Chapter 2 Exercise Key

Exercise 2.1 – Periodic Table: Complete the following table.

Name	Symbol	Group Number	Metal, Nonmetal or Metalloid?	Representative Element, Transition Metal or Inner Transition Metal?	Number for Period	Solid, Liquid, or Gas?
aluminum	Al	**13, 3A or IIIA**	**metal**	**representative element**	**3**	**solid**
silicon	**Si**	**14, 4A or IVA**	**metalloid**	**representative element**	**3**	**solid**
nickel	Ni	**10, 8B or VIIIB**	**metal**	**transition metal**	**4**	**solid**
sulfur	**S**	**16, 6A or VIA**	**nonmetal**	**representative element**	**3**	**solid**
fluorine	F	**17, 7A or VIIA**	**nonmetal**	**representative element**	**2**	**gas**
cesium	**Cs**	**1, 1A or IA**	**metal**	**representative element**	**6**	**solid**
mercury	Hg	**12, 2B or IIB**	**metal**	**transition metal**	**6**	**liquid**
uranium	**U**	(No group number)	**metal**	**inner transition metal**	**7**	**solid**
manganese	Mn	**7, 7B or VIIB**	**metal**	**transition metal**	**4**	**solid**
strontium	**Sr**	**2, 2A or IIA**	**metal**	**representative element**	**5**	**solid**
bromine	**Br**	17	**nonmetal**	**representative element**	4	**liquid**
silver	**Ag**	1B	**metal**	**transition metal**	5	**solid**
bismuth	**Bi**	VA	metal	**representative element**	**6**	**solid**
carbon	**C**	14	nonmetal	**representative element**	**2**	**solid**

Exercise 2.2 – Group Names: Write the name of the group to which each of the following elements belongs.

a. helium **noble gases**

b. Cl **halogens**

c. magnesium **alkaline earth metals**

d. Na **alkali metals**

Exercise 2.3 – Isotope Symbolism: Complete the following table.

Symbol	Atomic number	Mass number	Number protons	Number neutrons	Number electrons	Charge
$^{59}_{28}Ni$	**28**	**59**	**28**	**31**	**28**	**0**
$^{32}_{16}S^{2-}$	**16**	**32**	**16**	**16**	**18**	**2–**
$^{207}_{82}Pb^{2+}$	82	207	**82**	**125**	80	**2+**
$^{75}_{33}As$	**33**	**75**	33	42	33	**0**
$^{79}_{35}Br^{-}$	**35**	**79**	35	44	36	**–**

Exercise 2.4 – Metric-Metric Conversion Factors: Write conversion factors that include the following metric units.

a. joule and kilojoule $\frac{10^3\ J}{1\ kJ}$

b. meter and centimeter $\frac{10^2\ cm}{1\ m}$ **or** $\frac{1\ cm}{10^{-2}\ m}$

c. liter and gigaliter $\frac{10^9\ L}{1\ GL}$

d. gram and microgram $\frac{10^6\ \mu g}{1\ g}$ **or** $\frac{1\ \mu g}{10^{-6}\ g}$

e. gram and megagram $\frac{10^6\ g}{1\ Mg}$

f. pascal and millipascal $\frac{10^3\ mPa}{1\ Pa}$

Exercise 2.5 – Significant Figures: Identify whether each of the following values is exact or not. If it is not exact, write the number of significant figures it has.

a. 8.0 in 8.0 mL (derived from a measurement)

Measurements never lead to exact values. Zeros to the right of nonzero digits and to the right of the decimal point are significant. 8.0 is **not exact** and is **two significant figures.**

b. 80 from 80 desks in a classroom (determined by counting them)

Counting leads to exact values. 80 is **exact**.

c. 2000 in $\frac{2000 \text{ lb}}{1 \text{ ton}}$

English-English conversion factors with units of the same type of measurement top and bottom come from definitions, so the values in them are exact. 2000 is **exact.**

d. 453.6 in $\frac{453.6 \text{ g}}{1 \text{ lb}}$

Except for $\frac{2.54 \text{ cm}}{1 \text{ in.}}$, the values in English-metric conversion factors that we will see are calculated and rounded off. They are **not exact.** 453.6 is **four significant figures.**

e. 10^3 in $\frac{10^3 \text{ mg}}{1 \text{ g}}$

Metric-metric conversion factors with units of the same type of measurement top and bottom come from definitions, so the values in them are exact. 10^3 is **exact.**

f. 0.1067 in 0.1067 oz (calculated from its measured mass of 3.023 g)

