

Dr. Yau's Math Review for General Chemistry I

The following is a brief review of some of the math you should remember from your past. This is meant to jog your memory and not to teach you something new. If you find you need more explanations than given, or more practice questions, you should get help from a math or chemistry tutor. You can also ask for a Math Placement Test at the testing center, and based on the results of the placement test, the Math Department can advise you what to do to review your math. I am not going to teach you basic math in my chemistry class.

Review on Exponentials

Express in nonexponential form.

1. $10^3 = 10 \times 10 \times 10 = 1000$ (The exponent tells you how many zeroes)
2. $10^7 = 10,000,000$
3. $10^1 = 10$ (Exponent of 1 tells you there is one zero)
4. $10^0 = 1$ (Exponent of zero tells you there is no zero. Also, remember that anything to the power of zero equals to 1.)
5. $10^{-3} = ?$ (There are two ways to look at this.)
A negative exponent means it is the inverse, or reciprocal. $10^{-3} = 1/10^3 = 1/1000 = 0.001$ (one thousandth)
Or, you can consider $10^{-3} = 1 \times 10^{-3}$. To convert to the nonexponential form, the exponent must increase by 3, from -3 to 0 . This means the decimal point must move 3 places to the left of 1. Thus, $10^{-3} = 0.001$
6. $10^{-6} = 0.000001$ (Decimal is 6 places to the left of 1).
7. 23.8×10^{-5} in nonexponential would be 0.000238. (Decimal moved 5 places to the left from where it was.)

Working with exponents.

When moving a number from the denominator to the numerator (from the bottom to the top in a fraction), the exponent changes sign.

1. $1/10^3 = 10^{-3} = 0.001$
2. $1/10^{-2} = 10^2 = 100$

When you multiply, the exponents are added. When you divide, the exponent on the bottom is subtracted from the exponent at the top.

$$10^a \times 10^b = 10^{a+b}$$

$$\frac{10^a}{10^b} = 10^{a-b}$$

1. $10^3 \times 10^4 = 10^{3+4} = 10^7 = 10,000,000$
2. $10^3 \times 10^{-4} = 10^{3-4} = 10^{-1} = 0.1$
3. $10^3/10^5 = 10^{3-5} = 10^{-2} = 0.01$
4. $10^3/10^{-5} = 10^{3-(-5)} = 10^{3+5} = 10^8 = 100,000,000$
5. $\frac{10^{-3} \times 10^4}{10^{-5}} = 10^{-3+4+5} = 10^6 = 1,000,000$

When you raise an exponent to a power, you multiply the exponents.

$$(10^a)^b = 10^{a \times b}$$

1. $(10^3)^4 = 10^{3 \times 4} = 10^{12} = 1,000,000,000,000$

2. $(10^{-1})^3 = 10^{-3} = 0.001$

3. $(2 \times 10^{-2})^3 = 2^3 \times 10^{-6} = 8 \times 10^{-6} = 0.000008$

4. $(2 + 10^2)^2 = (2 + 100)^2 = 102^2 = 10404$

$(2 + 10^2)^2$ is NOT $(2^2 + 10^4)$ which would give you the wrong answer of 10004!

The distributive property in question 3 above does not apply when you are doing an addition or subtraction within the parenthesis.

Review on Expressing a number in scientific notation

A number in scientific notation has the decimal behind (to the right of) the first nonzero digit.

When the decimal has to be moved to the left, the exponent must increase.

When the decimal has to be moved to the right, the exponent must decrease.

If a number does not have exponents, think of it as having 10^0 . ($4.23 = 4.23 \times 10^0$)

Remember “ID”

← I D →

(Decimal to the left
Exponent **Increases**)

(Decimal to the right,
Exponent **Decreases**)

Express the following in scientific notation.

1. $552.8 \times 10^4 = ?$

The decimal has to be moved two places to the left, so the exponent must be increased by 2.

Answer is 5.528×10^6

2. $1788 \times 10^{-3} = ?$

The decimal has to be moved three places to the left, so the exponent must be increased by 3.

Answer is $1.788 \times 10^{-3+3} = 1.788 \times 10^0 = 1.788$

(Remember that $10^0 = 1$.)

3. $0.0000897 = ?$

The decimal has to be moved five places to the right, so the exponent must be decreased by 5.

You might wonder what to do since there is no exponent.

Remember that a number without exponentials actually has 10^0 .

$0.0000897 = 0.0000897 \times 10^0$

So, we are decreasing the exponent from 0 to -5.

Answer 8.97×10^{-5}

Order of Operation

*Even though your calculator may know some of the rules below and do it correctly, you need to know the rules yourself so that you enter the numbers in the right order. **I strongly urge you to go through all of the “Test Yourself on Your Scientific Calculator Skills” (accessed from my Homepage), to find out whether you truly know how to use your calculator.***

This is the order:

1. Do operations inside the parenthesis first.
2. Do logarithms, and powers next.
3. Do multiplication and divisions next.
4. Do addition and subtraction last.

Given the problem: $4 + 9 \div 3 - 2 \times 3 + (3 + 1) \times 4$

First think about which operation must be done FIRST.

First you do $9 \div 3 = 3$ and $2 \times 3 = 6$ and $(3+1) = 4$ and so $(3+1) \times 4$ becomes $4 \times 4 = 16$.

Then you do $4 + 3 - 6 + 16 = 17$

So $4 + 9 \div 3 - 2 \times 3 + (3 + 1) \times 4$

$= 4 + 3 - 6 + 16$

$= 17$

(The correct answer is 17.)

