

Homework #1

Solutions

- 1-9.** (a) diamond, element, nonmetal
 (b) brass, mixture, metals;
 (c) soil, mixture, contains metal and nonmetals
 (g) salt, compound, composed of metal and nonmetal
 (h) iron, element, metal
 (i) steel, mixture, metal

1-39.

	Z	A	e
³¹ P	15	31	15
¹⁸ O	8	18	8
³⁹ K	19	39	19
⁵⁸ Ni	28	58	28

1-47. Three: ¹⁶O, ¹⁷O, ¹⁸O.

1-48. All have the same number of protons but different numbers of neutrons.

1-49. 1.99268×10^{-23} g; 12.0000 amu

1-50. 1200.0 amu, 1300.3 amu

1-51. (b) The random selection will include isotopes ¹²C and ¹³C.

1-62. Fluorapatite, Ca₅(PO₄)₃F contains 5 Ca²⁺ and 3 PO₄³⁻ ions, therefore, there is a charge of (5)(+2) + 3(-3) = 10 - 9 remaining after counting up the contribution of the Ca²⁺ and PO₄³⁻ ions. Since fluorapatite is a neutral molecule, the charge on the fluoride ion must be -1.

1-88. Element X is a metal whose chemical properties are similar to potassium. There is only one isotope of element X. The mass of X in amu is 22.98976. Use the trends in masses in Table 1.4 to identify element X.

Answer: It is clear from the table that for the light elements the ratio of the atomic number to atomic mass is very close to 1:2. So the integer nearest to ½ of 22.98976 is 11. That makes the element sodium.

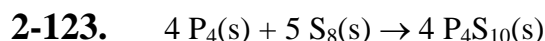
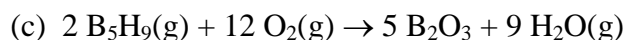
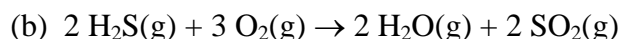
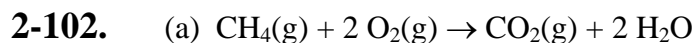
2-83. $\text{mol C} = (194.2 \times 0.4948) \text{ g} \times \frac{1 \text{ mol C}}{12.011 \text{ g}} = 8.000 \text{ mol C}$

$\text{mol H} = (194.2 \times 0.0519) \text{ g} \times \frac{1 \text{ mol H}}{1.0079 \text{ g}} = 10.0 \text{ mol H}$

$\text{mol N} = (194.2 \times 0.2885) \text{ g} \times \frac{1 \text{ mol N}}{14.0067 \text{ g}} = 4.000 \text{ mol N}$

$$\text{mol O} = (194.2 \times 0.1648) \text{ g} \times \frac{1 \text{ mol O}}{15.999 \text{ g}} = 2.000 \text{ mol O}$$

The molecular formula of caffeine is $\text{C}_8\text{H}_{10}\text{N}_4\text{O}_2$



$$0.500 \text{ mol P}_4 \times (4 \text{ mol P}_4\text{S}_{10}) / (4 \text{ mol P}_4) = 0.500 \text{ mol P}_4\text{S}_{10}$$

$$0.500 \text{ S}_8 \times (4 \text{ mol P}_4\text{S}_{10}) / (5 \text{ mol S}_8) = 0.400 \text{ mol P}_4\text{S}_{10}$$

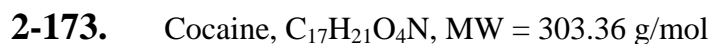
Since S_8 produces fewer moles of P_4S_{10} , therefore it is the limiting reagent. If P_4 is doubled, S_8 is still the limiting reagent, and the amount of P_4S_{10} produced remains unchanged. If S_8 is doubled, then P_4 becomes the limiting reagent and the yield of P_4S_{10} rises to a value of 0.500 mol.



$$150 \text{ g Al} \times \frac{1 \text{ mol Al}}{26.98 \text{ g}} \times \frac{2 \text{ mol Fe}}{2 \text{ mol Al}} = 5.56 \text{ mol Fe,}$$

$$250 \text{ g Fe}_2\text{O}_3 \times \frac{1 \text{ mol Fe}_2\text{O}_3}{159.7 \text{ g Fe}_2\text{O}_3} \times \frac{2 \text{ mol Fe}}{1 \text{ mol Fe}_2\text{O}_3} = 3.13 \text{ mol Fe,}$$

Therefore, the limiting reagent is Fe_2O_3 . The amount of Fe produced is 175 g Fe.



$$\Rightarrow \text{C} = 67.31\%; \text{H} = 6.98\%; \text{N} = 4.62\%; \text{O} = 21.10\%$$



$$\Rightarrow \text{C} = 60.00\%; \text{H} = 4.48\%; \text{O} = 35.52\%$$

With a 7.31% difference in the amount of C and a 2.5% difference in the amount of H, it should be possible to distinguish between cocaine and aspirin by elemental analysis of carbon and hydrogen.