Chem Honors WKS
Dimensional Analysis 2: Metric Conversions
Double Units & Squared/Cubed Units

NAME Answer Key
Period _______ **Date** ______________

Use the prefix conversions chart on the reference sheet to convert the measurements in part A. **Show all steps** needed to convert from starting units to ending units. You must use the proper number of sig figs in your answer.

A. Metric System

1) 40. mL to L

$$? \text{ L} = 40.\ \cancel{\text{mL}} \times \frac{1\times10^{-3}\ \text{L}}{1\ \cancel{\text{mL}}} = \boxed{0.040\ \text{L}}$$

2) 85 g to µg

$$? \ \mu\text{g} = 85\ \cancel{\text{g}} \times \frac{1\ \mu\text{g}}{1\times10^{-6}\ \cancel{\text{g}}} = \boxed{8.5\times10^{7}\ \mu\text{g}}$$

3) 6300 m to km

$$? \text{ km} = 6300\ \cancel{\text{m}} \times \frac{1\ \text{km}}{1\times10^{3}\ \cancel{\text{m}}} = \boxed{6.3\ \text{km}}$$

4) 2.50 kg to g

$$? \text{ g} = 2.50\ \cancel{\text{kg}} \times \frac{1\times10^{3}\ \text{g}}{1\ \cancel{\text{kg}}} = \boxed{2.50\times10^{3}\ \text{g}}$$

5) 544 ns to s

$$? \text{ s} = 544\ \cancel{\text{ns}} \times \frac{1\times10^{-9}\ \text{s}}{1\ \cancel{\text{ns}}} = \boxed{5.44\times10^{-7}\ \text{s}}$$

6) 1.92 L to mL

$$? \text{ mL} = 1.92\ \cancel{\text{L}} \times \frac{1\ \text{mL}}{1\times10^{-3}\ \cancel{\text{L}}} = \boxed{1920\ \text{mL} = 1.92\times10^{3}\ \text{mL}}$$

7) 74.0 cm to km

$$? \text{ km} = 74.0\ \cancel{\text{cm}} \times \frac{1\times10^{-2}\ \cancel{\text{m}}}{1\ \cancel{\text{cm}}} \times \frac{1\ \text{km}}{1\times10^{3}\ \cancel{\text{m}}} = \boxed{7.40\times10^{-4}\ \text{km}}$$

8) 4.13×10^{-4} MW to µW (W = watts)

$$? \ \mu\text{W} = 4.13\times10^{-4}\ \cancel{\text{MW}} \times \frac{1\times10^{6}\ \cancel{\text{W}}}{1\ \cancel{\text{MW}}} \times \frac{1\ \mu\text{W}}{1\times10^{-6}\ \cancel{\text{W}}} = \boxed{4.13\times10^{8}\ \mu\text{W}}$$

9) 1.50×10^{3} TB to GB (B = bytes)

$$? \text{ GB} = 1.50\times10^{3}\ \cancel{\text{TB}} \times \frac{1\times10^{12}\ \cancel{\text{B}}}{1\ \cancel{\text{TB}}} \times \frac{1\ \text{GB}}{1\times10^{9}\ \cancel{\text{B}}} = \boxed{1.50\times10^{6}\ \text{GB}}$$

B. Double Units & Squared/Cubed Units

10) In the US, milk is sold by the gallon, while in Denmark it is sold by the liter. Milk in the US costs \$3.29/gal. What is the equivalent cost in Danish Krone per liter (the exchange rate is 6.655 DKK/\$1.00 as of Sept. 22, 2016)?

$$? \text{ DKK/L} = \frac{\cancel{\$}3.29}{1\ \cancel{\text{gal}}} \times \frac{1\ \cancel{\text{gal}}}{4\ \cancel{\text{qts}}} \times \frac{1.057\ \cancel{\text{qts}}}{1\ \text{L}} \times \frac{6.655\ \text{DKK}}{\cancel{\$}1.00} = 5.786 = \frac{5.79\ \text{DKK}}{1\ \text{L}} = \boxed{5.79\ \text{DKK/L}}$$

11) The speed of sound in dry air at sea level and 20°C is 343.2 m/s. What would this be in km/day?

$$? \text{ km/day} = \frac{343.2\ \cancel{\text{m}}}{1\ \cancel{\text{s}}} \times \frac{1\ \text{km}}{1\times10^{3}\ \cancel{\text{m}}} \times \frac{60\ \cancel{\text{s}}}{1\ \cancel{\text{min}}} \times \frac{60\ \cancel{\text{min}}}{1\ \cancel{\text{hr}}} \times \frac{24\ \cancel{\text{hr}}}{1\ \text{day}} = 29{,}652 = \boxed{29{,}650\ \text{km/day}}$$

