

IB Chemistry Summer Assignment (Resources & Practice) – For Rising Juniors 2019-2020 School Year

Welcome to the 'Wonderful World of Chemistry'! Summer assignments help you to review some important concepts that were covered in your Honors Chemistry course. These concepts will be developed further in IB chemistry classes along with exploration of chemical relationships through activities, designing and performing experiments. Honors Chemistry concepts are foundation to IB Chemistry SL/HL so take time to review the content in detail before attempting to complete the assignment. In order to achieve this read the concept in your Honors Chemistry notebook/e-textbook and/or watch a video, write notes/steps for solving a problem and then try attempting the questions on assignment. You are required to turn in this assignment on the first day of the school. First week of the school we will review these topics in class. You take a formative assessment over these concepts during second week of school.

A list of internet resources are provided which will be helpful in completing the assignment.

Online Resources:

Tyler Dewitt: <https://www.tdwscience.com/videos>

Crash Course Chemistry:

<https://www.youtube.com/playlist?list=PL8dPuuaLjXtPHzzYuWy6fYEaX9mQQ8oGr>

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

IB online: <http://ibchem.com/>

IB textbook online: http://en.wikibooks.org/wiki/IB_Chemistry

General Chemistry textbook online: http://en.wikibooks.org/wiki/General_Chemistry

IB Chemistry Videos: Richard Thornley

https://www.youtube.com/channel/UCnKyCBclmK1dqPj9r3iw5gA?disable_polymer=true

Topics:

1. Dimensional Analysis, Significant Figures & Uncertainty in measurement:

You should be able to

- ✓ know the 7 base SI units (name and symbol)
- ✓ Identify and apply the SI prefixes (symbol and multiplier) from exa to atto
- ✓ Derive SI units for density, volume, concentration, pressure & energy
- ✓ Identify the significance of accuracy vs. precision, and how to calculate percent error.
- ✓ Apply the rules for significant digits in calculations & reporting answer
- ✓ Convert units using dimensional analysis (sometimes called the factor label method)
- ✓ Express numbers and do calculations using scientific notation.
- ✓ Understand the significance of uncertainty in measurements.

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The SI Units

Base quantity	Name	Symbol
Length	meter	m
Mass	kilogram	kg
Time	second	s
Electrical Current	ampere	A
Thermodynamic temperature	kelvin	K
Amount of substance	mole	mol
Luminous intensity	candela	cd

Prefix	Symbol for Prefix	Scientific Notation
exa	E	$1\,000\,000\,000\,000\,000\,000$
peta	P	$1\,000\,000\,000\,000\,000$
tera	T	$1\,000\,000\,000\,000$
giga	G	$1\,000\,000\,000$
mega	M	$1\,000\,000$
kilo	k	$1\,000$
hecto	h	100
deka	da	10
---	--	1
deci	d	0.1
centi	c	0.01
milli	m	0.001
micro	μ	$0.000\,001$
nano	n	$0.000\,000\,001$
pico	p	$0.000\,000\,000\,001$
fermi	f	$0.000\,000\,000\,000\,001$
atto	a	$0.000\,000\,000\,000\,000\,001$

Practice: Show your work and make sure to report your answer with correct significant figures:

- How many significant figures are in the following?
 - 456 _____
 - 0.045 _____
 - 761.0 _____
 - 0.0450 _____
 - 670 _____
 - 2531 _____
 - 0.0000250 _____
 - 4306 _____
 - 200.10 _____
- Convert the following (show your work)
 - 528 nm = _____ mm
 - 1.35 L = _____ dm³
 - 127°C = _____ K

