Chapter 2 - Atoms and Elements

Text Problems: 6, 7, 15, 22, 25, 28, 30, 39, 40, 45, 49, 65, 66, 68, 78

2.6 Each gold atom has a diameter of 2×145 pm = 290. pm

$$36 \text{ cm} \cdot \frac{1 \text{ m}}{100 \text{ cm}} \cdot \frac{10^{12} \text{ pm}}{1 \text{ m}} \cdot \frac{1 \text{ Au atom}}{290. \text{ pm}} = 1.2 \times 10^9 \text{ Au atoms}$$

2.7 Radon, Rn

2.15 Number of protons = number of electrons = 43; number of neutrons = 56

2.22 (^{24}Mg mass)(% abundance) + (^{25}Mg mass)(% abundance) + (^{26}Mg mass)(% abundance)

= atomic weight of Mg

(23.985 u)(0.7899) + (24.986 u)(0.1000) + (25.983 u)(0.1101)

= 24.31 u

2.25 Let x represent the abundance of ^{69}Ga and $(1 - x)$ represent the abundance of ^{71}Ga.

69.723 u = (x)(68.9257 u) + $(1 - x)$(70.9249 u)

$x = 0.6012$; ^{69}Ga abundance is 60.12%, ^{71}Ga abundance is 39.88%

2.28 (a) $4.24 \text{ mol Au} \cdot \frac{197.0 \text{ g Au}}{1 \text{ mol Au}} = 835 \text{ g Au}$

(b) $15.6 \text{ mol He} \cdot \frac{4.003 \text{ g He}}{1 \text{ mol He}} = 62.4 \text{ g He}$

(c) $0.063 \text{ mol Pt} \cdot \frac{195 \text{ g Pt}}{1 \text{ mol Pt}} = 12 \text{ g Pt}$

(d) $3.63 \times 10^{-4} \text{ mol Pu} \cdot \frac{244.7 \text{ g Pu}}{1 \text{ mol Pu}} = 0.0888 \text{ g Pu}$

2.30 (a) $16.0 \text{ g Na} \cdot \frac{1 \text{ mol Na}}{22.99 \text{ g Na}} = 0.696 \text{ mol Na}$

(b) $0.876 \text{ g Sn} \cdot \frac{1 \text{ mol Sn}}{118.7 \text{ g Sn}} = 7.38 \times 10^{-3} \text{ mol Sn}$

(c) $0.0034 \text{ g Pt} \cdot \frac{1 \text{ mol Pt}}{195 \text{ g Pt}} = 1.7 \times 10^{-5} \text{ mol Pt}$

(d) $0.983 \text{ g Xe} \cdot \frac{1 \text{ mol Xe}}{131.3 \text{ g Xe}} = 7.49 \times 10^{-3} \text{ mol Xe}$

2.39 (a) C, Cl

(b) C, Cl, Cs, Ca

(c) Ce

(d) Cr, Co, Cd, Cu, Ce, Cf, Cm

(e) Cm, Cf

(f) Cl

2.40 There are many correct answers for parts (a), (b), and (d). Some possible answers are shown below.

(a) C, carbon

(b) Na, sodium

(c) Cl, chlorine

(d) Ne, neon

2.45

Symbol	^{58}Ni	^{33}S	^{20}Ne	^{55}Mn
Number of protons	28	16	10	25
Number of neutrons	30	17	10	30
Number of electrons	28	16	10	25
Name of element	nickel	sulfur	neon	manganese

2.49 (a) Mg and Fe are the most abundant metals. (Very similar abundance values)

(b) H is the most abundant nonmetal.

(c) Si is the most abundant metalloid.

(d) Fe is the most abundant transition element.

(e) F, Cl, and Br are the halogens included and of these Cl is the most abundant.

2.65 (a) Each oil drop carries a charge that is a multiple of the average charge on an electron, 1.59×10^{-19} C.

(b)

Oil Drop	Number of electrons
1	1
2	7
3	6
4	10
5	4

(c) The average charge on the electron from the data is 1.59×10^{-19} C.

The average deviation is 0.01×10^{-19}

$$\frac{(1.59 \times 10^{-19}\ \text{C} - 1.60 \times 10^{-19}\ \text{C})}{1.60 \times 10^{-19}\ \text{C}} \cdot 100\% = -0.6\%$$

2.66 (a) Use current values to determine the atomic mass of oxygen if H = 1.0000 u

$$1.0000 \text{ u H} \cdot \frac{15.9994 \text{ u O}}{1.00794 \text{ u H}} = 15.874 \text{ u O}$$

The value of Avogadro's number is based on the atomic mass of carbon.

$$1.0000 \text{ u H} \cdot \frac{12.011 \text{ u C}}{1.00794 \text{ u H}} = 11.916 \text{ u C}$$

$$11.916 \text{ u C} \cdot \frac{6.02214199 \times 10^{23} \text{ particles}}{12.0000 \text{ u C}} = 5.9802 \times 10^{23} \text{ particles}$$

(b) $$16.0000 \text{ u O} \cdot \frac{1.00794 \text{ u H}}{15.9994 \text{ u O}} = 1.00798 \text{ u H}$$

$$16.0000 \text{ u O} \cdot \frac{12.011 \text{ u C}}{15.9994 \text{ u O}} = 12.011 \text{ u C}$$

$$12.011 \text{ u C} \cdot \frac{6.02214199 \times 10^{23} \text{ particles}}{12.0000 \text{ u C}} = 6.0279 \times 10^{23} \text{ particles}$$

2.68 (^{136}X mass)(% abundance) + (^{138}X mass)(% abundance) + (^{140}X mass)(% abundance) + (^{142}X mass)(% abundance) = atomic weight of Mg

(135.9090 u)(0.00193) + (137.9057 u)(0.00250) + (139.9053 u)(0.8848) + (141.9090 u)(0.1107)

= 140.1046 uThe element is cerium.

2.78 (a) mass of nucleus = 1.06×10^{-22} g (electron mass is negligible)

$$\text{nuclear radius} = 4.8 \times 10^{-6} \text{ nm} \cdot \frac{10^{-9} \text{ m}}{1 \text{ nm}} \cdot \frac{100 \text{ cm}}{1 \text{ m}} = 4.8 \times 10^{-13} \text{ cm}$$

volume of nucleus = $(^4/_3)(\pi)(4.8 \times 10^{-13} \text{ cm})^3 = 4.6 \times 10^{-37} \text{ cm}^3$

$$\text{density of nucleus} = \frac{1.06 \times 10^{-22} \text{ g}}{4.6 \times 10^{-37} \text{ cm}^3} = 2.3 \times 10^{14} \text{ g/cm}^3$$

(b) $$\text{atomic radius} = 0.125 \text{ nm} \cdot \frac{10^{-9} \text{ m}}{1 \text{ nm}} \cdot \frac{100 \text{ cm}}{1 \text{ m}} = 1.25 \times 10^{-8} \text{ cm}$$

volume of Zn atom = $(^4/_3)(\pi)(1.25 \times 10^{-8} \text{ cm})^3 = 8.18 \times 10^{-24} \text{ cm}^3$

volume of space occupied by electrons = $8.18 \times 10^{-24} \text{ cm}^3 - 4.6 \times 10^{-37} \text{ cm}^3$

= $8.18 \times 10^{-24} \text{ cm}^3$

$$\text{density of space occupied by electrons} = \frac{(30)(9.11 \times 10^{-28} \text{ g})}{8.18 \times 10^{-24} \text{ cm}^3} = 3.34 \times 10^{-3} \text{ g/cm}^3$$

(c) The nucleus is much more dense than the space occupied by the electrons.