12) The energy released when propane (C_3H_8) burns is 2,044 kJ/mol (kilojoules/mole). What is this amount in picojoules/molecule (pJ/mlcl)? (Use the conversion factor 1 mol = 6.022×10^{23} mlcl)

$$? \text{ pJ/mlcl} = \frac{\underline{2{,}044} \ \cancel{\text{kJ}}}{1 \ \cancel{\text{mol}}} \times \frac{1\times10^{3} \ \cancel{\text{J}}}{1 \ \cancel{\text{kJ}}} \times \frac{1 \text{ pJ}}{1\times10^{-12} \ \cancel{\text{J}}} \times \frac{1 \ \cancel{\text{mol}}}{6.022\times10^{23} \text{ mlcl}} = \underline{3.394}2\times10^{-6} = \boxed{\underline{3.394}\times10^{-6} \text{ pJ/mlcl}}$$

13) At an altitude of 10,000 m, the density of air is 4.20×10^{-4} g/cm^3. Convert this to µg/mm^3 (remember, to convert a cubed unit, put the *entire* conversion factor into parentheses and cube it).

$$? \ \mu\text{g/mm}^3 = \frac{\underline{4.20}\times10^{-4} \ \cancel{\text{g}}}{\cancel{\text{cm}^3}} \times \frac{1 \ \mu\text{g}}{1\times10^{-6} \ \cancel{\text{g}}} \times \left(\frac{1 \ \cancel{\text{cm}}}{1\times10^{-2} \ \cancel{\text{m}}} \times \frac{1\times10^{-3} \ \cancel{\text{m}}}{1 \text{ mm}}\right)^3 = \boxed{0.\underline{420} \ \mu\text{g/mm}^3}$$

14) In problem #10 you found that milk in Denmark costs 5.79 DKK/L. If the average Danish family uses 208 L of milk each year, how much do they spend, in DKK, on milk in one year?

$$\frac{5.79 \text{ DKK}}{1 \text{ L}} \Rightarrow ? \text{ DKK} = \underline{208} \ \cancel{\text{L}} \times \frac{5.79 \text{ DKK}}{1 \ \cancel{\text{L}}} = \underline{120}4 \text{ DKK} = \boxed{\underline{1.20}\times10^{3} \text{ DKK}}$$

15) The speed of light in a vacuum is 2.998×10^8 m/s. The average distance from the sun to the earth is 1.496×10^8 km. How much time, in minutes, does light take to travel this distance?

$$? \text{ min} = \underline{1.496}\times10^{8} \ \cancel{\text{km}} \times \frac{1\times10^{3} \ \cancel{\text{m}}}{1 \ \cancel{\text{km}}} \times \frac{1 \ \cancel{\text{s}}}{2.998\times10^{8} \ \cancel{\text{m}}} \times \frac{1 \text{ min}}{60 \ \cancel{\text{s}}} = \underline{8.316}7 = \boxed{\underline{8.317} \text{ min}}$$

16) Gold has a density of 19.31 g/cm^3. An explorer finds a large, pure gold statue and determines its mass to be 11.6 kg. What is the volume, in m^3, of this statue? (Remember to cube the conversion factor from cm $\rightarrow$ m.)

$$? \text{ cm}^3 = \underbrace{\underline{11.6} \text{ kg} \times \frac{1\times10^{3} \text{ g}}{1 \text{ kg}} \times \frac{1 \text{ cm}^3}{19.31 \text{ g}}}_{601 \text{ cm}^3} \times \left(\frac{1\times10^{-2} \text{ m}}{1 \text{ cm}}\right)^3 = \underline{6.00}7\times10^{-4} = \boxed{\underline{6.01}\times10^{-4} \text{ m}^3}$$

17) The average neon (Ne) atom has a mass of 20.18 atomic mass units/atom (atomic mass unit = amu). There are 1.661×10^{-24} g/amu. If the typical Ne light holds 1.00×10^{15} Ne atoms, what mass of neon, in kg, is in the Ne light? (Note: there are 2 double units in this problem.)

$$? \text{ kg} = \underline{1.00}\times10^{15} \ \cancel{\text{atoms}} \times \frac{20.18 \ \cancel{\text{amu}}}{1 \ \cancel{\text{atom}}} \times \frac{1.661\times10^{-24} \ \cancel{\text{g}}}{1 \ \cancel{\text{amu}}} \times \frac{1 \text{ kg}}{1\times10^{3} \ \cancel{\text{g}}} = \underline{3.35}2\times10^{-11} = \boxed{\underline{3.35}\times10^{-11} \text{ kg}}$$