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3. Express the following numbers in scientific notation.
 - a) 0.0723 _____
 - b) 36,040,000 _____
4. Check the following equalities for errors. If the answer is correct, write 'correct' in the space provided. If the answer is incorrect, rewrite it to make it correct.
 - a) $0.000\ 567 = 5.67 \times 10^{-3}$ _____
 - b) $43,570,000 = 4.357 \times 10^7$ _____
5. Round the following numbers to 3 significant figures.
 - a) 3.7852 kL
 - b) 912,074 m
 - c) 0.004320 cm
6. Convert 55.7 g into pg, mg, kg, ng, fg
7. The density of aluminum is 2.70 g/cm^3 . Express this value in units of kilograms per cubic meter?
8. A star is estimated to have a mass of $2 \times 10^{36}\text{ kg}$. Assuming it to be a sphere of average radius $7.0 \times 10^5\text{ km}$, calculate the average density of the star in units of grams per cubic centimeter.
9. Which has greater mass, 2.0 cm^3 of iron ($d=7.9\text{ g/cm}^3$) or 1.0 cm^3 of gold ($d=19.3\text{ g/cm}^3$)?
10. A person has a temperature of 102.5°F . What is this temperature on the Celsius Scale and on the Kelvin scale?
11. Perform the following mathematical operations, and express each result to the correct significant figures.
 - a) $97.381 + 4.2502 + 0.99195$
 - b) $827 (4.987 - 4.962)$
12. What is the absolute uncertainty for a digital thermometer that displays temperature to the tenths place?
13. What is the absolute uncertainty for a graduated cylinder that has 1 cm^3 markings?
14. You measure the mass of a graduated cylinder to be $101.34 \pm 0.05\text{ g}$. You then add some water and measure the mass of the water *and* graduated cylinder to be $156.58 \pm 0.05\text{ g}$. What is the mass of the water, with uncertainty and to the correct number of decimal places?
15. You measure the mass of a piece of unknown metal to be $14.56 \pm 0.05\text{ g}$ and its volume to be $5.6 \pm 0.5\text{ cm}^3$. What is its density, in g cm^{-3} , and the percent uncertainty for your answer?

2. Nomenclature:

You should be able to

- ✓ Know polyatomic ions, their formulas and charges. [Create Flash cards if you think that's helpful.]
- ✓ Apply polyatomic ions in writing chemical formulas.

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- ✓ Predict chemical names for ionic (binary and ternary), acidic, and inorganic covalent compounds.
- ✓ Predict chemical formulas including ionic (binary and ternary), acidic, and inorganic covalent compounds.

Polyatomic Ions Chart

Formula	Name	Formula	Name
NH_4^+	Ammonium	CrO_4^{2-}	Chromate
NH_3	Ammonia	$\text{Cr}_2\text{O}_7^{2-}$	Dichromate
$\text{C}_2\text{H}_3\text{O}_2^-$	Acetate	MnO_4^-	Permanganate
CH_3COO^-	Acetate	MnO_4^{2-}	Manganate
CN^-	Cyanide	NO_2^-	Nitrite
CO_3^{2-}	Carbonate	NO_3^-	Nitrate
HCO_3^-	Bicarbonate	OH^-	Hydroxide
$\text{C}_2\text{O}_4^{2-}$	Oxalate	PO_4^{3-}	Phosphate
ClO^-	Hypochlorite	SCN^-	Thiocyanate
ClO_2^-	Chlorite	$\text{Fe}(\text{CN})_6^{3-}$	Ferricyanide
ClO_3^-	Chlorate	SO_3^{2-}	Sulfite
ClO_4^-	Perchlorate	SO_4^{2-}	Sulfate
$\text{S}_2\text{O}_3^{2-}$	Thiosulfate	HSO_4^-	Hydrogen sulfate
BrO^-	Hypobromite	IO_3^-	Iodate
AsO_2^{3-}	Arsenite	SeO_4^{2-}	Selenate
BrO_3^-	Bromate	HSO_3^-	Hydrogen sulfite

Commonly Used Multivalent Metals

Symbol	Name	-ous	-ic
Fe (<i>Ferrum</i>)	Iron	+2	+3
Pb (<i>Plumbum</i>)	Lead	+2	+4
Sn (<i>Stannum</i>)	Tin	+2	+4
Hg (<i>Hydrargyrum</i>)	Mercury	+1	+2
Cu (<i>Cuprum</i>)	Copper	+1	+2

Prefixes

Mono=one	Hexa = six
Di = two	Hepta = seven
Tri = three	Octa = eight
Tetra = four	Nona = nine
Penta = five	Deca = ten

Practice writing and naming compounds:

- **Write chemical formulas for the following compounds:**
 1. Diphosphorus pentoxide
 2. Calcium Sulfate
 3. Iron (II) Nitrite
 4. Potassium Selenide

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5. Tetra carbon octahydride

Write names for the following compounds:

1. CsF
2. Mg(SO₃)
3. CSe₂
4. Al₂(SO₄)₃
5. C₆H₆

3. Atomic Structure & Periodic Table:

You should be able to

- ✓ State the location of subatomic particles (protons, electrons and neutrons), their relative masses and charges.
- ✓ Calculate the number of protons, electrons, neutrons, atomic number, mass number and charge of atoms/ions.
- ✓ Define isotopes, their applications & uses of radioisotopes.
- ✓ Calculate average atomic mass.
- ✓ Use periodic table to write electron configuration.
- ✓ Distinguish between groups and periods
- ✓ Determine the periodic trends such as atomic/ionic radius, ionization energy, electron affinity and electronegativity.
- ✓ Discuss the similarities and differences in the same group of elements.

