# P 5.8A (pg 1 of 2) Dimensional Analysis aka FLM - Factor Label Method

Set up all your work before you use a calculator. The answer is not as important as the proper use of the conversion (unit) factors! Show all your work and make the labels cancel out appropriately.

1. The human heart beats about 65 beats per minute. How many times will your heart beat in your lifetime if you live to be 72 years old?

2. How many kilometers will light travel in 1 year if the speed of light is $3.0 \times 10^8$ km/sec?

3. A leaky faucet drips 3.00 ml of water per minute. What is the water loss in gallons per year?
   - (FYI: 1 liter is equal to 1.06 quarts, 1 qallon = 4 quarts)

4. How much would it cost for the nails in order to build a fence 26.8 m long if you required 4 nails per picket of fence, and there were 8 pickets in each meter of fencing, and there were 80 nails to the kg, and they sold for 65 cents per kg?

5. How many millimeters can a car travel in a trip if it is driven for 2.5 hours for that trip at a rate of 85.0 km/hour?

6. You can probably ride your bike 13 mi/hr. Convert this speed to millimeters/second.
   - (1 km = 0.62 miles)

7. I used to run at a pace of 8.3 mi/hr. Convert that speed to kilometers per minute.
   - How many minutes did it take me to run one kilometer?
   - What is my pace in minutes per mile?

8. My dog Bucky used to eat 2.5 cups of food per day. Each cup of dog food weighs about 0.261 lbs. If a 40 lb bag of food costs $38, how much money will it cost to feed him for his life span of about 14 years?

9. If a monarch butterfly flies 113 cm in 0.670 s, and needs to take 48 wing beats every 1.00 minute to fly at that speed, how many wing beats (per one-way trip) will it take the poor little gal to fly from here to Costa Rica, a distance of about 2,500 miles (which they do every year).
   - An equality you might need to use to do this problem: 2.54 cm = 1 in

10. Every three times you clean your bedroom, your mother makes an apple pie. If you cleaned your bedroom 9 times. How many apple pies does she owe you?

11. A chemistry teacher working at a golf camp during the summer found a liquid. He thought that this was an important liquid to identify so he set out to determine its density. He found that a sample of the liquid had a mass equal to 455 golf balls and occupied a volume of 620 water cups that he obtained at the $7^{th}$ hole. Later he massed 100 golf balls and found they weighed 5 kg and the water cups at the $7^{th}$ hole of the golf course held 45 mL each. What is the density of the unknown liquid?

12. A Hamp High School senior was applying to college and wondered how many applications she needed to send. Her counselor explained that with the excellent grade she received in chemistry she would probably be accepted to one school out of every three to which she applied. [3 applications = 1 acceptance] She immediately realized that for each application she would have to write 3 essays, and each essay would require 2 hours work. Of course writing essays is no simple matter. For each hour of serious essay writing, she would need to expend 500 calories which she could derive from her mother's 1000 calorie apple pies. How many times would she have to clean her room in order to gain acceptance to 10 colleges? Hopefully you didn't skip problem No 10.

13. Because you never learned dimensional analysis, you will be working at a fast food restaurant for the next 35 years wrapping hamburgers. Each hour you wrap 184 hamburgers. You work 8 hours per day. You work 5 days a week. You get paid every 2 weeks with a salary of $840.34. How many hamburgers will you have to wrap to make your first one million dollars and become a millionaire?

**Answers –** Your calculation may be solved in a different order, but all your conversion factors will be the same.

1. $\frac{72\,yr}{1life}\frac{365day}{1yr}\frac{24hrs}{1day}\frac{60\,\text{min}}{1hr}\frac{65beats}{1\,\text{min}} = 2.5x10^{9}\,\frac{beats}{lifetime}(2sf)$

2. $\frac{3x10^{8}\,km}{1\,\text{sec}}\frac{365day}{1yr}\frac{24hr}{1day}\frac{60\,\text{min}}{1hr}\frac{60\,\text{sec}}{1\,\text{min}} = 9.5x10^{15}\,\frac{km}{yr}(2sf)$

