3
    D) SO_2

31. What is the number of protons and electrons in Na^+?
    A) 11 protons, 10 electrons
    B) 11 protons, 11 electrons
    C) 10 protons, 11 electrons
    D) 11 protons, 12 electrons

32. What is the number of protons and electrons in S^{2-}?
    A) 16 protons, 16 electrons
    B) 16 protons, 17 electrons
    C) 16 protons, 14 electrons
    D) 16 protons, 18 electrons

33. What is the number of protons and electrons in Mg^{2+}?
    A) 12 protons, 12 electrons
    B) 12 protons, 14 electrons
    C) 12 protons, 10 electrons
    D) 14 protons, 12 electrons

34. What is the number of protons and electrons in Br^-?
    A) 35 protons, 35 electrons
    B) 35 protons, 36 electrons
    C) 35 protons, 37 electrons
    D) 34 protons, 35 electrons

35. Which of the following molecules contains two elements in a ratio of 2:1?
    A) NO
    B) NCl_3
    C) N_2O_4
    D) P_4O_6

36. Which compound has the same empirical formula as $C_6H_{12}O_6$?
    A) $C_{12}H_{24}O_{12}$
    B) $C_3H_3O_3$
    C) CH_2ON
    D) CHO_2

37. Which pair of compounds has the same empirical formula?
    A) $C_2H_6O_3$ and CH_2O
    B) NO_2 and N_2O_4
    C) C_6H_6 and CH_4
    D) NO_2 and NO_4

38. What is the empirical formula of C_6H_6?
    A) C_6O
    B) CH_6
    C) C_3H_3
    D) CH

39. What is the empirical formula of P_4O_{10}?
    A) P_4O_5
    B) P_2O_5
    C) PO
    D) PO_5

40. What is the empirical formula of N_2O_5?
    A) N_2O_5
    B) NO
    C) NO_5
    D) N_2O

41. What is the empirical formula of $Na_2S_2O_4$?
    A) Na_2SO_2
    B) NaSO
    C) $Na_2S_2O_2$
    D) $NaSO_2$

42. Which of the following compounds is named potassium hydrogen phosphate?
    A) KH_2PO_4
    B) K_2HPO_4
    C) K_3PO_4
    D) $K_2Cr_2O_7$

43. Which of the following compounds is named lithium carbonate?
    A) Na_2CO_3
    B) $LiHCO_3$
    C) $LiCO$
    D) Li_2CO_3

44. What is the name of $KMnO_4$?
    A)   manganese potash
    B)   potassium managnese tetroxide
    C)   potassium permanganate
    D)   potassium oxide

45. What is the name of $KClO$?
    A) potassium chlorite
    B) potassium chloride
    C) potassium hypochlorite
    D) potassium oxide

46. What is the formula for ammonium sulfate?
    A) NH_4SO_4
    B) $NH_4(SO_4)_2$
    C) $(NH_4)_2SO_4$
    D) NH_4S

37. What is the formula for calcium hydrogen phosphate?
    A) Ca_2HPO_4
    B) $Ca(HPO_4)_2$
    C) $Ca_2H_2PO_4$
    D) $CaHPO_4$

48. What is the formula for lead (II) carbonate?
    A) $PbCO_3$
    B) Pb_2CO_3
    C) $Pb(CO_3)_2$
    D) PbC

49. What is the formula for copper (II) cyanide?
    A) $CuCN$
    B) $Cu(CN)_2$
    C) Cu_2CN
    D) $CuNCO$

50. One isotope of a metallic element has mass number 65 and 35 neutrons in the nucleus. The cation derived from the isotope has 28 electrons. What is the symbol for this cation?
    A) Br^-
    B) Br^{2+}
    C) Tb^{2+}
    D) Zn^{2+}

51. One isotope of a nonmetallic element has mass number 127 and 74 neutrons in the nucleus. The anion derived from the isotope has 54 electrons. What is the symbol for this anion?
    A) I^-
    B) W^-
    C) Xe^+
    D) the element does not exist

Use the following to answer questions 52-54:

ATOM OR

ION OF ELEMENT	A	B	C	D	E	F	G
Number of electrons	5	10	18	28	36	5	9
Number of protons	5	7	19	30	35	5	9
Number of neutrons	5	7	20	36	46	6	10

52. Which of the species are neutral?
    A) C
    B) A and B
    C) A, F and G
    D) E

53. Which of the species are negatively charged?
    A) C and D
    B) D, E and G
    C) A and D
    D) B and E

54. Which of the species are positively charged?
    A) C and D
    B) B and E
    C) A, C and F
    D) G

55. What are the conventional symbols for species C and F?
    A) $^{39}_{20}Ca^+$, $^{11}_{6}C$
    B) $^{39}_{19}K^+$, $^{11}_{5}B$
    C) $^{39}_{20}Ca^+$, $^{11}_{5}B$
    D) $^{39}_{19}K^+$, $^{11}_{6}C$

