

AP Chem Summer Packet Introduction

Hello Everyone!

I hope you're having a great summer. I'm excited to get things started in AP Chemistry, and happy that you are all in this class!

In many ways, AP Chemistry is to honors Chemistry as Algebra II is to Algebra I. As such, many of the topics we will see this year (especially at the start) are exact repeats of material you've seen in Hchem. And like in Algebra II, we will proceed through it fairly quickly, often adding greater depth to the information along the way. Don't worry, we will always review the old chem material rather than just assume you remember it! But in this one case, chapter 1 with basic knowledge such as the metric system and conversion factors, we are going to review that material via this short packet.

What follows here are the first few pages of notes that would have come from chapter one. Please read through them, filling in the blanks left for you (for working problems or for explanations). To help facilitate your review, I have also sent a copy of a KEY for these notes, filled in with my version of the solutions/explanations. The assigned HW problems from chapter 1 are also included at the end of the document. On the first day of class, along with introductions and going over class expectations & policies, we will have time to ask questions about the chapter I notes. After that, we will spend no more time in class on chapter 1 review.

Those people who complete and hand in the chapter 1 HW problems on the first day of class will receive up to two bonus points on our first 100-point test, which will include chapters 1 and 2, as well as a little bit of chapter 19. That test will NOT be the first week of school. Students who do not hand in the chapter 1 HW on day one are not penalized; they are allowed to hand it in when they hand in the chapter 1/2/19 HW, but will not be eligible for the bonus.

Good luck, have a great summer, and feel free to email me if you have any general questions, problems with the packet, or if you have any HW questions that can't wait until the first day of class. Best wishes - see you in August!

Sincerely,

Ken Conner

CHAPTER 1: Introduction – Chemical Foundations

The first few chapters of this course (and chapters 1, 2, and 19 in particular) are an *extremely fast* review of material that was previously covered in honors chem.

The English, Metric, and SI Systems

The standard system of measurement in America is the English system of measurement (feet, lbs, gallons, miles, . . .) but different units of measure lack a standard factor of increase.

ex. 12 in = 1 ft. 3 ft. = 1 yd. 5.5 yds. = 1 rod 1760 yds. = 1 mile

For this reason, most other nations have switched over to the metric system of measure where measurements increase by factors of 10.

ex. 10 cm = 1 dm 10 dm = 1 m 1000 m = 1 km

	<u>ENGLISH</u>	<u>METRIC</u>
LENGTH	foot	meter
VOLUME	gallon	liter
MASS	slug (lb.)	gram
TIME	second	second

In order to measure to varying accuracies, prefixes are used with the standard units. (*explain*)

<u>PREFIX</u>	<u>SYMBOL</u>	<u>FACTOR</u>
exa-	E	10^{18}
peta-	P	10^{15}
tera-	T	10^{12}
giga-	G	10^9
mega-	M	10^6
kilo-	k	10^3
hecto-	h	10^2
deca-	da	10^1
- - -	--	10^0
deci-	d	10^{-1}
centi-	c	10^{-2}
milli-	m	10^{-3}
micro-	μ	10^{-6}
nano-	n	10^{-9}
pico-	p	10^{-12}
femto-	f	10^{-15}
atto-	a	10^{-18}

You are required to know from “nano-” through “giga-” long-term

There is a short cut to convert between metric prefixes that bypasses using *conversion factors* as a part of *dimensional analysis*.

To convert from prefix A to prefix B, take the power of ten from A minus the power of ten from B, and adjust the decimal accordingly. Remember, positive moves decimal to right, negative moves it to the left.

exs: convert 25.7 μg to cg

convert 3.07×10^{-5} km to nm

NOTE: while the liter is the metric unit of volume, but from geometry, we know $V = l \cdot w \cdot h$, so volume can be expressed as length^3 , like in^3 , ft^3 , cm^3 (= cc's)

$$*** \quad 1 \text{ mL} = 1 \text{ cm}^3 \quad ***$$

$$*** \quad 1 \text{ L} = 1 \text{ dm}^3 \quad ***$$

ex. How many cc's are in .758 Liters?

*****CONVERSIONS*****

$$1 \text{ in.} = 2.54 \text{ cm}$$

$$1 \text{ ft.} = .305 \text{ m} \rightarrow \text{not exact!}$$

$$1 \text{ yd.} = .9144 \text{ m}$$

$$1 \text{ qt.} = .946 \text{ L}$$

$$1 \text{ lb.} = 454 \text{ g} (= .454 \text{ kg})$$

We can convert measurements b/t English and Metric by using *conversion factors*. This process is called *dimensional analysis*.

