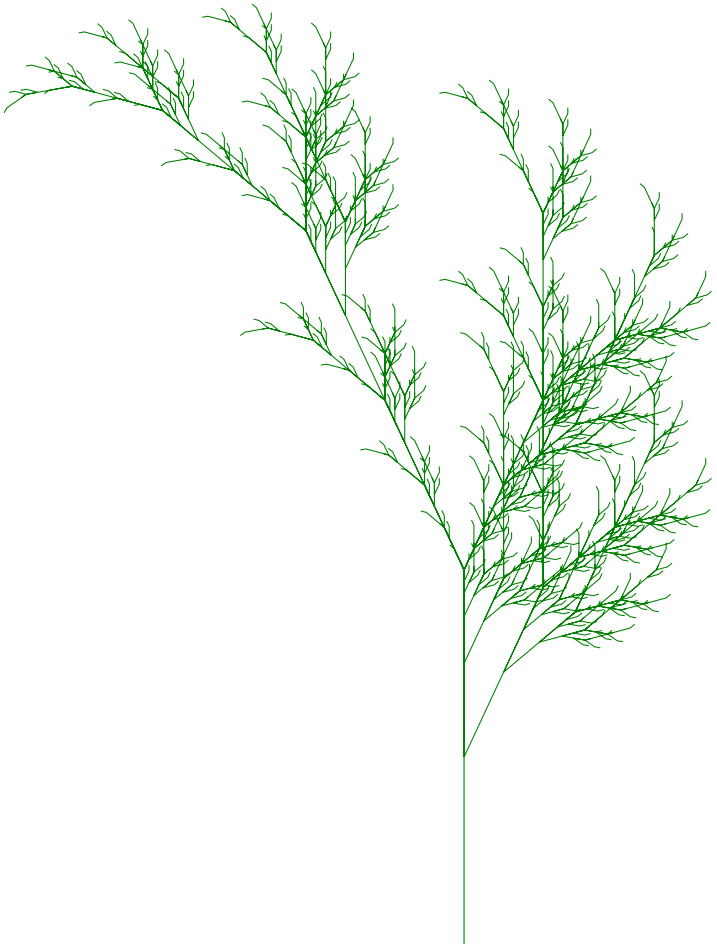


College Chemistry

A Comprehensive Set of Imperfect Notes

Daniel Torres

December 16, 2020 (V 0.2)

