W-GC General Chemistry Week 4 9/27

Gold : Density 19.3 g/mL

Statue 5 metric tonnes = _____ grams

$$5 \text{ tonnes} * \frac{1000 \text{ kg}}{1 \text{ tonne}} * \frac{1000 \text{ g}}{1 \text{ kg}}$$

5 ↑ 1 significant figure

$$5 \text{ tonnes} * \frac{10^3 \text{ kg}}{1 \text{ tonne}} * \frac{10^3 \text{ g}}{1 \text{ kg}}$$

$$5 * 10^{3+3} = 5 * 10^6 \text{ g} = \text{mass}$$

$VD = \left(\frac{M}{V}\right)V$ $\quad V = \frac{M}{D}$ $\quad D = \frac{M}{V}$ $\quad V = \frac{M}{D}$

$\frac{VD}{D} = \frac{M}{D}$ $\quad V = \frac{5 * 10^6 \text{ g}}{19.3 \text{ g/mL}} = 259067 \text{ mL}$

300000 mL

$3 * 10^5$ mL

B Statue : $3 * 10^5$ mL

Volume of a Frosty?

1 sig figs

$$20 \cancel{oz} * \frac{29.6\ mL}{1\ \cancel{oz}} = 592\ mL \rightarrow \boxed{600\ mL}$$

B Volume = $3 * 10^5$ mL

each Frosty 600 mL

How many frosty cup would it take to contain 1 Buddha

$$3 * 10^5\ mL * \frac{1\ \text{Frosty cup}}{600\ mL} = 500\ \text{cups}$$

300,000

1.) Mass: 28.5 g

Volume: 764 mL

D=?

$$D = \frac{M}{V}$$

$$D = \frac{28.5\ g}{764\ mL} = 0.037309\ g/mL$$

28.5 g: 3 sf; 764 mL: 3sf

$\boxed{0.0373\ g/mL}$

2.) Density: 2.16 g/mL

Volume: 8.3 mL

M=?

