1.7 - 1.10 – Dimensional Analysis, Classification of Matter Review

Feb 22-12:27 PM

Dimensional Analysis (Conversions)

Use a conversion factor to change units: ratio of equivalent values with different units.

Examples:

$$\frac{1\text{ mL}}{1\text{ cm}^3} \qquad \frac{3.0\text{ feet}}{1\text{ yard}} \qquad \frac{100\text{ cm}}{1\text{ m}}$$

Note: Conversion factors can be written TWO ways.

Relation: 1000 m = 1 km

Two factors for this are: $\frac{1000\,m}{1\,km}$ and $\frac{1\,km}{1000\,m}$

You have to choose the right one.

Feb 22-12:27 PM

Conversion Process (Resource P. 3)

A. Write down the value to convert.

Ex: 0.0067 m to nm

B. Multiply by a factor with the unit you want in the numerator, and the other in denominator. (Use the Table)

$$0.0067\,m \times \frac{1E9\,nm}{1\,m}$$

C. Cancel units and perform math operations.

$$0.0067\,\cancel{m} \times \frac{1E9\,nm}{1\,\cancel{m}} = 6.7E6\,nm$$

D. For multiple step conversions, add conversion factors, making sure that the undesired units cancel.

Aug 29-11:02 AM

Conversions Practice

With a table partner, convert:

1. 360 s to ms $360\,\cancel{s} \cdot \frac{1000\,ms}{1\,\cancel{s}} = 360{,}000\,ms$

2. 46 m/s to km/hr $\frac{46\,\cancel{m}}{1\,\cancel{s}} \cdot \frac{1\,km}{1000\,\cancel{m}} \cdot \frac{3600\,\cancel{s}}{1\,hr} = 165.6\,km/hr$

$= 170\,km/hr\,(2\,sig.\,figs.)$

3. 589.0 mm to km

$$589\,\cancel{mm} \cdot \frac{1\,\cancel{m}}{1000\,\cancel{mm}} \cdot \frac{1\,km}{1000\,\cancel{m}} = 5.89E-4\,km$$

Feb 22-12:27 PM

Multi Step Example

5. How many seconds in one year?

$$1\,year \cdot \frac{365\,\cancel{days}}{1.0\,\cancel{year}} \cdot \frac{24\,\cancel{hours}}{1\,\cancel{day}} \cdot \frac{60\,\cancel{minutes}}{1\,\cancel{hour}} \cdot \frac{60\,\cancel{seconds}}{1\,\cancel{minute}}$$

= 31,536,000 seconds!

Feb 22-12:27 PM

Temperature

Measure of thermal (kinetic) energy in a sample. Three systems commonly used, Fahrenheit, Celsius, Kelvin (which doesn't use "degrees").

ºF: Water freezes at 32 ºF, boils at 212 ºF.

ºC: Water freezes at 0 ºC, boils at 100 ºC.

K: Water freezes at 273 K , boils at 373 K. Kelvin is based on an ABSOLUTE scale: the lowest theoretical temperature is 0 K.

Feb 22-11:52 AM

Conversions: Resource Page 4

ºC to ºF : $^{\circ}F = 1.8\left(^{\circ}C\right) + 32$

ºF to ºC : $^{\circ}C = \dfrac{\left(^{\circ}F - 32\right)}{1.8}$

K to ºC: $^{\circ}C = K - 273$

ºC to K : $K = ^{\circ}C + 273$

Feb 22-11:52 AM

Temperature Examples

6. It's 70 ºF outside Hutch. What is that in ºC?

70.0 ºF = 21.1 ºC.

7. In London it's 12.0 ºC. What is that in ºF?

12.0 ºC = 53.6 ºF.

8. A lab reports their apparatus operating at 114 Kelvins. What's that in ºC? ºF?

114 Kelvins = -159ºC. -254 ºF.

Feb 22-11:52 AM

Density

Property of matter – amount of mass per volume.

$$\rho = \frac{mass\,(g)}{volume\,(mL)} = \frac{m}{v}$$

Symbol ρ = Greek letter Rho. This is NOT a unit!

Units are g/mL (or g/cm^3).

Feb 22-11:52 AM

Density Examples

9. What is the density of a piece of wood with a volume of 62.5 mL, and a mass of 50.0 grams?

$$\rho = \frac{m}{v} = \frac{50.0\,g}{62.5\,mL} = 0.800\,g/ml$$

Feb 22-11:52 AM

Density Examples

10. The density of gold is 19.3 g/mL. What is the volume of this ring if its mass is 8.26 g? (Assume it's pure.)

$\rho = \dfrac{m}{v}$ **Algebraic Shuffle**

$\rho \bullet v = m$

$$v = \frac{m}{\rho} = \frac{8.26\,g}{19.3\,\frac{g}{mL}} = 0.428\,ml$$

These three equations might be worth noting.

Feb 22-11:52 AM

11. Dimensional Analysis

With table partner, figure out how we ended up with units of mL, starting with volume:

$$V = \frac{m}{\rho} = \frac{g}{\frac{g}{ml}} = \frac{\frac{g}{1}}{\frac{g}{ml}} = \frac{\cancel{g}}{1} \bullet \frac{ml}{\cancel{g}} = ml$$

Feb 22-11:52 AM

Substances

What is matter?
Anything with mass that takes up space.

