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1A	CONTACT INFORMATION
<p><b>DR. DAVID HAMILTON GRAY</b> • De Anza College, Room SC1214, 21250 Stevens Creek Boulevard, Cupertino, CA 95014-5702  <b>PHONE</b> • +1.408.864.5608    <b>E-MAIL</b> • graydavid@fhda.edu    <b>ICLOUD</b> • tosyl8@icloud.com    <b>ZOOM</b> • 845-777-7253  <b>FACEBOOK</b> • tosyl8@icloud.com    <b>GOOGLE</b> • tosyl8tion@gmail.com    <b>SKYPE</b> • tosyl8@outlook.com    <b>TWITTER</b> • @tosyl8  <b>OFFICE HOURS</b> • M: 12:30 - 1:20 PM   T: 12:00 - 12:50 PM   W: 10:30 - 11:20 AM   TH: 1:30 PM - 2:20 PM   F: 9:30 - 10:20 AM  <i>Virtually all District facilities are closed indefinitely. All classes and office hours will be held online through the Zoom platform.</i></p>	

1B	COURSE DESCRIPTION
<p><b>PURPOSE</b> • This course is the first quarter of a three-quarter, one-year organic chemistry sequence, Chem 12. The Chem 12 sequence articulates to most one-year organic chemistry sequences for chemistry non-majors at two- and four-year institutions.</p> <p><b>LECTURE CONTENT</b> • This course focuses on the fundamentals of organic reactions: molecular structure, functional groups, stereochemistry, regiochemistry, mechanisms, and retrosynthesis. These core concepts provide the framework for exploring three classes of organic compounds: alkanes, alkenes, and alkyl halides. This course also integrates concepts from general chemistry – including bonding, thermodynamics, kinetics, and equilibrium – tailored to the unique reactivity of organic molecules.</p> <p><b>LAB CONTENT</b> • This lab course will introduce key physical techniques – extraction, distillation, recrystallization, and thin-layer chromatography (TLC) – and instrumental techniques – gas chromatography (GC), infrared spectroscopy (IR), mass spectrometry (MS), and nuclear magnetic resonance spectroscopy (NMR) – routinely used in synthesizing and identifying organic compounds.</p> <p><i>No lab experiments will be performed in person; however, most of the experiments will still be covered in detail in class, and other supplementary material will help take the place of conducting the experiments in-person.</i></p>	

