MEASUREMENT AND MATTER NOTES
HONORS CHEMISTRY

Directions: This packet will serve as your notes for this unit. Follow along with the PowerPoint presentation and fill in the missing information. Important terms / ideas are in all capitals and bolded!

- CHEMISTRY:
  **ALL ________ AND ________ THINGS ARE MADE OF ________... CHEMISTRY AFFECTS __________________!!!

- Branches of Chemistry
  - ORGANIC:
  - INORGANIC:
  - ANALYTICAL:
  - BIOCHEMISTRY:
  - PHYSICAL:

- Types of Chemistry
  - PURE CHEMISTRY:
  - APPLIED CHEMISTRY:

- Observations
  - QUALITATIVE:
  - QUANTITATIVE:

- Scientific Notation
  - Short cut for writing _____ or ________ numbers
  - Always contains a number greater than ___ and less than ____ followed by $X \times 10^N$ ($N = a$ ________)
  - Move the ________ (left or right) until the number is between 1 and 10 AND the number of ________ moved will = ____
  - If no ________ is present, assume it is at the ______!
Move ______: \( N \) is ____________

Move ________: \( N \) is ____________

*Example:

- Need to move decimal until number is between ___ and ____

- Which way is it moving?:

- Count the number of ______ moved (___) to give \( X \times 10^N \)

-More Examples:

    a) 0.00002789
    b) 1,230
    c) 99,800,000,000
    d) 0.0071

-Express _______________ in STANDARD NOTATION:

    Move decimal ______________ as before!

- Accuracy vs. Precision

- ACCURACY:

- PRECISION:

    *Tools with ______ numbers after the decimal = ______ precise

    **WHEN MAKING __________________, IT'S GOOD TO HAVE ______!!

-Dartboards: (draw the darts for each AND label the type):
• Precise vs. Imprecise

-Example:

Mass of silver = __________ g
Mass of silver = ______ g

________ precise measurement will have __________________ after the decimal, this means the ________ is more __________!

-Which is the ______________ measurement?

4.609 Liters 4.6 Liters 5 Liters

• PERCENT ERROR:

-Equation:

-Example: Sally found the mass of a ______ sample to be ________. What is the % error in her measurements?

• Measurements

-Quantities that have both a ___________ and a ______

-Fundamental to ______________ so it is important to ______ measurements and determine if a measurement is ______________

    WITHOUT ______ MEASUREMENTS, THE ______ OBTAINED IN THE LAB WILL BE ______________!!

• Making Measurements

-In making a measurement, write down all of the ________ (exact) digits that the ______________ gives and also one ______________ digit that you ______________

-Why would any digits be uncertain?

    1) Instruments are ________ free of ______

    2) Measuring ____________ involves some ____________
• Estimating Digits

-Digital Displays: ________________ on the display is the ________________ digit

-Scales: With __________ the bottom of the ___________ surface (______________) is where the reading is taken... estimate the ________ digit

*MUST READ THE ________________ AT ________________ FOR AN ________________ READING IN LAB!!

• SIGNIFICANT FIGURES ("SIG FIGS"):

- Rules:

1) All _____________ digits are significant

2) Zeros ___________ other sig figs ________

Ex:

3) Zeros at the ____ before an implied ________________ don't count (if it's there then they do)

Ex:

4) When a number is __________ than one, zeros before the ________ S.F. don't count

Ex:

5) Zeros after a ____________ do count (once you have a S.F.)

Ex:

• Rounding with Sig Figs

- If digit to the right is LESS than 5... _____________________!!

(Ex: 56.43 with 3 Sig Figs would be ______)

- If digit to the right is GREATER than 5... _____________________!!

(Ex: 67.39 with 3 Sig Figs would be ______)

- If digit to the right EQUALS 5... _____________________!!

(Ex: 94.65 with 3 Sig Figs would be ______, while 94.75 with 3 Sig Figs would be ______)

• Math with Sig Figs

- Multiplication and Division: Count SIG FIGS in each separate term and use the _________ amount in the answer!

