(4)   1.   Nitroglycerine, $C_3H_5(NO_3)_3$, has the same proportion of:

a) C to O atoms as does CO_2 b) C to O atoms as does C_3O_2

c) N to O atoms as does NO_2 d) N to O atoms as does N_2O_3

e) C to N atoms as does C_2N_2

(4)   2.   Which one of the following oxides of nitrogen contains the **smallest** percentage of nitrogen by mass?

a) N_2O_5 b) N_2O_3 c) N_2O d) NO_2 e) NO

(4)   3.   Which one of the following nuclides has the **smallest number of neutrons/atom?**

a) ^{114}Ag b) ^{114}Cd c) ^{113}Pd d) ^{112}Cd e) ^{112}In

(4)   4.   The number of individual **nitrogen atoms** present in 0.50 moles of nitroglycerin molecules, $C_3H_5(NO_3)_3$,   is   _____.

(4)   5.   One **molecule** of C_2H_6O contains:

a) 6 moles of hydrogen atoms   b) 16.0 g of oxygen atoms
c) 24.02 g of carbon atoms   d) one oxygen atom
              e) All of the above choices are correct

(4)   6.   Lithium has an atomic weight of 6.941 and exists as two nuclides. The major nuclide has an atomic mass of 7.0160 amu (92.5% abundance). The minor nuclide has an atomic mass of:

a) 5.9931 amu   b) 6.0160 amu   c) 6.1125 amu   d) 6.1572 amu

(4)   7.   An atom of an unknown element has a mass of 198 amu and has 42 more neutrons than protons. The unknown element is:

a) Ir   b) Pt   c) Au   d) Hg   e) Tl

(4)   8.   To illustrate the **Law of Definite Proportions** (Constant Composition), NO_2 should be compared to:

a)   NO   b) N_2O_3 c) N_2O_4 d) N_2O_5

(4)   9.   Which one of the following pairs of substances could be used to illustrate the **Law of Multiple Proportions**?

a) ^{35}Cl & ^{37}Cl b) C_3H_6 & C_7H_{14} c) N_2O & NO d) NI_3 & PI_3

(4)   10.   The percent by mass of **barium** in barium phosphate, $Ba_3(PO_4)_2$, is _____%.

(4)   11.   Choose the **incorrect** statement from among the following choices:

a)   All matter is composed of atoms.
b)   Atoms combine in small, whole number ratios.
c)   All atoms of a given element must have the same number of protons.
d)   All atoms of a given element must have the same number of neutrons.
e)   Atoms retain their identity during a chemical reaction.

(4)   12.   Which one of the following contains the **greatest number of atoms**?

a) 0.1 moles of S_8 molecules   b) 104.0 g of chromium atoms
c) 4.0 g of hydrogen atoms   d) 60.0 g of calcium atoms
      e) Five trillion O_2 molecules (1 trillion = 1×10^{12})

(4)   13.   A 0.10 mole sample of $(NH_4)_2Cr_2O_7$ (Molar Mass = 252 g/mol) contains _____ g of nitrogen atoms.

a) 2.80 g   b) 1.40 g   c) 0.70 g   d) 0.35 g   e) 0.20 g

(4)   14.   A sample of $C_{12}H_{22}O_{11}$ that contains 72.0 g of carbon also contains _____ g of oxygen.

a) 180.0 g   b) 88.0 g   c) 72.0 g   d) 44.0 g   e) 11.0 g

(4)   15.   The mass of **oxygen** associated with 171 g of $Al_2(SO_4)_3$ (Molar mass = 342 g/mol) is found in _____ g of $CaCO_3$ (Molar mass = 100 g/mol).

a) 200 g   b) 171 g   c) 100 g   d) 50 g   e) 25 g

(4)   16.   Which one of the following **cannot** be an empirical formula?

a) NO_2 b) C_3H_7 c) BH_3 d) P_2O_5 e) C_2H_2

(4) 17. The hydrate with **more than** 50% H_2O, by mass, is:

a) $LiNO_3 \cdot 3H_2O$ b) $CuSO_4 \cdot 5H_2O$ c) $MgCl_2 \cdot 6H_2O$

d) $Na_2SO_4 \cdot 7H_2O$ e) $KAl(SO_4)_2 \cdot 12H_2O$

(4) 18. If an unknown compound contains 0.6897 g sodium, 6.02×10^{21} atoms of boron, and 0.030 moles of oxygen atoms, the empirical formula of the unknown compound must be:

a) NaB_2O_2 b) $Na_2B_2O_3$ c) Na_3BO_3 d) Na_3BO_4

(4) 19. The molar mass of a compound whose empirical formula is C_2H_3Cl is 187 ± 3 g/mol. Which one of the following represents its molecular formula?

a) $C_6H_{12}Cl_3$ b) $C_9H_{10}Cl_2$ c) C_4Cl_4 d) $C_{12}H_9Cl$ e) $C_6H_9Cl_3$

(4) 20. When $KAl(SO_4)_2 \cdot xH_2O$, a hydrate salt, is strongly heated, all the water is driven off. If 2.58 g of anhydrous $KAl(SO_4)_2$ (Molar mass = 258 g/mol) is obtained from 4.74 g of $KAl(SO_4)_2 \cdot xH_2O$, what is the numerical value of x?

a) four   b) six   c) eight   d) ten   e) twelve

(6) 21. Potassium manganate is a dark green, crystalline substance whose composition is 39.6% potassium (K), 27.9% manganese (Mn), and 32.5% oxygen (O) by mass. Determine the empirical formula of potassium manganate. Show all work in the space provided.

22. Combustion of a 6.51 g sample of an organic compound produces 20.47 g CO_2 and 8.36 g H_2O.

(6)   a)   Determine the **empirical formula** of the compound. Show all work in the space provided below.

(2)   b)   If the molar mass of the organic compound is 112 g/mol, what is its **molecular formula**? Show all work in the space provided below.

(6)   23.   A 3.00 g sample of element Q reacts with sulfur to form 19.00 g of the compound QS_2. What is the most likely identity of element Q? Show all work in the space provided.