Announcements

Monday, January 26, 2009

MasteringChemistry:

- Lec 2 post (problems)
- Lec 3 pre (tutorials)
- Both due next Monday, Feb 2 before class.
- Past-due assignments can be re-worked for practice
- Late fee 10% per day for questions submitted late

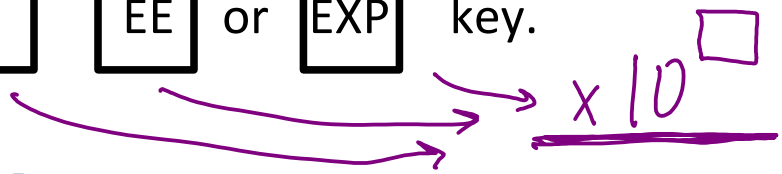
Elements to be memorized for exam 1 on webpage

Practice worksheets on webpage

- Unit conversion
- Density

Lab 1 this week, lab 2 next week - prelab worksheet finished before lab.

To use scientific notation on your calculator, you must use the [E] [EE] or [EXP] key.



To enter 1.38×10^{5} :

1.38 [E] 5

To enter 2.551×10^{-3} : = 0.002551

text calculator: 2.551 [E] [(−)] 3

numeric calculator: 2.551 [E] 3 [+/−]

1. Multiplying or dividing:
   a. find the value with the fewest sig figs
   b. round answer to that number of sig figs

You travel 20.0 miles in 3.0 hours. What is your average speed in miles per hour?

$\frac{20.0\ \text{mi}}{3.0\ \text{hr}} = 6.7\ \text{mi/hr}$

100.00 cm / 5 pieces = 20.000 cm

measurement exact #

$4.873 \times 10^{2}\ \text{cm} \times 9.2 \times 10^{-4}\ \text{cm} = 0.45\ \text{cm}^2$

4.873 E 2 x 9.2 E -4 = $4.5 \times 10^{-1}\ \text{cm}^2$

2. Adding and subtracting:
   a. Find the value with the fewest number of decimal places (numbers to right of decimal point)
   b. Answer is rounded to that number of decimal places

142.1 cm + 2.108 cm + 28.32 cm = 172.5 cm

round to 1 dec place

	Answer limited by
Multiplying or dividing	fewest sig figs
Adding or subtracting	fewest decimal places

Only round **once** at the end of a series of calculations!

Keep track of significance in intermediate calculations by underlining the last significant digit.

$$\frac{(14.3\ \text{g} + 125\ \text{g})}{(1.3\ \text{cm} \times 2.86\ \text{cm})} = \frac{139.3\ \text{g}}{3.718\ \text{cm}^2} = 37\ \text{g/cm}^2$$

On your own...

(17.236 - 17.1) x (2.338 x 1.53) =

0.136 (1 sf) x 3.57714 (3 sf) = 0.48649

↓ round to 1 sf

0.5

The **SI units** are a part of the metric system.

English system: feet, inches, pounds, etc.

Basic SI units:

length: meter (m)

mass: kilogram (kg)

temp: kelvin (K)

mass: measure of the amount of matter present
measured on a balance

weight: amount of gravitational force
measured on a scale

digital balance

kg (SI unit): mass of brick

g (gram): mass of paper clip

SI prefixes change the size of a unit by a power of 10

prefix	abbrev.	power of 10 (definition)
kilo	k	$10^3 = 1000$
centi	c	$10^{-2} = 1/100 = 0.01$
milli	m	$10^{-3} = 1/1000 = 0.001$

memorize

larger

smaller

large # small unit

1 kg = 10^3 g = 1000 g

1 cm = 10^{-2} m = $\frac{1}{100}$ m = 0.01 m

1 m = 10^2 cm = 100 cm

1 mL = 10^{-3} L = $\frac{1}{1000}$ L = 0.001 L

1 L = 10^3 mL = 1000 mL

0.1234 m

= 1.234 dm

= 12.34 cm

= 123.4 mm

larger

unit gets smaller

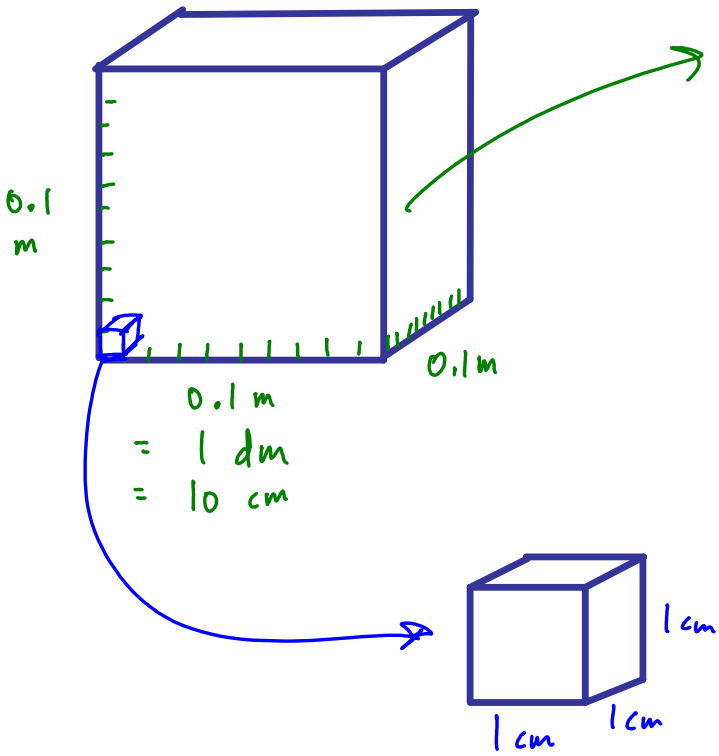
deci

($d = 10^{-1}$)

$c = 10^{-2}$

$m = 10^{-3}$

Volume is the amount of space occupied



$V = \ell \cdot w \cdot d$

$= 1\ cm^3 = 1\ cc$

$= 1\ mL$

$m = 10^{-3}$ $\quad 1\ mL = 10^{-3}\ L$

$1\ L = 10^3\ mL$

$1\ L = 1000\ mL$

Dimensional analysis is a process of unit conversion that works by cancelling unwanted units.

