Chapter 3 MC Review

1. What is the average mass, in grams, of one atom of iron?
   A. 6.02×10^{23} g C. 9.28×10^{-23} g
   B. 1.66×10^{-24} g D. 55.85 g

$$\frac{55.8\text{ g Fe}}{1\text{ mol Fe}} \times \frac{1\text{ mol Fe}}{6.02\times10^{23}\text{ atoms Fe}} = \boxed{9.28\times10^{-23}\text{ g(/atom)}}$$

2. Which of these quantities does *not* represent 1.00 mol of the indicated substance?
   A. 6.02×10^{23} C atoms C. 12.01 g C
   B. 26.0 g Fe D. 65.4 g Zn

All are molar mass or Avogadro's number except B.

3. One nanogram doesn't seem like a very large number. How many magnesium atoms are there in 1.00 ng of magnesium?
   A. 4.11×10^{-11} atoms C. 1.46×10^{34} atoms
   B. 2.48×10^{13} atoms D. 6.83×10^{-35} atoms

$$1.00\text{ ng Mg} \times \frac{1\times10^{-9}\text{ g}}{1\text{ ng}} \times \frac{1\text{ mol Mg}}{24.3\text{ g Mg}} \times$$

$$\frac{6.02\times10^{23}\text{ atoms Mg}}{1\text{ mol Mg}} = \boxed{2.48\times10^{13}\text{ atoms Mg}}$$

4. How many atoms are in 5.54 g of F_2?
   A. 6.02×10^{23} atoms C. 8.78×10^{22} atoms
   B. 0.146 atoms D. 1.76×10^{23} atoms

$$5.54\text{ g } F_2 \times \frac{1\text{ mol } F_2}{38.0\text{ g } F_2} \times \frac{2\text{ mol F}}{1\text{ mol } F_2}$$

$$\times \frac{6.02\times10^{23}\text{ atoms F}}{1\text{ mol F}} = 1.76\times10^{23}\text{ atoms F}$$

5. Determine the number of moles of aluminum in 96.7 g of Al.
   A. 0.279 mol C. 7.43 mol
   B. 3.58 mol D. 4.21 mol

$$97.6\text{ g Al} \times \frac{1\text{ mol Al}}{27.0\text{ g Al}} = 3.58\text{ mol}$$

6. How many moles of CF_4 are there in 171 g of CF_4?
   A. 0.51 mol C. 4.07 mol
   B. 1.94 mol D. 88.0 mol

$$171\text{ g } CF_4 \times \frac{1\text{ mol } CF_4}{88.0\text{ g } CF_4} = 1.94\text{ mol } CF_4$$

7. Which of the following samples contains the greatest number of atoms?
   A. 100 g of Pb C. 0.1 mole of Fe
   B. 2.0 mole of Ar D. 5 g of He

No quantities except B are as much as 2 moles.

8. How many sodium atoms are there in 6.0 g of Na_3N?
   A. 3.6×10^{24} atoms C. 1.3×10^{23} atoms
   B. 0.072 atoms D. 0.217 atoms

$$6.0\text{ g } Na_3N \times \frac{1\text{ mol } Na_3N}{83\text{ g } Na_3N} \times \frac{3\text{ mol Na}}{1\text{ mol } Na_3N}$$

$$\times \frac{6.02\times10^{23}\text{ atoms Na}}{1\text{ mol Na}} = 1.3\times10^{23}\text{ atoms Na}$$

9. Boron obtained from borax deposits in Death Valley consists of two isotopes. They are boron-10 and boron-11 with atomic masses of 10.013 amu and 11.009 amu, respectively. The atomic mass of boron is 10.81 amu (see periodic table). Which isotope of boron is more abundant, boron-10 or boron-11?
   A. This cannot be determined from data given.
   B. Neither, their abundances are the same.
   C. Boron-10
   D. Boron-11

The average molar mass of B is closer to the mass of B-11, so it is more abundant.

