ISOTOPE WORKSHEET KEY

Complete the following table.

Symbol of isotope	Number of protons	Number of neutrons	Number of electrons	Atomic number	Mass number
$^{35}_{17}Cl$	**17**	**18**	**17**	**17**	**35**
$^{34}_{16}S$	**16**	**18**	**16**	**16**	**34**
$^{209}_{83}\mathbf{Bi}^{3+}$	83	**126**	80	**83**	209
$^{115}_{49}\mathbf{In}$	49	66	**49**	**49**	115
$^{197}_{79}\mathbf{Au}^{+}$	79	118	78	79	**197**

CHEMISTRY 151 - ISOTOPE SYMBOLISM KEY

Complete the following table.

Symbol	Atomic number	Mass number	Number of protons	Number of neutrons	Number of electrons
$^{59}_{27}Co$	**27**	**59**	**27**	**32**	**27**
$^{27}_{12}Mg^{2+}$	**12**	**27**	**12**	**15**	**10**
$^{31}_{15}P^{3-}$	**15**	**31**	**15**	**16**	**18**
$^{190}_{76}\mathbf{Os}$	76	190	**76**	**114**	76
$^{238}_{92}\mathbf{U}$	**92**	**238**	92	146	92
$^{45}_{21}\mathbf{Sc}^{3+}$	**21**	45	21	**24**	18

CHEMISTRY 151 - ATOMIC MASSES KEY

Naturally occurring iron consists of 5.82% iron-54 with atoms of mass 53.940 u, 91.66% iron-56 with atoms of mass 55.935 u, 2.19% iron-57 with atoms of mass 56.935 u, and 0.33% iron-58 with atoms of mass 57.933 u. Calculate iron's atomic mass.

atomic mass = 0.0582(53.940) + 0.9166(55.935) + 0.0219(56.935) + 0.0033(57.933)

= 3.14 + 51.27 + 1.25 + 0.19 = **55.85 u**

METRIC SYSTEM WORKSHEET KEY

1. What is the SI standard for each of the following.

meter, m	a. length	**kelvin, K**	c. temperature
second, s	b. time	**kilogram, kg**	d. mass

2. What are the accepted SI base units for each of the following?

joule, J	a. energy	**gram,g**	c. mass
liter, L	b. volume	**pascal, Pa**	d. gas pressure

3. Complete the following.

a. $1\mathbf{0^3}$ g = 1 kg
b. $\mathbf{10^3}$ mm = 1 m
c. $\mathbf{10^6}$ μL = 1 L
d. **2.54** cm = 1 in.
e. **1.057** qt = 1 L
f. **28.35** g = 1 oz

4. Write conversion factors that include the following units.

a. grams and megagrams $\dfrac{\mathbf{10^6\ g}}{\mathbf{1\ Mg}}$
b. nanometers and meters $\dfrac{\mathbf{10^9\ nm}}{\mathbf{1\ m}}$
c. pounds and kilograms $\dfrac{\mathbf{2.205\ lb}}{\mathbf{1\ kg}}$
d. joules and kilojoules $\dfrac{\mathbf{10^3\ J}}{\mathbf{1\ kJ}}$
e. liters and gallons $\dfrac{\mathbf{3.785\ L}}{\mathbf{1\ gal}}$

SCIENTIFIC NOTATION WORKSHEET KEY

1. Do the following without your calculator.

a. $10^4\,(10^7) = \mathbf{10^{11}}$
b. $10^4\,(10^{-7}) = \mathbf{10^{-3}}$
c. $\dfrac{10^8}{10^2} = \mathbf{10^6}$
d. $\dfrac{10^{-11}}{10^5} = \mathbf{10^{-16}}$
e. $\dfrac{10^{13}\ 10^6}{10^{-4}} = \mathbf{10^{23}}$
f. $(1 \times 10^4) + (2 \times 10^4) = \mathbf{3 \times 10^4}$
g. $(1.0 \times 10^4) + (2.0 \times 10^3) = \mathbf{1.2 \times 10^4}$
h. $\left(10^6\right)^3 = \mathbf{10^{18}}$

2. Do the following calculations with your calculator.

a. $\dfrac{1.62\times10^{-7}\ \left(10^3\right)}{\left(10^6\right)19.00} = \mathbf{8.53\times10^{-12}}$

b. $\dfrac{47.6\left(10^3\right)}{(36.32-18.15)(1.057)(453.6)} = \mathbf{5.46}$

c. $\dfrac{1.23 \times 10^7\ (2.54)^3\ (19.00)}{\left(10^3\right)} = \mathbf{3.83 \times 10^6}$

