YOULearn #2 - UNIT CONVERSIONS

Type of measurement	Base unit	Unit sy oo	
mass	gram	g	
length	metre	m	
volume	litre	L	
pressure	Pascal	Pa	
temperature	Kelvin	К	
time	second	S	
amount of matter	mole	mol	

and love it!

• *SI prefixes we will use regularly*:

Prefix	Symbol	As a power
mega	Μ	10 ⁶
kilo	k	10 ³
hecto	h	10 ²
deka	da	10
		1
deci	d	10 ⁻¹
centi	С	10 ⁻²
milli	m	10 ⁻³
micro	μ	10 ⁻⁶
nano	n	10 ⁻⁹

A. Calculations Using Unit Conversions

- You *must*follow the same method shown below.
- We can convert from one unit to another by using relationships that are equivalent to each other then arranged as a ratio. The ratio is called the **conversion factor.**
- For example, with time we know the following relationships:

Relationship	Conversion Factor
1 min = 60 s	$\frac{1\min}{60s}$ and $\frac{60s}{1\min}$
1 hour = 60 min	$\frac{1hour}{60\min}$ and $\frac{60\min}{1hour}$
24 hours = 1 day	$\frac{1 day}{24 hours}$ and $\frac{24 hours}{1 day}$

Note that the values in the ratios are equal to each other (i.e. 1min = 60 s). Therefore, the ratio really has a value equal to 1. Multiplying any factor by the conversion factor is equivalent o multiplying by 1 and will not change the value of the expression.

The general formula for solving problems using the conversion factor method:

Unknown Amount = (initial amount given in the problem) x (conversion factor)

Examples:

1. How many seconds are there in 49 minutes?

$$\frac{49 \text{ min} \times \frac{60 \text{ sec}}{1 \text{ min}} = 2940 \text{ sec}}{2900 \text{ sec}}$$
2. How many hours are there in 448 minutes?

$$\frac{448 \text{ min} \times \frac{1 \text{ hr}}{60 \text{ min}} = 7.4666 \text{ hr}}{7.47 \text{ hr}}$$
3. How many minutes are there in 44 days? (2 steps)

$$\frac{448 \text{ min} \times \frac{1 \text{ hr}}{60 \text{ min}} = 7.4666 \text{ hr}}{1 \text{ days}} \times \frac{60 \text{ min}}{1 \text{ days}} = 63360 \text{ min}}{1 \text{ days}}$$

4. How many seconds are there in 3 days? (3 steps)

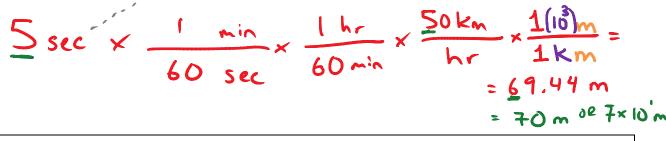
$$\frac{3 \text{ days}}{1 \text{ days}} \times \frac{24 \text{ hr}}{1 \text{ days}} \times \frac{60 \text{ min}}{1 \text{ hr}} \times \frac{60 \text{ see}}{1 \text{ min}} = \frac{259200 \text{ sec}}{300000 \text{ see}}$$

Note:

- All the units cancel each other except the desired unit (s). (show this in your work!)
- The expression " 3 days" is multiplied by three conversion factors that are all equivalent to "1". The final answer changed because the "expression" has a different unit, but the actual **value** is still the same.
- 5. If the density of sea water is 1.2 g/mL, calculate the mass of 45mL of sea water.



