Unit Equations:

Practice: Please set up unit equations for each of the following metric relationships

a) Scoville (Sc) and kiloScoville (kSc) → 1 k = $1x10^3$, so **1 kSc = $1x10^3$Sc**

b) mole (mol) and millimole (mmol) → 1 m = $1x10^{-3}$, so **1 mmol = $1x10^{-3}$mol**

c) megacalorie (Mcal) and calorie (cal) → 1 M = $1x10^6$, so **1 Mcal = $1x10^6$cal**

d) farad (f) and picofarad (pf) → 1 p = $1x10^{-12}$, so **1 pf = $1x10^{-12}$f**

e) gigawatt (GW) and watt (W) → 1 G = $1x10^9$, so **1 GW = $1x10^9$W**

f) nanotesla (nT) and tesla (T) → 1 n = $1x10^{-9}$, so **1 nT = $1x10^{-9}$T**

Conversion Factors:

Practice: Please give the 2 possible conversion factors for each of the following (the first 6 are from above)

a) Scoville (Sc) and kiloScoville (kSc) $\frac{1\times10^3\ \text{Sc}}{1\ \text{kSc}}$ **OR** $\frac{1\ \text{kSc}}{1\times10^3\ \text{Sc}}$

b) mole (mol) and millimole (mmol) $\frac{1\times10^{-3}\ \text{mol}}{1\ \text{mmol}}$ **OR** $\frac{1\ \text{mmol}}{1\times10^{-3}\ \text{mol}}$

c) megacalorie (Mcal) and calorie (cal) $\frac{1\times10^6\ \text{cal}}{1\ \text{Mcal}}$ **OR** $\frac{1\ \text{Mcal}}{1\times10^6\ \text{cal}}$

d) farad (f) and picofarad (pf) $\frac{1\times10^{-12}\ \text{f}}{1\ \text{pf}}$ **OR** $\frac{1\ \text{pf}}{1\times10^{-12}\ \text{f}}$

e) gigawatt (GW) and watt (W) $\frac{1\times10^9\ \text{W}}{1\ \text{GW}}$ **OR** $\frac{1\ \text{GW}}{1\times10^9\ \text{W}}$

f) nanotesla (nT) and tesla (T) $\frac{1\times10^{-9}\ \text{T}}{1\ \text{nT}}$ **OR** $\frac{1\ \text{nT}}{1\times10^{-9}\ \text{T}}$

g) 4.184 J = 1 g•1 °C $\frac{4.184\ \text{J}}{1\ \text{g}\cdot1^\circ\text{C}}$ **OR** $\frac{1\ \text{g}\cdot1^\circ\text{C}}{4.184\ \text{J}}$

h) 0.789 g = 1 mL $\frac{0.789\ \text{g}}{1\ \text{mL}}$ **OR** $\frac{1\ \text{mL}}{0.789\ \text{g}}$

i) 1 mol•1 K = 8.314 J $\frac{8.314\ \text{J}}{1\ \text{mol}\cdot1\ \text{K}}$ **OR** $\frac{1\ \text{mol}\cdot1\ \text{K}}{8.314\ \text{J}}$

j) 83 miles = 1 hour $\frac{83\ \text{mi}}{1\ \text{hr}}$ **OR** $\frac{1\ \text{hr}}{83\ \text{mi}}$

Sig Figs and Conversion Factors:

Practice: For each of the following, state the system of measure for each unit, the quality measured by each unit, and then give the number of sig figs in the conversion factor. = match, and = no match

a) 1 J = 0.2390 cal — **J = metric energy, cal = standard energy, 4 s f. (different systems)**

b) 1 km = 1.09×10^{3} yards — **kM = metric distance, yd = standard distance, 3 s.f. (different systems)**

c) 1 L = 1×10^{-3} m^3 — **L = metric volume, m^3 = metric volume, infinite s.f.**

d) 1 mL = 1.13 g — **mL = metric volume, g = metric mass, 3 s f. (different qualities)**

e) 5280 ft = 1 mile — **ft = standard distance, mile = standard distance, infinite s.f.**

f) 1 kg = 2.20 lb — **kg = metric mass, lb = standard mass, 3 s.f. (different systems)**

g) 65 miles = 1 hr — **miles = standard distance, hr = standard time, 2 s f. (different qualities)**

h) 0.26420 L = 1 gal — **L = metric volume, gal = standard volume, 5 s f. (different systems)**

i) 196.97 g Au = 1 mole Au — **g AU = metric mass, hr = metric count, 5 s.f. (different qualities)**

j) 1 ML = 1×10^{6} L — **ML = metric volume, L = metric volume, infinite s f.**

Using Conversion Factors:

Practice: Perform the following conversions

a) 28.0 cm → m — 1 c = 1×10^{-2} → 1 cm = 1×10^{-2}m → $\frac{1\ cm}{1\times10^{-2}\ m}$ or $\frac{1\times10^{-2}\ m}{1\ cm}$ → $28.0\ cm\times\frac{1\times10^{-2}\ m}{1\ cm}=0.280\ m$

b) 1000. m → km — 1 k = 1×10^{3} → 1 km = 1×10^{3}m → $\frac{1\ km}{1\times10^{3}\ m}$ or $\frac{1\times10^{3}\ m}{1\ km}$ → $1000.\ m\times\frac{1\ km}{1\times10^{3}\ m}=1.000\ km$

c) 9.28 m → mm — 1 m = 1×10^{-3} → 1 mm = 1×10^{-3}m → $\frac{1\ mm}{1\times10^{-3}\ m}$ or $\frac{1\times10^{-3}\ m}{1\ mm}$ → $9.28\ m\times\frac{1\ mm}{1\times10^{-3}\ m}=9280\ mm$

d) 10.68 g →mg — 1 m = 1×10^{-3} → 1 mg = 1×10^{-3}g → $\frac{1\ mg}{1\times10^{-3}\ g}$ or $\frac{1\times10^{-3}\ g}{1\ mg}$ → $10.68\ g\times\frac{1\ mg}{1\times10^{-3}\ g}=10680\ mg$

e) 4.5 m → dm — 1 d = 1×10^{-1} → 1 dm = 1×10^{-1}m → $\frac{1\ dm}{1\times10^{-1}\ m}$ or $\frac{1\times10^{-1}\ m}{1\ dm}$ → $4.5\ m\times\frac{1\ dm}{1\times10^{-1}\ m}=45\ dm$

f) 12 m → Mm — 1 M = 1×10^{6} → 1 Mm = 1×10^{6}m → $\frac{1\ Mm}{1\times10^{6}\ m}$ or $\frac{1\times10^{6}\ m}{1\ Mm}$ → $12\ m\times\frac{1\ Mm}{1\times10^{6}\ m}=1.2\times10^{-5}\ Mm$

g) 23.6 kJ to J — 1 k = 1×10^{3} → 1 kJ = 1×10^{3}J → $\frac{1\ kJ}{1\times10^{3}\ J}$ or $\frac{1\times10^{3}\ J}{1\ kJ}$ → $23.6\ kJ\times\frac{1\times10^{3}\ J}{1\ kJ}=23600\ J$

h) 1.6411×10^{7} pg → g — 1 p = 1×10^{-12} → 1 pg = 1×10^{-12}g → $\frac{1\ pg}{1\times10^{-12}\ g}$ or $\frac{1\times10^{-12}\ g}{1\ pg}$ →

$1.6411\times10^{7}\ pg\times\frac{1\times10^{-12}\ g}{1\ pg}=1.6411\times10^{-5}\ g$

i) $6.8\text{x}10^{4}$ ng → g 1 n = $1\text{x}10^{-9}$ → 1 ng = $1\text{x}10^{-9}$g → $\frac{1\ ng}{1\times10^{-9}\ g}$ or $\frac{1\times10^{-9}\ g}{1\ ng}$ → $6.8\times10^{4}\ ng\times\frac{1\times10^{-9}\ g}{1\ ng}=6.8\times10^{-5}\ g$