UNIT ANALYSIS 1 WORKSHEET KEY

1. Your instructions are to measure out 0.20 liters of a solution. Your only measuring instrument is calibrated in milliliters. How many milliliters do you measure out?

$$? \text{ mL} = 0.20 \text{ L}\left(\frac{10^3 \text{ mL}}{1 \text{ L}}\right) = \mathbf{2.0 \times 10^2 \text{ mL}}$$

2. A doctor prescribes 25 mg of a medicine for a patient. The pills are described in micrograms. How many micrograms of the medicine should the patient take?

$$? \text{ µg} = 25 \text{ mg}\left(\frac{1 \text{ g}}{10^3 \text{ mg}}\right)\left(\frac{10^6 \text{ µg}}{1 \text{ g}}\right) = \mathbf{2.5 \times 10^4 \text{ µg}}$$

3. Convert 12.62 feet into centimeters.

$$? \text{ cm} = 12.62 \text{ ft}\left(\frac{12 \text{ in.}}{1 \text{ ft}}\right)\left(\frac{2.54 \text{ cm}}{1 \text{ in.}}\right) = \mathbf{384.7 \text{ cm}}$$

4. Convert 8.0 fluid ounces into milliliters.

$$? \text{ mL} = 8.0 \text{ fl oz}\left(\frac{1 \text{ qt}}{32 \text{ fl oz}}\right)\left(\frac{1 \text{ gal}}{4 \text{ qt}}\right)\left(\frac{3.785 \text{ L}}{1 \text{ gal}}\right)\left(\frac{10^3 \text{ mL}}{1 \text{ L}}\right) = \mathbf{2.4 \times 10^2 \text{ mL}}$$

5. What is the density in g/ml of a liquid with a mass of 42.5 lb and a volume of 10.7 qt?

$$\frac{? \text{ g}}{\text{mL}} = \frac{42.5 \text{ lb}}{10.7 \text{ qt}}\left(\frac{453.6 \text{ g}}{1 \text{ lb}}\right)\left(\frac{4 \text{ qt}}{1 \text{ gal}}\right)\left(\frac{1 \text{ gal}}{3.785 \text{ L}}\right)\left(\frac{1 \text{ L}}{10^3 \text{ mL}}\right) = \mathbf{1.90 \text{ g/mL}}$$

6. What volume in quarts would 43.6 lb of benzene occupy?

$$? \text{ qt} = 43.6 \text{ lb}\left(\frac{453.6 \text{ g}}{1 \text{ lb}}\right)\left(\frac{1 \text{ mL}}{0.87865 \text{ g}}\right)\left(\frac{1 \text{ L}}{10^3 \text{ mL}}\right)\left(\frac{1.057 \text{ qt}}{1 \text{ L}}\right) = \mathbf{23.8 \text{ qt}}$$

7. Calculate the mass in pounds of 2.0 liters of olive oil.

$$? \text{ lb} = 2.0 \text{ L}\left(\frac{10^3 \text{ mL}}{1 \text{ L}}\right)\left(\frac{0.918 \text{ g}}{1 \text{ mL}}\right)\left(\frac{1 \text{ lb}}{453.6 \text{ g}}\right) = \mathbf{4.0 \text{ lb}}$$

UNIT ANALYSIS 2 WORKSHEET KEY

1. How many seconds are in 3.5 days?

$$?\,s = 3.5\,\text{days}\left(\frac{24\,\text{hr}}{1\,\text{day}}\right)\left(\frac{60\,\text{min}}{1\,\text{hr}}\right)\left(\frac{60\,\text{s}}{1\,\text{min}}\right) = \mathbf{3.0 \times 10^5\ s}$$

2. How many eggs are in 7.89×10^3 dozen eggs?

$$?\,\text{eggs} = 7.89 \times 10^3\ \text{dozen}\left(\frac{12\,\text{eggs}}{1\,\text{dozen}}\right) = \mathbf{9.47 \times 10^4\ eggs}$$

3. Seventeen apples weigh 3.25 pounds. They cost 59 cents for one pound. What is the cost of 8.95×10^3 apples?

$$?\,\$ = 8.95 \times 10^3\ \text{apples}\left(\frac{3.25\,\$}{17\ \text{apples}}\right)\left(\frac{59\ \text{cents}}{1\,\text{lb}}\right)\left(\frac{1\,\$}{100\ \text{cents}}\right) = \mathbf{1.01 \times 10^3\ \$}$$