56. Which of the following are elements? (a) SO_2, (b) S_8, (c) Cs, (d) N_2O_5, (e) O, (f) O_2, (g) O_3, (h) CH_4, (i) KBr, (j) S, (k) P_4, (l) LiF
    A) (b), (c), (e) and (j) only
    B) (d) and (l)
    C) (f), (g) and (k) only
    D) (b), (c), (e), (f), (g), (j), and (k)

57. Which metallic elements are most likely to form cations with different charges?
    A) alkali metals
    B) transition metals
    C) alkaline earth metals
    D) metalloids

58. Which of the following elements has a common ion with a 2+ charge?
    A) Li
    B) Mg
    C) S
    D) I

59. Which of the following elements has a common ion with a 2– charge?
    A) Li
    B) Mg
    C) S
    D) I

60. Which of the following acids contains a Group 7A element?
    A) HNO_2
    B) H_2SO_4
    C) HBr
    D) H_3PO_4

61. Which of the following acids contains a Group 5A element?
    A) $HClO_4$
    B) H_2SO_4
    C) HBr
    D) H_3PO_4

62. The formula for calcium oxide is CaO. What are the formulas for magnesium oxide and strontium oxide?
    A) Mg_2O, Sr_2O
    B) MgO_2, SrO_2
    C) MgO, SrO
    D) MgO, Sr_3O

63. Predict the formula of a binary compound formed from F and O.
    A) F_2O
    B) FO
    C) FO_2
    D) FO_4

64. Predict the formula of a binary compound formed from Sr and Cl.
    A) Sr_2Cl
    B) Sr_2Cl_2
    C) SrCl
    D) $SrCl_2$

65. Which of the following is a halogen whose anion contains 36 electrons?
    A) Se
    B) Br
    C) Kr
    D) Rb

66. Which of the following is an alkali metal whose cation contains 36 electrons?
    A) Se
    B) Br
    C) Kr
    D) Rb

Chapter 3Chang

67. The atomic masses of $^{35}_{17}$ Cl (75.53 percent) and $^{37}_{17}$ Cl (24.47 percent) are 34.968 amu and 36.956 amu, respectively. Calculate the average atomic mass of chlorine. The percentages in parentheses denote the relative abundances.
    A) 35.96 amu
    B) 35.45 amu
    C) 36.47 amu
    D) 71.92 amu

68. The atomic masses of ^6_3Li and ^7_3Li are 6.0151 amu and 7.0160 amu, respectively. Calculate the natural abundances of these two isotopes. The average atomic mass of Li is 6.941 amu.
    A) ^6Li = 7.5 %; ^7Li = 92.5 %
    B) ^6Li = 0.075 %; ^7Li = 99.025 %
    C) ^6Li = 92.5 %; ^7Li = 7.5 %
    D) ^6Li = 25 %; ^7Li = 75 %

69. How many atoms are there in 5.10 moles of sulfur (S)?
    A) 3.07×10^{24}
    B) 9.59×10^{22}
    C) 6.02×10^{23}
    D) 9.82×10^{25}

70. How many moles of cobalt (Co) atoms are there in 6.00×10^9 (6 billion) Co atoms?
    A) 1×10^{-14}
    B) 1.00×10^{14}
    C) 9.96×10^{-15}
    D) 3.61×10^{33}

71. How many moles of calcium (Ca) atoms are in 77.4 g of Ca?
    A) 4.66×10^{25} mol
    B) 1.93 mol
    C) 1.29×10^{-22} mol
    D) 0.518 mol

72. How many grams of gold (Au) are there in 15.3 moles of Au?
    A) 9.21×10^{24} g
    B) 7.77×10^{-2} g
    C) 15.3 g
    D) 3.01×10^3 g

73. What is the mass in grams of a single (one) atom of Hg?
    A) 1.208×10^{26} g
    B) 3.002×10^{21} g
    C) 8.278×10^{-27} g
    D) 3.331×10^{-22} g

74. What is the mass in grams of a single (one) atom of As?
    A) 1.244×10^{-22} g
    B) 2.217×10^{-26} g
    C) 8.039×10^{21} g
    D) 4.510×10^{25} g

75. What is the mass in grams of 1.00×10^{12} lead (Pb) atoms?
    A) 1.66×10^{-12} g
    B) 2.25×10^{-11} g
    C) 3.44×10^{-10} g
    D) 6.02×10^{11} g

76. How many atoms are present in 3.14 g of copper (Cu)?
    A) 2.98×10^{22}
    B) 1.92×10^{23}
    C) 1.89×10^{24}
    D) 6.02×10^{23}

77. Calculate the molecular mass of CH_4.
    A) 16 g
    B) 12 g
    C) 16 g
    D) 16 g

78. Calculate the molecular mass of SO_3.
    A) 32 g
    B) 80 g
    C) 48 g
    D) 192 g

79. Calculate the molar mass of Li_2CO_3.
    A) 73.0 g
    B) 66.0 g
    C) 41.0 g
    D) 96.0 g

80. Calculate the molar mass of CS_2.
    A) 44.0 g
    B) 12.0 g
    C) 64.0 g
    D) 76.0 g

81. Calculate the molar mass of a compound if 0.372 mole of it has a mass of 152 g.
    A) 0.372 g/mol
    B) 152 g/mol
    C) 56.5 g/mol
    D) 409 g/mol