Periodic Table of Chemical Elements

Daniel Torres

Z mass
Symbol
Name

	1 IA	2 IIA	3 IIIB	4 IVB	5 VB	6 VIB	7 VIIB	8 VIIIB	9 VIIIB	10 VIIIB	11 IB	12 IIB	13 IIIA	14 IVA	15 VA	16 VIA	17 VIIA	18 VIIIA
1	1 1.0079 H Hydrogen																	2 4.0025 He Helium
2	3 6.941 Li Lithium	4 9.0122 Be Beryllium											5 10.811 B Boron	6 12.011 C Carbon	7 14.007 N Nitrogen	8 15.999 O Oxygen	9 18.998 F Flourine	10 20.180 Ne Neon
3	11 22.990 Na Sodium	12 24.305 Mg Magnesium											13 26.982 Al Aluminium	14 28.086 Si Silicon	15 30.974 P Phosphorus	16 32.065 S Sulphur	17 35.453 Cl Chlorine	18 39.948 Ar Argon
4	19 39.098 K Potassium	20 40.078 Ca Calcium	21 44.956 Sc Scandium	22 47.867 Ti Titanium	23 50.942 V Vanadium	24 51.996 Cr Chromium	25 54.938 Mn Manganese	26 55.845 Fe Iron	27 58.933 Co Cobalt	28 58.693 Ni Nickel	29 63.546 Cu Copper	30 65.39 Zn Zinc	31 69.723 Ga Gallium	32 72.64 Ge Germanium	33 74.922 As Arsenic	34 78.96 Se Selenium	35 79.904 Br Bromine	36 83.8 Kr Krypton
5	37 85.468 Rb Rubidium	38 87.62 Sr Strontium	39 88.906 Y Yttrium	40 91.224 Zr Zirconium	41 92.906 Nb Niobium	42 95.94 Mo Molybdenum	43 96 Tc Technetium	44 101.07 Ru Ruthenium	45 102.91 Rh Rhodium	46 106.42 Pd Palladium	47 107.87 Ag Silver	48 112.41 Cd Cadmium	49 114.82 In Indium	50 118.71 Sn Tin	51 121.76 Sb Antimony	52 127.6 Te Tellurium	53 126.9 I Iodine	54 131.29 Xe Xenon
6	55 132.91 Cs Caesium	56 137.33 Ba Barium	57-71 La-Lu Lanthanide	72 178.49 Hf Halfnium	73 180.95 Ta Tantalum	74 183.84 W Tungsten	75 186.21 Re Rhenium	76 190.23 Os Osmium	77 192.22 Ir Iridium	78 195.08 Pt Platinum	79 196.97 Au Gold	80 200.59 Hg Mercury	81 204.38 Tl Thallium	82 207.2 Pb Lead	83 208.98 Bi Bismuth	84 209 Po Polonium	85 210 At Astatine	86 222 Rn Radon
7	87 223 Fr Francium	88 226 Ra Radium	89-103 Ac-Lr Actinide	104 261 Rf Rutherfordium	105 262 Db Dubnium	106 266 Sg Seaborgium	107 264 Bh Bohrium	108 277 Hs Hassium	109 268 Mt Meitnerium	110 281 Ds Darmstadtium	111 280 Rg Roentgenium	112 285 Uub Ununbium	113 284 Uut Ununtrium	114 289 Uuq Ununquadium	115 288 Uup Ununpentium	116 293 Uuh Ununhexium	117 292 Uus Ununseptium	118 294 Uuo Ununoctium

- Alkali Metal
- Alkaline Earth Metal
- Metal
- Metalloid
- Non-metal
- Halogen
- Noble Gas
- Lanthanide/Actinide

57 138.91 La Lanthanum	58 140.12 Ce Cerium	59 140.91 Pr Praseodymium	60 144.24 Nd Neodymium	61 145 Pm Promethium	62 150.36 Sm Samarium	63 151.96 Eu Europium	64 157.25 Gd Gadolinium	65 158.93 Tb Terbium	66 162.50 Dy Dysprosium	67 164.93 Ho Holmium	68 167.26 Er Erbium	69 168.93 Tm Thulium	70 173.04 Yb Ytterbium	71 174.97 Lu Lutetium

89 227 Ac Actinium	90 232.04 Th Thorium	91 231.04 Pa Protactinium	92 238.03 U Uranium	93 237 Np Neptunium	94 244 Pu Plutonium	95 243 Am Americium	96 247 Cm Curium	97 247 Bk Berkelium	98 251 Cf Californium	99 252 Es Einsteinium	100 257 Fm Fermium	101 258 Md Mendelevium	102 259 No Nobelium	103 262 Lr Lawrencium

Contents

To The Reader

First and foremost, I genuinely care about the progress of each and every one of my students and I want to see you all succeed. This is why I decided to write this manuscript. This set of lecture notes was designed with a focus on the student–with a focus on you. It introduces the basic concepts of college chemistry in a way that a student of any level can hopefully understand. These notes start with the fundamentals and–at this point–end with solids and liquids. Some of the chapters included in this guide can be challenging. Success is not an accident. Only with hard work, patience and perseverance you will be able to achieve what you want. I hope to encourage you not only to successfully pass this class. More importantly, I hope to inspire you to see that you can do this.