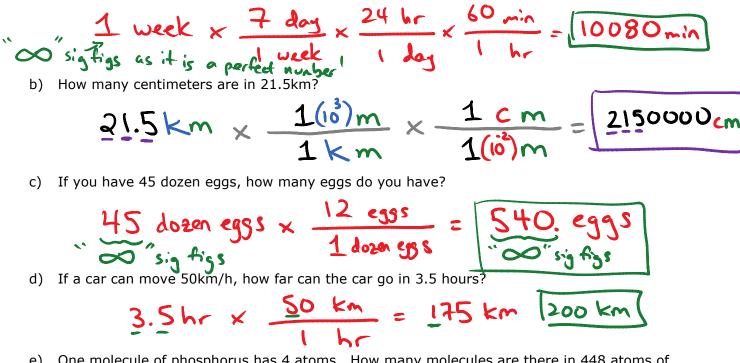
6. If a car is moving at 50km/h, calculate how far (in metres) the car moves in 5 seconds.



ALWAYS INCLUDE THE UNITS FOR ALL THE CALCULATIONS WE DO IN CHEMISTRY. **DO NOT BE TEMPTED TO EXCLUDE THEM!**

More Examples:(<u>Hint</u>: always put the *unit convertor* 2nd!)

a) How many minutes are there in 1 week?



e) One molecule of phosphorus has 4 atoms. How many molecules are there in 448 atoms of phosphorus?

f) If one mole of carbon has a mass of 12.0g, what is the mass of 4.7 moles of carbon?

$$4.7 \text{ mole } \times \frac{12.0 \text{ g}}{1 \text{ mole}} = 56.4 \text{ g} 56 \text{ g}$$

g) The density of aluminum is 2.7g/mL. What is the volume of 7.4 g of aluminum?

$$7.4gAl \times \frac{1}{2.7g} = 2.7407 \text{ ALAI} [2.7 \text{ ALAI}]$$

h) If a car averages 60km/h, how long will it take to cover 57km?



"Only those who have the patience to do simple things perfectly, will acquire the skill to do difficult things easily."

~ Johann von Schiller (German philosopher)

WARNING! The unit conversion method is used EXTENSIVELY in Chemistry 11, learn it and love it!

B. Multiple Unit Conversions ~ Chain Conversions + values = unlimited sig
1. How many minutes are there in 3 days?

$$3 \text{ day} \times 24 \text{ hr}$$

 $4 \text{ day} \times 60 \text{ min} = 4320 \text{ min}$
 $4 000 \text{ min}$
 $4 0000 \text{ min}$
 $4 000 \text{ min}$
 $4 0000 \text{ min}$
 $4 000 \text{ min}$
 $4 000$

4. If 1 yard = 3 feet, 1 foot = 12 inches, and 1 inch = 2.54cm, how many meters are in 50 yards?

$$50ydx - \frac{3ft}{1yd} \times \frac{12in}{1ft} \times \frac{2.54cm}{1in} \times \frac{1(i^2)m}{1cm} = 45.72m$$

5. A sprinter can run 100 metres in 10 seconds. How fast is the sprinter moving in km/h?

$$\frac{100 \text{ m}}{10 \text{ s}} \times \frac{1 \text{ km}}{1(10^3) \text{ m}} \times \frac{3600 \text{ s}}{1 \text{ hr}} = 36 \text{ km} \text{ hr}$$

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C. <u>Derived Quantities</u>

- Quantities made up by combining two or more other values.
- Derived unit is a unit made by combining two or more units.

area (m²) volume (cm³) density (g/L)

Examples:(<u>Hint</u>: $cm^2 = cm \times cm$, the value of the power tells you how many times you must convert the unit!)

1. Convert 1.5 cm² to m².
1. 5 cm² ×
$$\frac{1(10^{2})m}{1 cm} \times \frac{1(10^{3})m}{1 cm} = 1.5 \times 10^{-4} m^{2}$$

2. Convert 25m³ to cm³. 25m³ = 25m × m × m
 $25m^{3} \times \frac{cm}{(10^{2})m} \times \frac{cm}{(10^{2})m} \times \frac{cm}{(10^{2})m} = 2.5 \times 10^{7} cm^{3}$