82. How many molecules of ethane (C_2H_6) are present in 0.334 g of C_2H_6?
    A) 2.01×10^{23}
    B) 6.69×10^{21}
    C) 4.96×10^{22}
    D) 8.89×10^{20}

83. Calculate the number of O atoms in 1.50 g of glucose ($C_6H_{12}O_6$), a sugar.
    A) 9.03×10^{23}
    B) 5.42×10^{24}
    C) 3.01×10^{22}
    D) 1.13×10^{24}

84. Urea [$(NH_2)_2CO$] is used for fertilizer and many other things. Calculate the number of N atoms in 1.68×10^4 g of urea.
    A) 3.37×10^{26}
    B) 1.01×10^{28}
    C) 6.02×10^{23}
    D) 5.96×10^{25}

85. Pheromones are a special type of compound secreted by the females of many insect species to attract the males for mating. One pheromone has the molecular formula $C_{19}H_{38}O$. Normally, the amount of this pheromone secreted by a female insect is about 1.0×10^{-12} g. How many molecules are there in this quantity?
    A) 1.0×10^{12}
    B) 6.0×10^{11}
    C) 2.3×10^{10}
    D) 2.1×10^{9}

86. Tin (Sn) exists in Earth's crust as SnO_2. Calculate the percent composition by mass of Sn in SnO_2.
    A) 33.33 %
    B) 86.83 %
    C) 63.22 %
    D) 78.77 %

87. For many years chloroform ($CHCl_3$) was used as an inhalation anesthetic in spite of the fact that it is also a toxic substance that may cause severe liver, kidney, and heart damage. Calculate the percent composition by mass of Cl in this compound.
    A) 89.07 %
    B) 60.00 %
    C) 73.14 %
    D) 81.22 %

88. Cinnamic alcohol is used mainly in perfumery, particularly in soaps and cosmetics. Its molecular formula is $C_9H_{10}O$. How many molecules of cinnamic alcohol are contained in a sample of mass 0.469 g?
    A) 9.35×10^{21}
    B) 4.45×10^{22}
    C) 2.11×10^{21}
    D) 2.82×10^{23}

89. All of the substances listed below are fertilizers that contribute nitrogen to the soil. Which of these is the richest source of nitrogen on a mass percentage basis?
    A) Urea, $(NH_2)_2CO$
    B) Ammonium nitrate, NH_4NO_3
    C) Guanidine, $HNC(NH_2)_2$
    D) Ammonia, NH_3

90. Allicin is the compound responsible for the characteristic smell of garlic. An analysis of the compound gives the following percent composition by mass: C: 44.4 percent; H: 6.21 percent; S: 39.5 percent; O: 9.86 percent. What is its molecular formula given that its molar mass is about 162 g?
    A) $C_{12}H_{20}S_4O_2$
    B) $C_7H_{14}SO$
    C) $C_6H_{10}S_2O$
    D) $C_5H_{12}S_2O_2$

91. Peroxyacylnitrate (PAN) is one of the components of smog. It is a compound of C, H, N, and O. Determine the empirical formula from the following percent composition by mass: 19.8 percent C, 2.50 percent H, 11.6 percent N, 66.1 percent O. What is its molecular formula given that its molar mass is about 120 g?
    A) C_2HNO_6
    B) $C_2H_3NO_5$
    C) CH_5N_2O
    D) $C_3H_6N_4O_3$

92. The formula for rust can be represented by Fe_2O_3. How many moles of Fe are present in 24.6 g of the compound?
    A) 2.13 mol
    B) 0.456 mol
    C) 0.154 mol
    D) 0.308 mol

93. How many grams of sulfur (S) are needed to react completely with 246 g of mercury (Hg) to form HgS?
    A) 39.3 g
    B) 24.6 g
    C) 9.66×10^3 g
    D) 201 g

94. Calculate the mass in grams of iodine (I_2) that will react completely with 20.4 g of aluminum (Al) to form aluminum iodide (AlI_3).
    A) 192 g
    B) 288 g
    C) 61.2 g
    D) 576 g

95. Tin(II) fluoride (SnF_2) is often added to toothpaste as an ingredient to prevent tooth decay. What is the mass of F in grams in 24.6 g of the compound?
    A) 18.6 g
    B) 24.3 g
    C) 5.97 g
    D) 75.7 g

96. What is the empirical formula of the compound with the following composition?
    2.1 percent H, 65.3 percent O, 32.6 percent S.
    A) H_2SO_4
    B) H_2SO_3
    C) $H_2S_2O_3$
    D) HSO_3

97. What is the empirical formula of the compound with the following composition?
    40.1 percent C, 6.6 percent H, 53.3 percent O.
    A) CH_2O_2
    B) CH_2O
    C) C_2H_6O
    D) $C_2H_4O_2$