4. The distance from Santa Cruz to Santa Barbara is about 280 miles. If a car gets 23.6 miles per gallon, and the price of gas is 55 cents per liter, how much will it cost for gas to drive from Santa Cruz to Santa Barbara.

$$?\,\$ = 280\,\text{mi}\left(\frac{1\,\text{gal}}{23.6\,\text{mi}}\right)\left(\frac{4\,\text{qt}}{1\,\text{gal}}\right)\left(\frac{1\,\text{L}}{1.057\,\text{qt}}\right)\left(\frac{55\ \text{cents}}{1\,\text{L}}\right)\left(\frac{1\,\$}{100\ \text{cents}}\right) = \mathbf{25\,\$}$$

5. It is found that five pears weigh an average of 1.9 pounds. A box of pears costs $7.94. The price per pound is 55 cents. How many pears are in a box?

$$\frac{?\ \text{pears}}{\text{box}} = \frac{5\ \text{pears}}{1.9\,\text{lb}}\left(\frac{1\,\text{lb}}{0.55\,\$}\right)\left(\frac{7.94\,\$}{1\,\text{box}}\right) = \mathbf{38\ pears/box}$$

6. The Sun is about 9.3×10^7 miles from earth. Light travels at a rate of 3.00×10^8 meters/second. How many minutes does it take light to travel from the sun to the earth?

$$?\,\text{min} = 9.3 \times 10^7\ \text{mi}\left(\frac{5280\,\text{ft}}{1\,\text{mi}}\right)\left(\frac{12\,\text{in.}}{1\,\text{ft}}\right)\left(\frac{2.54\,\text{cm}}{1\,\text{in.}}\right)\left(\frac{1\,\text{m}}{10^2\ \text{cm}}\right)\left(\frac{1\,\text{s}}{3.00 \times 10^8\ \text{m}}\right)\left(\frac{1\,\text{min}}{60\,\text{s}}\right) = \mathbf{8.3\ min}$$

7. Calculate the volume of 7.89×10^3 pounds of lead.

$$?\,\text{L} = 7.89 \times 10^3\ \text{lb}\left(\frac{453.6\,\text{g}}{1\,\text{lb}}\right)\left(\frac{1\,\text{mL}}{11.34\,\text{g}}\right)\left(\frac{1\,\text{L}}{10^3\ \text{mL}}\right) = \mathbf{316\ L\ Pb}$$

8. Calculate the mass of 0.373 gallons of platinum.

$$?\,\text{kg} = 0.373\,\text{gal Pt}\left(\frac{4\,\text{qt}}{1\,\text{gal}}\right)\left(\frac{1\,\text{L}}{1.057\,\text{qt}}\right)\left(\frac{10^3\ \text{mL}}{1\,\text{L}}\right)\left(\frac{21.45\,\text{g}}{1\,\text{mL}}\right)\left(\frac{1\,\text{kg}}{10^3\ \text{g}}\right) = \mathbf{30.3\ kg}$$

9. A car travels at a rate of 2.73×10^{-4} km/min.

   a. How many years are required for it to travel 7.95×10^3 feet?

$$?\ \text{year} = 7.95 \times 10^3\ \text{ft}\left(\frac{12\,\text{in.}}{1\,\text{ft}}\right)\left(\frac{2.54\,\text{cm}}{1\,\text{in.}}\right)\left(\frac{1\,\text{m}}{10^2\ \text{cm}}\right)\left(\frac{1\,\text{km}}{10^3\ \text{m}}\right)\left(\frac{1\,\text{min}}{2.73 \times 10^{-4}\ \text{km}}\right)\left(\frac{1\,\text{hr}}{60\,\text{min}}\right)\left(\frac{1\,\text{day}}{24\,\text{hr}}\right)\left(\frac{1\,\text{year}}{365\,\text{day}}\right)$$

   $= \mathbf{0.0169\ years}$

   b. How many millimeters will it travel in 3.58×10^{-4} years?