j) 8.54 g → cg 1 c = $1\text{x}10^{-2}$ → 1 cg = $1\text{x}10^{-2}$g → $\frac{1\ cg}{1\times10^{-2}\ g}$ or $\frac{1\times10^{-2}\ g}{1\ cg}$ → $8.54\ g\times\frac{1\ cg}{1\times10^{-2}\ g}=854\ cg$

k) 25.0 mL → L 1 m = $1\text{x}10^{-3}$ → 1 mL = $1\text{x}10^{-3}$L → $\frac{1\ mL}{1\times10^{-3}\ L}$ or $\frac{1\times10^{-3}\ L}{1\ mL}$ → $25.0\ mL\times\frac{1\times10^{-3}\ L}{1\ mL}=0.0250\ L$

l) 22.4 L → µL 1 µ = $1\text{x}10^{-6}$ → 1 µL = $1\text{x}10^{-6}$L → $\frac{1\ \mu L}{1\times10^{-6}\ L}$ or $\frac{1\times10^{-6}\ L}{1\ \mu L}$ → $22.4\ L\times\frac{1\ \mu L}{1\times10^{-6}\ L}=2.24\times10^{7}\ \mu L$

m) 0.65 Gs → s 1 G = $1\text{x}10^{9}$ → 1 Gs = $1\text{x}10^{9}$s → $\frac{1\ Gs}{1\times10^{9}\ s}$ or $\frac{1\times10^{9}\ s}{1\ Gs}$ → $0.65\ Gs\times\frac{1\times10^{9}\ s}{1\ Gs}=6.5\times10^{8}\ s$

n) 5.5 kg → g 1 k = $1\text{x}10^{3}$ → 1 kg = $1\text{x}10^{3}$g → $\frac{1\ kg}{1\times10^{3}\ g}$ or $\frac{1\times10^{3}\ g}{1\ kg}$ → $5.5\ kg\times\frac{1\times10^{3}\ g}{1\ kg}=5500\ g$

o) 0.468 TL → L 1 T = $1\text{x}10^{12}$ → 1 TL = $1\text{x}10^{12}$L → $\frac{1\ TL}{1\times10^{12}\ L}$ or $\frac{1\times10^{12}\ L}{1\ TL}$ →

$0.468\ TL\times\frac{1\times10^{12}\ L}{1\ TL}=4.68\times10^{11}\ L$

p) $9.0\text{x}10^{5}$ µL → L 1 µ = $1\text{x}10^{-6}$ → 1 µL = $1\text{x}10^{-6}$L → $\frac{1\ \mu L}{1\times10^{-6}\ L}$ or $\frac{1\times10^{-6}\ L}{1\ \mu L}$ → $9.0\times10^{5}\ \mu L\times\frac{1\times10^{-6}\ L}{1\ \mu L}=0.90\ L$

Okay, here are some for you to try:

1) 58216 microliters to dekaliters $58216\ \mu L\times\frac{1\times10^{-6}\ L}{1\ \mu L}\times\frac{1\ daL}{1\times10^{1}\ L}=5.8216\times10^{-3}\ daL$

2) 46.875 terabytes to kilobytes $46.875\ TB\times\frac{1\times10^{12}\ B}{1\ TB}\times\frac{1\ kB}{1\times10^{3}\ B}=4.6875\times10^{10}\ kB$

3) How many femtoseconds in 22.16 milliseconds $22.16\ ms\times\frac{1\times10^{-3}\ s}{1\ ms}\times\frac{1\ fs}{1\times10^{-15}\ s}=2.216\times10^{13}\ fs$

4) $3.78\text{x}10^{-2}$ megagrams to centigrams? $3.78\times10^{-2}\ Mg\times\frac{1\times10^{6}\ g}{1\ Mg}\times\frac{1\ cg}{1\times10^{-2}\ g}=3.78\times10^{6}\ cg$

5) 650.89 Gm → pm $650.89\ Gm\times\frac{1\times10^{9}\ m}{1\ Gm}\times\frac{1\ pm}{1\times10^{-12}\ m}=6.5089\times10^{23}\ pm$

6) 249 cm → km $249\ cm\times\frac{1\times10^{-2}\ m}{1\ cm}\times\frac{1\ km}{1\times10^{3}\ m}=2.49\times10^{-3}\ km$