Every conversion factor in a dimensional analysis problem is actually a special case of what mathematical property?

exs. A stick is 10.2 inches long, how long is it in centimeters?

We can use the inverted factor to find the length in feet of a coil of rope is 2500 cm long in inches or even feet.

This process can be used for ANY of the previously listed conversions. ANY equation can be made into a conversion factor.

SHORT CUT: Just remember to put the unit that you're going TO on TOP and the unit that you're coming FROM goes on BOTTOM. (unless it is inverted)

exs. If an ounce is exactly $1/16$ of a pound, what is the mass in grams of a rock weighing 18.3 ounces?

An givenn car has an average fuel efficiency of 32.5 miles per gallon. Convert this to kilometers per liter.

Look at the words – how many QUARTS are in a gallon?

How many liters are in 87.4 in^3 ?

Review of Significant Digits

Any calculations that we make are subject to some uncertainty. In the real world, measurements are rarely exact. There is always some error. To account for this, we use significant digits to keep our calculations consistent. A summary of the 5* rules is listed below:

- (1) All non-zero digits are significant. 374 () 589.2 ()
- (2) All zeroes between two non-zero digits ARE significant. 10.006 () 103,001 ()
- (3) All zeroes to the right of a non-zero digit NOT followed by a decimal are NOT significant unless indicated by a decimal or a bar above the zero.
 109,000 () 109 $\overline{0}$ 00 () 5.0×10^5 () 500. ()
- (4) All zeroes to the right of a decimal but to the left of a non-zero digit and a decimal are NOT significant. 0.005 () 0.00301 () 1050.001 ()
- (5) All zeroes to the right of BOTH a non-zero digit and a decimal are significant.
 1000.00 () 103.0 () 1.3000 () 100,000.0040 ()
- (5a) Exact numbers have an infinite number of significant digits! (Why is this true?)
 exs. 1 ft. is exactly 12 in. 1 meter is exactly 100 cm 98 people is exact, but 100 isn't

RULE FOR ADDING AND SUBTRACTING WITH SIG. FIGURES??

RULE FOR MULTIPLICATION AND DIVISION WITH SIG. FIGURES??

exs: $97.381 + 4.2502 + 0.99195$

$5.1 \times 10^{-3} - 3.6 \times 10^{-4}$

$$\frac{9.2 \times 100.65}{8.932}$$

$$\frac{(6.626 \times 10^{-34})(2.998 \times 10^8)}{2.54 \times 10^{-9}}$$

Introduction to Chemistry

CHEMISTRY is a **physical** science based on knowledge gained from application of the scientific method. More specifically, Chemistry is the science of materials, their composition and structure, and the changes they undergo.

There are three steps to the scientific method:

- (1) Make Observations
- (2) Form a Hypothesis (possible explanation)
- (3) Perform Experiments

If hypotheses agree with observations, they are grouped into a *theory* or *model*. Theories are tested by experiments, and adjusted to fit the results. (*Background, Hypothesis, Purpose, Method, Data, Results*)

Scientific knowledge is often classified as a **law** or a **theory**. A LAW summarizes observed phenomenon (often with a formula) whereas a THEORY (or model) attempts to explain **why** the observed phenomenon happens.

def: *Matter* is anything that occupies space and has mass. *exs.* water, air, rocks, people

def: *Mass* is a measure of the amount of matter a body possesses.

def: *Weight* is the measure of the Earth's attraction for a body. Weight is a result of gravity while mass is not.

THE MASS OF A BODY IS CONSTANT. ITS WEIGHT IS NOT.

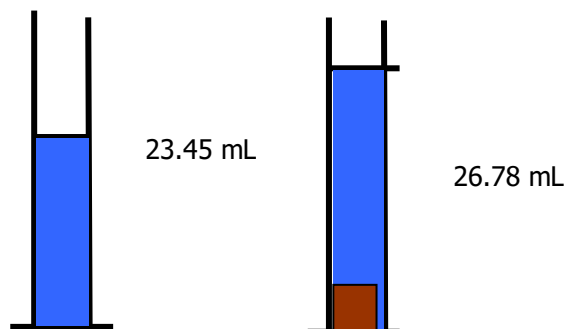
exs. wt. on moon, weightless in space, wt. on Jupiter.