Measurements never lead to exact values. Thus, values calculated from measurements are not exact. Zeros to the left of nonzero digits are not significant, and zeros between nonzero digits are significant. 0.1067 is **not exact** and is **four significant figures.**

g. 0.006665 in 0.006665 lb (calculated from the 0.1067 oz described in part f.)

Values calculated from nonexact values are not exact. 0.006665 is **not exact** and has **four significant figures.**

h. 10 in 10% of the tablet desks in a room are for left handed people (determined by counting 8 left-handed desks and counting 80 desks total and then calculating the percent)

Values calculated from exact values and not rounded off are exact. The 10 is **exact.**

i. 21 from 21% of the desks have initials carved in them (determined by counting 17 desks with initials and counting 80 desks total and then calculating the percent)

Even if a value is calculated from exact values, if the answer is rounded off, the rounded answer is not exact. 17 divided by 80 and multiplied by 100 yields 21.25. Thus, the 21% includes a value that was rounded off. The 21 is **not exact** and has **two significant figures.**

j. 6.00×10^3 from the temperature of the surface of the sun, 6.00×10^3 °C.

The value 6.00×10^3 must have come from a measurement, an estimate, or a calculation, so it is **not exact** and has **three significant figures.**

Exercise 2.6 – Rounding Off Answers Derived from Multiplication and Division: A first class stamp allows you to send a letter with a mass up to 1/2 ounce. You weigh a letter and find it has a mass of 10.5 grams. What is its mass in ounces? Report your answer to the correct significant figures. Can you mail this letter with one stamp?

$$?\,\text{oz} = 10.5\,\text{g}\left(\frac{\text{lb}}{453.6\,\text{g}}\right)\left(\frac{16\,\text{oz}}{\text{lb}}\right) = \mathbf{0.370\ oz}$$

Exercise 2.7 - Rounding Off Answers Derived from Multiplication and Division: The re-entry speed of the Apollo 10 space capsule was 11.0 km/s. How many hours would it have taken for the capsule to fall through 25.0 miles of the stratosphere?

$$?\,\text{hr} = 25.0\,\text{mi}\left(\frac{5280\,\text{ft}}{1\,\text{mi}}\right)\left(\frac{12\,\text{in.}}{1\,\text{ft}}\right)\left(\frac{2.54\,\text{cm}}{1\,\text{in.}}\right)\left(\frac{1\,\text{m}}{10^2\,\text{cm}}\right)\left(\frac{1\,\text{km}}{10^3\,\text{m}}\right)\left(\frac{1\,\text{s}}{11.0\,\text{km}}\right)\left(\frac{1\,\text{min}}{60\,\text{s}}\right)\left(\frac{1\,\text{hr}}{60\,\text{min}}\right)$$

$$= \mathbf{1.02 \times 10^{-3}\ hr}$$

Exercise 2.8 - Rounding Off Answers Derived from Addition and Subtraction: Report the answers to the following calculations to the correct number of decimal positions. Assume that each number is ±1 in the last decimal position reported.

a. 684 – 595.325 = **89**

b. 92.771 + 9.3 = **102.1**

Exercise 2.9 - Rounding Off Answers: The mass of a liquid can be found by first weighing a container, adding the liquid to the container, weighing the container and the liquid, and finding the mass of the liquid by subtracting the mass of the container from the total mass of container and liquid. A container is found to have a mass of 42.6 g. When 10.2 mL of a liquid is added to the container, the mass increases to 50.7 g. What is the density of this substance? The set-up for this problem is below. Do the calculation and report your answer to the correct significant figures.

$$\frac{?\,\text{g}}{\text{mL}} = \frac{50.7\,\text{g} - 42.6\,\text{g}}{10.2\,\text{mL}} = \mathbf{0.79\ g/mL}$$