Ex: 3.052 X 2.10 X 0.75 =
CORRECT SIG FIGS =
**Addition and Subtraction**: Count DECIMAL PLACES in each separate term and use the __________ amount in the answer!

Ex: 3.45645 mL - 2.43 mL =  
CORRECT SIG FIGS =  

- Sig Fig Practice

-How many __________ are in these numbers?

1) 91,600  
2) 0.003005

-Calculated and ________ using the appropriate rule:

3) 0.04216 + 0.0004134 =  
4) (5.610) X (34.908) X (2.30) =

- SI Units

-English system is not used in __________, instead we will use the International System of Units (______________)

-Decimal based system (______________ conversions)... makes sharing ______ easier

-Seven Base Units are used (only look at five for now)

  Mass ➔ ________________  
  Length ➔ ________________  
  Temperature ➔ ________________  
  Time ➔ ________________  
  Amount ➔ ________________

- Non SI Units

-Two units used in _______________ that are ______ SI units

  Volume ➔ ________________  
  Temperature ➔ ________________

-To these base units (grams, liters, seconds, meters) ______________ are attached to make the new unit ______________ or ______________ than the base unit...
• Prefixes

\[ M \text{ (mega)} = \quad c \text{ (centi)} = 10^{-2} \]
\[ k \text{ (kilo)} = 10^3 \quad m \text{ (milli)} = \quad \]
\[ D \text{ (deka)} = 10^1 \quad \mu \text{ (micro)} = 10^{-6} \]
\[ d \text{ (deci)} = \quad n \text{ (nano)} = \quad \]

Positive exponents are ___________ than the base unit, while negative are ___________\!

- Ex: 1 km = ________ m (KILO is ___________\!)

- Ex: ________ mm = 1 m (MILLI is ___________\!)

• DERIVED UNITS:

-Examples:

• Which Unit Should Be Used?
  a) Length of an ____________ (mm or km)
  b) Amount of water contained in a ________ (\mu L or kL)
  c) Mass of piece of ____________ (dg or mg)
  d) Time it takes to ____________ your eye once (ks or ms)

• TEMPERATURE:

-Use a ________________ to measure

- Water FREEZES at ________ and BOILS at ________

- Zero point on the ____________ scale is ABSOLUTE ZERO (___________)

• Temperature Conversions

- Equations to know:

  \[
  \text{FAHRENHEIT TO CELSIUS} \quad \text{CELSIUS TO FAHRENHEIT} \quad \text{CELSIUS TO KELVIN}
  \]

  \[
  C = .56 \times (F - 32) \quad F = (1.8 \times C) + 32 \quad \text{______________}
  \]

- Example: What is ________ expressed in Kelvin?
• **Conversion Factors**

-Amounts can be expressed in different _________ ways

-Some Common Conversions:

1 in = 2.54 cm  
1 m = 1000 mm  
1 mL = 1 cm³

1 ft = 12 in  
1 _______ = 1 km  
1000 mL = _______

1 yd = _______  
1 g = _______  
1 min = 60 s

1 mi = 5280 ft  
1 g = 100 cg  
1 hr = _______

1 m = 10 dm  
1 g = 1000 mg  
1 day = 24 hr

1 m = _______  
1000 g = _______  
365 days = _______

• **Dimensional Analysis:** Way to analyze and solve problems using the units of the measurements (conversion factors)

-Steps:

1) Start with what is _______

2) Determine what ______ you must end up in

3) Multiply what is given by a ___________________________ that will _______ out the starting unit

4) Continue __________________ by conversion factors until the desired unit is reached

5) Do the __________ multiply across the top, then divide

   **In these problems, the UNITS ARE YOUR ______________… LET THEM __________ THE WAY!!!**

-Example: What is _______ expressed in meters?