(On the surface of the earth - wt. & mass can be used interchangeably.)

def: The *density* of a substance is its mass per unit of volume. i.e.

$$d = \frac{m}{V}$$

ex: A graduated cylinder with 23.45 mL of water in it is shown at right before and after a piece of metal is dropped into the cylinder. If the metal is known to have a density of 2.70 g/mL, find the mass of the submerged sample of metal.



In more advanced problems, the density can be used as a conversion factor.

For example, at a given temp, the density of iron is known to be 7.87 g/cm³.

What two different conversion factors can be made from this density?

ex: Assuming that individual 45.0 lb. weights in the workout room are made of iron, use the given density of iron (above) to find the volume in quarts of one of these weights.

Matter has three phases:

solid

def shape & def vol

rocks, etc. . . "glass"

liquid

def vol no def shape

water, . . .

gas

neither def vol nor def shape

air, . . .

def: Anything that does not have definite shape is referred to as *fluid*. exs. liquids and gases.

A GAS exists in gaseous form at room temperature and normal pressure. A VAPOR is something which is normally not a gas a normal temp. and pressure.

exs. water vapor, oxygen, nitrogen

def: Matter that has parts with different properties is HETEROGENEOUS.

ex. cement with rocks in it, cereal and milk, people, . . .

def: Matter that has identical properties throughout is HOMOGENEOUS.

ex. sugar crystals, salt rock, water, . . .

def: A *mixture* is a combination of substances that are NOT chemically joined. They can be separated by ordinary physical means (filtration, distillation, chromatography).

ex. cereal and milk, salt and sand, mud, ink . . .

def: A *compound* is a combination of elements that cannot be separated by physical means but can be separated by ordinary chemical means.

ex. water (electrolysis), sugar (carbon and water)

def: An *element* is a substance that cannot be further divided by ordinary chemical means.

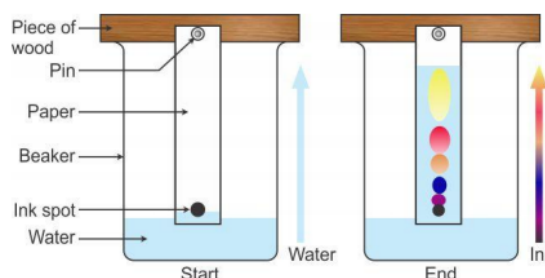
ex. Oxygen, Carbon, Iron, . . .

Most of our physical means of separation are readily apparent (filtration, manual separation).

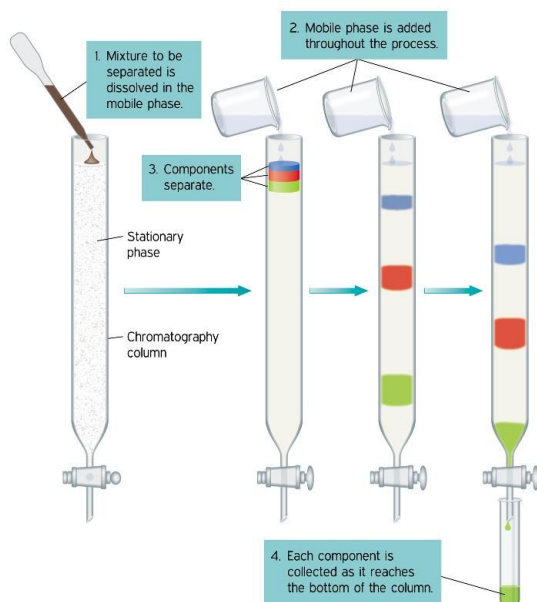
What is meant by “Distillation”?

Another unusual means of physical separation is “Chromatography” which comes in several forms, but the two most common are “paper chromatography” and “column chromatography”.

In paper chromatography, water or some other solvent is used to pass through the substance (often ink or biological reagents) and dissolve it. Substances will separate based on mass and/or how well they match the polarity of the solvent!



Paper Chromatography



For substances more complicated than ink, column chromatography is often used.

In column chromatography, a column is prepared with a stationary phase (that doesn't move – usually polar, like a silica gel) and then a mobile phase (usually non-polar) is added.