98. Monosodium glutamate (MSG), a food-flavor enhancer, has been blamed for "Chinese restaurant syndrome," the symptoms of which are headaches and chest pains. MSG has the following composition by mass: 35.51 percent C, 4.77 percent H, 37.85 percent O, 8.29 percent N, and 13.60 percent Na. What is its molecular formula, if its molar mass is about 169 g/mol?
    A) $C_3H_9O_4NNa_2$
    B) $C_4H_6O_4N_2Na$
    C) $C_5H_8O_4NNa$
    D) $C_4H_4O_5NNa$

99. Which of the following equations is balanced?
    A) $2C + O_2 \rightarrow CO$
    B) $2CO + O_2 \rightarrow 2CO_2$
    C) $H_2 + Br_2 \rightarrow HBr$
    D) $2K + H_2O \rightarrow 2KOH + H_2$

100. Which of the following equations is balanced?
    A) $2Mg + O_2 \rightarrow 2MgO$
    B) $O_3 \rightarrow 3O_2$
    C) $2H_2O_2 \rightarrow H_2O + O_2$
    D) $N_2 + 3H_2 \rightarrow 3NH_3$

101. Which of the following equations is balanced?
    A) $2Zn + AgCl \rightarrow 2ZnCl_2 + Ag$
    B) $S_8 + 8O_2 \rightarrow 4SO_2$
    C) $NaOH + 2H_2SO_4 \rightarrow Na_2SO_4 + H_2O$
    D) $Cl_2 + 2NaI \rightarrow 2NaCl + I_2$

102. Which of the following equations is balanced?
    A) $2N_2O_5 \rightarrow 3N_2O_4 + O_2$
    B) $2KNO_3 \rightarrow 2KNO_2 + 3O_2$
    C) $NH_4NO_3 \rightarrow 2N_2O + 2H_2O$
    D) $NH_4NO_2 \rightarrow N_2 + 2H_2O$

103. Which of the following equations is balanced?
    A) $2NaHCO_3 \rightarrow Na_2CO_3 + H_2O + CO_2$
    B) $P_4O_{10} + 4H_2O \rightarrow 4H_3PO_4$
    C) $2HCl + CaCO_3 \rightarrow CaCl_2 + 2H_2O + CO_2$
    D) $2Al + 3H_2SO_4 \rightarrow Al_2(SO_4)_3 + H_2$

104. Which of the following equations is balanced?
    A) $CO_2 + 2KOH \rightarrow K_2CO_3 + 2H_2O$
    B) $CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$
    C) $Be_2C + H_2O \rightarrow 2Be(OH)_2 + CH_4$
    D) $Cu + 2HNO_3 \rightarrow Cu(NO_3)_2 + NO + H_2O$

105. Consider the combustion of carbon monoxide (CO) in oxygen gas:
    $2CO(g) + O_2(g) \rightarrow 2CO_2(g)$
    Starting with 3.60 moles of CO, calculate the number of moles of CO_2 produced if there is enough oxygen gas to react with all of the CO.
    A) 7.20 mol
    B) 44.0 mol
    C) 3.60 mol
    D) 1.80 mol

106. Silicon tetrachloride ($SiCl_4$) can be prepared by heating Si in chlorine gas:
$Si(s) + 2Cl_2(g) \rightarrow SiCl_4(l)$
In one reaction, 0.507 mole of $SiCl_4$ is produced. How many moles of molecular chlorine were used in the reaction?
A) 2.03 mol
B) 4.00 mol
C) 1.01 mol
D) 0.507 mol

107. The annual production of sulfur dioxide from burning coal and fossil fuels, auto exhaust, and other sources is about 26 million tons. The equation for the reaction is
$S(s) + O_2(g) \rightarrow SO_2(g)$
How much sulfur, present in the original materials, would result in that quantity of SO_2?
A) 2.3×10^{16} tons
B) 3.0×10^{23} tons
C) 2.6×10^{7} tons
D) 1.3×10^{7} tons

108. When baking soda (sodium bicarbonate or sodium hydrogen carbonate, $NaHCO_3$) is heated, it releases carbon dioxide gas, which is responsible for the rising of cookies, donuts, and bread. The balanced equation for this process is:
$2NaHCO_3 \rightarrow Na_2CO_3 + H_2O + CO_2$. Calculate the mass of $NaHCO_3$ required to produce 20.5 g of CO_2.
A) 8.38 g
B) 78.3 g
C) 157 g
D) 39.1 g

109. When potassium cyanide (KCN) reacts with acids, a deadly poisonous gas, hydrogen cyanide (HCN), is given off. Here is the equation:
$KCN(aq) + HCl(aq) \rightarrow KCl(aq) + HCN(g)$
If a sample of 0.140 g of KCN is treated with an excess of HCl, calculate the amount of HCN formed, in grams.
A) 0.0581 g
B) 0.0651 g
C) 0.0883 g
D) 0.0270 g

110. Fermentation is a complex chemical process of wine making in which glucose is converted into ethanol and carbon dioxide:

$C_6H_{12}O_6 \rightarrow 2C_2H_5OH + 2CO_2$

Starting with 500.4 g of glucose, what is the maximum amount of ethanol in liters that can be obtained by this process? (Density of ethanol = 0.789 g/mL.)
   A) 0.324 L
   B) 0.256 L
   C) 0.202 L
   D) 2.56 L

111. Each copper(II) sulfate unit is associated with five water molecules in crystalline copper(II) sulfate pentahydrate ($CuSO_4.5H_2O$). When this compound is heated in air above 100° C, it loses the water molecules and also its blue color:

$CuSO_4.5H_2O \rightarrow CuSO_4 + 5H_2O$

If 9.60 g of $CuSO_4$ are left after heating 15.01 g of the blue compound, calculate the number of moles of H_2O originally present in the compound.
   A) 0.125 mol
   B) 5.38 mol
   C) 0.0600 mol
   D) 0.300 mol

112. For many years the recovery of gold — that is, the separation of gold from other materials — involved the use of potassium cyanide:

$4Au + 8KCN + O_2 + 2H_2O \rightarrow 4KAu(CN)_2 + 4KOH$

What is the minimum amount of KCN in moles needed to extract 29.0 g of gold?
   A) 58.0 mol
   B) 0.294 mol
   C) 0.147 mol
   D) 0.0736 mol

113. Limestone ($CaCO_3$) is decomposed by heating to quicklime (CaO) and carbon dioxide. Calculate how many grams of quicklime can be produced from 1.0 kg of limestone.
   A) 5.6×10^2 g
   B) 2.3×10^2 g
   C) 4.4×10^2 g
   D) 8.6×10^2 g

114. Nitrous oxide (N_2O) is also called "laughing gas." It can be prepared by the thermal decomposition of ammonium nitrate (NH_4NO_3). The other product is H_2O. The balanced equation for this reaction is:

$NH_4NO_3 \rightarrow N_2O + 2H_2O$

How many grams of N_2O are formed if 0.46 mole of NH_4NO_3 is used in the reaction?
A) 2.0 g
B) 3.7×10^1 g
C) 2.0×10^1 g
D) 4.6×10^{-1} g

115. The fertilizer ammonium sulfate [$(NH_4)_2SO_4$] is prepared by the reaction between ammonia (NH_3) and sulfuric acid:

$2NH_3(g) + H_2SO_4(aq) \rightarrow (NH_4)_2SO_4(aq)$

How many kilograms of NH_3 are needed to produce 1.00×10^5 kg of $(NH_4)_2SO_4$?
A) 1.70×10^4 kg
B) 3.22×10^3 kg
C) 2.58×10^4 kg
D) 7.42×10^4 kg

116. A common laboratory preparation of oxygen gas is the thermal decomposition of potassium chlorate ($KClO_3$). Assuming complete decomposition, calculate the number of grams of O_2 gas that can be obtained from 46.0 g of $KClO_3$. (The products are KCl and O_2.)
A) 12.0 g
B) 18.0 g
C) 6.00 g
D) 36.0 g

117. Nitric oxide (NO) reacts with oxygen gas to form nitrogen dioxide (NO_2), a dark-brown gas:

$2NO(g) + O_2(g) \rightarrow 2NO_2(g)$

In one experiment 0.886 mole of NO is mixed with 0.503 mole of O_2. Calculate the number of moles of NO_2 produced (note: first determine which is the limiting reagent).
A) 0.886 mol
B) 0.503 mol
C) 1.01 mol
D) 1.77 mol

118. The depletion of ozone (O_3) in the stratosphere has been a matter of great concern among scientists in recent years. It is believed that ozone can react with nitric oxide (NO) that is discharged from the high-altitude jet plane, the SST. The reaction is
$O_3 + NO \rightarrow O_2 + NO_2$
If 0.740 g of O_3 reacts with 0.670 g of NO, how many grams of NO_2 will be produced?
A) 1.410 g
B) 0.670 g
C) 0.709 g
D) 0.883 g

119. Propane (C_3H_8) is a component of natural gas and is used in domestic cooking and heating. The balanced equation for the combustion of propane is:
$C_3H_8 + 5O_2 \rightarrow 3CO_2 + 4H_2O$
How many grams of carbon dioxide can be produced by burning 3.65 moles of propane? Assume that oxygen is the excess reagent in this reaction.
A) 161 g
B) 11.0 g
C) 332 g
D) 482 g

120. Consider the reaction
$MnO_2 + 4HCl \rightarrow MnCl_2 + Cl_2 + 2H_2O$
If 0.86 mole of MnO_2 and 48.2 g of HCl react, how many grams of Cl_2 will be produced?
A) 42.3 g
B) 93.6 g
C) 63.4 g
D) 23.4 g

121. Hydrogen fluoride is used in the manufacture of Freons (which destroy ozone in the stratosphere) and in the production of aluminum metal. It is prepared by the reaction
$CaF_2 + H_2SO_4 \rightarrow CaSO_4 + 2HF$
In one process 6.00 kg of CaF_2 are treated with an excess of H_2SO_4 and yield 2.86 kg of HF. Calculate the percent yield of HF.
A) 93.0 %
B) 95.3 %
C) 47.6 %
D) 62.5 %

