The Physical Science Tome of Infinite Wisdom

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Contents

Unit 1

Matter

Density Formulas

When Density is unknown	Density is measured in
$density = \frac{mass}{volume}$	$\frac{\mathrm{g}}{\mathrm{cm}^2}$ | $\frac{\mathrm{g}}{\mathrm{mL}}$
When Mass is unknown	Mass is measured in
$mass = density \cdot volume$	g | kg | mg
When Volume is unknown	Volume is measured in
$volume = \frac{mass}{density}$	L | mL | cm^2

Appendix A

Taking Excellent Notes

A.1 The old, terrible way of taking notes

Most of your notes look something like this; just a wall of text:

How most freshmen take notes

Matter is anything that has mass and takes up space (volume). It's the stuff that makes up everything we can see and touch, from the smallest atom to the largest galaxy. We can classify matter in a few ways. First, we can look at its physical state. The three main states are solid, liquid, and gas. A solid has a definite shape and volume; its particles are packed tightly together and vibrate in place. Think of a block of ice or a rock. A liquid has a definite volume but no definite shape, taking the shape of its container. Its particles are close but can slide past one another. Water is a great example. A gas has no definite shape or volume, and its particles are far apart and move randomly and quickly. The air we breathe is a mixture of gases like nitrogen and oxygen. There's also a fourth state, plasma, which is a super-heated gas where atoms are stripped of their electrons. It's found in stars and lightning. Beyond states, we can also classify matter as a pure substance or a mixture. A pure substance has a fixed composition and consistent properties throughout, like gold or distilled water. A mixture, on the other hand, is a combination of two or more substances that are not chemically bonded and can be separated by physical means. Think of a salad or salt water. Matter is also classified into pure substances: elements and compounds. An element is the simplest form of matter and cannot be broken down into a simpler substance by chemical means. Every element is made up of only one type of atom. The periodic table is a complete list of all the known elements, such as carbon (C), oxygen (O), and iron (Fe).

This is VERY hard to use later. You can't find anything when you need it, and you need to do a TON of reading.

There is a better way.

A.2 The EASY way to get great notes

1. Excellent notes use an Outline format
   (a) This is required for my class to get your points for notes!
   (b) This works in all of your classes.

2. Examples

Good

1. Main Idea 1
   a. Detail 1
   b. Detail 2
      i) Detail about Detail 2
      i) Another detail about Detail 2
   c. Detail 3
2. Main Idea 2
   etc...

Note the good indentation ↦

Indentation ↦ represents more specific stuff

Bad

1. Main Idea 1
a. Detail 1
b. Detail 2
i) Detail about Detail 2
i) Another detail about Detail 2
c. Detail 3
2. Main Idea 2
etc...

Nothing is indented. This is hard to read and find information later. Indenting is an easy way to make your notes better.

3. It is better to over-indent than under-indent.

4. Style
   (a) Choose whatever style you like the most. You can use any combination of the following:
      1. Numbers
         a. Letters
            i) Roman Numerals
         • Bullet Points
            ☐ Boxes
         ↳ Curly Arrows
            - Dashes

5. Other useful symbols and conventions
   • **Bolding**, Underlining and Double Underlining your text to represent important words.

Put misc. things you want to remember in the margins.

- Δ Greek letter "Delta". In math and science, means "Change".
- $\Rightarrow$ Double arrows for definitions.
- $\rightsquigarrow$ Squiggly arrows for saying when one things leads to another thing.
- $\approx$ For when things are about the same.
- $\dashrightarrow$ Dashed arrows.
- ★ For really important stuff that you want to call out.
- Put a box around definitions.
- Double Box formulas.

6. Fancy Box Ideas

Blue Pointy Box

Title

Centered Title Box

Step By Step Math

$$i = \frac{n(n+1)}{2}. \tag{A.1}$$

$$\sum_{i=1}^{n} i = \frac{n(n+1)}{2}. \tag{A.2}$$

7. Advanced / Extra stuff

Questions/Thoughts

   (a) To really take your notes to the next level, incorporate colors.
   (b) Bring different colored pens and highlighters to draw attention to specific details.
   (c) Come up with your own system of what each color means.

8. Abbreviations

   (a) To take notes QUICKLY and keep up, you must abbreviate (a.k.a. shorten) as much as possible, while still having what you write down make sense later.

Appendix B

Calculating Grades

B.1 Calculating the effect of a new grade on your existing average

Yo Mr. Vober! If I get a bad grade on this, will it bring down my grade?

Bruh, that's how math works.

If you get a grade on your test that's HIGHER than your current average, your grade goes UP ↑

If you get a grade on your test that's LOWER than your current average, your grade goes DOWN ↓

If it's worth a lot of points, it makes it go up or down by a lot more.

k

How to Calculate Your New Grade If You Get X out of Y on the New Assignment

$$\text{New Grade} = \frac{(\text{Total Points Scored So Far}) + (\text{Your Points from the New Assignment})}{(\text{Total Points Possible So Far}) + (\text{New Assignment Max Score Possible})}$$

Appendix C

Math in Physical Science

C.1 Numbers

Generally, in this class, you should give your final answers in decimal form. If it is a fraction that makes sense, like $\frac{4}{5}$, fine, give it as a fraction. If it ends up being some weird fraction like $\frac{85}{217}$, please just use decimal form.

Rounding Decimals

Answers should be rounded to two or three decimal places.