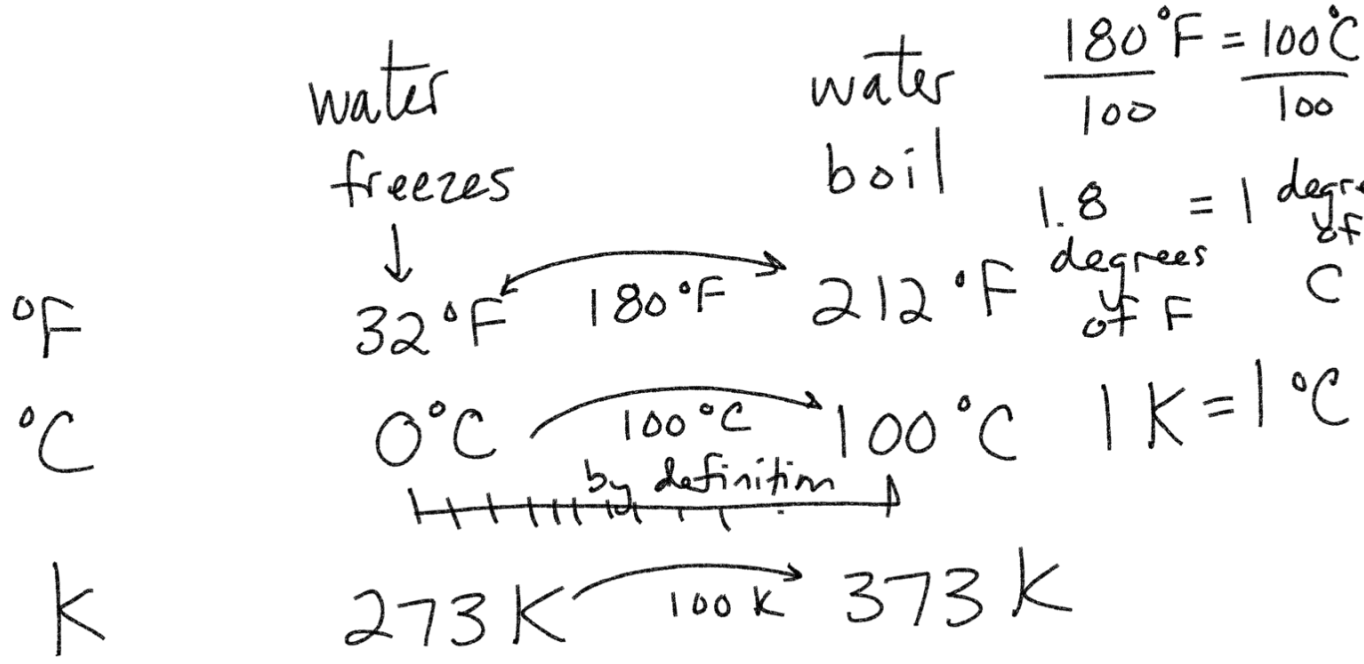
$$VD = \left(\frac{M}{V}\right)V$$

$$M = VD = (8.3\ \cancel{mL})(2.16\ g/\cancel{mL}) = 17.928\ g$$

8.3 mL: 2 sf; 2.16 g/mL: 3sf; 2 sf

$\boxed{18\ g}$

Farenheit scale



Celsius → is based on the freezing and boiling point of water.

Kelvin → based off of absolute zero

Absolute zero → no movement. (-273.15°C)

temperature is based off of movement

$K = {}^\circ C + 273$

$40\,^\circ C = \_\_\_\_ K$

$K = 40 + 273 = \boxed{313\,K}$

$^\circ C = K - 273$

$415\,K = \_\_\_\_ ?$

$^\circ C = 415 - 273 = \boxed{142\,^\circ C}$

$18\,^\circ C = \_\_\_\_ ^\circ F$ $\quad ^\circ F = 32 + 1.8(^\circ C)$

$= 32 + 1.8(18)$

$32 + 32.4$

$= 64.4 = \boxed{64\,^\circ F}$

$95\,^\circ F = \_\_\_\_ ^\circ C$

$^\circ C = \frac{5}{9}(^\circ F - 32)$

$\downarrow$

$\frac{5}{9}(95 - 32)$

$\frac{5}{9}(63) = \boxed{35\,^\circ C}$

Density is an intensive property — unrelated to the amount.

TABLE 1.4

Densities of Some Substances at 25°C

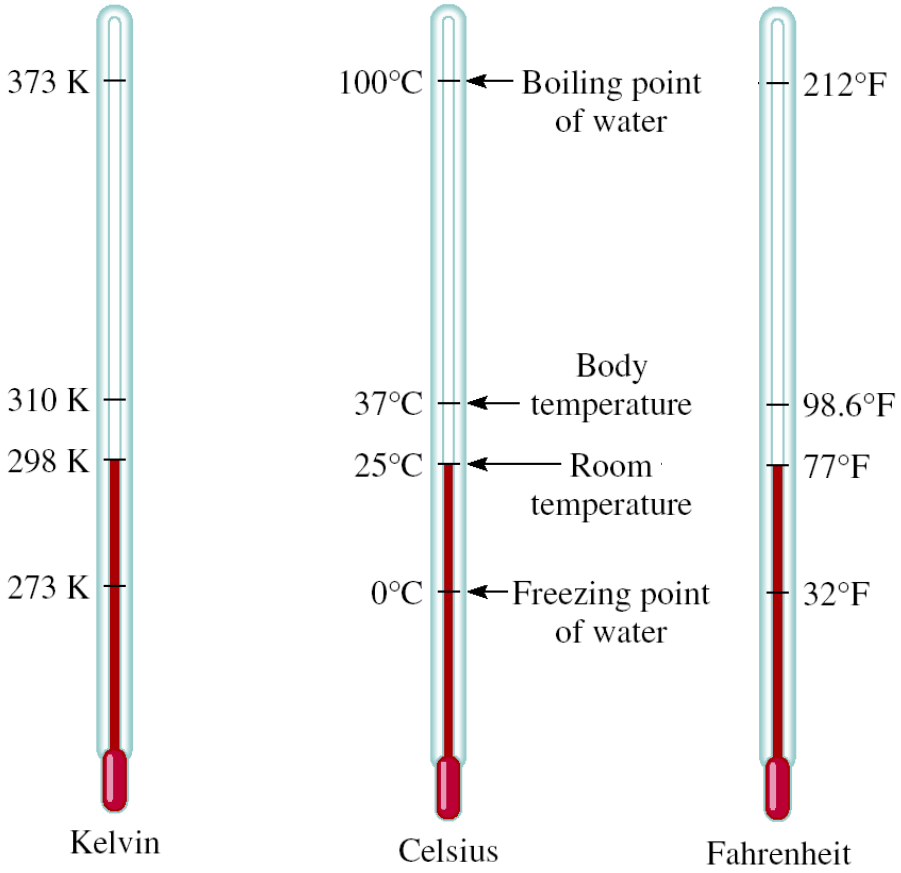
Substance	Density (g/cm^3)
Air*	0.001
Ethanol	0.79
Water @ room temp	1.00
Mercury	13.6
Table salt	2.2
Iron	7.9
Gold	19.3
Osmium†	22.6

*Measured at 1 atmosphere.
†Osmium (Os) is the densest element known.

