HW#1: Mathematics problems: Name ________________________________
4 pages Section # __________________

1. Write the correct metric equivalents
   a. 1 ng = ______ $1\times10^{-9}$ ____ g
   b. 1 µL = ______ $1\times10^{-6}$ ____ L
   c. 1 km = ______ 1000 _______ m
   d. 1 GW = ______ $1\times10^9$ ______ W (W = Watt)
   e. 1 MJ = ______ $1\times10^6$ ______ J (J = Joule)
   f. 1 cm = ______ $1\times10^{-2}$ ______ m
   g. 1 s = ______ $1\times10^9$ ______ ns (s = second)
   h. 1 mg = ______ $1\times10^{-3}$ ______ g
   i. 1 L = ______ $1\times10^6$ ____ µL
   j. 1 m = ______ $1\times10^{-3}$ ______ km

2. Convert the following metric units. Show your work. Train yourself to work on paper, not just in your head or on the calculator screen. Make sure your answers make sense!
   a. 15 mg to kg
      $0.000015$ kg or $1.5\times10^{-5}$ kg
   b. 0.105 nm to mm
      $0.000000105$ mm or $1.05\times10^{-7}$ mm
   c. 0.0095 µs to s
      $0.000000095$ s or $9.5\times10^{-9}$ s
   d. 18 nm to cm
      $0.0000018$ cm or $1.8\times10^{-6}$ cm
   e. 1 km to cm
      $100,000$ cm or $1\times10^5$ cm
   f. 1 km to mm
      $1,000,000$ or $1\times10^6$ mm
   g. 0.025 mL to L
      $0.000025$ or $2.5\times10^{-5}$ L
   h. $4.99\times10^{-4}$ mm to km
      $499$ or $4.99\times10^{-10}$ km
   i. 55.5 cm/µsec to mm/sec
      $555,000,000$ or $5.55\times10^8$ mm/sec
   j. $3.00\times10^4$ mg/m³ to g/cm³
      $0.0000300$ or $3.00\times10^{-5}$ mm/sec

3. Write the rule for treating significant figures in addition problems. **To the last known digit**

   Apply the above rule to the following arithmetic, with correct sig figs in your answer.
   a. 5.698 + 12.3
      __18.0__
   b. 0.0034 + 0.00989
      __0.0133__
   c. 4.658 – 2.3
      __2.4__
   d. 87000 + 21.2
      ___87000 to 87021 OK___

**Rounding is important!**
4. Write the rule for treating significant figures in multiplication problems.

Final answer has significant figures equal to (and no more than) the value with the fewest overall number of SF

5. Apply the above rule to the following arithmetic, with correct sig figs in your answer.

a. \(5.6981 \times 1334.3\)  
   b. \(9.00034 \times 0.00989\)  
   c. \(4.658 \times 2.3\)  
   d. \(49500.0 \times 21.2\)

   \[
   \begin{array}{cccc}
   & 7603.0 & 0.0890 & 11 & 1.05 \times 10^6 \\
   SF & 5 & 3 & 2 & 3 ((must round up) \\
   \end{array}
   \]

   e. \((31.41 \times 698.0 \times 34.40)/9.0 \times 10^{-2}\)

   \[
   8.4 \times 10^6 \]

   \[
   Rounding is important! 8380000 is not correct, ambiguous SF
   \]

6. Write the rule for treating significant figures where addition and multiplication operations are conducted in a long sequence.

Follow the order of mathematical operations, determining the # of sig figs using the rules at the end of each step. It’s good to keep an extra digit or two through the calculation to avoid rounding errors.

7. Apply the above rule to the following arithmetic, with correct sig figs in your answer.

a. \((32.13 - 31.95) \times 32.95\) = \(5.9\) \(\text{____} \)

   \[
   \text{Rounding is important, only 2 SF from first term!}
   \]

   b. \((0.008998 \times 4.387) + 0.0004297\) = \(0.03990\)

   c. \((48.7980 \div (0.034329 + 1.145))\) = \(41.38 \text{ or } 41.39\) depending on rounding

8. What is wrong with how the following numbers are written?

a. \(44.59 \times 10^4\) use one digit for sci notation \(4.459 \times 10^5\)

   b. \(46500 \text{ mm}\) ambiguous SF, use sci. notation \(4.65 \times 10^4\) mm \([\text{or } 4.65 \times 10^3 \text{ mm}]\)

9. Perform the following operations, with correct sig figs, of course. Write the answer in decimal and scientific notation.