1C	CLASS STRUCTURE																								
<p><b>SECTIONS</b> • This course is divided into two sections (see <a href="#">TABLE 1</a> for course registration numbers [CRNs].) Once you enroll in a particular section, you must attend only that section for the duration of the quarter. Both sections are completely independent of any other sections offered this quarter.</p> <p><b>CLASS PERIODS</b> • This course is divided into a <i>lecture</i> and a <i>lab</i>. Only one grade is assigned for lecture and lab combined, so the lecture and lab cannot be taken separately <i>under any circumstances</i>, since doing so would violate articulation agreements with other institutions.</p>																									
<table border="1"> <thead> <tr> <th colspan="2">TABLE 1</th> <th colspan="4">COURSE SCHEDULE</th> </tr> <tr> <th>Session</th> <th>Room</th> <th colspan="2">Section 01Z (21587)</th> <th colspan="2">Section 02Z (21588)</th> </tr> </thead> <tbody> <tr> <td>Lecture</td> <td>Online</td> <td>MWF</td> <td>11:30 AM – 12:30 PM</td> <td>MWF</td> <td>11:30 AM – 12:30 PM</td> </tr> <tr> <td>Lab</td> <td>Online</td> <td>MW</td> <td>9:00 AM – 10:15 AM</td> <td>MW</td> <td>2:30 PM – 3:45 PM</td> </tr> </tbody> </table> <p><i>Both lecture and lab will be presented online in synchronous format, meaning you are expected to be available online on the Zoom platform during the times in TABLE 1. Some course material will also be presented in asynchronous format, meaning there will be activities or assignments posted to the Canvas platform for you to complete outside of scheduled class time.</i></p>		TABLE 1		COURSE SCHEDULE				Session	Room	Section 01Z (21587)		Section 02Z (21588)		Lecture	Online	MWF	11:30 AM – 12:30 PM	MWF	11:30 AM – 12:30 PM	Lab	Online	MW	9:00 AM – 10:15 AM	MW	2:30 PM – 3:45 PM
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1D	GRADES																																																																																						
<p><b>GRADES</b> • The total number of points possible in this course is 1000 (see <a href="#">TABLE 2</a> for the point distribution). No artificial curve is used in grading, meaning the final letter grade is based solely on the number of points earned. Final grades will be assigned based on a plus/minus grading scale (<a href="#">TABLE 3</a>). <i>A grade is 'C' or better is required to pass this course.</i></p> <p><b>LAB POINTS*</b> • The total number of points possible in lab could normally be reduced due to failure to follow laboratory safety or chemical hygiene guidelines (see <a href="#">SECTION 7A</a> for details). Since no labs will be conducted in-person this quarter, the total number of points possible in lab will automatically be 200.</p>																																																																																							
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1E	REGISTRATION												
<p><b>DEADLINES</b> • Registration deadlines (<a href="#">TABLE 4</a>) are <i>strictly</i> enforced by De Anza in accordance with state regulations. Exceptions to deadlines are only made in extreme emergencies, so make sure you take whatever action you need to take before the deadline.</p> <p><b>ENROLLMENT</b> • Due to safety policies, enrollment in each section of organic chemistry is strictly limited to 26 students with <i>no exceptions whatsoever</i>. Additionally, you may not attend this class unless you are enrolled or auditing (see <a href="#">SECTION 3c</a>).</p> <p><b>WAIT LISTS</b> • Open spaces in each section will be filled following the order of the official wait list; any remaining spaces will be filled on a first-come, first-serve basis.</p> <p><b>DROPS AND WITHDRAWALS</b> • If you do not attend the first day of class, <i>I am required by contract to drop you from the course</i>, unless you inform me in writing as to why you were absent. Additionally, if you are absent without excuse before the drop deadline for the course (see <a href="#">TABLE 4</a>), you may be dropped from the course so that students from the wait list may add the course instead. <i>After the drop deadline, you are entirely responsible for initiating any drops or withdrawals from the course.</i></p>													
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1F	ASSESSMENT SCHEDULE			
<p><b>PLANNING</b> • In creating the assessment schedule for this course (<a href="#">TABLE 5</a>), it is not feasible to avoid assessments in other courses, since each course runs at its own pace. Part of being an adept student is having the ability to balance the demands of different courses simultaneously. You have been given this schedule at the beginning of the quarter, so you have ample forewarning to properly manage your study time. <i>Assessments will not be given on alternate days due to the workload in other classes.</i></p> <p><b>SCHEDULE CHANGES</b> • Although every attempt will be made to adhere to the established assessment schedule, unforeseen circumstances could require a change in which day an assessment is given. Difficulties resulting from such unexpected changes will be handled on an individual basis.</p> <p><b>FINAL EXAM</b> • The final exam for this course will be posted on <b>MONDAY, DECEMBER 7TH, 2020</b> at <b>11:30 AM</b>. This time has been assigned by the college and cannot be changed except in dire emergencies (see <a href="#">SECTION 3B</a> for details). <i>The final exam will not be given at an alternate time due to the final exam schedule of other courses.</i></p>	TABLE 5		SCHEDULE	
	QUIZ	EXAM	LAB EXAM	
	#1	10/5/20	10/19/20	12/2/20
	#2	10/28/20	11/9/20	————
#3	11/18/20	11/25/20	————	

1G	ASSESSMENTS
<p><b>FORMAT</b> • Types of question may include true/false, fill-in-the-blank, definitions, calculations, short-answer, or other formats applicable specifically to this course, such as mechanisms, synthesis, or structural elucidations. <i>No multiple choice exams will be given in this course.</i></p> <p><b>QUIZZES</b> • Quizzes are focused assessments intended to gauge your level of preparedness between tests. Quizzes are not explicitly cumulative and will instead focus on recently-presented material.</p> <p><b>TESTS</b> • Tests are broader assessments that are more cumulative in nature and will focus on all material presented since either the beginning of the quarter or since the previous exam.</p> <p><b>FINAL EXAM</b> • The final exam is a comprehensive assessment that covers all material presented in lecture. The final exam does not include lab-related material, but it will include lecture-related material that was presented in lab.</p> <p><b>LAB EXAMS</b> • Lab exams are assessments focused solely on material presented in lab. Questions on lab exams will include material presented during lab lecture as well as any calculations or interpretations associated with your lab reports.</p> <p><i>All assessments will be held asynchronously, meaning you will complete them outside of scheduled class time. All assessments must be submitted through the Canvas platform.</i></p>	