Water that is 4 °C is the most dense version of water

$1\ cm^3 = 1\ mL$

A Comparison of Temperature Scales



Please know

$$K = {}^0C + 273.15$$

273 K = 0 ^{0}C

373 K = 100 ^{0}C

$^\circ F = 1.8\,^\circ C + 32$

try ...

$$^0F = \frac{9}{5} \times {}^0C + 32$$

32 ^{0}F = 0 ^{0}C

212 ^{0}F = 100 ^{0}C

$$^\circ C = (^\circ F - 32) * \frac{5}{9}$$

Convert 172.9 ^{0}F to degrees Celsius.

$$^0F = \frac{9}{5} \times {}^0C + 32$$

$$^0F - 32 = \frac{9}{5} \times {}^0C$$

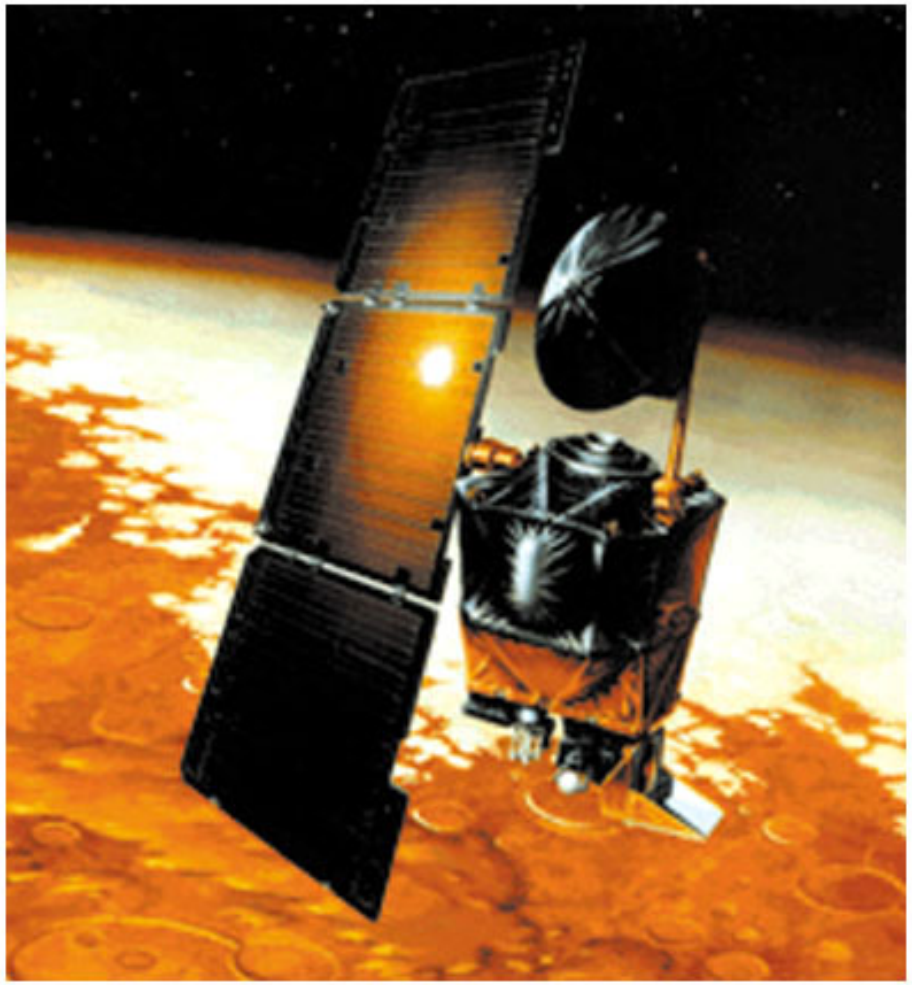
$$\frac{5}{9} \times (^0F - 32) = {}^0C$$

$$^0C = \frac{5}{9} \times (^0F - 32)$$

$$^0C = \frac{5}{9} \times (172.9 - 32) = 78.3$$

Chemistry In Action

On 9/23/99, $125,000,000 Mars Climate Orbiter entered Mar's atmosphere 100 km (62 miles) lower than planned and was destroyed by heat.