Exercise 2.10 – Unit Analysis: The average human body contains 13 gallons of water. What is this volume in quarts?

$$? \text{ qt} = 13 \text{ gal}\left(\frac{4 \text{ qt}}{1 \text{ gal}}\right) = \mathbf{52 \text{ qt}}$$

Exercise 2.11 – Unit Analysis: The diameter of a proton is 2 x 10^{-15} meters. What is this diameter in nanometers?

$$? \text{ nm} = 2 \text{ x } 10^{-15} \text{ m}\left(\frac{10^9 \text{ nm}}{1 \text{ m}}\right) = \mathbf{2 \text{ x } 10^{-6} \text{ nm}}$$

Exercise 2.12 – Unit Analysis: The mass of an electron is 9.1093897 x 10^{-31} kg. What is this mass in nanograms?

$$? \text{ lb} = 9.1093897 \text{ x } 10^{-31} \text{ kg}\left(\frac{10^3 \text{ g}}{1 \text{ kg}}\right)\left(\frac{10^9 \text{ ng}}{1 \text{ g}}\right) = \mathbf{9.1093897 \text{ x } 10^{-19} \text{ ng}}$$

Exercise 2.13 – Unit Analysis: There are 2035 tons of sulfuric acid used to make Jell-O each year. Convert this to kilograms.

$$? \text{ kg} = 2035 \text{ tons}\left(\frac{2000 \text{ lb}}{1 \text{ ton}}\right)\left(\frac{453.6 \text{ g}}{1 \text{ lb}}\right)\left(\frac{1 \text{ kg}}{10^3 \text{ g}}\right) = \mathbf{1.846 \text{ x } 10^6 \text{ kg}}$$

Exercise 2.14 – Unit Analysis: A piece of Styrofoam has a mass of 88.978 g and a volume of 2.9659 L. What is its density in g/mL?

$$\frac{? \text{ g}}{\text{mL}} = \frac{88.978 \text{ g}}{2.9659 \text{ L}}\left(\frac{1 \text{ L}}{10^3 \text{ mL}}\right) = \mathbf{0.030000 \text{ g/mL}}$$

Exercise 2.15 – Unit Analysis: The density of blood plasma is 1.03 g/mL. A typical adult has about 2.5 L of blood plasma. What is the mass in kilograms of the blood plasma in this person?

$$?\text{kg} = 2.5 \text{ L}\left(\frac{10^3 \text{ mL}}{1 \text{ L}}\right)\left(\frac{1.03 \text{ g}}{1 \text{ mL}}\right)\left(\frac{1 \text{ kg}}{10^3 \text{ g}}\right)$$

$$\text{or} \quad ?\text{kg} = 2.5 \text{ L}\left(\frac{1.03 \text{ kg}}{1 \text{ L}}\right) = \mathbf{2.6 \text{ kg}}$$

Exercise 2.16 – Unit Analysis: Pain information is transferred through the nervous system between 12 and 30 meters per second. If a student drops a textbook on her toe, how long will it take for the pain information with a velocity of 18 meters per second to travel 6.0 feet to reach the brain?

$$? \text{ s} = 6.0 \text{ ft}\left(\frac{12 \text{ in.}}{1 \text{ ft}}\right)\left(\frac{2.54 \text{ cm}}{1 \text{ in.}}\right)\left(\frac{1 \text{ m}}{10^2 \text{ cm}}\right)\left(\frac{1 \text{ s}}{18 \text{ m}}\right) = \mathbf{0.10 \text{ s}}$$

Exercise 2.17 – Unit Analysis: An electron takes 6.2 x 10^{-9} seconds to travel across a TV set that is 22 inches wide. What is the velocity of the electron in km/hr?

$$\frac{?\,\text{km}}{\text{hr}} = \frac{22\,\text{in.}}{6.2 \times 10^{-9}\,\text{s}}\left(\frac{2.54\,\text{cm}}{1\,\text{in.}}\right)\left(\frac{1\,\text{m}}{10^2\,\text{cm}}\right)\left(\frac{1\,\text{km}}{10^3\,\text{m}}\right)\left(\frac{60\,\text{s}}{1\,\text{min}}\right)\left(\frac{60\,\text{min}}{1\,\text{hr}}\right)$$