1H	COURSE MATERIALS
<p><i>Since this course is being conducted entirely online, no specific materials, such as a lab notebook, are required.</i></p>	

1I	ONLINE RESOURCES
<p><b>CANVAS</b> • This course <i>requires</i> the use of the Canvas platform for the completion of some or all of the course assignments. You can access Canvas either through your MyPortal account or directly at <a href="https://deanza.instructure.com/">https://deanza.instructure.com/</a>.</p> <p><b>MEDIA ARCHIVE</b> • Recordings and written notes of all lectures are available at <a href="http://nebula2.deanza.edu/~gray/">http://nebula2.deanza.edu/~gray/</a>.</p>	

1J	DISABILITY ACCOMMODATIONS
<p>Accommodations for a range of disabilities are available through Disability Support Programs &amp; Services (DSPS). To receive an academic accommodation on assessments – such as additional time, a reduced-distraction environment, or the use of alternative media or assistive technology – you must first be evaluated by Disability Support Services (DSS) and obtain a Test Accommodation Verification (TAV) form. <i>Absolutely no accommodations can be provided on assessments with a completed TAV form.</i></p>	

1K	CODE OF CONDUCT
<p>All De Anza students and staff are expected to abide by the Code of Conduct, which is based on the following four principles: 1) mutual respect between students, faculty, and staff; 2) pursuit of studies with honesty and integrity; 3) respect for College and personal property; and, 4) compliance with all rules and regulations. Because I am responsible for maintaining a safe learning environment, disruptive or abusive behavior towards any student or staff cannot be tolerated. Violations of the Code may be reported for disciplinary action and, in extreme cases, may prompt your removal from the class pending further action.</p> <p><i>The Code of Conduct still applies in all platforms that the class is conducted, including Zoom, Canvas, and e-mail.</i></p>	

1J	DIVERSITY AND EQUITY
<p><b>DIVERSITY</b> • Each of us is born into different cultures, raised speaking different languages, driven to follow different beliefs, compelled to preserve different traditions, trained to follow different conceptions of the Divine. But we all breathe the same air, we all drink the same water, we all are warmed by the same sun, we all marvel at the same moon, we are all made of the same atoms. Beneath our skin lies less than a 1% variation in our genetic composition, so to discriminate on the basis of race, color, national or ethnic origin, age, gender, religion, marital status, sexual orientation, physical ability, economic disposition, social status, or physical appearance is to focus on these insignificant differences between us and ignore the fact that we are all human.</p> <p><b>EQUITY</b> • Each of us has different strengths and weaknesses, therefore the tools each of us needs to succeed differ as well. Although I strive to use a range of instructional modes to address the diverse needs of the class, please do not hesitate to tell me if there is a mode of instruction I am not using that would better address your particular need and I will do my best to accommodate.</p>	

**TEXTBOOK • Organic Chemistry, 3rd edition by David Klein (Wiley: 2017, ISBN 978-1-119-31615-2)**

**ALTERNATE TEXTS •** There are other excellent texts available which may be useful if you are seeking additional problems or an alternate presentation of the course material. If you wish to use an alternate text, please consult with me first so that I can advise you whether the text you intend to use is appropriate for the level of this course. Also, due to the high cost of textbooks, if you have already purchased a previous edition of the official text, you are welcome to use the old edition, with the understanding that the problem numbers and section numbers (or even topics) in older editions may not match those found in the syllabus.

**SUGGESTED PROBLEMS •** In addition to the in-chapter problems in each section, the problems listed below are suggested for further skill development. These problems are not necessarily an indicator of the types of questions that will be found on assessments, but they do address the same material. Although homework can improve your understanding immensely, you are not required to submit homework, so you are not required to use any homework system that may be associated with the text.