College chemistry is not an easy subject. You may experience frustration due to the terminology or the math content. This guide is developed in chapters and sections in order to break down the very basics of the chemistry concepts. One of my mail goals is to help you solve chemistry problems. Solving problems–not only chemistry problems but problems of any kind–is an extremely useful skill in life. Chemists approach the solving of problems in a very specific way. They use critical thinking and previous knowledge in order to find the solution based on the information presented. As you study this set of lecture, I encourage you to read the different section of a chapter, highlight the main ideas and find key words that represent new concepts. Numerous examples are presented along the chapters with the full solution. A lot of examples are also presented without the worked solution, just including the answer. Plenty of end of the chapter problems are further included. After you read the content of a chapter I highly encourage you to work on the end of the chapter problems. As with any skill, practice makes perfect.

I used numerous tools along this guide to help you focus on the most relevant content. For example, *yellow notes* are used to indicate important formulas or tables. Also, when the numerical problems get to complex, an *analyze the problem box* is included to help you identify what is given and what is asked in the problem.

This set of lectures resonates with the open textbook movement that is taking over CUNY as well as SUNY. Education is expensive and you as student often rely on textbooks to learn. These valuable educational resources are often used for a very limited period of time and tossed or returned when a class has finished. The open textbook movement aims to alleviate the cost of education by relying on resources that are free for both the students and for the educators. Still, these sources are imperfect and not as curated as textbooks, and this is the price to pay. I warn you this set of lecture is indeed imperfect, and hence its title. Yet, it is the result of many hours of work–indeed months of work. Still, it contains typos and often times incorrect answers. Your role is key. I encourage you first to be understanding and patient, and then to contribute to the development of this guide. With your input we can make this guide a better educational resource. Mind that this guide was written by an educator and as such it sometimes use terms and a way of thinking that correspond to the educators'point of view.

This set of lecture does not intent to replace any textbook. Indeed, there are many high-quality textbooks in the literature that I recommend:

- Chemical Principles: The Quest for Insight by Peter Atkins et al.
- Chemistry: The Central Science by Theodore E. Brown et al.
- Chemistry by Steven S. Zumdahl et al.
- Chemistry: The Molecular Nature of Matter and Change by Martin Silberberg et al.
- Chemistry by Raymond Chang et al.
- Chemistry: Atoms First by OpenStax

With the help of the textbooks above you can certainly expand and complement the information presented in this guide.

This guide was fully coded in LaTeXfrom the cover or the periodic table to the molecular orbital diagrams or the solid representations. Chemistry is a microscopic science not accessible to the naked eye. Visuals play a very important role in chemistry education. Visuals–in the form of images or diagrams–helps makes chemistry more apparent to the viewer. One of the weak points of many open education chemistry guides are the visuals. They tend to be simplistic with low quality. This guide extensively relies on images and diagrams and uses Tikz and other open-source tools to generate diagrams. All other images used here are open-source images.

The work of chemists is certainly challenging, but also exciting and rewarding. Chemists produce everything from plastics and paints to pharmaceuticals, foods, flavors, fragrances, detergents, and cosmetics. Chemistry students are well-prepared for medical, veterinarian, dentistry, optometry or pharmacy school. I hope you enjoy this guide and more importantly I wish you success in your career.

Daniel Torres
New York City

Online classes might not be for you?

Think about the reasons why you signed up to this online class. On one hand, you might have signed to this class because you are truly interested in online education and because you feel you can succeed. If this is the case, I congratulate you! I am certain this hybrid class will suit your needs. On the other hand, you might have signed up because there were no more sits in any face-to-face class at the most convenient times for you. If this is the case, I have to warn you: chances are this class is not for you. And more importantly, chances are you will not pass this class. I encourage you to educate yourself in online learning so that you can make sure this class truly suits your needs. I do not want you to waste many and time. The following describes some general information about online learning so that you can make educated choices.

What is a fully Online class and a hybrid class?