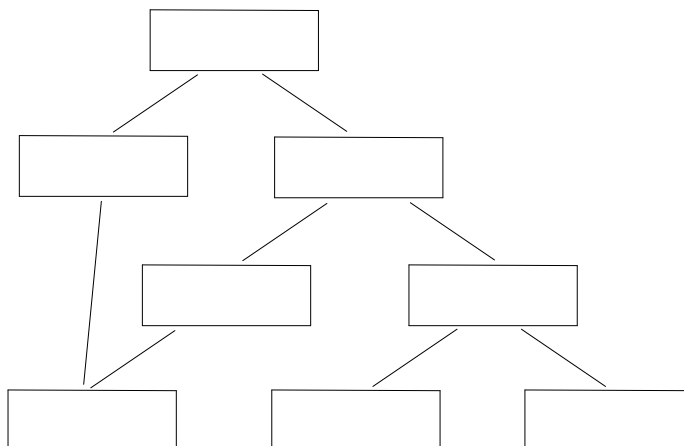
The trick is that the stationary phase and the mobile phases must be OPPOSITE polarities!

Things that match the polarity of the stationary phase tend to move more slowly, and things that match the polarity of the mobile phase move more quickly. Once they reach the bottom, they can be collected separately!

In making mixtures, the components **do not** lose their identity (sugar & salt), while in making compounds, components **do** lose their identity.

ex. sodium (explosive w/ water) + chlorine (poisonous gas) -----> salt (neither explosive nor poisonous)

common examples of mixtures, elements, and CMPDS - Air, sugar, carbon dioxide, concrete, soil, rubbing alcohol, salt water, salt, . . .



def: A *physical change* is one where the substance changes form, but not composition. It physically changes but is still the same “chemical”.

ex. ice to water - it is still H₂O

other changes?

def: A *chemical change* is one where the substance changes composition. It becomes a different compd(s).

A change in physical properties is generally an indicator of a chemical change. For example, if something changes color, it has probably turned into a new substance.

exs?

Temperature

def: The *temperature* of a system is the measure of its ability to transfer or acquire heat from other systems. Temperature can be measured in Fahrenheit, Celsius, or Kelvin.

(discuss idea of coldness is just absence of heat. Heat is transferred, cold is not.)

def: *Absolute Zero* is the coldest possible temperature, and has a value of -273.15 °C.

Celsius/Fahrenheit: °C = 5/9 (°F – 32) and °F = (9/5)°C + 32.

Another important way to measure temperature is in degrees Kelvin. It is designed so that absolute zero has a temperature of 0 K. We can say K = °C + 273.15 and °C = K – 273.15.

*(273.15 is **not** exact)*

Accuracy and Precision

ACCURACY

vs.

PRECISION



Good Accuracy
Good Precision



Bad Accuracy
Bad Precision



Bad Accuracy
Good Precision



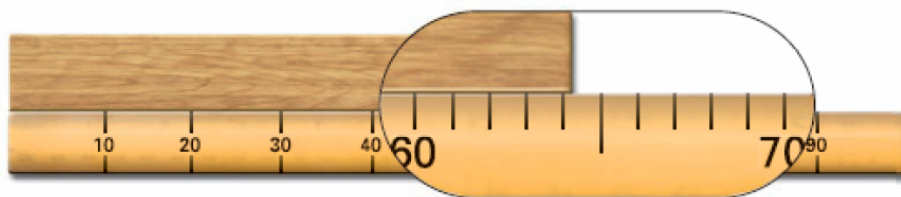
Good Accuracy
Bad Precision

Accuracy is measured in terms of *error*, while precision is measured in terms of *deviation*.

To be as accurate as scientifically allowed, you are **required** to estimate one decimal place past the smallest denoted hashmark.

So for example, what would be the best reading for the following two measurements of the same stick?

- 1) _____
2) _____



And if we had more and more markings as we zoomed closer and closer, we could be even more precise with our measurement!

HW Problems from Ch. 1

pp. 32 Review Questions: #'s 4, 5, 8

pp. 32-33 Active Learning Questions: #'s 4, 15

pp. 33-34h, Questions/Exercises: #'s 19, 42, **44**, 47a, 48, **51**, 54, 57, 61ab, 63ab, 64d, 69, 74, 77, 86, 87, 91, 98, 107, **119**

BOLD → English, Metric, SI Units, converting English-English or metric-metric

Italic → Converting b/t English and Metric and Sig Figs

Underline → Temp, Mass/Matter, Chemical vs. Physical, density, accuracy vs. precision

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mega-	M	10^6
kilo-	k	10^3
hecto-	h	10^2
deca-	da	10^1
---	--	10^0
deci-	d	10^{-1}
centi-	c	10^{-2}
milli-	m	10^{-3}
micro-	μ	10^{-6}
nano-	n	10^{-9}
pico-	p	10^{-12}
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atto-	a	10^{-18}

You are required to know from “nano-” through “giga-” long-term

There is a short cut to convert between metric prefixes that bypasses using *conversion factors* as a part of *dimensional analysis*.