TABLE 6		LECTURE SCHEDULE			
WEEK	DAY	ASSESS	SECTIONS	TOPIC	PROBLEMS
1	9/21		————	<i>Introduction</i> – Start at the beginning; when you get to the end, stop.	————
	9/23		1.1, 1.6	<i>Atomic structure</i> – Bringing order to chaos.	1: 44
	9/25		1.2, 1.3, 1.5, 1.7	<i>Bonding</i> – Keeping it all held together.	1: 37, 45, 48, 51, 57
2	9/28		1.4, 1.8 – 1.13; 2.2	<i>Molecules</i> – Terribly tiny tinker toys.	1: 35, 36, 38, 39, 41 – 43, 46, 49, 50, 52 – 55
	9/30		2.1, 2.4 – 2.6	<i>Structures and physical properties</i> – Nice photons!	2: 34 – 38, 40, 48, 50, 55
	10/2		2.7 – 2.13; 6.8	<i>Delocalization</i> – That's neither here nor there.	2: 41, 44, 46, 47, 52 – 54, 56, 60, 61
3	10/5	<i>Quiz 1</i>	4.1 – 4.3	<i>Nomenclature</i> – A thiol by any other name still stinks.	4: 36, 37, 39, 40
	10/7		2.3	<i>Functional groups</i> – The many flavors of organic molecules.	————
	10/9		4.6 – 4.8	<i>Rotomers</i> – That molecule is always so gauche.	4: 38, 41, 42, 45, 56
4	10/12		4.9 – 4.15	<i>Cyclic molecules</i> – It's enough to make your head spin.	4: 43, 44, 46 – 48, 50 – 52
	10/14		5.1 – 5.4	<i>Chirality</i> – Mirror, mirror, on the wall.	5: 31, 33, 34, 36, 38, 39, 41, 50, 51, 52
	10/16		5.5 – 5.6, 5.8 – 5.9	<i>Stereochemistry</i> – Not what happens when soda spills on your stereo.	5: 37, 40, 44, 46ab, 53, 55, 57
5	10/19	<i>Test 1</i>	3.2; 6.7 – 6.10	<i>Mechanisms</i> – Road maps for chemical reactions.	6: 27, 30 – 40
	10/21		4.4; 6.1 – 6.3, 6.11	<i>Thermodynamics</i> – Leaves you with a warm feeling inside.	6: 19, 26, 28, 41
	10/23		6.5 – 6.6	<i>Kinetics</i> – A molecule in motion stays in motion.	6: 42
6	10/26		10.1 – 10.6	<i>Radical reactions</i> – Spray cans on stun!	10: 23 – 26, 30, 31
	10/28	<i>Quiz 2</i>	6.4, 6.12	<i>Equilibrium</i> – The eternal balancing act.	6: 20 – 23, 25, 44
	10/30		3.1, 3.3 – 3.9	<i>Acids &amp; bases</i> – Not the tools of a successful rock band.	3: 34 – 48
7	11/2		7.1 – 7.5	<i>Bimolecular substitution</i> – Is this carbon taken?	7: 47, 48, 51, 54 – 56
	11/4		7.9	<i>Unimolecular substitution</i> – Time to go it alone.	7: 52, 71 – 73
	11/6		————	<i>Problem workshop 1</i> – S <sub>N</sub> 1 and S <sub>N</sub> 2 reactions	————
8	11/9	<i>Test 2</i>	5.11; 7.7	<i>Alkenes</i> – They're all keen to react.	7: 49
	11/11	<b>• College Closed – Veterans' Day •</b>			
	11/13		7.6, 7.8, 7.9	<i>Elimination</i> – Molecular downsizing.	7: 50, 53, 57 – 70
9	11/16		7.10 – 7.13	<i>Problem workshop 2</i> – S <sub>N</sub> 1, S <sub>N</sub> 2, E1, and E2 reactions	7: 76, 77
	11/18	<i>Quiz 3</i>	8.1 – 8.4	<i>Reactions of alkenes</i> – Surprise, fear, joy.	8: 41, 44, 46, 47, 56, 79
	11/20		8.5 – 8.7, 8.9; 10.7	<i>More reactions of alkenes</i> – Now with 50% more.	8: 54, 58, 59, 81
10	11/23		8.10 – 8.12; 10.10	<i>Oxidation of alkenes</i> – Alkenes love oxygen, too.	8: 49, 50, 52, 55, 57, 60; 10: 27, 29, 32, 33
	11/25	<i>Test 3</i>	8.13, 8.14 11.1 – 11.5	<i>Retrosynthesis</i> – .reverse in everything do to how learninG	8: 62, 63, 80
	11/27	<b>• College Closed – Thanksgiving •</b>			
11	11/30		————	<i>Problem workshop 3</i> – Synthesis and reactions of alkenes	————
	12/2		8.8	<i>Hydrogenation</i> – Leaves you feeling lighter than air.	8: 42, 43, 45, 48, 53, 67
	12/4		————	<i>Review</i> – Once more from the top.	————

The following is a listing of the major topics that will be covered each day in lecture. This list should not be considered the exclusive set of topics that found on assessments; instead, it should be viewed as a set of milestones to be reached in your study.