122. Nitroglycerin ($C_3H_5N_3O_9$) is a powerful explosive. Its decomposition may be represented by

$4C_3H_5N_3O_9 \rightarrow 6N_2 + 12CO_2 + 10H_2O + O_2$

This reaction generates a large amount of heat and many gaseous products. It is the sudden formation of these gases, together with their rapid expansion, that produces the explosion. Calculate the percent yield in this reaction if the amount of O_2 generated from 2.00×10^2 g of nitroglycerin is found to be 6.55 g.
   A) 23.2 %
   B) 44.6 %
   C) 92.9 %
   D) 62.5 %

123. Titanium(IV) oxide (TiO_2) is a white substance produced by the action of sulfuric acid on the mineral ilmenite ($FeTiO_3$):

$FeTiO_3 + H_2SO_4 \rightarrow TiO_2 + FeSO_4 + H_2O$

Its opaque and nontoxic properties make it suitable as a pigment in plastics and paints. In one process 8.00×10^3 kg of $FeTiO_3$ yielded 3.67×10^3 kg of TiO_2. What is the percent yield of the reaction?
   A) 92.9 %
   B) 62.5 %
   C) 12.3 %
   D) 87.1 %

124. Ethylene (C_2H_4), an important industrial organic chemical, can be prepared by heating hexane (C_6H_{14}) at 800 °C:

$C_6H_{14} \rightarrow C_2H_4 +$ other products

If the yield of ethylene production is 42.5 percent, what mass of hexane must be reacted to produce 481 g of ethylene?
   A) 5.56×10^3 g
   B) 3.47×10^3 g
   C) 9.95×10^2 g
   D) 1.13×10^3 g

125. Industrially, nitric acid is produced by the Ostwald process represented by the following equations:

$4NH_3(g) + 5O_2(g) \rightarrow 4NO(g) + 6H_2O(l)$
$2NO(g) + O_2(g) \rightarrow 2NO_2(g)$
$2NO_2(g) + H_2O(l) \rightarrow HNO_3(aq) + HNO_2(aq)$

What mass of NH_3 (in g) must be used to produce 1.00 ton of HNO_3 by the above procedure, assuming an 80 percent yield in each step?(1 ton = 2000 lb; 1 lb = 453.6 g.)
   A) 9.6×10^5 g
   B) 1.2×10^6 g
   C) 1.5×10^6 g
   D) 1.9×10^6 g

126. A sample of a compound of Cl and O reacts with an excess of H_2 to give 0.233 g of HCl and 0.403 g of H_2O. Determine the empirical formula of the compound.
    A) ClO_4
    B) Cl_2O_7
    C) Cl_2O_5
    D) ClO_2

127. How many moles of O are needed to combine with 0.212 mole of C to form CO_2?
    A) 0.424 mol
    B) 1.00 mol
    C) 2.00 mol
    D) 0.212 mol

128. The aluminum sulfate hydrate $[Al_2(SO_4)_3 \cdot xH_2O]$ contains 8.20 percent Al by mass. Calculate x, that is, the number of water molecules associated with each $Al_2(SO_4)_3$ unit.
    A) 2
    B) 5
    C) 18
    D) 9

129. Mustard gas $(C_4H_8Cl_2S)$ is a poisonous gas that was used in World War I and banned afterward. It causes general destruction of body tissues, resulting in the formation of large water blisters. There is no effective antidote. Calculate the percent composition by mass of the chlorine in mustard gas.
    A) 30.19 %
    B) 44.57 %
    C) 5.069 %
    D) 20.16 %

130. The carat is the unit of mass used by jewelers. One carat is exactly 200 mg. How many carbon atoms are present in a 24-carat diamond?
    A) 3.0×10^{23} atoms
    B) 6.0×10^{23} atoms
    C) 2.4×10^{23} atoms
    D) 4.8×10^{23} atoms

131. An iron bar weighed 664 g. After the bar had been standing in moist air for a month, exactly one-eighth of the iron turned to rust (Fe_2O_3). Calculate the final mass of the rust.
    A) 83.0 g
    B) 107 g
    C) 209 g
    D) 119 g

132. Calculate the percent composition by mass of phosphorus (P) in calcium phosphate [$Ca_3(PO_4)_2$], a major component of bone.
    A) 15.38 %
    B) 19.97 %
    C) 22.96 %
    D) 33.29 %

133. Lysine, an essential amino acid in the human body, contains C, H, O, and N. In one experiment, the complete combustion of 2.175 g of lysine gave 3.94 g CO_2 and 1.89 g H_2O. In a separate experiment, 1.873 g of lysine gave 0.436 g NH_3. The approximate molar mass of lysine is 150 g. What is the molecular formula of the compound?
    A) $C_5H_{12}N_3O_2$
    B) $C_5H_{10}N_2O_3$
    C) $C_6H_{14}N_2O_2$
    D) $C_7H_{16}NO_2$