3. If an iron bar has a volume of 5.0L and a mass of 39kg, what is the density of the iron bar in g/L?

$$\frac{39 \text{ kg}}{5.0 \text{ L}} \times \frac{(10)^{3} \text{ g}}{\text{ kg}} = 7800 \text{ g}}{\text{ L}}$$

4. What is the volume occupied by 35g of mercury. The density of mercury is 13.6g/mL.

$$35g \times \frac{1}{13,6g} = 2.573 \text{ mL}$$
 [2.6 mL]

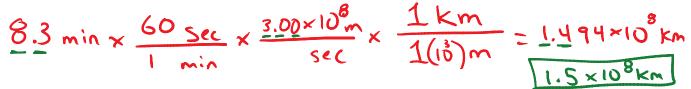
5. Convert 50km/h into m/s.

$$50 \text{ km} \times \frac{(10^3)\text{m}}{\text{ km}} \times \frac{1 \text{ h}}{3600 \text{ s}} = 13.88 \text{ m}}{\text{ s}} [10 \text{ m}]$$

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D. Challenging Unit Conversions:

 Light travels at a rate of 3.00x 10⁸m/s. It takes light 8.3 minutes to travel from the sun to Earth. What is the distance from the sun to Earth in kilometres?



2. The Cullinan diamond, the largest diamond ever found, has an uncut volume of 177mL. If 1mL of diamond has a mass of 3.51g and 1carat = 0.200g, how many carats was the Cullinan diamond?

$$177mL \times \frac{3.51g}{1mL} \times \frac{1cout}{0.200g} = 3106.35 curchs [3110 curchs]$$

3. Express 0.0098cL/ms² in kL/s²

$$\frac{0.0098 \text{ ct}}{\text{ms}^{2}} \times \frac{1(10)}{1 \text{ ct}} \times \frac{1 \text{ kL}}{1(10)} \times \frac{1 \text{ kL}}{1(10)} \times \frac{1 \text{ ms}^{2}}{1(10)} = 9.8 \times 10 \frac{\text{ kL}}{\text{ s}^{2}}$$

4. The pressure in a hot air balloon is 9.0 lb/in³. Convert the pressure inside the balloon to kg/m³.

$$\frac{9.0 \, 15}{10^3} \times \frac{1 \, \text{kg}}{2.2 \, 15} \times \frac{(1 \, \text{in})^3}{(2.5 \, \text{Verm})^3} \times \frac{(1 \, \text{cm})^3}{(1 \, (\text{io})^{10})^3} = \frac{300 \, 000 \, \text{kg}}{13.0 \times 10^5 \, \text{kg}}$$

5. A Celtic chicken farmer wants to buy a gift for his wife. The gift was worth 2 horses. At the local market, 3 horses were worth 5 cows, 1 cow was worth 4 pigs, 3 pigs were worth 4 goats, and 1 goat was worth 9 chickens. How much was the gift going to cost the farmer, who had to pay in chickens?

6. The largest iceberg in the world requires 6.53×10^7 kJ of heat energy to melt. One kilogram of TNT or dynamite releases 1.5×10^4 kJ of energy when exploded. Provided that all of the energy of an explosion went into melting the iceberg, how many pounds of TNT would be needed?

$$6.53 \times 10^7 \text{ kJ} \times \frac{1 \text{ kg}}{1.5 \times 10^7 \text{ kJ}} \times \frac{1(10^3) \text{ g}}{1 \text{ kg}} \times \frac{110}{454 \text{ g}} = 9538.83 \text{ lb}$$

 9600 lb

7. Express 50.0024 mL/min² in μ L/s²

$$\frac{50.0024 \text{ m/L}}{\text{m/n}^{2}} \times \frac{1(10^{3})\text{L}}{1 \text{ m/L}} \times \frac{1 \text{ m/L}}{1(10^{6})\text{L}} \times \frac{1 \text{ m/n}}{60 \text{ see}} \times \frac{1 \text{ m/n}}{60 \text{ see}} = 13.8895 \text{ m/L}}{3^{2}}$$