Key

Dimensional analysis practice problems
An important skill to learn for science/engineering courses.

INSTRUCTIONS: Use dimensional analysis for all of the following problems. Show your work (show which units cancel by crossing them out). Use **significant figures** for your final answer. _Remember, you are always responsible for knowing metric to metric conversions, but you do not need to memorize metric to English conversions._

REMEMBER: THE PROBLEMS ARE EASY ONCE YOU FIGURE OUT WHAT INFORMATION TO START WITH.

1. When one gram of gasoline burns in a car's engine, the amount of energy given off is approximately 1.03×10^4 cal. Express this quantity in joules (J). (Use 1 cal = 4.184 J)

$$1.03 \times 10^4 \text{ cal} \times \left(\frac{4.184 \text{ J}}{1 \text{ cal}}\right) = 43095 \rightarrow \boxed{4.31 \times 10^4 \text{ J}}$$

2. The pressure reading from a barometer is 742 mm Hg. Express this reading in kilopascals, kPa. (Use 760 mm Hg = 1.013×10^5 Pa)

$$742 \text{ mm Hg} \times \left(\frac{1.013 \times 10^5 \text{ Pa}}{760 \text{ mm Hg}}\right) \times \left(\frac{1 \text{ kPa}}{1000 \text{ Pa}}\right) = \boxed{98.9 \text{ kPa}}$$

3. How many megayears is equivalent to 6.02×10^{23} nanoseconds (ns)?

$$6.02 \times 10^{23} \text{ ns} \times \left(\frac{1 \text{ s}}{10^9 \text{ ns}}\right)\left(\frac{1 \text{ min}}{60 \text{ s}}\right)\left(\frac{1 \text{ hr}}{60 \text{ min}}\right)\left(\frac{\text{day}}{24 \text{ hr}}\right)\left(\frac{1 \text{ yr}}{365 \text{ days}}\right)\left(\frac{1 \text{ megayr}}{10^6 \text{ yr}}\right) = \boxed{19.1 \text{ My}}$$

↖ not accounting for leap yr

4. The average student is in class 330 min/day.

a. How many hours/day is the average student in class? *You should know what conversion factors you will need!*

$$\frac{330 \text{ min}}{\text{day}} \cdot \left(\frac{\text{hr}}{60 \text{ min}}\right) = \boxed{5.5 \text{ hr/day}}$$

b. How many seconds is the average student in class per week?

$$1 \text{ week} \times \left(\frac{5 \text{ days of school}}{1 \text{ week}}\right) \times \left(\frac{5.5 \text{ hr}}{1 \text{ day}}\right) \times \left(\frac{60 \text{ min}}{1 \text{ hr}}\right) \times \left(\frac{60 \text{ s}}{1 \text{ min}}\right) = \boxed{9.9 \times 10^4 \text{ s}}$$

c. Calculate how many seconds you are in class a day (pick any weekday you have class). Show any calculations you have to do as dimensional analysis below. *Answers will vary between you and your classmates.*

answers will vary.

5. Approximately how many pounds do you weigh? ___150___ lbs.

The human body is *approximately* 60% water by mass. You can write this as a conversion factor: 60g water / 100g body mass. (Does this make sense?)

you can use lb. instead

Using that conversion factor, how many pounds of water are there in your body? (This is a rough estimate, since it also depends on body fat).

$$150 \text{ lb body} \times \left(\frac{60 \text{ lb water}}{100 \text{ lb body}}\right) = \boxed{90 \text{ lb water}}$$

full label, so you don't confuse lb water vs lb body

6. French cooks usually weigh ingredients. A French recipe uses 225 grams of granulated sugar. How many cups are needed if there are 2 cups of sugar per pound of sugar? Round to the nearest cup.

(Note that you are changing from units of weight, grams, to units of volume, cups. The conversion factor 2 cups per pound is true for sugar but may not be the same for all other ingredients.)

(1 lb = 453.6g)

$$225 \text{ g} \times \left(\frac{1 \text{ lb}}{453.6 \text{ g}}\right) \times \left(\frac{2 \text{ cups}}{\text{lb}}\right) = 0.99 \text{ cups} \left(\text{or } 1 \text{ cup}\right)$$

(How many sig figs would you use? In real life, would you use 0.99 cups or 1 cup?)

7. Convert 10.3 g · cm^3/second^2 to kg · m^3 /hour^2

(· means multiplication, so both g and cm^3 are in the numerator; seconds is abbreviated "s" and hour is "h") Use conversion factors that you already know (or *should* know!)

$$\frac{10.3 \text{ g} \cdot \text{cm}^3}{\text{s}^2} \times \left(\frac{\text{kg}}{1000 \text{ g}}\right) \times \left(\frac{\text{m}^3}{100^3 \text{ cm}^3}\right) \times \left(\frac{60^2 \text{ min}^2}{1 \text{ hr}^2}\right)\left(\frac{60^2 \text{ s}^2}{1 \text{ min}^2}\right) = \boxed{0.134 \frac{\text{kg m}^2}{\text{hr}^2}}$$

8. A car accelerates at 12 mi/hr·s (miles per hour-seconds). Write that acceleration in m/s^2.

(1 mile = 1.609 km)

$$\frac{12 \text{ mi}}{\text{hr} \cdot \text{s}} \times \left(\frac{1.609 \text{ km}}{1 \text{ mi}}\right) \times \left(\frac{1000 \text{ m}}{1 \text{ km}}\right) \times \left(\frac{1 \text{ hr}}{60 \text{ min}}\right) \times \left(\frac{1 \text{ min}}{60 \text{ s}}\right) = \boxed{5.4 \text{ m/s}^2}$$