IB Chemistry 1st Year Summer Assignments

Here are a few resources for you to utilize in case you need a refresher.

- Khan Academy Chemistry: https://www.khanacademy.org/science/chemistry

- ChemGuide - UK (very helpful throughout the year, as it is specific to IB Chemistry): http://www.chemguide.co.uk/

- Chemistry Lectures: http://www.chemtopics.com/lectures.htm

- Crash Course Chemistry: https://www.youtube.com/playlist?list=PL8dPuuaLjXtPHzzYuWy6fYEaX9mQQ8oGr

Below are 5 ideas that you should master over the summer. While they are not ideas from the IB Curriculum, they are fundamental ideas that will help you succeed in IB Chemistry. I will be going over them VERY briefly during the beginning week of the school year and we will have summer final the second week of school.

IDEA 1 – SHOW YOUR WORK

What does SHOW YOUR WORK even mean? You see it everywhere. It means different things to different people. But when in Chemistry, SHOW YOUR WORK means something very specific.

When showing work, you're describing a narrative, giving a step by step recipe for solving a problem. Even if you know how to solve the problem in your head, SHOW YOUR WORK means that you need to know how to express that know-how onto paper. It's a way of explaining your thought processes- even the ones you don't realize that you have. It is a systematic way of describing your work. And on top of that, if a person grading your work does not understand what it is you're trying to do, they will give up and you won't get to take part in any of that sweet partial credit everyone always talks about.

I'll use an example, but the step by step process is how to solve it.

How many moles of Sodium are in a 120.0g sample of Sodium?

Step 1: Identify Variables and Constants

To perform this calculation, write out what you're given and identify what dimension the value measures. Include units and give the number as written (to keep significant figures).

Also, other information is provided. You will learn about it this year, with the periodic table, knowing that the substance is sodium will give you that the Molar Mass of Sodium is 22.99 g/mol. Even though this isn't a variable, it is a constant (or tabulated value) so you should list it as well.

Last, identify what it is you're trying to find. You can do this by writing the dimension you're looking for and signal it's the missing one with a "?".

So now you've listed out your givens you can either use this to identify what equation to use, or you can simply state the equation. Write the equation out that you're going to use.

In this case, we're using the Molar Mass equation where Molar Mass equals mass over moles.

Mass = 120.0 g

Molar Mass = 22.99 g/mol

n (moles) = ?

Molar Mass = mass/moles

Now, beneath we use the equation, rearrange the equation to solve for the unit you're trying to find. Do this BEFORE you input your numbers in, so that you can see the proper rearrangement of the equation before it becomes a mess.

This requires algebra, but it's easier to do algebra with letters than with numbers and units.

Once you have the variables declared and the equation solved for the variable you want to find, plug the numbers in.

With the problem clearly described, the numbers clearly entered, it is time to check your work by checking the units. This is a form of dimensional analysis. If your units don't come out right, then something went wrong.

To check this, cross out the units that cancel out in the numerator and denominator. In this case, grams cancels with grams and moles is left in the denominator of a denominator.
(This means it goes to the numerator. Check your algebra books for this if this confuses you)

Finally, give your answer to the correct number of significant figures (in this case, 4 based on the measurement given in the original problem) and the correct unit.

Often times, units should include substances. Think logically on these counts. If you say "5.220 moles," the question is 'moles of what? 'Say moles of Sodium or "mol Na" to be clear.

SHOW YOUR WORK FAQ
Q: Do I have to show my work all the time?
A: When there is math or conversions involved, yes, it is appropriate to show your work.

Q: If I don't, can I lose points?
A: Frequently, and this also goes for work that is not coherent and clear. Don't make a grader search for the answer.

Q: What if that's how I solve a problem?
A: Unfortunately, SHOW YOUR WORK doesn't include the following: · Cross multiplying. This is not work, it's unsolved algebra problems

Mass = 120.0 g

Molar Mass = 22.99 g/mol

n (moles) = ??