C.2 Scientific Notation

C.2.1 Why

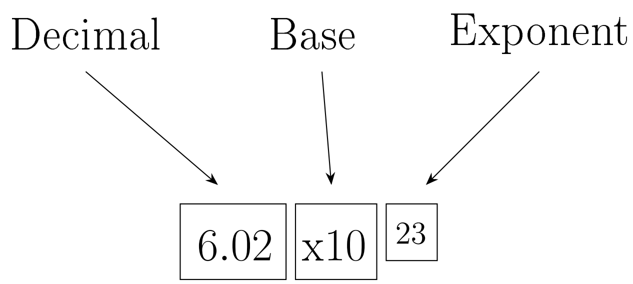
Scientific Notation is just a more convienent way to display really big and really small numbers. For instance, instead of writing

$$6{,}020{,}000{,}000{,}000{,}000{,}000{,}000{,}000$$

over and over in a problem, it is much more convienent to write

$$6.02 \times 10^{23}$$

C.2.2 How to read and write Scientific Notation



The *Decimal* portion of the number is just all of the numbers expressed so you have

One digit **.** (All the other numbers)

Examples: 1.157   2.23   1.050433404

The *Base* portion of the number is either 10^{25} or E25 to save space. Either is fine by me.
The exponent tells you how far you have to move the decimal place to get back to the "normal" way of writing numbers...
If you have a positive exponent, it means you move the decimal to the right. If you have a negative exponent, it means you move the decimal to the left.

Calculators with one line displays often show exponents as E25 instead of $x10^{25}$

Negative exponents → numbers < 1.
Positive exponents → big numbers at least > 1

C.3 Units

Units of measurement give standards so that the numbers from our measurements refer to the same thing. (Wikipedia, 2003)

Pretend someone tells you that they have a new cousin. You ask how old they are. They say 5. You might automatically assume that they mean 5 years old. What if they just got a new baby cousin, who is 5 months old?

Telling someone HOW something was measured is pretty important. We call the way we measured something a Unit.

> **Definition**
>
> **Unit** - What is used to tell HOW something is measured. This comes after the number. Examples: 15 **seconds** or

C.4 Examples of solving Math Problems in Physical Science

Now that we have discussed what units are in Math and Science, let's look the general steps you should be doing for all of the math problems in this class. We will use an example problem from near the beginning of the year involving Gas Laws.

C.4.1 General Steps

When solving math-based problems in this class, you will *generally* follow the following five steps:

1. Write down the numbers that you are **GIVEN** (with units).
2. Write down the number you are asked to **FIND** (with units.)
   (a) I usually write a ? instead of a number, because we are going to solve for this. We don't know what it is yet!
3. Narrow down your formulas until you have one that allows you to solve for the missing number.
   (a) Look at your list of **GIVENS** and **FINDS** and pick a formula that has the same variables in it as are in the list
      i. For instance, if you are given Pressures and Volumes, and are asked to find a Volume, you should look for a formula involving Pressures and Volumes
         A. This would be Boyle's Law
4. Get the correct version of the formula you chose, so that it reads

$$\textbf{\textit{FIND}} = \text{...all the other variables you are given}$$

   (a) You can do this with algebra (if you have learned that in your math class) OR
   (b) Pick the correct "version" of the formula from the list provided by Mr. Vober. Check the wall or your notes for the different "versions".
5. Plug in the **GIVENS** into the matching places in the formula you chose.
6. Solve the math problem
7. Record you final answer, **with units**.
   (a) The units for the answer will be the same as the same type of number in the **GIVENS**
   (b) Example: You are solving for a mass, and the **GIVEN** mass is measured in kg → your answer will also be in kg

C.4.2 Worked Example 1

Example 1

A balloon is filled with air. The pressure of the balloon is 10 atm to start. This expands it to a starting volume of 2 mL. The balloon is then squeezed to a new pressure of 28 atm. What would be the new volume of the balloon after it is squeezed?

"What would be the new volume of the balloon after it is squeezed?" is asking us to find V_2

Find

$V_2 = ?$

The problem tells a story. I can tell if the variable is P, V or T from the units. The $_1$ and $_2$ are from reading the story. If the value is from *before* we changed something, then it is a $_1$, otherwise, it is from *after* we changed something, and it gets a $_2$

Given

$P_1 = 10\,\mathrm{atm}$ $V_1 = 2\,\mathrm{mL}$ $P_2 = 28\,\mathrm{atm}$

Formula

$$\underbrace{V_2}_{\text{The "Find" variable by itself on the left}} = \underbrace{\frac{P_1 \cdot V_1}{P_2}}_{\text{All the variables you are "Given"}}$$

I pick a formula that has the thing we are asked to find on one side, and all of the other variables on the other.

Work

$$V_2 = \frac{P_1 \cdot V_1}{P_2}$$

$$V_2 = \frac{(10\,\cancel{atm}) \cdot (2\,\mathrm{mL})}{(28\,\cancel{atm})}$$

$$V_2 = \frac{(20\,\mathrm{mL})}{(28\,)}$$

You can treat the units and numbers almost as two seperate things. See C.3 for more details.

Answer with units

$$\boxed{V_2 = 0.71\,\mathrm{mL}}$$

0.71428571428 rounded to two decimal places.

Bibliography

Wikipedia. (2003, October). Units of measurement. *Wikipedia.org*. Retrieved November 22, 2019, from https://simple.wikipedia.org/wiki/Unit_of_measurement