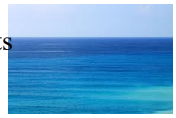
Substance: Matter with uniform composition.

12. Is water a pure substance? Discuss this and write.

Distilled water – Yes
– Hydrogen and Oxygen

Tap water – No
– Different minerals at different locations.

Sea water?
– No – Different components organisms, minerals, etc.



Feb 27-12:32 PM

States of Matter

Matter occurs in four different forms:
Solid: Definite shape and volume.
Liquid: Definite volume, takes container's shape, flows.
Gas: Flows, fills entire container's volume, particles far apart. Compressible.
Plasma: Energetic, gas-like state of matter: atoms are separated from electrons. Stars, Eye of the Storm.
Demo: Jacob's Ladder.




Feb 27-12:32 PM

Gas vs. Vapor

Gas - exists as only a gas at room temperature (Or whatever temperature the conditions are set to).

Vapor - gaseous form of a solid or liquid at room temperature.
Example: Water can be in gaseous form at room temperature or lower.

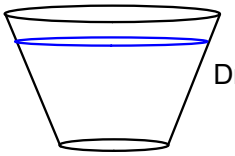
Feb 27-12:32 PM

Mixture

Two or more substances together which can consist of solids, liquids, gases, or combinations.

Heterogeneous – Does not blend smoothly.
13. Discuss and provide two examples.
Iced tea, gravel in water.

Homogeneous – Constant composition throughout.
14. Discuss and provide two examples.
Salty water, homogenized milk – what's in it?



Feb 27-12:45 PM

Homogeneous Mixture Examples

15. List examples of the following solution types:
Gas/Gas solutions? Welding gases – CO_2/Argon

Liquid/Liquid? Alcohol in water.

Solid/Solid? Brass: zinc and copper.
Alloys: metal/metal solution

Gas/Liquid/Solid?
CO_2 in sugary soda pop!

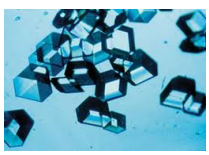
Feb 27-12:45 PM

Physical Properties of Matter

Can be observed or measured without changing the sample's composition.

16. Discuss and list three physical properties.
Density, color, hardness, melting/boiling point, shape, crystal structure.

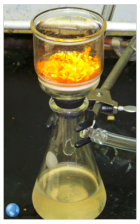

Melting Lead


Crystals Forming

Physical Change: the process of altering physical properties.

Feb 27-12:32 PM

Separation Techniques

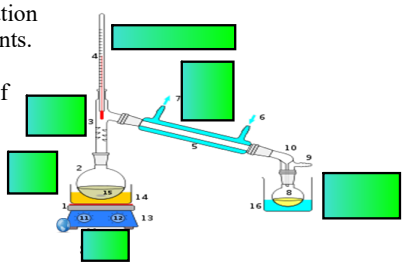


Physical properties are harnessed to separate mixtures into compounds, but it won't break compounds into elements.

Filtration– Porous barrier separates a solid from a liquid.

Distillation – Separation based on boiling points.

17. Label the parts of the distillation apparatus.



Feb 27-12:32 PM

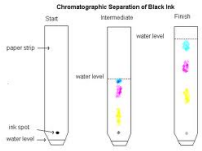
More Separation Techniques

Magnetic Separation – Iron can be separated from other components.

Crystallization – Pure solid particles form from a saturated solution.

Sugar crystals in a jar.

Chromatography – Relies on the ability of substances to move in a fluid. Demonstration.



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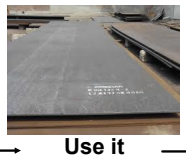
Chemical Properties of Matter

Ability of substances to combine with or change into one or more other substances.

18. Iron can form rust. How is this chemical property?

Make it →



Use it →

Rust it

If it combines with oxygen, then it is no longer the same substance.

The process of substances changing to other ones is a chemical change.

Feb 27-12:32 PM

19. Copper Questions

Which are chemical properties? Which are physical? Explain each of your choices.

Copper is reddish brown and shiny – Physical

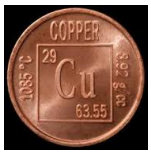
Its density is 8.92 g/mL – Physical

Its melting point is 1,085 °C – Physical

It forms green copper carbonate in moist air – Chemical

It makes new substances with nitric acid – Chemical

It's a good conductor of heat and electricity – Physical



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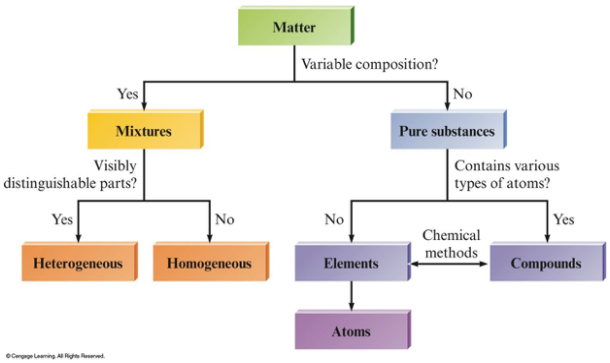
The Organization of Matter



Aug 23-3:22 AM

Homework

Read 2.1 - 2.4

1.7 - 1.10 Problems in Booklet

Read AP Chemistry Color Guide (Resources 8 & 9)

Due: Next Class

Feb 22-12:27 PM

Attachments

7. Fall Final Review & Resources.docx