Molar Mass = mass/moles

Moles = mass/molar mass

Moles = 120.0 g / 22.99 g/mol = 5.21966072 mol Na = 5.220 mol Na

IDEA 2 – DESIRED QUALITIES OF AN IB STUDENT

· Intelligence

This quality is not just about being “smart”. It is being “smart” enough to identify what you do not know or understand and then actively seeking sources of help. This also includes knowing when you “get it”, and when you need to stay after/ask for help.

· Self-Motivation

This quality describes your attitude. Enrollment in this “honor” level class is voluntary. Your desire to learn the material should be your chief motivation. You understand that the teacher will not cajole, plead, beg, etc. an honors level student to do the assigned work. You should be ready and willing to learn each day.

· Integrity / Character

This quality is about doing the right thing in all situations. If you have integrity, you do not cheat on any assignment, be it a test, quiz, project or homework. You do your own work. If you have integrity it means you do not help others to cheat, be it providing homework for someone to copy or providing the questions / answers for a test or quiz in class or for another class.

· Work Ethic / Industriousness

This quality means that the work you turn in is of your highest quality. You show complete and organized work on all assignments (tests, quizzes, homework, projects) clearly identifying how you arrived at the solutions. Showing just answers does not show any work ethic at all and is unacceptable.

Industriousness means that you use all available time to learn and improve. This could simply be starting your homework if there is time left in class. It could mean asking questions about a concept of which you are unsure. When given an extended problem / project / reading assignment industriousness means that you start on the assignment promptly and not wait until the night before the test or due date. This quality means you do not do work for another class or play games on your phone during class time.

· Safety

Honors students treat the lab and lab materials with respect. While they may not yet know all the safety regulations, they do know that horsing around or misbehaving in the lab can potentially cause injury or worse to themselves and their peers. Honors students do not need to be told how to behave properly in a lab, or when to appropriately observe safe and correct lab techniques. Honors students ensure the lab is cleaner than when they found it. Labs should be read, at a minimum, the night before. You should highlight and write notes on your procedure. All prelab assignments should be done promptly and if there are questions you should discuss those with Mr. Lam BEFORE the class period in which you are supposed to perform the lab.

· Inquisitiveness

This quality means that if you have a question you ask the question as soon as possible. An honors student does not just sit there and take notes, they think: Did I understand? Does it make sense? What if? Do not make the mistake of if a concept you do not understand now in class will

all make sense later on. Being inquisitive also means taking advantage of all opportunities to help yourself including:
Your teacher in class
Your teacher out of class
Your textbook!
Other students who may have a grasp of the concept

· Ingenuity
This quality is about applying knowledge, not just rote memorization. An honors student can devise solutions to problems they have never seen before. They can take what they have cumulatively learned in this class and all of their current and previous classes and apply it toward the solution of a new problem.

IDEA 3 - THE METRIC SYSTEM/SI SYSTEM
In the next section, we introduce the standards for basic units of measurement. These standards were selected because they are reproducible and unchanging and because they allow us to make precise measurements. The values of fundamental units are arbitrary (Prior to the establishment of the National Bureau of Standards in 1901, at least 50 different distances had been used as “1 foot” in measuring land within New York City. Thus the size of a 100 ft by 200 ft lot in New York City depended on the generosity of the seller and did not necessarily represent the expected dimensions.)

In the United States, all units are set by the National Institute of Standards and Technology, NIST (Formerly the National Bureau of Standards, NBS). Measurements in the scientific world are expressed in the units of the METRIC SYSTEM or its modernized successor, the International System of Units (SI). The SI, adopted by the National Bureau of Standards in 1964, is based on the seven fundamental units listed in Table 1 below. All other units of measurement are derived from them.

Physical Property	**Name of Unit**	**Symbol**
Length	meter	m
Mass	kilogram	kg
Time	second	s
Temperature	Kelvin	K
Amount of substance	mole	mol
Electric current	ampere	A
Luminous intensity	candela	cd

Table 1 – The Seven Fundamental Units of Measurement (SI)

In chemistry we use the first five most often. The metric and SI systems are DECIMAL SYSTEMS, in which prefixes are used to indicate fraction and multiples of ten. The same prefixes are used with all units of measurement. The commonly used prefixes are below.