Now try it with your calculator. Try entering in exactly the same order as written:

$4 + 9 \div 3 - 2 \times 3 + (3+1) \times 4$

You should be getting the same answer of 17.

Unless you have an ancient calculator, your calculator should know to do the operations inside a parenthesis, and the multiplication and division first before addition and subtraction. What you don't want to do is to press ENTER after $4+9$ before pressing $\div 3$. If you did, you are telling the calculator to do $4+9$ before dividing by 3, but the problem does not tell you to add first. You are supposed to do $9 \div 3$ before adding 4 to it.

Now, using your calculator, do the following calculation *without* writing down intermediate answers. In other words, use "chain operation" to do the following computations:

3.1×4.2

5.7×2.8

The answer should be 0.815789474...

If your calculator shows 6.395789473...

you have entered the operations incorrectly into your calculator. You must have entered the steps in this order:

$3.1 \times 4.2 \div 5.7 \times 2.8$

which is incorrect. You are asking the calculator to do this *instead*.

$\left(\frac{3.1 \times 4.2}{5.7} \right) \times 2.8$ which is not what the original problem asked for!

The correct way to enter the operations is to either put parenthesis around the terms in the numerator and denominator

$\frac{(3.1 \times 4.2)}{(5.7 \times 2.8)}$

or remember that 2.8 is in the denominator, so you need to press \div not X:

$3.1 \times 4.2 \div 5.7 \div 2.8$

It is important you understand this sequence of operations because you will OFTEN be needing to do this type of calculations this semester.

Practise with this problem, using your calculator:

$$\frac{3.2 \times 10^{32} \times 5.1 \times 10^{-29}}{7.4 \times 10^{12}} = ?$$

Is your answer 2.205405×10^{-9} ? If it isn't get help immediately! Do not procrastinate!

Brief Review of Algebra

This review is limited to how you can **simplify algebraic terms when fractions are involved**.

Whenever you see a fraction in the denominator (bottom part of a fraction), simplify by inverting it, as follows:

$$\frac{1}{a/b} = \frac{b}{a}$$

Remember also, that you often can simplify by canceling the top and bottom by a common factor.

$\frac{A}{AB} = \frac{1}{B}$ (A in the numerator canceled with the A in the denominator. One way to think about this is you divided top and bottom by A.)

HOWEVER....

you cannot cancel A in the case shown below!

$\frac{A}{A+B} \neq \frac{1}{B}$ (When you divide the bottom (A+B) by A what do you get? You don't get B. You get $\frac{A+B}{A}$ which can be rewritten as $1 + \frac{B}{A}$, but not B.)

Simplify the following expressions:

1. $\frac{A/B}{R/S} = ?$ $= \frac{A}{B} \times \frac{S}{R} = \frac{AS}{BR}$

2. $\frac{12}{4/3} = ?$ Ans. 9 not 1!

If you answer was "1" you were being very careless and you can NOT afford to be careless!

Units can be handled just like algebraic terms.

3. $\frac{\text{gallon}}{\text{mile/gallon}} = \text{gallon} \times \frac{\text{gallon}}{\text{mile}} = \frac{\text{gallon}^2}{\text{mile}}$

4. $\frac{\text{gallon}}{\text{gallon/mile}} = \text{mile}$

5. $\text{in}^3 \times \text{in} = ?$ $= \text{in}^{3+1} = \text{in}^4$

6. $\frac{\text{in}^2}{\text{in}^3} = ?$ $= \text{in}^{2-3} = \text{in}^{-1}$ (which is the same as 1/in)

7. What is another way of looking at $\text{g} \cdot \text{mL}^{-1}$? Ans. It is the same as g/mL.

Solving for X

When you are asked to “solve for x” that means you have to rearrange a given equation so that you end up with plain x (not x^2 and not $\frac{1}{x}$) on one side of the equation and everything else on the other side.

1. $\begin{array}{l} x + b \\ x \end{array} = c$ (To move b to the right side, subtract b from both sides.)
 $= c - b$

2. $\begin{array}{l} x - b \\ x \end{array} = d$ (To move b to the right side, add b to both sides.)
 $= d + b$

3. $\begin{array}{l} x A \\ x \end{array} = B$ (To move A to the right side, divide both sides by A.)
 $= B/A$

4. $\begin{array}{l} x \\ F \end{array} = G$ (To move F to the right side, multiply both sides by F.)
 $x = G F$

5. $\begin{array}{l} F \\ x \end{array} = G$

$x = ?$ $x = \frac{F}{G}$! It is NOT $\frac{G}{F}$!!

You have to be very careful when x is in the denominator! You must first move x to the numerator by doing a “cross multiply.”

$\frac{F}{x} = G$ is the same as...

$\frac{F}{x} = \frac{G}{1}$ and when we "cross multiply" we get...

$(F)(1) = (G)(x)$ Then we move G to the left side by dividing both sides by G.

$\frac{F}{G} = x$ Thus $x = \frac{F}{G}$

Now try this...

6. Given $\frac{H}{x} = \frac{J + K}{L}$, solve for x

Ans. $x = \frac{H L}{J + K}$

7. Given $F = 1.8 C + 32$. Solve for C.

Strategy: You want to move 1.8 and 32 to the other side of the equal sign.

So, you want to first subtract 32 from both sides, and then divide both side by 1.8.

Ans. $C = \frac{F - 32}{1.8}$