WKS 2-7 - Chem Honors
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

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

2) 85 g to µg

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

3) 6300 m to km

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

4) 2.50 kg to g

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

5) 544 ns to s

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

6) 1.92 L to mL

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

7) 74.0 cm to km

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

8) 4.13×10^{-4} MW to µW (W = watts)

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

9) 1.50×10^{3} TB to GB (B = bytes)

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

B. Double Units & Squared/Cubed Units

Use any needed conversion factors from the previous worksheet.

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 6.3512 DKK/$1.00 as of Oct. 3, 2020)?

$ → DKK; gal → qts → L

$$\frac{\$3.29}{1\ \text{gal}} \times \frac{1\ \text{gal}}{4\ \text{qts}} \times \frac{1.057\ \text{qts}}{1\ \text{L}} \times \frac{6.3512\ \text{DKK}}{\$1.00} = 5.5216 = \frac{5.52\ \text{DKK}}{1\ \text{L}} = \boxed{5.52\ \text{DKK/L}}$$

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?

m → km; s → min → hr → day

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

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)

kJ → J → pJ; mol → mlcl

$$? \frac{2{,}044\ \text{kJ}}{1\ \text{mol}} \times \frac{1\times10^{3}\ \text{J}}{1\ \text{kJ}} \times \frac{1\ \text{pJ}}{1\times10^{-12}\ \text{J}} \times \frac{1\ \text{mol}}{6.022\times10^{23}\ \text{mlcl}} = 3.3942\times10^{-6} = \boxed{3.394\times10^{-6}\ \text{pJ/mlcl}}$$

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).

g → µg; cm^3 → m^3 → mm^3 (or cm^3 → mm^3)

$$\frac{4.20\times10^{-4}\ \text{g}}{\text{cm}^3} \times \frac{1\ \mu\text{g}}{1\times10^{-6}\ \text{g}} \times \underbrace{\left(\frac{1\ \text{cm}}{1\times10^{-2}\ \text{m}} \times \frac{1\times10^{-3}\ \text{m}}{1\ \text{mm}}\right)^3}_{\left(\frac{1\ \text{cm}}{10\ \text{mm}}\right)^3 = \frac{1\ \text{cm}^3}{1000\ \text{mm}^3}} = \boxed{0.420\ \mu\text{g/mm}^3}$$

14) In problem #10 you found that milk in Denmark costs 5.52 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?

$$208\ \text{L} \times \frac{5.52\ \text{DKK}}{1\ \text{L}} = 1148.16\ \text{DKK} = \boxed{1150\ \text{DKK}}$$

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?

km → m → s → min

$$1.496\times10^{8}\ \text{km} \times \frac{1\times10^{3}\ \text{m}}{1\ \text{km}} \times \underbrace{\frac{1\ \text{s}}{2.998\times10^{8}\ \text{m}}}_{\text{Relates time to distance}} \times \frac{1\ \text{min}}{60\ \text{s}} = 8.3167 = \boxed{8.317\ \text{min}}$$

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 → m.)

kg → g → cm^3 → m^3

$$\underbrace{11.6\ \text{kg} \times \frac{1\times10^{3}\ \text{g}}{1\ \text{kg}} \times \underbrace{\frac{1\ \text{cm}^3}{19.31\ \text{g}}}_{\text{Relates mass to volume}}}_{601\ \text{cm}^3} \times \underbrace{\left(\frac{1\times10^{-2}\ \text{m}}{1\ \text{cm}}\right)^3}_{\frac{1\times10^{-6}\ \text{m}^3}{1\ \text{cm}^3} = \frac{1\ \text{m}^3}{1\times10^{6}\ \text{cm}^3}} = 6.007\times10^{-4} = \boxed{6.01\times10^{-4}\ \text{m}^3}$$

17) The average neon (Ne) atom has a mass of 20.18 amu/atom (atomic mass unit = amu). 1 amu = 1.661×10^{-24} g. If the typical Ne light holds 1.00×10^{15} Ne atoms, what mass of neon, in kg, is in the Ne light?

atoms → amu → g → kg

$$1.00\times10^{15}\ \text{Ne atoms} \times \frac{20.18\ \text{amu}}{1\ \text{Ne atom}} \times \frac{1.661\times10^{-24}\ \text{g}}{1\ \text{amu}} \times \frac{1\ \text{kg}}{1\times10^{3}\ \text{g}} = 3.352\times10^{-11} = \boxed{3.35\times10^{-11}\ \text{kg}}$$