1 lb ≠ 1 N

1 lb = 4.45 N

"This is going to be the cautionary tale that will be embedded into introduction to the metric system in elementary school, high school, and college science courses till the end of time."

Scientific Notation

The number of atoms in 12 g of carbon:

602,200,000,000,000,000,000,000

6.022×10^{23}

The mass of a single carbon atom in grams:

0.00000000000000000000000199

1.99×10^{-23}

$N \times 10^{n}$

N is a number between 1 and 10

n is a positive or negative integer

Scientific Notation

568.762

← move decimal left

$n > 0$

$568.762 = 5.68762 \times 10^{2}$

0.00000772

→ move decimal right

$n < 0$

$0.00000772 = 7.72 \times 10^{-6}$

Addition or Subtraction

1. Write each quantity with the same exponent *n*
2. Combine N_1 and N_2
3. The exponent, *n*, remains the same

$4.31 \times 10^{4} + 3.9 \times 10^{3} =$

$4.31 \times 10^{4} + 0.39 \times 10^{4} =$

4.70×10^{4}

Scientific Notation

Multiplication

1. Multiply N_1 and N_2
2. Add exponents n_1 and n_2

$(4.0 \times 10^{-5}) \times (7.0 \times 10^{3}) =$
$(4.0 \times 7.0) \times (10^{-5+3}) =$
$28 \times 10^{-2} =$
2.8×10^{-1}

Division

1. Divide N_1 and N_2
2. Subtract exponents n_1 and n_2

$8.5 \times 10^{4} \div 5.0 \times 10^{9} =$
$(8.5 \div 5.0) \times 10^{4-9} =$
1.7×10^{-5}

Significant Figures

- Any digit that is not zero is significant

  1.234 kg 4 significant figures

- Zeros between nonzero digits are significant

  606 m 3 significant figures

- Zeros to the left of the first nonzero digit are **not** significant

  0.08 L 1 significant figure

- If a number is greater than 1, then all zeros to the right of the decimal point are significant

  2.0 mg 2 significant figures

- If a number is less than 1, then only the zeros that are at the end and in the middle of the number are significant

  0.00420 g 3 significant figures

How many significant figures are in each of the following measurements?

24 mL	2 significant figures
3001 g	4 significant figures
0.0320 m^3	3 significant figures
6.4 x 10^4 molecules	2 significant figures
560 kg	2 significant figures

Significant Figures

Addition or Subtraction

The answer cannot have more digits to the right of the decimal point than any of the original numbers.

89.332
+1.1 ⟵ one significant figure after decimal point
90.432 ⟵ round off to 90.4

3.70 ⟵ two significant figures after decimal point
-2.9133
0.7867 ⟵ round off to 0.79

Significant Figures

Multiplication or Division

The number of significant figures in the result is set by the original number that has the ***smallest*** number of significant figures

$$4.51 \times 3.6666 = 16.536366 = 16.5$$

3 sig figs

round to 3 sig figs

$$6.8 \div 112.04 = 0.0606926 = 0.061$$

2 sig figs

round to 2 sig figs

Significant Figures

Exact Numbers

Numbers from definitions or numbers of objects are considered to have an infinite number of significant figures

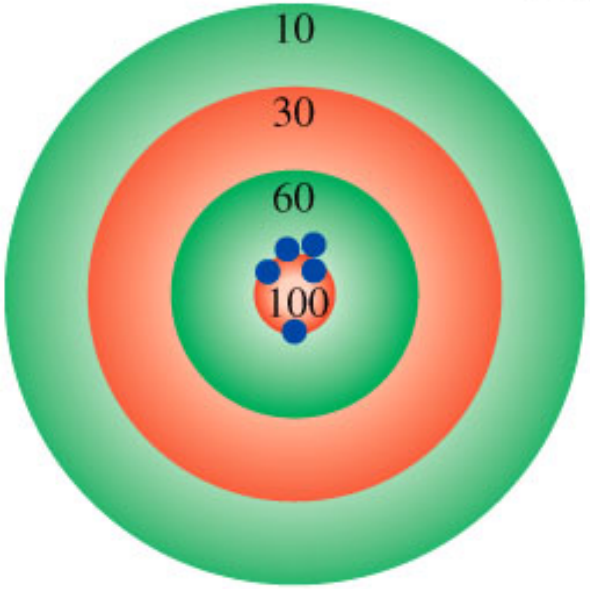
The average of three measured lengths; 6.64, 6.68 and 6.70?