134. What mole ratio of molecular chlorine (Cl_2) to molecular oxygen (O_2) would result from the breakup of the compound Cl_2O_7 into its constituent elements?
    A) 1:3.5
    B) 3.5:1
    C) 2:1
    D) 1:3

135. Which of the following substances contains the greatest mass of chlorine?
    A) 5.0 g Cl_2
    B) 60.0 g $NaClO_3$
    C) 0.10 mol KCl
    D) 0.50 mol Cl_2

136. Platinum forms a compound with chlorine, which contains 26.7 percent Cl by mass. Determine the empirical formula of the compound.
    A) $PtCl_3$
    B) $PtCl_2$
    C) $PtCl$
    D) Pt_2Cl_3

137. A mixture of $CuSO_4 \cdot 5H_2O$ and $MgSO_4 \cdot 7H_2O$ is heated until all the water is lost. If 5.020 g of the mixture gives 2.988 g of the anhydrous salts, what is the percent by mass of $CuSO_4 \cdot 5H_2O$ in the mixture?
    A) 66.33 %
    B) 70.86 %
    C) 22.90 %
    D) 55.67 %

138. A mixture of methane (CH_4) and ethane (C_2H_6) of mass 13.43 g is completely burned in oxygen. If the total mass of CO_2 and H_2O produced is 64.84 g, calculate the fraction of CH_4 in the mixture.
    A) 0.613
    B) 0.295
    C) 0.387
    D) 0.833

139. Leaded gasoline contains an additive to prevent engine "knocking." On analysis, the additive compound is found to contain carbon, hydrogen, and lead (Pb) (hence, "leaded gasoline"). When 51.36 g of this compound are burned in an apparatus such as that shown in Figure 3.5, 55.90 g of CO_2 and 28.61 g of H_2O are produced. Determine the empirical formula of the gasoline additive.
    A) PbC_4H_{12}
    B) PbC_4H_{10}
    C) PbC_8H_{20}
    D) PbC_2H_6

140. Calculate the mass of KI in grams required to prepare 5.00×10^2 mL of a 2.80 M solution.
    A) 1.40 g
    B) 2.32 g
    C) 232 g
    D) 486 g

141. What mass of $NaNO_3$ would be required to prepare 250 mL of a 0.707 M solution?
    A) 0.177 g
    B) 15.0 g
    C) 23.2 g
    D) 1.50×10^4 g

142. How many moles of $MgCl_2$ are present in 60.0 mL of 0.100 M $MgCl_2$ solution?
    A) 60.0 moles
    B) 0.572 moles
    C) 6.00×10^{-3} moles
    D) 6.00 moles

143. How many grams of KOH are present in 35.0 mL of a 5.50 M solution?
    A) 10.8 g
    B) 0.193 g
    C) 1.96 g
    D) 308 g

144. Calculate the molarity of a solution of 29.0 g of ethanol (C_2H_5OH) in 545 mL of solution.
    A) 2.30 M
    B) 5.32×10^{-2} M
    C) 0.630 M
    D) 1.15 M

145. Calculate the molarity of a solution of 15.4 g of sucrose ($C_{12}H_{22}O_{11}$) in 74.0 mL of solution.
    A) 4.5×10^{-2} M
    B) 0.608 M
    C) 208 M
    D) 60.8 M

146. Calculate the molarity of a solution of 6.57 g of methanol (CH_3OH) in 1.50×10^2 mL of solution.
    A) 4.38×10^{-2} M
    B) 1.37 M
    C) 0.213 M
    D) 3.92 M

147. Calculate the molarity of a solution of 10.4 g of calcium chloride ($CaCl_2$) in 2.20×10^2 mL of solution.
    A) 0.426 M
    B) 4.73×10^{-2} M
    C) 0.963 M
    D) 0.505 M

148. Calculate the volume in mL required to provide 2.14 g of sodium chloride from a 0.270 M solution.
    A) 7.92 mL
    B) 2.14 mL
    C) 136 mL
    D) 15.2 mL

149. Calculate the volume in mL required to provide 4.30 g of ethanol from a 1.50 M solution.
    A) 2.87 mL
    B) 30.7 mL
    C) 22.3 mL
    D) 62.2 mL

150. How many grams of cesium iodide (CsI) would be needed to make 2.50×10^2 mL of a 0.100 M solution?
    A) 25 g
    B) 6.50 g
    C) 0.100 g
    D) 18.3 g

151. How many grams of sulfuric acid (H_2SO_4) would be needed to make 2.50×10^2 mL of a 0.100 M solution?
    A) 2.45 g
    B) 25 g
    C) 100 g
    D) 6.25 g

152. Water is added to 25.0 mL of a 0.866 M KNO_3 solution until the volume of the solution is exactly 500 mL. What is the concentration of the final solution?
    A) 0.0433 M
    B) 0.500 M
    C) 0.0866 M
    D) 0.0217 M