To convert from prefix A to prefix B, take the power of ten from A minus the power of ten from B, and adjust the decimal accordingly. Remember, positive moves decimal to right, negative moves it to the left.

exs: convert 25.7 μg to cg

$$10^{-6} \rightarrow 10^{-2}$$

$$-6 - (-2) = -4$$

$$\cancel{25.7} = \boxed{.00257 \text{ cg}}$$

convert $3.07 \times 10^{-5} \text{ km}$ to nm

$$10^3 \rightarrow 10^{-9}$$

$$3 - (-9) = 12$$

$$3.07 \times 10^{-5} \times 10^{12} = \boxed{3.07 \times 10^7 \text{ nm}}$$

NOTE: while the liter is the metric unit of volume, but from geometry, we know $V = l \times w \times h$, so volume can be expressed as length^3 , like in^3 , ft^3 , cm^3 (= cc's)

$$*** \quad 1 \text{ mL} = 1 \text{ cm}^3 \quad ***$$

$$*** \quad 1 \text{ L} = 1 \text{ dm}^3 \quad ***$$

ex. How many cc's are in .758 Liters?

$$\cancel{.758 \text{ L}} \times \frac{1 \text{ mL}}{10^{-3} \text{ L}} \times \frac{1 \text{ cm}^3}{1 \text{ mL}} = \boxed{758 \text{ cc's}}$$

*****CONVERSIONS*****

$$1 \text{ in.} = 2.54 \text{ cm}$$

$$1 \text{ ft.} = .305 \text{ m}$$

$$1 \text{ yd.} = .914 \text{ m}$$

$$1 \text{ qt.} = .946 \text{ L}$$

$$1 \text{ lb.} = 454 \text{ g} (= .454 \text{ kg})$$

We can convert measurements b/t English and Metric by using *conversion factors*. This process is called *dimensional analysis*.

Every conversion factor in a dimensional analysis problem is actually a special case of what mathematical property?

Mult. Prop. of 1

exs. A stick is 10.2 inches long, how long is it in centimeters?

$$10.2 \text{ in} \times \frac{2.54 \text{ cm}}{1 \text{ in}} = 25.908$$

$$\boxed{25.9 \text{ cm}}$$

We can use the inverted factor to find the length in feet of a coil of rope is 2500 cm long in inches or even feet.

$$2500 \text{ cm} \times \frac{1 \text{ in}}{2.54 \text{ cm}} \times \frac{1 \text{ ft.}}{12 \text{ in}} =$$

$$\boxed{\frac{780 \text{ in}}{82 \text{ ft}}}$$

This process can be used for ANY of the previously listed conversions. ANY equation can be made into a conversion factor.

SHORT CUT: Just remember to put the unit that you're going TO on TOP and the unit that you're coming FROM goes on BOTTOM. (unless it is inverted)

exs. If an ounce is exactly 1/16 of a pound, what is the mass in grams of a rock weighing 18.3 ounces?

$$18.3 \cancel{\text{oz}} \times \frac{1 \cancel{\text{lb}}}{16 \cancel{\text{oz}}} \times \frac{454 \text{g}}{1 \cancel{\text{lb}}} = 519. \cancel{20} \quad \boxed{519 \text{g}}$$

An given car has an average fuel efficiency of 32.5 miles per gallon. Convert this to kilometers per liter.