Say you're throwing a party. You prepare for:

15 guests (start)

3 drinks per guest (one) 3 drinks / guest (per 1 guest)

In dimensional analysis, we use:
- 1 single given value to start with
- conversion factors
  - 2 units "per" /
  - equation (2.54 cm = 1 in)

Start with the single value…

$$15 \text{ guests} \times \frac{3 \text{ drinks}}{1 \text{ guest}} = 45 \text{ drinks}$$

…then mult. by conversion factor fraction so original unit cancels.

Dimensional analysis

remember…
$k = 10^3$
$c = 10^{-2}$
$m = 10^{-3}$

43.2 m = ? cm

(100 cm = 1 m)

$43.2\ \text{m} \times \frac{100\ \text{cm}}{1\ \text{m}} = 4320\ \text{cm}$

$= 4.32 \times 10^3\ \text{cm}$

1000 mm = 1 m
1000 m = 1 km

217 in = ? km (start with a roadmap)

Give the answer with the correct number of sig figs and in scientific notation.

in → cm → m → km

in → ft → m → km

in → ft → mi → km

$217\ \text{in} \times \frac{2.540\ \text{cm}}{1\ \text{in}} \times \frac{1\ \text{m}}{100\ \text{cm}} \times \frac{1\ \text{km}}{1000\ \text{m}} =$

$217 \times 2.540 \div 100 \div 1000 = 0.00551\ \text{km}$

$5.51 \times 10^{-3}\ \text{km}$

$41\ \text{in}^2 = ?\ \text{cm}^2, \quad (1\ \text{in} = 2.540\ \text{cm})$

$41\ \text{in}^2 \times \frac{(2.540\ \text{cm})^2}{(1\ \text{in})^2} = 41\ \text{in}^2 \times \frac{2.540^2\ \text{cm}^2}{1\ \text{in}^2} = 264.5156$

$= 260\ \text{cm}^2$

$2.6 \times 10^2\ \text{cm}^2$

Density is the amount of mass per unit volume

$$D = \frac{\text{mass}}{\text{volume}}$$

Convert units before dividing if they don't match!

An object has a mass of14.3 g and a volume of 9.8 mL. What is its density? in g/mL

$D = \frac{14.3\,g}{9.8\,mL} = 1.5\,g/mL$

$14.3\,g \times \frac{1\,oz}{28.35\,g} = 0.50440902\,oz$

What is D in oz/in^3 = $\frac{0.504409\,oz}{0.59803\,in^3}$ = $0.84\,oz/in^3$

$9.8\,mL \times \frac{1\,cm^3}{1\,mL} \times \frac{1\,in^3}{2.540^3\,cm^3} = 0.59803\,in^3$

Density is an **intensive property** (it does not depend on quantity.) So, it can be used to identify substances.

Substance	Density
gold	19.3 g/mL
mercury	13.6 g/mL
water	0.997 g/mL
air	0.00130 g/mL = 1.30 g/L

Density is **THE** conversion factor between mass and volume.

What volume Hg has a mass of 4.86 g? (start)
The density of Hg is 13.6 g/mL. (per 1 mL; conv. factor)

$$4.86\,g \times \frac{1\ mL}{13.6\ g} = 0.357\ mL\ Hg$$

$$4.86\,g \times \frac{1\ mL}{13.6\,g} \times \frac{1\ cm^3}{1\ mL} = 0.357\ cm^3\ Hg$$

$$D\,(Hg) = 13.6\ g/mL$$

If you have 9.48 L Hg, what is its mass in grams?

$$9.48\ L \times \frac{1000\ mL}{1\ L} \times \frac{13.6\,g}{1\ mL} = 1.29 \times 10^5\ g\ Hg$$

128928.

Subst D = 4.21 g/cm³ — what vol in qt is 2.91 lb of subst? (start; end)

lb → g → cm³ → mL → L → qt

$$2.91\ lb \times \frac{453.6\,g}{1\ lb} \times \underbrace{\frac{1\ cm^3}{4.21\,g}}_{\text{Density}} \times \frac{1\ mL}{1\ cm^3} \times \frac{1\ L}{1000\ mL} \times \frac{1.057\,qt}{1\ L}$$

start

An object has a mass of 12.1 kilograms and a density of 4.5 g/mL. What is the volume of this object in fluid ounces? (1 fl oz = 29.57 mL)

fl → end

kg → g → mL → fl oz

$$12.1\ \text{kg} \times \frac{1000\ \text{g}}{1\ \text{kg}} \times \frac{1\ \text{mL}}{4.5\ \text{g}} \times \frac{1\ \text{fl oz}}{29.57\ \text{mL}} =$$

91 fl oz

Unit Conversion worksheet on webpage