TABLE 7		CORE TOPICS
WEEK	DAY	PROBLEMS
1	9/21	Organic chemistry; structure writing; functional groups; essentials of mechanism; introduction to synthesis
	9/23	Wave behavior of electrons and energy quantization; standing waves; wavefunctions; atomic orbitals; electron density diagrams; nodes; orbital filling rules; ground versus excited states; valence electrons; valency; periodic trends; isotopes
	9/25	Classical versus quantum bonding models; molecular orbitals (MOs); highest occupied and lowest unoccupied MOs (HOMO and LUMO); bonds and antibonds; sigma ( $\sigma$ ) and pi ( $\pi$ ) bonds; bond order; covalent and ionic bonding models; bond length, strength, and polarity
2	9/28	Lewis structures; line structures; dash-wedge convention; cations, anions, and radicals; VSEPR theory; hybridization; SMOGs; structures of small molecules: methane, methylum, methanide, methyl radical, ethane-1,2-diyl radical, ethene, ethyne, carbon dioxide, ammonia, water
	9/30	Formal charge and oxidation state; molecular polarity; dipole moment; intermolecular forces
	10/2	Curved arrow formalism; hyperconjugation; carbocation rearrangement; delocalization (resonance); structural evidence of delocalization; resonance structures; factors in writing resonance structures: charge separation, octet completion, electronegativity, violations of the octet rule; resonance stabilization; allyl, benzyl, and aspartyl cations and anions; vinyl and acetylenyl cations and anions
3	10/5	Common versus systematic (IUPAC) nomenclature; condensed structures; homologs; identifying parent chains; simple and complex substituents; nomenclature of cyclic and bicyclic alkanes
	10/7	Primary (1°), secondary (2°), tertiary (3°), and quaternary (4°) centers; nomenclature of haloalkanes and alcohols; functional group priorities
	10/9	Newman projections; torsional strain; eclipsed, staggered, <i>syn</i> , <i>gauche</i> , <i>anti</i> rotomers; conformational analysis; irrotation of multiple bonds
4	10/12	Angle strain; ring strain; chair, boat, and twist-boat forms of cyclohexane; axial and equatorial positions; diaxial interactions; conformations of substituted cyclohexanes; <i>cis</i> and <i>trans</i> substitution of cyclic compounds; polycyclic compounds
	10/14	Chirality; superposability; stereocenters; enantiomers; absolute stereoconfigurations (R & S); Cahn-Ingold-Prelog nomenclature priority rules; optical activity; polarimetry; specific rotation
	10/16	Diastereomers; physical properties of stereoisomers; determining configuration; <i>meso</i> compounds; racemic solutions; enantiomeric excess
5	10/19	Single-electron and electron-pair bond formation and dissociation; stepwise and concerted mechanisms; nucleophiles and electrophiles; anionic and cationic mechanisms; leaving groups; stereo- and regiochemical consequences of mechanisms
	10/21	Systems; internal energy; enthalpy and entropy; exothermic and endothermic processes; free energy; spontaneity; exergonic and endergonic processes; bond dissociation energy; Hess's law; heat of formation; carbocation rearrangement
	10/23	Reaction coordinate diagrams; elementary steps; transition states; activation energy; intermediates; rate laws and constants; molecularity and reaction order; molecular energy distribution; Arrhenius expression; rate-limiting step; principle of microscopic reversibility; Hammond postulate
6	10/26	Free-radical halogenation: initiation, propagation, and termination steps of chain mechanisms, halogen selectivity, initiators and inhibitors
	10/28	Chemical potential; equilibrium constants; reaction progress diagrams; equilibrium and free energy; catalysis
	10/30	Arrhenius, Brønsted-Lowry, and Lewis acids/base definitions; conjugate pairs; auto-ionization of water; strong versus weak acids/bases; $pK_a$ , $pK_b$ , and $pH$ ; structural effects on acidity: hybridization, induction, delocalization, solvent; predicting reversibility using $pK_a$ ; leveling effect
7	11/2	Nucleophiles and bases; protic and aprotic solvents; bimolecular nucleophilic substitution ( $S_N2$ ): steric hindrance, inversion of configuration
	11/4	Unimolecular nucleophilic substitution ( $S_N1$ ): effect of carbocation stability, loss of configuration, ion-pair formation; reversibility of substitution reactions; substitution reactions with allylic, benzylic, vinyl, and aryl substrates
	11/6	<b>Problem workshop 1</b> – $S_N1$ and $S_N2$ reactions
8	11/9	Configurations of alkenes: <i>cis</i> , <i>trans</i> , <i>E</i> , <i>Z</i> ; phantom atoms; nomenclature of alkenes; Bredt's rule; stability of alkenes
	11/11	• College Closed – Veterans' Day •
	11/13	Zaitsev and Hoffmann elimination; bimolecular elimination ( $E2$ ): effect of steric hinderance; stereoselectivity ( <i>synperiplanar</i> and <i>antiperiplanar</i> configurations); unimolecular eliminations ( $E1$ )
9	11/16	<b>Problem workshop 2</b> – $S_N1$ , $S_N2$ , $E1$ , and $E2$ reactions
	11/18	Markovnikov addition; Electrophilic addition: hydrohalogenation, hydrolysis, and solvolysis
	11/20	Vicinal dihalogenation; halohydrins; oxymercuration-demercuration; hydroboration-oxidation
10	11/23	<i>syn</i> -Dihydroxylation; epoxidation; <i>anti</i> -dihydroxylation; peroxide effect; ozonolysis
	11/25	_____
	11/27	• College Closed – Thanksgiving •
11	11/30	<b>Problem workshop 3</b> – Synthesis and reactions of alkenes
	12/2	Catalytic hydrogenation
	12/4	_____