153. You have 505 mL of a 0.125 M HCl solution and you want to dilute it to exactly 0.100 M. How much water should you add?
    A) 25.0 mL
    B) 63.1 mL
    C) 50.5 mL
    D) 126 mL

154. A 35.2-mL, 1.66 M $KMnO_4$ solution is mixed with 16.7 mL of 0.892 M $KMnO_4$ solution. Calculate the concentration of the final solution.
    A) 2.55 M
    B) 0.638 M
    C) 1.41 M
    D) 1.28 M

155. A 46.2-mL, 0.568 M calcium nitrate [$Ca(NO_3)_2$] solution is mixed with 80.5 mL of 1.396 M calcium nitrate solution. Calculate the concentration of the final solution.
    A) 1.96 M
    B) 1.09 M
    C) 0.982 M
    D) 2.25 M

156. How many grams of NaCl are required to precipitate most of the Ag^+ ions from 2.50×10^2 mL of 0.0113 M $AgNO_3$ solution?
   A) 2.83 g
   B) 0.661 g
   C) 8.55 g
   D) 0.165 g

157. The concentration of Cu^{2+} ions in the water (which also contains sulfate ions) discharged from a certain industrial plant is determined by adding excess sodium sulfide (Na_2S) solution to 0.800 L of the water. The molecular equation is:
   $Na_2S(aq) + CuSO_4(aq) \rightarrow Na_2SO_4(aq) + CuS(s)$
   Calculate the molar concentration of Cu^{2+} in the water sample if 0.0177 g of solid CuS is formed.
   A) $1.77 \times 10^{-2}\ M$
   B) $5.66 \times 10^{-4}\ M$
   C) $2.31 \times 10^{-3}\ M$
   D) $2.31 \times 10^{-4}\ M$

158. Calculate the volume in mL of a 1.420 M NaOH solution required to titrate 25.00 mL of a 2.430 M HCl solution.
   A) 60.75 mL
   B) 42.78 mL
   C) 17.61 mL
   D) 22.43 mL

159. Calculate the volume in mL of a 1.420 M NaOH solution required to titrate 25.00 mL of a 4.500 M H_2SO_4 solution.
   A) 56.25 mL
   B) 158.5 mL
   C) 112.5 mL
   D) 225.0 mL

160. Calculate the volume in mL of a 1.420 M NaOH solution required to titrate 25.00 mL of a 1.500 M H_3PO_4 solution.
   A) 112.5 mL
   B) 26.41 mL
   C) 79.23 mL
   D) 50.00 mL

161. What volume of a 0.500 M HCl solution is needed to completely neutralize 10.0 mL of a 0.300 M NaOH solution?
     A) 6.00 mL
     B) 0.300 mL
     C) 10.0 mL
     D) 3.00 mL

162. What volume of a 0.500 M HCl solution is needed to completely neutralize 10.0 mL of a 0.200 M $Ba(OH)_2$ solution?
     A) 10.0 mL
     B) 0.200 mL
     C) 2.00 mL
     D) 8.00 mL

Answers:

1.	D		41.	D		81.	D	121.	A
2.	B		42.	B		82.	B	122.	C
3.	A		43.	D		83.	C	123.	D
4.	E		44.	C		84.	A	124.	B
5.	C		45.	C		85.	D	125.	A
6.	D		46.	C		86.	D	126.	B
7.	B		47.	D		87.	A	127.	A
8.	D		48.	A		88.	C	128.	C
9.	D		49.	B		89.	D	129.	B
10.	A		50.	D		90.	C	130.	C
11.	B		51.	A		91.	B	131.	D
12.	E		52.	C		92.	D	132.	B
13.	A,		53.	D		93.	A	133.	C
14.	B		54.	A		94.	B	134.	A
15.	D		55.	B		95.	C	135.	D
16.	B		56.	D		96.	A	136.	B
17.	C		57.	B		97.	B	137.	B
18.	D		58.	B		98.	C	138.	C
19.	A		59.	C		99.	B	139.	C
20.	B		60.	C		100.	A	140.	C
21.	B		61.	D		101.	D	141.	B
22.	A		62.	C		102.	D	142.	C
23.	D		63.	A		103.	A	143.	A
24.	C		64.	D		104.	B	144.	D
25.	A		65.	B		105.	C	145.	B
26.	B		66.	D		106.	C	146.	B
27.	C		67.	B		107.	D	147.	A
28.	C		68.	A		108.	B	148.	C
29.	A		69.	A		109.	A	149.	D
30.	D		70.	C		110.	A	150.	B
31.	A		71.	B		111.	D	151.	A
32.	D		72.	D		112.	B	152.	A
33.	C		73.	D		113.	A	153.	D
34.	B		74.	A		114.	C	154.	C
35.	C		75.	C		115.	C	155.	B
36.	A		76.	A		116.	B	156.	D
37.	B		77.	C		117.	A	157.	D
38.	D		78.	B		118.	C	158.	B
39.	B		79.	A		119.	D	159.	B
40.	A		80.	D		120.	D	160.	C
								161.	A
								162.	D