Practice:

Atomic number = Number of _____ of the element

Mass number = number of _____ + _____

Neutron number = Mass number – proton #

Charge = proton # - electron #

When Charge = 0, proton # and electron # must be the SAME

When there is a POSITIVE charge, there are MORE _____ than _____

When there is a NEGATIVE charge, there are MORE _____ than _____

Substance	Symbol	Atomic #	Proton #	# of Neutrons	Mass #	# of electrons	net charge	Location on PT	
								Group number	Period Number
	⁴⁰ K ⁺			21		18			
Strontium					88	36			

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	^{89}Y								
		15			31		0		
Bromine				46			-1		
	$^{128}\text{Te}^{2-}$								
	P				32		0		
Chlorine				19			-1		
	^{195}Pt								
		6		7			0		

1. An element is a mixture of two isotopes. One isotope of the element has an atomic mass of 34.96885 amu and has a relative abundance of 75.53%. The other isotope has an atomic mass of 36.96590 amu. Calculate the average atomic mass and identify the element.
2. Write Electron Configuration for the element/ion from column #2 of the above chart.
3. Which is larger? Ba or Ba^{+2} Why?
4. Which is larger? Br or Br^{-1} Why?
5. Why is Lithium larger than Fluorine?
6. Why is Oxygen smaller than Selenium?
7. Why does it take less energy to remove an electron from Sodium than from Chlorine?
8. List the following elements in order from largest to smallest electronegativity: Sodium, Sulfur, and Strontium.

4. Matter & Energy:

You should be able to

- ✓ Classify matter into categories (States of matter/Phases of matter).
- ✓ Know the definitions/difference between the terms substance, element, compound, mixture, solution, homogeneous and heterogeneous.
- ✓ Differentiate and give examples of physical properties vs chemical properties of a substance.
- ✓ Differentiate and give examples of physical change vs chemical change.
- ✓ Be familiar with energy units: Joule, calorie, and Calorie.
- ✓ Know the definition of specific heat capacity (Cp)
- ✓ Solve energy problems using the heat transfer equation.

1. Classify each type of matter as element, compound, or mixture, write your answer in the blank:

Soil _____

Sea water _____

Platinum _____

Bronze _____

Distilled water _____

Salad Dressing _____

Nitrogen gas (N_2) _____

Ammonia (NH_3) _____

Sucrose _____

Cadmium _____

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Pure table salt (NaCl) _____ Gasoline _____

2. Identify whether each of the following changes is a physical change or chemical change.
 - a) Water freezing: _____
 - b) Iron Rusting: _____
 - c) Chopping wood: _____
 - d) Baking cookies: _____
 - e) Painting the door: _____
 - f) Mowing Lawn: _____
 - g) Growing Tall: _____
3. _____ is anything that has mass and volume.
4. The two states of matter that occupy a definite volume are _____ and _____
5. _____ and _____ are the other two states of matter.
6. _____ change alter the identity of a substance, whereas _____ changes do not.
7. What is the relationship between the kinetic energy of molecules and their physical state?
8. If something is considered a colloid, then it is classified as a _____, but more specifically as a _____.
9. Compounds are separated by _____, while mixtures are separated by _____, such as filtration.
10. Bromine and alcohol are mixed together in a flask, but you want to separate the two from each other. If the boiling point of bromine is 59 degrees Celsius and the boiling point of alcohol is 35 degrees Celsius, which liquid do you expect to come out of the flask at 45 degrees Celsius?
11. You are provided with an unknown liquid substance. Mention three physical properties that would help you in the identification process.
12. On a Snickers bar's nutrition label you have noticed that it provides 271 food calories. Convert this energy into Joules.
13. You heated 150g of water in a Styrofoam cup in a microwave oven. You noticed that the temperature was raised from 22.0 °C to 51.0 °C. Calculate the amount of heat absorbed by water?
14. Draw a reaction coordinate diagram for an exothermic reaction both with and without a catalyst. Label the axes, change in enthalpy, and activation energies
15. Draw a reaction coordinate diagram for an endothermic reaction both with and without a catalyst. Label the axes, change in enthalpy, and activation energies.