A fully online course are Web-delivered courses. These are classes taught through the Internet at the distance. This means you will take the class with your laptop, tablet or even your smartphone. Online courses are also distant in time and normally you do not have to be online at a specific time taking the course. Hybrid online classes have a face-to-face component. This means you are required to attend a physical class normally once a weak. Online classes are not face-to-face classes and hence you will not have as instructor guiding your learning. You will have to be more independent, proactive and organized in order to submit your assignments on time and study for the different terms.

Online learning and comfort

One of the benefits of online education is the fact that there are no physical class sessions. This is not true for hybrid classes that contain a face to face component that need to be fulfilled. As an online student you will have to read lecture material and complete assignments sending them electronically, with no need to fight traffic, leave work early for class, or miss important family time. Online courses give you the opportunity to plan study time around the rest of their day. You can study and work at your convenience.

Time management

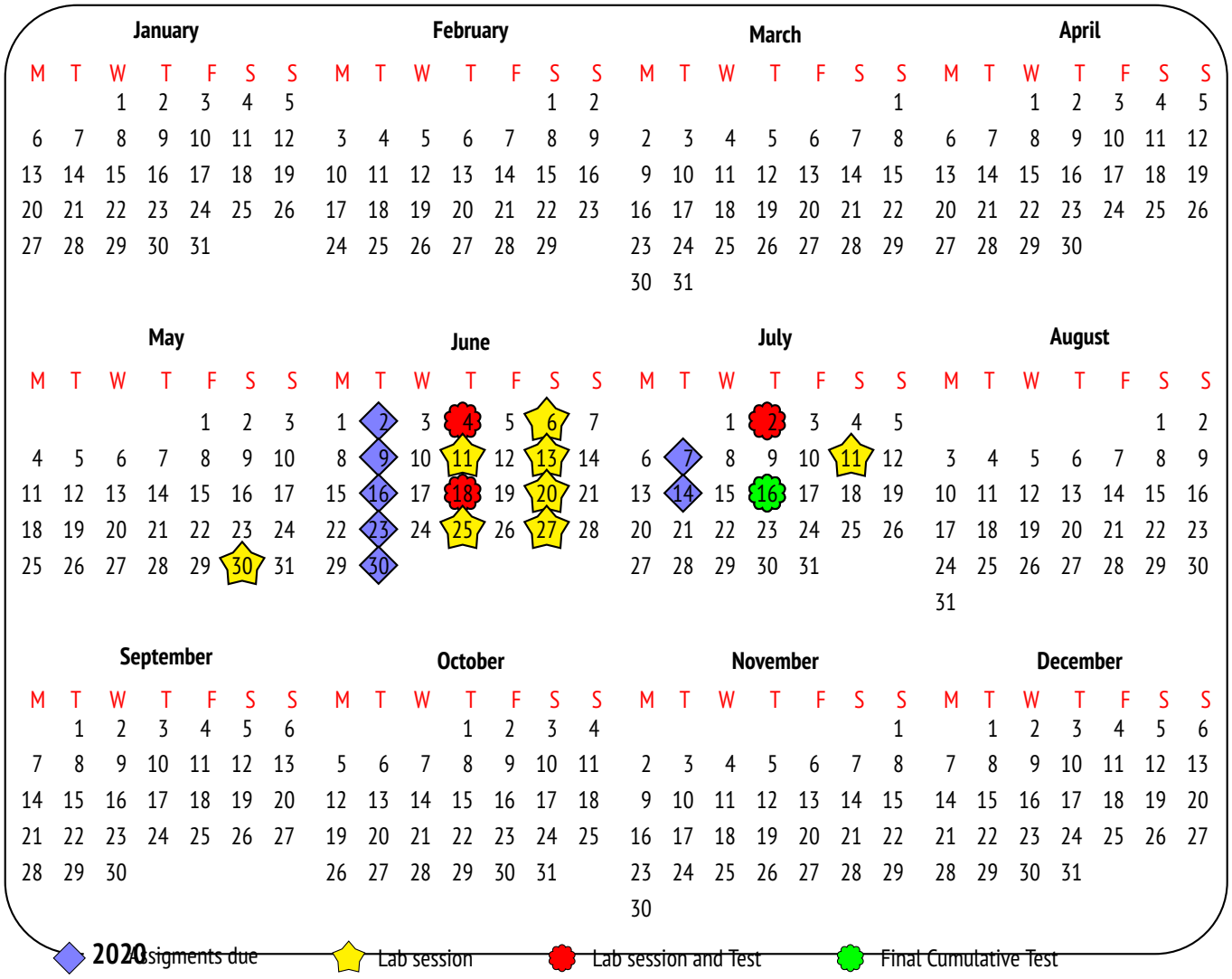
Online courses require a lot of time and intensive work. Unless you are very organized and have a strict discipline chances are you will not pass this class. During online study time management is a difficult task. You might not have enough time during your day to study due to their various everyday commitments and that will certainly affect your chances to succeed in an online class. A regular schedule planner would be a significant help and you can even set reminders for your courses and assignments.