Symbol	Prefix	Conversion	Example
T	tera	10^{12}	1 Tg = 1,000,000,000,000 g
G	giga	10^{9}	1 Gm = 1,000,000,000 m
M	mega	10^{6}	1 ML= 1,000,000 L
k	kilo	10^{3}	1 km = 1000 m
h	hecto	10^{2}	1 hg = 100 g
da	deca	10	1 dag = 10 g
d	deci	10^{-1}	1 dm = 0.1 m
c	centi	10^{-2}	1 cg = 0.01 g
m	milli	10^{-3}	1 mL = 0.001 L
µ	micro	10^{-6}	1 µm = 0.000001 m
n	nano	10^{-9}	1 ns = 0.000000001 s
p	pico	10^{-12}	1 pg = 0.000000000001 g

TEMPERATURE

We sense temperature as a measure of the hotness of an object. Indeed, temperature determines the direction of heat flow. Heat always flows spontaneously from a substance of higher temperature to one at lower temperature. Thus, we feel the influx of energy when we touch a hot object, and we know that the object is at a higher temperature that is our hand.

The temperature scales commonly employed in scientific studies are Celsius and Kelvin scales. The Celsius scale is widely used in chemistry and as the everyday scale of temperature in most countries. It is based on the assignment of 0°C to the freezing point and 100°C to its boiling point at sea level.

The Kelvin scale, however, is the SI temperature scale, and the SI unit of the temperature is the Kelvin (K). Historically, the Kelvin scale is based on the properties of gases. Zero on this scale is the lowest attainable temperature, -273.15 C, a temperature referred to as ABSOLUTE ZERO. Notice we do not use a degree sign for Kelvin. Both Celsius and Kelvin scales have equal-sized units - that is, a Kelvin is the same size as a degree Celsius. Thus, the Kelvin and the Celsius scale are related as follows:

$K = C + 273.15$

IDEA 4 – DIMENSIONAL ANALYSIS

Dimensional analysis is a way of examining the measurements of a problem to determine the answer to the problem.

For instance: How many quarters are in 12 dollars?

You’ll probably be able to figure this one out in your head. Or at least your instinct is to grab a calculator, but before you do, we’ll need to solve this problem with dimensional analysis. This problem may be easy to solve in your head, but others you’ll do in Chemistry will require this method of solving to give you the correct answer (or to be counted in “Show Your Work”). First, to do a conversion, an equality must be known that compares quarters and dollars. In this case, we know that 1 dollar equals 4 quarters.

Write this algebraically as:

1 dollar = 4 quarters

This is a conversion factor. Conversion factors always equal 1. They are not for changing numbers, conversion factors are for changing units. If your conversion factor does not equal 1, it means that the equation you derived it from is not equal.

$$12\ \cancel{\text{dollars}} \times \frac{4\ \text{quarters}}{1\ \cancel{\text{dollar}}} = 48\ \text{quarters}$$

Conversion factors can be chained, which means that as long as the conversions are sensible, and they are lined up correctly, multiple conversions can be lined up. This saves time when attempting to make many conversions. As long as units are maintained, you can trust this conversion method.

How many hours in 2 weeks?

Two things are known:
There are 7 days in 1 week There are 24 hours in 1 day

There is no conversion factor easily known that converts hours to weeks (clearly there is, but you probably don’t know it off the top of your head.) Instead, we will chain our conversions. First, start with what is given: 2 weeks

Then line up the conversion that matches 2 weeks and will cancel out the unit ‘week.’

Instead of solving, continue on, by lining up the next conversion factor that cancels out days and gives you hours:

The units cross out and the only unit left is the one you wish to find.

$$2\ \cancel{\text{weeks}} \times \frac{7\ \cancel{\text{days}}}{1\ \cancel{\text{week}}} \times \frac{24\ \text{hours}}{1\ \cancel{\text{day}}} = 336\ \text{hours}$$

Try the conversions in the question section. These conversions are simple conversions. Remember that every number MUST have a unit attached to it, in every step of the work you show. No points will be given if no work is shown.