= **3.2 x 10^{8} km/hr**

Exercise 2.18 – Unit Analysis: The mass of the ocean is about 1.8 x 10^{21} kg. If the ocean contains 0.041% by mass calcium ions, Ca^{2+}, how many tons of Ca^{2+} are in the ocean?

$$?\,\text{ton Ca}^{2+} = 1.8 \times 10^{21}\,\text{kg ocean}\left(\frac{0.041\,\text{kg Ca}^{2+}}{100\,\text{kg ocean}}\right)\left(\frac{2.205\,\text{lb}}{1\,\text{kg}}\right)\left(\frac{1\,\text{ton}}{2000\,\text{lb}}\right)$$

= **8.1 x 10^{14} ton Ca^{2+}**

Exercise 2.19 – Unit Analysis: While you are at rest, your heart pumps about 5.0 liters of blood per minute. Your brain gets about 15% by volume of your blood. What volume of blood in liters is pumped through your brain in 1.0 hour of rest?

$$?\,\text{L to brain} = 1.0\,\text{hr}\left(\frac{60\,\text{min}}{1\,\text{hr}}\right)\left(\frac{5.0\,\text{L total}}{1\,\text{min}}\right)\left(\frac{15\,\text{L to brain}}{100\,\text{L total}}\right) = \mathbf{45\,L}$$

Exercise 2.20 – Unit Analysis: A normal adult has from 4 to 6 million red blood cells per mm^3 of blood. Consider a person with 5.5 L of blood and 5 x 10^6 red blood cells per mm^3 of blood. How many red blood cells does this person have?

$$?\,\text{rbc} = 5.5\,\text{L blood}\left(\frac{10^3\,\text{mL}}{1\,\text{L}}\right)\left(\frac{1\,\text{cm}^3}{1\,\text{mL}}\right)\left(\frac{1\,\text{m}}{10^2\,\text{cm}}\right)^3\left(\frac{10^3\,\text{mm}}{1\,\text{m}}\right)^3\left(\frac{5 \times 10^6\,\text{rbc}}{1\,\text{mm}^3\,\text{blood}}\right)$$

or $$?\,\text{rbc} = 5.5\,\text{L blood}\left(\frac{10^3\,\text{cm}^3}{1\,\text{L}}\right)\left(\frac{10\,\text{mm}}{1\,\text{cm}}\right)^3\left(\frac{5 \times 10^6\,\text{rbc}}{1\,\text{mm}^3\,\text{blood}}\right)$$

= **3 x 10^{13} red blood cells**

Exercise 2.21 – Temperature Conversions:

a. N,N-dimethylaniline, $C_6H_5N(CH_3)_2$, melts at 2.5 °C. What is N,N-dimethylaniline's melting point in °F and K?

$$°F = 2.5\,°C\left(\frac{1.8\,°F}{1\,°C}\right) + 32\,°F \;\; = \;\; \mathbf{36.5\,°F}$$

K = 2.5 °C + 273.15 = **275.7 K**

b. Benzenethiol, C_6H_5SH, melts at 5.4 °F. What is benzenethiol's melting point in °C and K?

$$°C = (5.4\,°F - 32\,°F)\,\frac{1\,°C}{1.8\,°F} \;\; = \;\; \mathbf{-14.8\,°C}$$

K = –14.8 °C + 273.15 = **258.4 K**

c. The hottest part of the flame for a Bunsen burner is found to be 2.15 x 10^3 K. What is this temperature in °C and °F?

°C = 2.15 x 10^3 K – 273.15 = **1.88 x 10^3 °C**

$$°F = 1.88 \text{ x } 10^3\,°C\left(\frac{1.8\,°F}{1\,°C}\right) + 32\,°F \;\; = \;\; \mathbf{3.42 \text{ x } 10^3\,°F}$$

or **3.41 x 10^3 °F** if the unrounded answer to the first calculation is used in the second calculation.