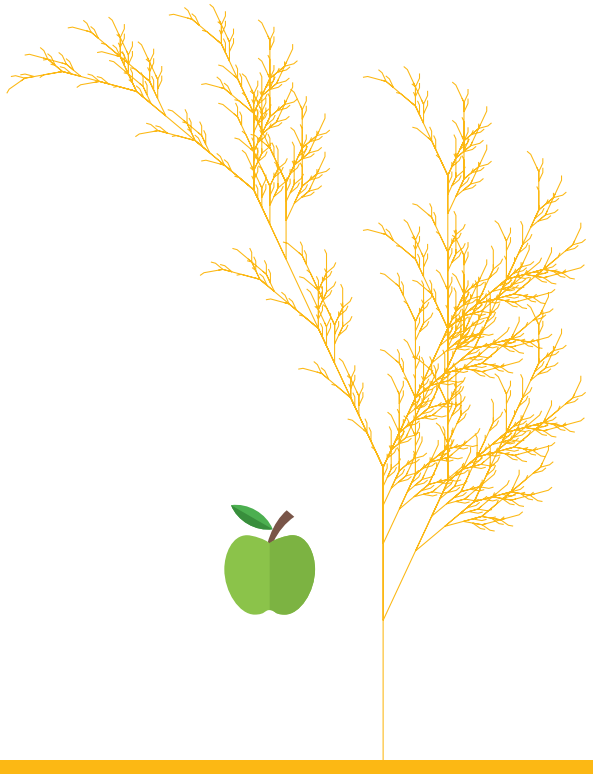
Self-Motivation

Self-motivation is an eLearning essential requirement; if you lack this quality you will certainly struggle while studying online and even fail. You need to find the motivation to follow an online calendar with numerous study hours and assignments and no-one but you to push you through the semester. Only a positive attitude will help you overcome the challenges in eLearning.

Computer Literacy

Technological proficiency is a must for online courses, as it enables you to manage assignments and courseware in an organized manner without struggling. You might think you are tech savvy, and thus able to manage computers well. However, lack of computer literacy is a major issue among online students. You might not be able to operate basic programs such as Microsoft Word and PowerPoint and therefore are not able to handle their files. More importantly, you have to be an expert in blackboard.


January
February
March
April
May
June
July
August
September
October
November
December
2020
Assigments due
Lab session
Lab session and Test
Final Cumulative Test



College Chemistry

A Comprehensive Set of Imperfect Notes

This set of lectures intend to cover the first semester of a College Chemistry class. The intention here is to present the content in a simple and clear way, while including numerous worked examples and many problems with solution. In particular, this current version of the manuscript contains more than 90 solved problems and more than 200 problems with solution. It also contains numerous diagrams and graphs specifically developed to clarify the content as well as a periodic table. The organization of the notes is based on 10 chapters and five parts, each made of two chapters. This organization is intended to help the reader digest the large content typically covered in a General Chemistry class. Every part ends with a review quiz that assesses content. Finally, this set of notes are made to complement and not replace any existing textbook.