   \begin{tabular}{cc}
   sci notation & decimal \\
   \end{tabular}

   a. \((8.650 \times 10^6) \div [(2.10 \times 10^5) \times (0.00510)]\) = \(8.08 \times 10^3\) \(8080\) (avoid trailing zeros if possible)

   b. \([(4.98 \times 10^{-4}) \times (1.005 + 9.72)] \div
      [(4.098 \times 10^{-3}) - (6.4 \times 10^{-1})]\) = \(-0.0089\) \(-8.9 \times 10^{-3}\)
10. The exact unit equivalents of measure in U.S. surveying are below:

\[ 7.92 \text{ inches} = 1 \text{ link} \quad 100 \text{ links} = 1 \text{ chain} \quad 10 \text{ chains} = 1 \text{ furlong} \quad 80 \text{ chains} = 1 \text{ mile} \]

a. The Kentucky Derby is a race of 1.250 miles. What is the length of the race in? (show work)

\[
\begin{align*}
\text{furlongs} &= 1.250 \text{ miles} \times \frac{80 \text{ ch}}{1 \text{ mi}} \times \frac{1 \text{ furlong}}{10 \text{ ch}} = 10.00 \text{ furlongs} 4 \text{ SF} \\
\text{inches} &= 1.25 \text{ mi} \times [80 \text{ ch/mi}] \times [100 \text{ lk/1 ch}] \times [7.92 \text{ in/1 lk}] = 7.920 \times 10^4 \text{ in}
\end{align*}
\]

b. A horse runs a race at the speed of 2.92 meters per second. What is this speed in chains/hour

\[
\begin{align*}
2.92 \text{ m/s} &\times 100 \text{ cm/1 m} \times 1 \text{ in/2.54 cm} \times 1 \text{ ft/12 in} \times 1 \text{ mi/5280 ft} \times 80 \text{ ch/1 mi} \times 3600 \text{ s/1 hr} = 523 \text{ ch/hr}
\end{align*}
\]

11. Water contains 18.01 g/mole, and the density of water is 0.9975 g/mL 25 °C. How many moles of water are in 1.00 cups, if there are 8 oz/cup, 128 oz in 1 gal, and 3.785 L/gal? (show work)

\[
\begin{align*}
1.00 \text{ C} &\times 8 \text{ oz/cup} \times 1 \text{ gal/128 oz} \times 3.785 \text{ L/gal} \times 1000 \text{ mL/L} \times 0.09975 \text{ g/mL} \times 1 \text{ mol/18.01 g} = 13.1 \text{ mol}
\end{align*}
\]

12. A sample of gasoline has a density measured to be 0.65 g/mL. How much does 34.58 L of gasoline weigh in: kg, ng, and pounds. (show work)

\[
\begin{align*}
\text{kg} &= 22 \text{ kg} \text{ (only 2 SF, due to measured value of density)} \\
34.58 \text{ L} &\times 1000 \text{ mL/L} \times 0.65 \text{ g/mL} \times 1 \text{ kg/1000 g} = 22.48 \text{ kg} \\
\text{ng} &= 2.2 \times 10^{13} \text{ ng} \text{ (who'd measure this in nanograms?)}
\end{align*}
\]

\[
\begin{align*}
\text{pounds} &= 4.8 \text{ to } 5.0 \times 10^1 \text{ pounds OK, depending on rounding step} \\
34.58 \text{ L} &\times 1000 \text{ mL/L} \times 0.65 \text{ g/mL} \times 1 \text{ pound/453.6 g} = 49.5 \text{ pounds}
\end{align*}
\]
13. Calculate the speed of light expressed in the units of city blocks per snap. 1 city block = 528 feet. 1 snap = 0.483 seconds. In a vacuum, the speed of light is $2.998 \times 10^8$ m/s  (show work)

$$\frac{2.998 \times 10^8 \text{ m}}{1 \text{ s}} \times \frac{100 \text{ cm}}{1 \text{ m}} \times \frac{1 \text{ in}}{2.54 \text{ cm}} \frac{1 \text{ ft}}{12 \text{ in}} \frac{1 \text{ C.b.}}{528 \text{ ft}} \times \frac{0.483 \text{ s}}{1 \text{ snap}} = 8.998 \times 10^5 \text{ cb/snap}$$

3 or 4 SF OK, depends on definition of city block and snap

14. solve, with correct SF

a. $(1.700 \times 10^4) \times (2.010 \times 10^{-8}) = 3.418 \times 10^{-4}$

b. $(7.0 \times 10^{15}) \times (1.08 \times 10^{-3}) = 9.2 \times 10^{15}$

$(8.2000 \times 10^{-4})$

c. $\frac{(2.00 \times 10^{-19})}{(3.899 \times 10^{2})(7.1 \times 10^5)} = 7.2 \times 10^{-28}$

d. $(1.255 \times 10^{-5}) \times (6.022 \times 10^{23}) = 7.558 \times 10^{18}$

e. $\log_{10} 100 = 2$

f. $\log_{10} 0.001 = -3$

g. $\log_{10} 4.23 \times 10^{-4} = -3.37$