10. The percent composition by mass of a compound is 76.0% C, 12.8% H, and 11.2% O. The molar mass of this compound is 284.5 g/mol. What is the molecular formula of the compound?
    A. $C_{18}H_{36}O_2$ C. $C_{16}H_{28}O_4$
    B. $C_9H_{18}O$ D. $C_{20}H_{12}O_2$

$$\left.\begin{aligned}
&\frac{76.0\%\text{ C}}{100\%} \times \frac{284.5\text{ g}}{1\text{ mol}} \times \frac{1\text{ mol C}}{12.0\text{ g C}} = 18\text{ mol C}\\
&\frac{12.8\%\text{ H}}{100\%} \times \frac{284.5\text{ g}}{1\text{ mol}} \times \frac{1\text{ mol H}}{1.01\text{ g H}} = 36\text{ mol H}\\
&\frac{11.2\%\text{ O}}{100\%} \times \frac{284.5\text{ g}}{1\text{ mol}} \times \frac{1\text{ mol O}}{16.0\text{ g O}} = 2\text{ mol O}
\end{aligned}\right\} \; C_{18}H_{36}O_2$$

11. Balance the equation below using the smallest set of whole numbers. What is the coefficient of H_2O?
    ___$PCl_3(l)$ + ___ $H_2O(l)$ → ___$H_3PO_3(aq)$+ ___$HCl(aq)$
    A. 1 C. 3
    B. 2 D. 5

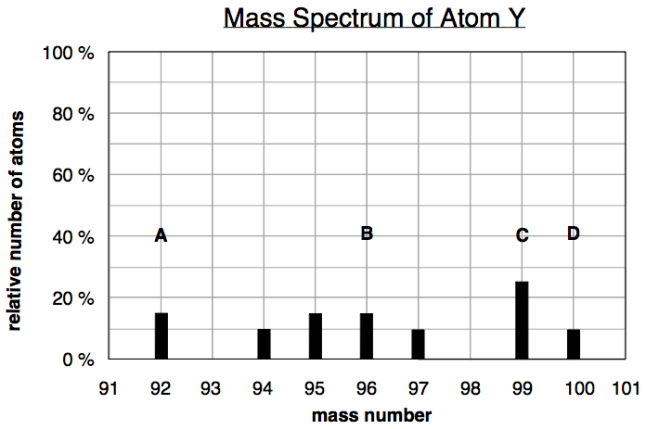
$$1\ PCl_3 + 3\ H_2O \rightarrow 1\ H_3PO_3 + 3\ HCl$$

12. A gold wire has a diameter of 1.00 mm. What length of this wire contains exactly 1.00 mol of gold? [Given: density of Au = 17.0 g/cm^3]
    A. 2630 m C. 251 m
    B. 3.69 m D. 14.8 m

$$V = \pi(d/2)^2\ell,\ \text{so}\ \ell = \frac{4V}{\pi d^2} = \frac{4\left(\text{mass}\times\frac{1}{\text{Density}}\right)}{\pi\left(1.00\text{ mm}\times\frac{1\text{ cm}}{10\text{ mm}}\right)^2}$$

$$= \frac{4\left(1.00\text{ mol Au}\times\frac{197\text{ g Au}}{1\text{ mol Au}}\times\frac{1\text{ cm}^3\text{ Au}}{17.0\text{ g Au}}\right)}{\pi(0.100\text{ cm})^2}\times\frac{1\text{ m}}{100\text{ cm}} = 14.8\text{ m}$$

The following 3 questions refer to the mass spectrum of Atom Y as shown below:



13. Based on the mass spectrum of atom Y, which of the following statements is *false*?
    A. peak D comes from an atom with 4 more protons than the atom that gave peak B
    B. peak A and peak D come from atoms that have the same number of electrons
    C. there are seven isotopes of atom Y
    D. peak C comes from the most abundant isotope of atom Y

    The isotopes are all from the same element, so must have the same number of protons.

14. The identity of compound Y is:
    A. zirconium
    B. molybdenum (MM = 95.95 amu)
    C. americium
    D. einsteinium

    Mo is the only element whose average atomic mass falls near the middle of the range of isotope masses, where the approximate weighted average lies.

15. Which peak comes from an atom with the greatest number of neutrons?
    A. A
    B. all peaks in the spectrum have the same number of neutrons
    C. C
    D. D

    All isotopes have the same number of protons, and since mass # A = atomic # Z + Number of neutrons, the difference in mass number is due to different numbers of neutrons. Thus, peak D, with the highest mass number, has the highest number of neutrons.