**TEXTBOOK • *Experimental Organic Chemistry: A Miniscale and Microscale Approach, 6th edition by John C. Gilbert and Stephen F. Martin (Brooks/Cole: 2011; ISBN 978-1-439-04914-3)***

If you have a previous edition of the lab text or you are unable to purchase the current lab text, a copy of the lab text is available on reserve at the library. Be aware that aside from page numbers, the procedures in older editions may also differ from the current version of the text.

TABLE 8		LAB SCHEDULE				
WEEK	DAY	EXERCISE		THEORY	PROCEDURE	ACTIVITY
1	9/21		—	—	—	<i>Introduction and syllabus</i>
	9/23		2.1 – 2.6	—	—	<i>Glassware, solvents, and lab techniques</i>
2	9/28		2.17 – 2.19, 2.21	155 – 163	163 – 165	<i>Lab 1</i> – Base and acid extractions: Part B
	9/30		2.24 – 2.29	155 – 163	165 – 166	<i>Lab 1</i> – Base and acid extractions: Part C
3	10/5		2.9 – 2.11	91 – 99	99 – 104	<i>Lab 1</i> – Base and acid extractions: Recrystallization
	10/7		2.7	111 – 115	—	<i>Lab 1</i> – Base and acid extractions: Melting point
4	10/12	<i>Lab 1</i>	—	179 – 184	185 – 186	<i>Lab 2</i> – Thin-layer chromatography (TLC): Plate preparation
	10/14		—	179 – 184	185 – 186	<i>Lab 2</i> – Thin-layer chromatography (TLC): Plate development
5	10/19		2.11	471 – 473	473 – 474	<i>Lab 3</i> – 2-chloro-2-methylbutane: Synthesis
	10/21	<i>Lab 2</i>	2.13 – 2.16, 2.22	125 – 145	—	<i>Lab 3</i> – 2-chloro-2-methylbutane: Distillation
6	10/26		—	235 – 254	—	<i>Lab 3</i> – 2-chloro-2-methylbutane: Infrared (IR) spectroscopy
	10/28		—	235 – 254	—	<i>IR spectroscopy workshop</i>
7	11/2	<i>Lab 3</i>	—	258 – 278	—	<i>Nuclear magnetic resonance (NMR) spectroscopy workshop</i>
	11/4		—	Hand-out	Hand-out	<i>Lab 4</i> – Relative reactivity of alkyl halides
8	11/9		4.7	342 – 346	347 – 348	<i>Lab 5</i> – Dehydration of an alcohol: Synthesis
	11/11	<b>• College Closed – Memorial Day •</b>				
9	11/16	<i>Lab 4</i>	—	196 – 206	—	<i>Lab 5</i> – Dehydration of an alcohol: Gas chromatography (GC)
	11/18		—	235 – 254	—	<i>Lab 5</i> – Dehydration of an alcohol: IR & NMR spectroscopy
10	11/23		—	301 – 308	—	<i>Mass spectrometry</i>
	11/25	<i>Lab 5</i>	—	Hand-out	—	<i>Spectrum workshop 1</i>
11	11/30		—	Hand-out	—	<i>Spectrum workshop 2</i>
	12/2	<i>Exam</i>	—	—	—	<i>Lab exam</i>