Look at the words – how many QUARTS are in a gallon?

$$\frac{32.5 \cancel{\text{mi}}}{\cancel{\text{gal}}} \times \frac{1760 \cancel{\text{yd}}}{1 \cancel{\text{mi}}} \times \frac{914 \cancel{\text{m}}}{1 \cancel{\text{yd}}} \times \frac{1 \cancel{\text{km}}}{1000 \cancel{\text{m}}} \times \frac{1 \cancel{\text{gal}}}{4 \cancel{\text{qt}}} \times \frac{1 \cancel{\text{qt}}}{.946 \cancel{\text{L}}} = \boxed{13.8 \text{ km/L}}$$

How many liters are in 87.4 in³?

$$87.4 \cancel{\text{in}^3} \times \left(\frac{2.54 \cancel{\text{cm}}}{1 \cancel{\text{in}}} \right)^3 \times \frac{1 \cancel{\text{mL}}}{1 \cancel{\text{cm}^3}} \times \frac{10^{-3} \text{L}}{1 \cancel{\text{mL}}} = \boxed{.222 \text{L}}$$

Review of Significant Digits

Any calculations that we make are subject to some uncertainty. In the real world, measurements are rarely exact. There is always some error. To account for this, we use significant digits to keep our calculations consistent. A summary of the 5* rules is listed below:

- (1) All non-zero digits are significant. 374 (**3**) 589.2 (**4**)
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 1000.00 (**6**) 103.0 (**4**) 1.3000 (**5**) 100,000.0040 (**10**)
- (5a) Exact numbers have an infinite number of significant digits! (Why is this true?)
 exs. 1 ft. is exactly 12 in. 1 meter is exactly 100 cm 98 people is exact, but 100 isn't

RULE FOR ADDING AND SUBTRACTING WITH SIG. FIGURES??

Compute the sum/diff & round answer to the LEAST ACCURATE COLUMN!!

RULE FOR MULTIPLICATION AND DIVISION WITH SIG. FIGURES??

Compute the product/quotient & round answer to the same # of figs as the factor w/ the least!

exs: $97.381 + 4.2502 + 0.99195$

$$\begin{array}{r} 97.381 \\ 4.2502 \\ 0.99195 \\ \hline 102.62315 \end{array}$$

102.623

2 figs $\frac{9.2 \times 100.65}{8.932}$

$$\frac{9.2 \times 100.65}{8.932} = 103.669951$$

100 or 1.0×10^2

$5.1 \times 10^{-3} - 3.6 \times 10^{-4}$

$$\begin{array}{r} .0051 \\ - .00036 \\ \hline .00474 \end{array}$$

.0047

$(6.626 \times 10^{-34})(2.998 \times 10^8)$

3 figs $\frac{2.54 \times 10^{-9}}{7.82076 \times 10^{-17}}$

7.82×10^{-17}

Introduction to Chemistry

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THE MASS OF A BODY IS CONSTANT. ITS WEIGHT IS NOT.

exs. wt. on moon, weightless in space, wt. on Jupiter.

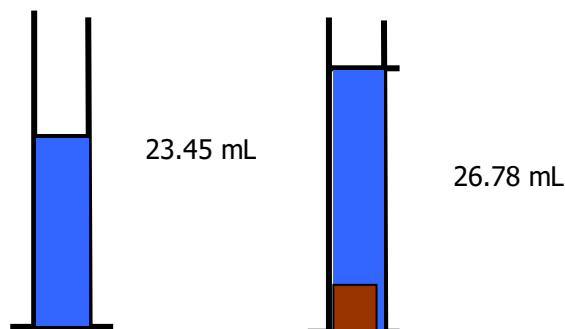
(On the surface of the earth - wt. & mass can be used interchangeably.)

def: The *density* of a substance is its mass per unit of volume. i.e.

$$d = \frac{m}{V}$$

ex: A graduated cylinder with 23.45 mL of water in it is shown at right before and after a piece of metal is dropped into the cylinder. If the metal is known to have a density of 2.70 g/mL, find the mass of the submerged sample of metal.

$$\begin{array}{r} 26.78 \\ - 23.45 \\ \hline 3.33 \text{ mL} \end{array} \times \frac{2.70 \text{ g}}{1 \text{ mL}} = \boxed{9.00 \text{ g}}$$



In more advanced problems, the density can be used as a conversion factor.

For example, at a given temp, the density of iron is known to be 7.87 g/cm³.