$$\frac{6.64 + 6.68 + 6.70}{3} = 6.67333 = 6.67 = \cancel{7}$$

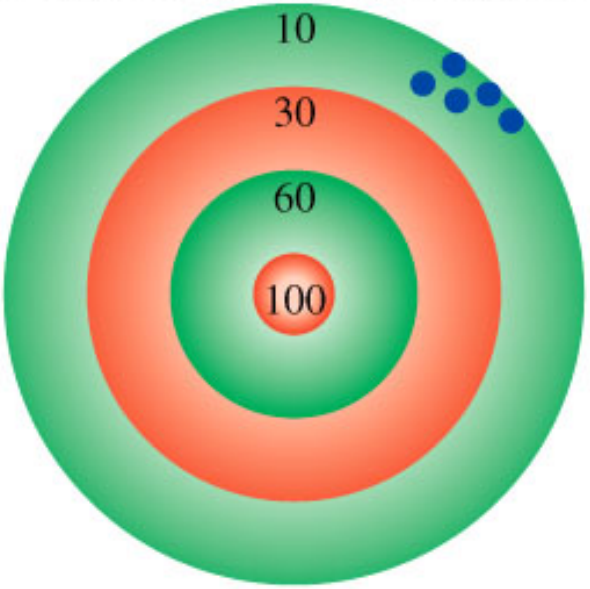
Because 3 is an ***exact number***

Accuracy – how close a measurement is to the *true* value

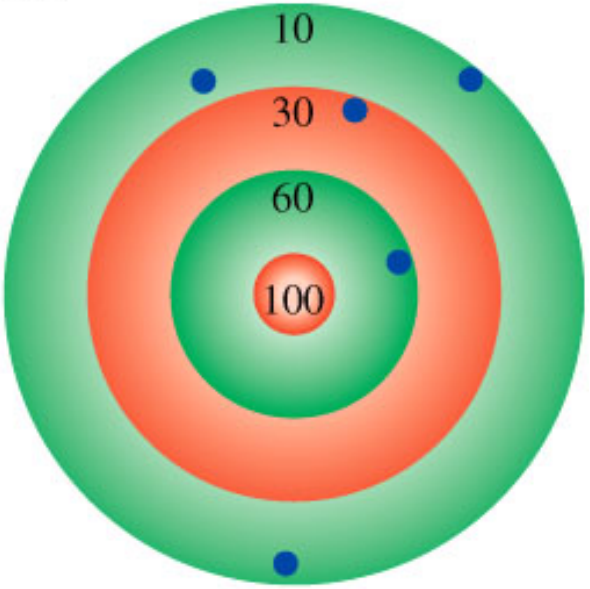
Precision – how close a set of measurements are to each other



accurate
&
precise



precise
but
not accurate



not accurate
&
not precise

Dimensional Analysis Method of Solving Problems

1. Determine which unit conversion factor(s) are needed
2. Carry units through calculation
3. If all units cancel except for the ***desired unit(s)***, then the problem was solved correctly.

given quantity x conversion factor = desired quantity

$$\text{given unit} \times \frac{\text{desired unit}}{\text{given unit}} = \text{desired unit}$$

Dimensional Analysis Method of Solving Problems

How many mL are in 1.63 L?

Conversion Unit 1 L = 1000 mL

$$1.63\ \cancel{L} \times \frac{1000\ mL}{1\ \cancel{L}} = 1630\ mL$$

$$1.63\ L \times \frac{1\ L}{1000\ mL} = 0.001630\ \frac{L^2}{mL}$$

The speed of sound in air is about 343 m/s. What is this speed in miles per hour?

conversion units

meters to miles

seconds to hours

1 mi = 1609 m 1 min = 60 s 1 hour = 60 min

$$343\ \frac{\cancel{m}}{\cancel{s}} \times \frac{1\ mi}{1609\ \cancel{m}} \times \frac{60\ \cancel{s}}{1\ \cancel{min}} \times \frac{60\ \cancel{min}}{1\ hour} = 767\ \frac{mi}{hour}$$