$$?\ \text{mm} = 3.58 \times 10^{-4}\ \text{year}\left(\frac{365\,\text{day}}{1\,\text{year}}\right)\left(\frac{24\,\text{hour}}{1\,\text{day}}\right)\left(\frac{60\,\text{min}}{1\,\text{hour}}\right)\left(\frac{2.73 \times 10^{-4}\ \text{km}}{1\,\text{min}}\right)\left(\frac{10^3\ \text{m}}{1\,\text{km}}\right)\left(\frac{10^3\ \text{mm}}{1\,\text{m}}\right)$$

   $= \mathbf{5.14 \times 10^4\ mm}$

UNIT ANALYSIS 3 KEY

1. A 15 oz can of cat food contains 0.15% calcium. If there are three servings per can, how many grams of calcium are in each serving?

$$? \text{ g} = \text{One serving}\left(\frac{1 \text{ can}}{3 \text{ servings}}\right)\left(\frac{15 \text{ oz food}}{1 \text{ can}}\right)\left(\frac{0.15 \text{ oz Ca}}{100 \text{ oz food}}\right)\left(\frac{1 \text{ lb}}{16 \text{ oz}}\right)\left(\frac{453.6 \text{ g}}{1 \text{ lb}}\right) = \mathbf{0.21\ g\ Ca}$$

2. Consider a typical pet vitamin.

   a. This pet vitamin contains 5% water. Water is 88.8% oxygen. How many micrograms of oxygen are there in the water in a 2.954 g vitamin tablet?

$$? \text{ μg O} = 2.954 \text{ g tab}\left(\frac{5 \text{ g } H_2O}{100 \text{ g tab}}\right)\left(\frac{88.8 \text{ g O}}{100 \text{ g } H_2O}\right)\left(\frac{10^6 \text{ μg}}{1 \text{ g}}\right) = \mathbf{1 \times 10^5\ \mu g\ O}$$

   b. Each pet vitamin tablet contains 14 μg of potassium. What is the percent potassium in a 2.954 g tablet?

$$\frac{? \text{ g K}}{\text{g tab}} \times 100 = \frac{14 \text{ μg}}{2.954 \text{ g tab}}\left(\frac{1 \text{ g}}{10^6 \text{ μg}}\right) \times 100 = \mathbf{4.7 \times 10^{-4}\ \%\ K}$$

   c. There are 39.10 g K per mole of potassium. How many moles of potassium are there in a 2.954 g vitamin tablet?

$$? \text{ mol K} = 2.954 \text{ g tab}\left(\frac{4.7 \times 10^{-4} \text{ g K}}{100 \text{ g tab}}\right)\left(\frac{1 \text{ mol K}}{39.10 \text{ g K}}\right) = \mathbf{3.6 \times 10^{-7}\ mol\ K}$$

   d. There are 6.022×10^{23} atoms per mole of potassium. How many atoms of potassium are there in a 2.954 g tablet?

$$? \text{ atoms} = 2.954 \text{ g tab}\left(\frac{4.7 \times 10^{-4} \text{ g K}}{100 \text{ g tab}}\right)\left(\frac{1 \text{ mol K}}{39.10 \text{ g K}}\right)\left(\frac{6.022 \times 10^{23} \text{ atoms}}{1 \text{ mol K}}\right) = \mathbf{2.1 \times 10^{17}\ atoms\ K}$$

3. How pounds of sugar are there in 4.0 gallons of a sugar water solution that is 2.00 M $C_6H_{12}O_6$? The 2.00 M $C_6H_{12}O_6$ means that there are 2.00 moles of glucose per liter of sugar water. There are 180.158 grams of glucose per mole of glucose.

$$? \text{ lb } C_6H_{12}O_6 = 4.0 \text{ gal sugar water}\left(\frac{4 \text{ qt}}{1 \text{ gal}}\right)\left(\frac{1 \text{ L}}{1.057 \text{ qt}}\right)\left(\frac{2.00 \text{ mol } C_6H_{12}O_6}{1 \text{ L sugar water}}\right)\left(\frac{180.158 \text{ g } C_6H_{12}O_6}{1 \text{ mol } C_6H_{12}O_6}\right)\left(\frac{1 \text{ lb}}{453.6 \text{ g}}\right)$$

$$= \mathbf{12\ lb\ C_6H_{12}O_6}$$

4. How many grams of oxygen are there in 1.000 liter of pure oxygen at STP? There are 22.414 liters of any ideal gas per mole of that gas at STP, which is standard temperature, 0 °C, and standard pressure, 1 atm. You can assume that the oxygen acts ideally. There are 31.9988 g oxygen per mole of oxygen.