5. Mole Concept & Stoichiometry:

- ✓ Be familiar with the concept of a mole as the fundamental “counting unit” of chemistry:
 - one mole of a substance contains 6.02×10^{23} particles of that substance
 - one mole of a substance has a definite mass called its molar mass
- ✓ Be able to interconvert between grams, moles and atoms of a given substance
- ✓ Be able to calculate the percent composition of a substance

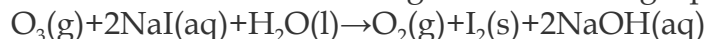
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- ✓ Be able to calculate the empirical formula and molecular formula of a substance
- ✓ Be able to solve basic mol-mol, mol-mass, mass-mass and mass-volume stoichiometry problems

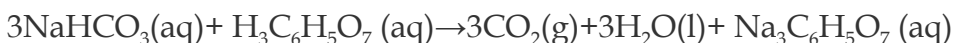
1. Calculate the molar mass of the following substances.
 - a) $(\text{NH}_4)_2\text{Cr}_2\text{O}_7$
 - b) P_4O_6
 - c) $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$
2. Arrange the following substances in order of increasing mass percent of Carbon.
 - a) C_2H_6
 - b) $\text{C}_2\text{H}_5\text{OH}$
 - c) C_6H_6
3. A compound contains 57.69% C, 6.56% H, 28.37% O and 8.28% N by mass. What is the empirical formula of the compound?
4. What is the molecular formula of a compound with an empirical formula of NH_2Cl . The molar mass of the compound is 51.5 g/mol?
5. Balance the following equations:
 - a) $\text{C}_8\text{H}_{16} + \text{O}_2 \rightarrow \text{CO}_2 + \text{H}_2\text{O}$
 - b) $\text{CaSO}_4 + \text{AlCl}_3 \rightarrow \text{CaCl}_2 + \text{Al}_2(\text{SO}_4)_3$
6. How many atoms of Sulfur are in
 - a) 25 molecules of CS_2
 - b) 25 grams of CS_2
 - c) 25 molecules of Cr_2S_3
 - d) 25 grams of Cr_2S_3
7. What is the mass of 345 molecules of CO_2 ? Calculate the volume occupied by 345 molecules of CO_2 at STP (Standard temperature and pressure)
8. How many sulfur dioxide molecules are there in 1.80 mol of sulfur dioxide? What's volume occupied of this gas at STP?
9. The world population is estimated to be approximately 7 billion people. How many moles of people are there?
10. How many molecules of CH_4 are in 48.2 g of this compound?
11. Lithium and nitrogen react to produce lithium nitride:
$$6\text{Li (s)} + \text{N}_2\text{(g)} \rightarrow 2\text{Li}_3\text{N (s)}$$
How many moles of N_2 are needed to react with 0.630 mol of lithium?
12. The combustion of ammonia in the presence of excess oxygen yields NO_2 and H_2O :
$$4\text{NH}_3\text{(g)} + 7\text{O}_2\text{(g)} \rightarrow 4\text{NO}_2\text{(g)} + 6\text{H}_2\text{O (g)}$$
How many grams of NO_2 is produced when 43.9 g of ammonia is combusted completely?

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13. A method used by the Environmental Protection Agency (EPA) for determining the concentration of ozone in air is to pass the air sample through a "bubbler" containing sodium iodide, which removes the ozone according to the following equation:



- a) How many moles of sodium iodide are needed to remove 5.05×10^{-6} mol O_3 ?
b) How many grams of sodium iodide are needed to remove 1.5 mg of O_3 ?
14. Define the terms *limiting reactant* and *excess reactant*. Why are the amounts of products formed in a reaction determined only by the amount of the limiting reactant? Why should you base your choice of what compound is the limiting reactant on its number of initial moles, not on its initial mass in grams?
15. A manufacturer of bicycles has 4809 wheels, 2300 frames, and 2240 handlebars. How many bicycles can be manufactured using these parts? How many wheels are left over? How many frames are left over? How many handlebars are left over?
16. The fizz produced when an Alka-Seltzer® tablet is dissolved in water is due to the reaction between sodium bicarbonate (NaHCO_3) and citric acid ($\text{H}_3\text{C}_6\text{H}_5\text{O}_7$):



- In a certain experiment 1.00 g of sodium bicarbonate and 1.00 g of citric acid are allowed to react. Which is the limiting reactant? How many grams of carbon dioxide form? How many grams of the excess reactant remain after the limiting reactant is completely consumed?
17. Define the terms *theoretical yield*, *actual yield*, and *percent yield*. Why is the actual yield in a reaction almost always less than the theoretical yield? Can a reaction ever have 110% actual yield?
18. Sulfur and oxygen react to produce sulfur trioxide. In a particular experiment, 7.9 grams of SO_3 are produced by the reaction of 9.0 grams of O_2 with 10.0 grams of S. What is the % yield of SO_3 in this experiment?
- $$\text{S}(\text{s}) + \text{O}_2(\text{g}) \rightarrow \text{SO}_3(\text{g}) \text{ (not balanced)}$$