7) 45.14 dm → Mm $45.14\ dm\times\frac{1\times10^{-1}\ m}{1\ dm}\times\frac{1\ Mm}{1\times10^{6}\ m}=4.514\times10^{-6}\ Mm$

8) 570 kg → µg $570\ kg \times \frac{1\times10^{3}\ g}{1\ kg} \times \frac{1\ \mu g}{1\times10^{-6}\ g} = 5.7\times10^{11}\ \mu g$

9) 2383.7 Mg → mg $2383.7\ Mg \times \frac{1\times10^{6}\ g}{1\ Mg} \times \frac{1\ mg}{1\times10^{-3}\ g} = 2.3837\times10^{6}\ mg$

10) 39.46 µg → cg $39.46\ \mu g \times \frac{1\times10^{-6}\ g}{1\ \mu g} \times \frac{1\ cg}{1\times10^{-2}\ g} = 3.946\times10^{-3}\ cg$

11) 139.42 pL → nL $139.42\ pL \times \frac{1\times10^{-12}\ L}{1\ pL} \times \frac{1\ nL}{1\times10^{-9}\ L} = 0.13942\ nL$

12) $5.23\text{x}10^{-4}$ TL → kL $5.23\times10^{-4}\ TL \times \frac{1\times10^{12}\ L}{1\ TL} \times \frac{1\ kL}{1\times10^{3}\ L} = 5.23\times10^{5}\ kL$

Conversion between systems of measure:

Practice: (use the "SI Units and Conversion Factors" table in your book, or the conversion table I gave you, to do these)

1) Convert 103 kg to ounces $103\ kg \times \frac{1\times10^{3}\ g}{1\ kg} \times \frac{1\ oz}{28.3\ g} = 3.64\times10^{4}\ oz$

2) What is the equivalent of 653 nm in angstroms? $653\ nm \times \frac{1\times10^{-9}\ m}{1\ nm} \times \frac{1\ \text{Å}}{1\times10^{-10}\ m} = 6530\ \text{Å}$

3) How many liters are there in 6.375 pints $6.375\ pt \times \frac{1\ gal}{8\ pt} \times \frac{3.785\ L}{1\ gal} = 3.02\ L$

4) 0.75 tons is equal to how many kg? $0.75\ ton \times \frac{907.185\ kg}{1\ ton} = 6.8\times10^{2}\ kg$

5) How many amu are in $3.89266\text{x}10^{-17}$ pounds?

$$3.89266\times10^{-17}\ lb \times \frac{0.45359\ kg}{1\ lb} \times \frac{1\times10^{-3}\ g}{1\ kg} \times \frac{1\ amu}{1.6606\times10^{-24}\ g} = 10633\ amu$$

6) What is the distance in µm of 8.00 ft? $8.00\ ft \times \frac{1\ m}{3.281\ ft} \times \frac{1\ \mu m}{1\times10^{-6}\ m} = 2.44\times10^{6}\ \mu m$

7) How many millimeters in a marathon (26.22 miles) $26.22\ mi \times \frac{5280\ ft}{1\ mi} \times \frac{1\ m}{3.281\ ft} \times \frac{1\ mm}{1\times10^{-3}\ m} = 4.219\times10^{7}\ mm$

8) What is the volume in nL of 2.336 gallons? $2.336\ gal \times \frac{3.785\ L}{1\ gal} \times \frac{1\ nL}{1\times10^{-9}\ L} = 8.842\times10^{9}\ nL$

9) Given that 1 mL = 0.789 g (for ethanol), convert $7.39\text{x}10^{7}$ m^3 of ethanol to tons of ethanol

$$7.39\times10^{7}\ m^3 \times \frac{1\ L}{1\times10^{-3}\ m^3} \times \frac{1\ mL}{1\times10^{-3}\ L} \times \frac{0.789\ g}{1\ mL} \times \frac{1\ kg}{1\times10^{3}\ g} \times \frac{1\ ton}{907.158\ kg} = 6.43\times10^{7}\ ton$$