$$? \text{ g } O_2 = 1.000 \text{ L } O_2\left(\frac{1 \text{ mol } O_2}{22.414 \text{ L } O_2}\right)\left(\frac{31.9988 \text{ g } O_2}{1 \text{ mol } O_2}\right) = \mathbf{1.428\ g\ O_2}$$

5. The standard change in enthalpy for the combustion of hydrogen gas is −286 kJ per mole of hydrogen. How much heat is released when 1.000 liter of hydrogen gas at STP is burned?

$$? \text{ kJ} = 1.000 \text{ L } H_2\left(\frac{1 \text{ mol } H_2}{22.414 \text{ L } H_2}\right)\left(\frac{-286 \text{ kJ}}{1 \text{ mol } H_2}\right) = \mathbf{-12.8\ kJ}$$

CHEMISTRY 151
UNIT ANALYSIS WORKSHEET KEY

1. The different colors of light have different wavelengths. The human eye is most sensitive to light whose wavelength is 555 nm (greenish-yellow). What is this wavelength in millimeters?

$$? \text{ mm} = 555 \text{ nm}\left(\frac{1 \text{ m}}{10^9 \text{ nm}}\right)\left(\frac{10^3 \text{ mm}}{1 \text{ m}}\right) = \mathbf{5.55 \times 10^{-4} \text{ mm}}$$

2. A submicroscopic particle suspended in solution has a volume of 1.4 μm^3. What is its volume in liters?

$$? \text{ L} = 1.4 \ \mu\text{m}^3 \left(\frac{1 \text{ m}}{10^6 \ \mu\text{m}}\right)^3 \left(\frac{10^2 \text{ cm}}{1 \text{ m}}\right)^3 \left(\frac{1 \text{ L}}{10^3 \text{ cm}^3}\right) = \mathbf{1.4 \times 10^{-15} \text{ L}}$$

3. The human body is 0.0040% iron. How many milligrams of iron does a 165-pound person contain?

$$? \text{ mg Fe} = 165 \text{ lb person}\left(\frac{0.0040 \text{ lb Fe}}{100 \text{ lb person}}\right)\left(\frac{453.6 \text{ g}}{1 \text{ lb}}\right)\left(\frac{10^3 \text{ mg}}{1 \text{ g}}\right) = \mathbf{3.0 \times 10^3 \text{ mg Fe}}$$

CHEMISTRY 151 - DENSITY KEY

1. Hematite (iron ore) weighing 70.7 g was placed in a flask. The flask with the hematite was then filled with water to a total volume of 53.2 mL. The hematite and the water were found to weigh 109.3 g. The density of water at room temperature is 0.997 g/mL. What is the density of the Hematite?

$$\text{denisty} = \frac{? \text{ g hem}}{\text{mL hem}} = \frac{70.7 \text{ g hem}}{(53.2 \text{ mL total} - 38.7 \text{ mL water}) \text{ mL hem}} = \mathbf{4.88 \text{ g/mL}}$$

$$? \text{ mL water} = (109.3 - 70.7) \text{ g water}\left(\frac{1 \text{ mL water}}{0.997 \text{ g water}}\right) = 38.7 \text{ mL water}$$

2. Ethyl acetate has a characteristic fruity odor and is used as a solvent in paint lacquers and perfumes. An experiment requires 0.985 kg ethyl acetate. What volume in liters is necessary?

   You would be given the density of ethyl acetate on a table. It is 0.902 g/ml.

$$? \text{ L eth.} = 0.985 \text{ kg}\left(\frac{10^3 \text{ g}}{1 \text{ kg}}\right)\left(\frac{1 \text{ mL eth.}}{0.902 \text{ g}}\right)\left(\frac{1 \text{ L}}{10^3 \text{ mL}}\right) = \mathbf{1.09 \text{ L ethyl acetate}}$$

3. Under certain conditions, the density of dry air is 1.205 g/L. What is the mass of air in a room that is 3.658 m by 4.572 m by 2.438 m?

$$? \text{ g air} = (3.658 \times 4.572 \times 2.438) \text{ m}^3 \left(\frac{10^2 \text{ cm}}{1 \text{ m}}\right)^3 \left(\frac{1 \text{ L}}{10^3 \text{ cm}^3}\right)\left(\frac{1.205 \text{ g}}{1 \text{ L}}\right) = \mathbf{4.913 \times 10^4 \text{ g air}}$$