**In order to cancel a unit, one must be on the "______" and the other must be on the "_________" (immediately write the top unit on the _______ for the conversion factor)!!

-More Examples: (SHOW ALL WORK!)

   a) 3.48 g to ______
b) _____ L to mL

c) 66 mm to _____

d) 1.130 days to _____

• DENSITY:
  - Which is heavier a pound of ___________ or a pound of ______?
  - People say "______" because they are confusing _______ with __________

\[ D = \]

- Units are __________ or __________

• INTENSIVE PROPERTY:
  - If ____________ is given, mass or volume could be determined...

\[ M = \quad V = \]

- Practice:
  a) A piece of wood has a mass of ______ and a volume of 23 mL. What is the density?

b) Mercury metal is poured into a graduated cylinder that holds ________. The mercury used to fill the cylinder weighs 0.3060 kg. Calculate the density (in g/cm³) of mercury.

c) A piece of wood has a density of 0.82 g/mL and a volume of ______. What is the mass of the wood in mg?

d) Aluminum has a density of ______ g/cm³. What is the mass (in kg) of a cube with a side of 6.78 cm?
• Density of Water

-Liquid water at room temperature will have a density of ________________

-When water becomes ice it’s density actually ________________ (0.92 g/cm³)… due to the shape
the crystals form that trap ________________ inside (about ______ of ice is below water
and the rest is above)

• How Does Something Float?

-Lower density items _______ on higher density items… ice is ________________ than water!

-Most _______ is less dense than water

-Helium is less dense than ______

-A _______ is less dense than water

• Density and Temperature

-If temperature ________________, density will ________________

-If temp ________________, generally density will ________________

• Lava Lamp Density

*LABEL THE DIAGRAM WITH EACH STEP NUMBER!

1) Heat from _______ transferred to the coil and _______ the “lava”

2) As the temperature ________________, the lava density ________________
BELOW the density of the liquid, making it _______ up

3) At the top away from the ________, the temperature of the lava
begins to ________

4) As the temperature ________________, the lava density ________________
ABOVE the density of the liquid, making it _______ down

5) Lava _______ the coil and the process ________________

**THE LAVA LAMP _______ BECAUSE OF ________________!!!
- **MATTER:**
  - **MASS:**
  - **WEIGHT:**

  *MASS _______ WEIGHT!

- **Three States of Matter**
  - **SOLID:** definite, definite, high, not easily, moving particles
  - **LIQUID:** shape, but has a definite volume, not easily compressed
  - **GAS:** shape, volume (takes the shape of the container), density, easily compressed, moving particles (VAPOR = state that is liquid or solid)

- **KINETIC MOLECULAR THEORY:**

- Phase Changes

  ![Diagram](High) ENERGY ![Diagram](Low)

  *Substances can change phase by ________ or ________________ energy!!*

- **MELTING:**
- **FREEZING:**
- **EVAPORATION:**
- **CONDENSATION:**
- **SUBLIMATION:**
• Describing Matter
  -INTENSIVE PROPERTY:
    Ex:
  -EXTENSIVE PROPERTY:
    Ex:

• Types of Properties
  -PHYSICAL PROPERTY:
    Ex:
  -CHEMICAL PROPERTY:
    Ex:

• Types of Changes
  -PHYSICAL CHANGE:
    Ex:
  -CHEMICAL CHANGE:
    Ex:

• MIXTURE:
  -Two Types
    o HOMOGENEOUS:
      Ex:
    o HETEROGENEOUS:
      Ex:

• SOLUTION:
  -SOLUTE:
  -SOLVENT:
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<th>Solvent</th>
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</tr>
<tr>
<td>Ocean water</td>
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</tbody>
</table>

- **INSOLUBLE:**
- **SOLUBLE:**

**What Affects Solubility Rate?**

1) \__________\________: increasing the _______ will \__________\ the dissolving rate

2) \__________\________: \__________\ will increase dissolving rate

3) \__________\________: the greater amount of _______ that is added, the _______ soluble it will become