What two different conversion factors can be made from this density?

$$\frac{7.87 \text{ g}}{1 \text{ cm}^3} \text{ or } \frac{1 \text{ cm}^3}{7.87 \text{ g}}$$

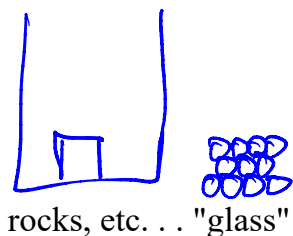
ex: Assuming that individual 45.0 lb. weights in the workout room are made of iron, use the given density of iron (above) to find the volume in quarts of one of these weights.

$$45.0 \text{ lb} \times \frac{454 \text{ g}}{1 \text{ lb}} \times \frac{1 \text{ cm}^3}{7.87 \text{ g}} \times \frac{1 \text{ mL}}{1 \text{ cm}^3} \times \frac{10^{-3} \text{ L}}{1 \text{ mL}} \times \frac{1 \text{ qt}}{0.946 \text{ L}} \times \frac{1 \text{ gal}}{4 \text{ qt}} = \boxed{0.686 \text{ gal}}$$

Matter has three phases:

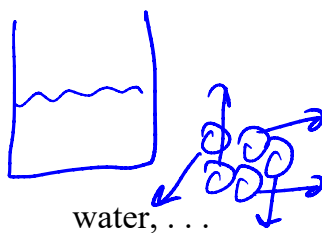
solid

def shape & def vol



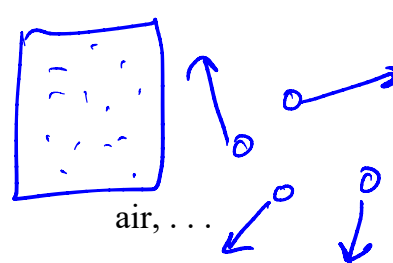
liquid

def vol no def shape



gas

neither def vol nor def shape



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exs. water vapor, oxygen, nitrogen

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ex. cement with rocks in it, cereal and milk, people, . . .

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ex. sugar crystals, salt rock, water, . . .

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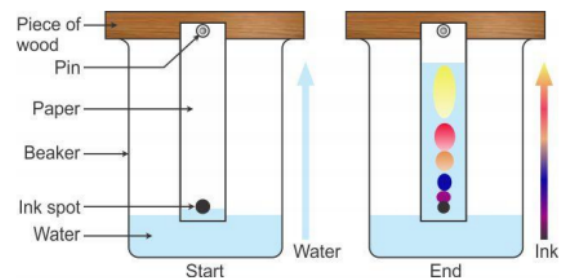
ex. Oxygen, Carbon, Iron, . . .

Most of our physical means of separation are readily apparent (filtration, manual separation).

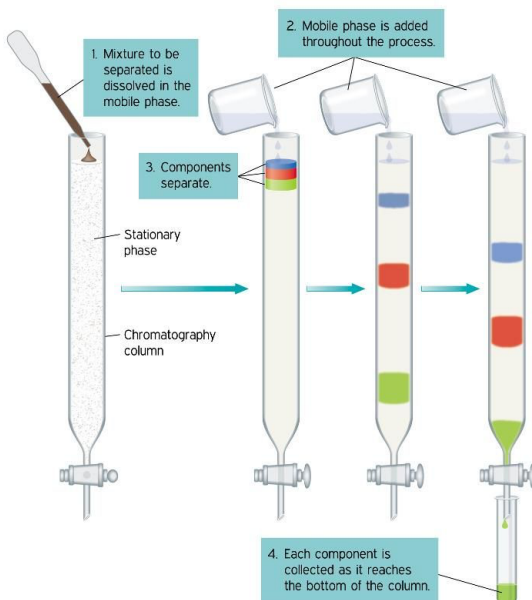
What is meant by "Distillation"? *using heating @ a specific temperature to boil off one liquid at a time.*

Another unusual means of physical separation is "Chromatography" which comes in several forms, but the two most common are "paper chromatography" and "column chromatography".

In paper chromatography, water or some other solvent is used to pass through the substance (often ink or biological reagents) and dissolve it. Substances will separate based on mass and/or how well they match the polarity of the solvent!



Paper Chromatography



For substances more complicated than ink, column chromatography is often used.

In column chromatography, a column is prepared with a stationary phase (that doesn't move – usually polar, like a silica gel) and then a mobile phase (usually non-polar) is added.