*Lab exercise 6 is due the day of the lecture final (December 7<sup>th</sup>)*



<b>3A</b>	<b>ABSENCES</b>
<p>Since all assessments are being conducted asynchronously, after the add deadline (see <a href="#">TABLE 4</a>) there is no penalty for missing any synchronous portion of the class. By contract, if you are not present on the first day of class, I am required to drop you from the class unless you contact me in writing explaining your absence. If you are absent consistently before the add deadline, you may be dropped from the course on the assumption you are no longer continuing with the course in order to make space for the next person on the wait list.</p>	

<b>3B</b>	<b>MAKE-UP POLICIES</b>
<p><b>LECTURE</b> • No assignments will be given during the lecture portion of the course, so there is nothing to make up if you miss lecture. Audio recordings of the lecture and written notes can be found online at the class archive (see <a href="#">SECTION 1I</a>).</p> <p><b>LAB LECTURE</b> • No assignments will be given during the synchronous portion of lab, so there is nothing to make up if you miss lab. Audio recordings of the lab and written notes can be found online at the class archive (see <a href="#">SECTION 1I</a>).</p> <p><b>QUIZZES, TESTS, LAB EXERCISES, AND THE LAB EXAM</b> • All assessments are being conducted asynchronously outside of class time. Since a generous amount of time will be given for each assessment, late assessments will be accepted or missing assessment will be made up only under extremely dire circumstances.</p> <p><b>FINAL EXAM</b> • If a true, verifiable emergency arises and you are unable to take the final exam within the scheduled time, please contact me <i>immediately</i> explaining your situation. If the circumstances warrant it, alternate arrangements will be made for you to complete your final. If for whatever reason you are unable to take your final exam before the end of the quarter, a grade of <i>incomplete</i> may be given so that you may finish the work at a later time. If the incomplete is not resolved within a mutually established time frame, a zero will be given for the final and your grade will be assigned based on your remaining work.</p>	

<b>3C</b>	<b>MORE COURSE INFORMATION</b>
<p><b>PASS/NO PASS</b> • If you are taking this course out of general interest or otherwise would like to receive course credit but do not need receive a letter grade, this course may be taken on a <i>pass/no-pass</i> basis. A grade of 'C' or higher is considered passing, while a grade of 'D+' or lower is considered non-passing. You must designate this course pass/non-pass before the official registration deadline (see <a href="#">TABLE 4</a>). <b>Note:</b> Once the pass/non-pass deadline has passed, you cannot later convert a pass/non-pass grade into a letter grade or <i>vice versa</i>.</p> <p><b>AUDITING</b> • If you have taken this course before at De Anza or another community college, you may take this course again on an <i>audit</i> basis for review. Auditing students may attend lecture and lab lecture but may not participate in lab experiments and will not receive credit for the course. Information about auditing can be found at <a href="https://www.deanza.edu/policies/auditing.html">https://www.deanza.edu/policies/auditing.html</a>.</p> <p><b>PLUS/MINUS GRADES</b> • According to State education code, the maximum grade point possible for a course is 4.0, meaning that a grade of 'A+' is equivalent to a grade of 'A' for the purposes of calculating GPA. Additionally, since a grade of 'C' is considered the minimum passing grade for a course within the California Community College system, there is no such grade as 'C-' at De Anza.</p>	