You should line up your work as shown above when asked to show your work for conversions.

IDEA 5 - SCIENTIFIC NOTATION/SIGNIFICANT FIGURES
In chemistry, we measure and calculate many things, so we must be sure we understand how to use numbers. In this section we will discuss the notation of very large and very small numbers. We use scientific notation when we deal with very large and very small numbers. For example, 197 grams of gold contains approximately 602,000,000,000,000,000,000,000 gold atoms. The mass of one gold atom is approximately 0.000 000 000 000 000 000 000 327 grams
In using such large and small numbers, it is inconvenient to write down all the zeroes. In scientific (also known as exponential) notation.

Practice your scientific notation with this web site:
http://janus.astro.umd.edu/cgi-bin/astro/scinote.pl

This game will help you learn to convert from scientific notation into standard notation and back again.

I teach my students the PACIFIC-ATLANTIC rule for significant figures. If the decimal is Present, you start counting the first non-zero significant digit from the PACIFIC (left) side and all digits after that is significant. If the decimal if Absent, you start counting the first non-zero significant digit from the ATLANTIC (right) side and all digits after that is significant.

234.12 - decimal is present, so you start counting the first non-zero digit from the left side and all digits after that is significant. Total Significant figure = 5

0.000013400 - decimal is present, so you start counting the first non-zero digit from the left side and all digits after that is significant. Total Significant figure = 5

0.02004 - decimal is present, so you start counting the first non-zero digit from the left side and all digits after that is significant. Total Significant figure = 4

34912700 - decimal is absent, so you start counting the first non-zero digit from the right side and all digits after that is significant. Total Significant figure = 6

10010 - decimal is absent, so you start counting the first non-zero digit from the right side and all digits after that is significant. Total Significant figure = 4

When figuring out significant figures during arithmetic operations, there are different rules depending on the operation.

Adding or subtracting: Round the sum or difference to the same number of decimal places as the measurement with the fewest decimal places. Rounding like this is honest, because you’re acknowledging that your answer can’t be any more precise than the least-precise measurement that went into it.

35.7 miles + 634.38 miles + 0.97 miles = 671.05 miles = 671.1 miles

The answer is 671.1 miles. Adding the three values yields a raw sum of 671.05 miles. However, the 35.7 miles measurement extends only to the tenths place. Therefore, you round the answer to the tenths place, from 671.05 to 671.1 miles.

Multiplying or dividing: Round the product or quotient so that it has the same number of significant figures as the least-precise measurement—the measurement with the fewest significant figures.

27 ft * 13.45 ft = 363.15 ft^2 = 360 ft^2 = 3.6 x 10^2 ft^2

Of the two measurements, one has two significant figures (27 feet) and the other has four significant figures (13.45 feet). The answer is therefore limited to two significant figures. You need to round the raw product, 363.15 feet^2. You could write 360 feet^2, but doing so may imply that the final 0 is significant and not just a placeholder. For clarity, express the product in scientific notation.

Convert full notation numbers to scientific notation. Be sure to round to the correct sig figs.

____________: 0.00000879 dm3

____________: 0.04020 m

____________: 1720 K

____________: 23,985.02 cm

____________: 20,000 g

____________: 102.00 kg

Complete the calculation and round your answer to the correct number of significant figures.

120 g - 72.92 g = ______________________

34.2 g / 7.1 dm3 = ______________________

[(87.2 g - 65 g) / 87.2 g] x 100: ______________________

In addition, here are a few additional ideas that you should already know, but not specifically master. We will again VERY briefly go over them during the beginning weeks of the school year.