3. $\frac{3.00ml}{1\,\text{min}}\frac{1L}{1000ml}\frac{60\,\text{min}}{1hr}\frac{24hr}{1day}\frac{365day}{1yr}\frac{1.06qt}{1L}\frac{1gal}{4qt} = 418\,\frac{gal}{yr}(3sf)$

4. $\frac{26.8m}{1fence}\frac{8pickets}{1m}\frac{4nails}{1picket}\frac{1kg}{80nails}\frac{\$0.65}{1kg} = 6.97\,\frac{\$}{fence}(3sigfigs)$

5. $\frac{2.5hr}{1trip}\frac{85km}{1hr}\frac{1{,}000{,}000mm}{1km} = 2.1x10^{8}\,\frac{mm}{trip}(2sigfig)$

6. $\frac{13mi}{1hr}\frac{1km}{0.62mile}\frac{1{,}000{,}000mm}{1km}\frac{1hr}{60\,\text{min}}\frac{1\,\text{min}}{60\,\text{sec}} = 5800\,\frac{mm}{\text{sec}}(2sf)$

7. $\frac{8.3mi}{1hr}\frac{1km}{0.62mi}\frac{1hr}{60\,\text{min}} = 0.22\,\frac{km}{\text{min}}(2sf)$

   0.22km/1min is my speed, flip this ratio and divide for the time/km: $\frac{1\,\text{min}}{0.22km} = 4.5\,\frac{\text{min}}{km}(2sf)$

   $\frac{4.5\,\text{min}}{1km}\frac{1km}{0.62mile} = 7.3\,\frac{\text{min}}{mile}(2sf)$

8. $\frac{14\,yr}{1life}\frac{365day}{1yr}\frac{2.5cup}{1day}\frac{0.261lb}{1cup}\frac{\$38}{40lbs} = 3200\,\frac{\$}{yr}(2sf)$

9. $\frac{48beats}{1\,\text{min}}\frac{1\,\text{min}}{60\,\text{sec}}\frac{0.67\,\text{sec}}{113cm}\frac{2.54cm}{1in}\frac{12in}{1ft}\frac{5280\,ft}{1mile}\frac{2500mi}{1trip}1{,}900{,}000\,\frac{beats}{trip}(2sf)$

10. $\frac{1pie}{3cleanings} * 9cleanings = 3pies$

11. $\frac{5kg}{100gb}\frac{1000g}{1kg}\frac{455gb}{620cups}\frac{1cup}{45ml} = 0.8\,\frac{g}{ml}(1sf)$

12. $\frac{3cleanings}{1pie}\frac{1pie}{1000cals}\frac{500cals}{1hr}\frac{2hrs}{1essay}\frac{3essays}{1app}\frac{3apps}{1accept} * 10accepts = 270cleanings(2sf)$

13. $\frac{184burgers}{1hr}\frac{8hrs}{1day}\frac{5day}{1wk}\frac{2wk}{\$840.34}\frac{\$1{,}000{,}000}{1millionaire} = 17{,}500{,}000\,\frac{burgers}{millionaire}(3sf)$

    Could you become a millionaire in 35 years wrapping burgers?

    $\frac{184burgers}{1hr}\frac{8hrs}{1day}\frac{5day}{1wk}\frac{50wk}{1yr} * 35yrs = 12{,}900{,}000\,\frac{burgers}{in35yrs}(3sf)$ is all you can wrap in 35 years, so you would not even make it to a million bucks in 35 years

    So how many years would it take to make the million bucks??

    $17{,}500{,}000\,\frac{burgers}{millionaire}\frac{1hr}{184burgers}\frac{1dy}{8hrs}\frac{1wk}{5days}\frac{1yr}{50wks} = 47.6yrs!$

    Whew, I am pooped just thinking about it.

    OR you could solve the previous question this way: $\frac{17{,}500{,}000burgers}{1millionaire}\frac{35yrs}{12{,}900{,}000burgers} = 47.5\,\frac{yrs}{millionaire}$

    the values are slightly different because of the rounding off that was done.