4) \__________\________: more surface area a solute has, the _______ its dissolving rate will be

**Separating Mixtures**

- Differences in \______________\ properties can be used to separate mixtures

1) **DECANT**: \__________\ one layer leaving behind another layer of a mixture (\____________\)

2) **FILTRATION**: separates a _______ from the _______

3) **MAGNET**: removes substances that are \____________\ (ex: _____ filings)

4) **CHROMATOGRAPHY**: separates \__________\n
5) **DISTILLATION**: uses a difference in \____________\ of two substances to separate them

**PURE SUBSTANCE:**

- Two Types
  - **ELEMENT:**
    
    Ex:
  
  - **COMPOUND:**
    
    Ex:
• Chemical Symbols
- Each element has a _____ or ______ letter symbol
- First letter is always ______________ and the second letter (if present) is ____________
- Ex:
- Sometimes the symbols come from the ______ name (ex:___________________)

• CHEMICAL REACTION:
  *Basically, a __________________________ has taken place…

  - REACTANTS:
  - PRODUCTS:
  - Examples:

• Chemical Reaction Indicators
  1) Energy Transfer ➔

      Ex:

  2) Color Change ➔

      Ex:

  3) Production of Gas ➔

      Ex:

  4) PRECIPITATE ➔

      Ex:

      *ONLY CAN BE ______________ THAT A ______________ TOOK PLACE, IF THE
SUBSTANCE ______________!!

• Reaction Laws
  - LAW OF CONSERVATION OF ENERGY: Energy can neither be __________ nor
____________... only changed from one _______ to another!

      Ex:
- **LAW OF CONSERVATION OF MASS**: Mass can neither be __________ nor __________. Total mass in the universe is __________!

 Ex:

- **LAW OF CONSERVATION OF MASS / ENERGY**: Total ______________ of mass and energy in the universe is a ______________!

 Ex:

- **ENERGY**:
  - ______________ is the SI unit for energy
  - Another common unit is ______________
  - 1 calorie = __________ Joules
  - 1 kilocalorie = _______ calories

- **THERMODYNAMICS**:
  - Energy is ______________ in a chemical reaction (_______________ to ____________)
  - HEAT (_______________) is also usually produced or absorbed
    - System:
    - Surroundings:

- **Heat Transfer**
  - **EXOTHERMIC**:
    Ex:
  - **ENDOTHERMIC**:
    Ex:

- **HEAT CAPACITY**:
  - ______________ Property… depends on how much! (Ex: ______________ vs. ______________)
  - **SPECIFIC HEAT CAPACITY** (C or Cp):
    - Water has a ________ Cp (4.184 J/g°C)… need ________ heat to raise the temperature
    - Metals have a ________ Cp… ________ heat needed to raise the temperature
• **Specific Heat Problems**

- Units are usually _________ or _________

- Equation:

  \[ q = \text{________} \text{ (Joules)} \]

  \[ m = \text{________} \text{ (grams)} \]

  \[ c = \text{________} \]

  \[ \Delta T = \text{________} \text{ Temp} - \text{________} \text{ Temp (°C)} \]

- Example: When _______ of heat is added to _______ of olive oil at 21°C, the temperature increases to 85°C. What is the specific heat of the olive oil?

- Example: How many calories does _______ of water absorb when it is heated from 25.0°C to 80.0°C?

• **CALORIMETRY:**

  - **CALORIMETER:** _______ used to measure _______ (ex: _____________… good insulators)

  - **ENTHALPY (H):** measure of _____________ as heat

    _____________ = _____________

    *Heat gained by system will be _________ as heat lost by surroundings (and vice versa)!

    Ex: Place a hot piece of metal in water

  - Example: An unknown metal with a mass of _______ grams is heated to a temperature of 80.0°C. It is then placed in _______ grams of water that is at a temperature of _______. The temperature of the water and metal then rise to a temperature of 23.5°C. What is the specific heat of the metal?