IDEA 6 - POLYATOMIC IONS

Ions are essential components in making ionic compounds. We have monoatomic cations and anions and polyatomic cations and anions. You can easily determine the charges of monoatomic cations and anions just by looking at the periodic table and the element's placement. Polyatomic ions are a bit harder. They need to be memorized. In previous chemistry classes, you may have been given a table of common polyatomic ions along with their charges, but in IB chemistry you are expected to have them memorized. You must know the name, formula, and charge.

-1		-2	
Acetate	CH_3COO^{-1} or $C_2H_3O_2^{-1}$	Carbonate	CO_3^{-2}
Bromate	BrO_3^{-1}	Chromate	CrO_4^{-2}
Chlorate	ClO_3^{-1}	Oxalate	$C_2O_4^{-2}$
Chlorite	ClO_2^{-1}	Peroxide	O_2^{-2}
Cyanide	CN^{-1}	Sulfate	SO_4^{-2}
Hydrogen carbonate or Bicarbonate	HCO_3^{-1}	Sulfite	SO_3^{-2}
Hydroxide	OH^{-1}	**-3**	
Hypochlorite	ClO^{-1}	Borate	BO_3^{-3}
Iodate	IO_3^{-1}	Citrate	$C_6H_5O_7^{-3}$
Nitrate	NO_3^{-1}	Phosphate	PO_4^{-3}
Nitrite	NO_2^{-1}	Phosphite	PO_3^{-3}
Perchlorate	ClO_4^{-1}	**+1**	
Permanganate	MnO_4^{-1}	Ammonium	NH_4^{+1}

IDEA 7 - SIMPLE STOICHIOMETRY

1. How many moles are in 18.7 grams of pure Titanium? (Hint: No reaction needed)

2. What is the % composition by mass of Fe in $FePO_4$? (Hint: No reaction needed)

3. Write a balanced chemical equation predicting the products for the combustion of C_8H_{20}. (Hint: hydrocarbons combust into predictable products!)

   Express each answer to the correct number of sig figs and SHOW ALL WORK.

4. If I do this reaction with 32.5 grams of oxygen, how many grams of carbon dioxide will be formed?

IDEA 8 - EMPIRICAL AND MOLECULAR FORMULA

1. A compound is found to contain 64.9% Carbon, 13.5% Hydrogen, and 21.6% Oxygen. Determine the empirical formula for the compound.

2. If the compound in problem 1 is known to have a molar mass of 148.28 g mol^{-1}, what is its molecular formula?

IDEA 9 - LIMITING AND EXCESS REAGENT

2.12 grams of Na (s) react with 32.1 cm^3 of Cl_2 (g)

1. Write a balanced chemical equation to show the synthesis of solid NaCl from Na (s) and Cl_2 (g).

2. What is the theoretical yield (in g) of NaCl?

3. Identify the limiting reactant: ______________________

4. Identify the excess reactant: ______________________

5. Calculate the amount of excess (in g).

6. If 0.12g of NaCl is actually synthesized, what is the percent yield and percent error for the reaction?

IDEA 10 - TERMS

Syntax is an important concept in IB Chemistry. We must use proper scientific words in our language. Make sure you know the meanings of the following terms. Use a trusted source on the internet and/or the PreIB/AP Review Guides to look up the terms you do not know. Consider creating flash cards or quizlets to help you study the terms with which you are not comfortable.

1. Element
2. Atom
3. Compound
4. Proton
5. Neutron
6. Electron
7. Isotope
8. Ion
9. Relative atomic mass
10. Period (as on the periodic table)
11. Group (as on the periodic table)
12. Transition elements
13. Alkali metals
14. Alkaline earth metals
15. Halogens
16. Noble gases
17. Ionization energy
18. Atomic radius
19. Electronegativity
20. Electron Affinity
21. Melting point
22. Boiling point
23. Ionic bond
24. Covalent bond
25. Metallic Bond
26. Cation
27. Anion
28. Conductivity
29. Avogadro’s constant (number)
30. Molecular Formula
31. Empirical Formula
32. Reactants
33. Products
34. Solute
35. Solvent
36. Solution
37. Precipitate (as in chemistry)
38. States of Matter
39. Exothermic reaction
40. Endothermic reaction