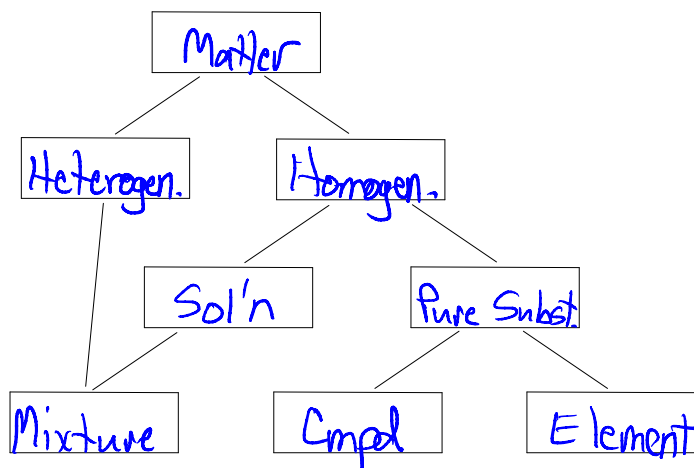
The trick is that the stationary phase and the mobile phases must be OPPOSITE polarities!

Things that match the polarity of the stationary phase tend to move more slowly, and things that match the polarity of the mobile phase move more quickly. Once they reach the bottom, they can be collected separately!

In making mixtures, the components **do not** lose their identity (sugar & salt), while in making compounds, components **do** lose their identity.

ex. sodium (explosive w/ water) + chlorine (poisonous gas) -----> salt (neither explosive nor poisonous)

common examples of mixtures, elements, and compounds - Air, sugar, carbon dioxide, concrete, soil, rubbing alcohol, salt water, salt, ...



def: A *physical change* is one where the substance changes form, but not composition. It physically changes but is still the same “chemical”.

ex. ice to water - it is still H₂O

other changes? *crush rock salt, wood chips, boiling, ...*

def: A *chemical change* is one where the substance changes composition. It becomes a different compd(s).

A change in physical properties is generally an indicator of a chemical change. For example, if something changes color, it has probably turned into a new substance.

exs? *burn wood, cook steak, iron rusts, Avocado browns, ...*

Temperature

def: The *temperature* of a system is the measure of its ability to transfer or acquire heat from other systems. Temperature can be measured in Fahrenheit, Celsius, or Kelvin.

(discuss idea of coldness is just absence of heat. Heat is transferred, cold is not.)

def: *Absolute Zero* is the coldest possible temperature, and has a value of -273.15 °C.

Celsius/Fahrenheit: °C = 5/9 (°F – 32) and °F = (9/5)°C + 32.

Another important way to measure temperature is in degrees Kelvin. It is designed so that absolute zero has a temperature of 0 K. We can say K = °C + 273.15 and °C = K – 273.15.

(273.15 is **not** exact)

Accuracy and Precision

ACCURACY

nearness to the correct value

vs.

PRECISION

nearness to each other



Good Accuracy
Good Precision



Bad Accuracy
Bad Precision



Bad Accuracy
Good Precision



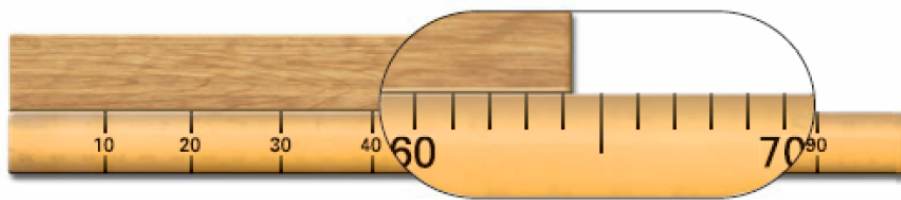
Good Accuracy
Bad Precision

Accuracy is measured in terms of *error*, while precision is measured in terms of *deviation*.

To be as accurate as scientifically allowed, you are **required** to estimate one decimal place past the smallest denoted hashmark.

So for example, what would be the best reading for the following two measurements of the same stick?

- if marks to 10's col... 1) closer to 60... infer 64
- if marks to ones ... 2) closer to 64 than to 65 ... infer 64.3-ish?



And if we had more and more markings as we zoomed closer and closer, we could be even more precise with our measurement!

HW Problems from Ch. 1

pp. 32 Review Questions: #'s 4, 5, 8

pp. 32-33 Active Learning Questions: #'s 4, 15

pp. 33-34h, Questions/Exercises: #'s 19, 42, **44**, 47a, 48, **51**, 54, 57, 61ab, 63ab, 64d, 69, 74, 77, 86, 87, 91, 98, 107, **119**

BOLD → English, Metric, SI Units, converting English-English or metric-metric

Italic → Converting b/t English and Metric and Sig Figs

Underline → Temp, Mass/Matter, Chemical vs. Physical, density, accuracy vs. precision