<b>3D</b>	<b>ELECTRONIC RESOURCES</b>
<p>Since all assessments will be open-note, there is no restriction on the types of electronic devices you use in class, provided that you complete your work without any assistance from others in any form.</p>	

<b>3E</b>	<b>ACADEMIC INTEGRITY</b>
<p>Cheating and plagiarism are two of the most serious academic violations of the Code of Conduct (see <a href="#">SECTION 1K</a>). No matter how difficult your life situation might currently be, and no matter how much pressure you might be under to succeed or to help someone else, <b>I do not consider cheating or plagiarism to be excusable in any form or under any circumstance.</b> I fully believe such a lack of ethics in this early phase of your academic career is indicative of how you will behave in your future occupation, and since many of you are seeking careers in professions that involve the public, I find such behavior not merely unethical but dangerous. <u><a href="#">Any student(s) caught cheating or plagiarizing on any assignment will automatically receive zero credit for that assignment.</a></u> Further, all instances of cheating or plagiarism will be reported to the deans of Physical Sciences, Math, and Engineering (PSME) and of Student Development for possible further disciplinary action, which in extreme cases may result in expulsion from De Anza.</p>	

3F	EXPECTATIONS
<p><b>SELF-RELIANCE</b> • It is only through your own effort and dedication that you will ever truly master the material in this course. I can teach you in every way imaginable, but I can do nothing to make you learn; I can only act as your guide. You have to be the one that dedicates yourself to your own future.</p> <p><b>TIME</b> • Although the quantity of time needed to master the material will vary widely from person to person, a standard academic guideline is to expect that – between reading, review your notes, and working problems – you will need to set aside at least two hours for studying for each hour of lecture or lab lecture.</p> <p><b>READING</b> • Chemistry is its own language. Even common English words have a completely different meaning in a chemical context; for example, a hood is normally something worn over the head, but in lab it is a safety system for removing hazardous fumes. Therefore, the only way I can conduct a lively class discussion is if you read all assigned passages before you come to class. I do not expect you will understand everything that you read – otherwise there would be no need for this course – but you will be far more able to participate in and benefit from class discussions by reading ahead of time. If English is not your primary language, reading in advance is even more crucial, since it provides you the opportunity to familiarize yourself with new vocabulary or terminology first so you are far more able to understand a lecture.</p> <p><b>PARTICIPATION</b> • I am not a video to be viewed passively; I am a living, breathing, feeling creature that expects to interact with you in class. When I ask a question or request participation from the class, I get irritated when I receive no form of response. I do not expect that you, individually, will always have the right answers, but I do expect that you, the class, will be engaged.</p> <p><b>PROBLEMS</b> • Working problems is often an extremely effective means of mastering a concept. I only have a limited quantity of time in lecture, so I frequently will be unable to cover every single conceptual or mathematical detail presented in the text. You must therefore take it upon yourself to work as many problems as you deem necessary in order to succeed. When you do work problems, resist the urge to look at the answer key first, unless you are truly stuck on a problem. You will learn far more by first running into the proverbial brick wall then learning from your mistakes than simply glancing at the answer.</p> <p><b>PROFICIENCY</b> • Assessments for this course are designed under the assumption you have reached a reasonable level of proficiency in each concept or skill. If it takes too long for you to solve problems because of a lack of practice, you will be unable to complete the assessments. Likewise, you are expected to be able to address the heart of a problem with concise yet complete answers. If you answer in several paragraphs what requires just a few sentences to express, you will never finish; yet, if you answer in just a few words what requires a few sentences to clearly express, you are unlikely to receive full credit.</p>	

3G	SUBMITTING ASSIGNMENTS ONLINE
<p>All assignments turned in online will be submitted through the Canvas system; assignments sent by e-mail will not be accepted. If you have a physical document that needs to be converted into electronic format and do not have access to a document scanner, many apps such as Adobe Scan are available for using your phone as a scanner. All assignments must be submitted as a <i>single document in PDF format</i>. Several tools are available for converting a wide range of electronic formats into PDF format.</p>	

3H	STUDY TIPS
<p><b>MAKE STUDYING A HABIT</b> • Make studying a habit, not a chore. Clear out time every day, even if it not at the same time every day. Do not worry about how much you accomplish at first, just remained focused on your goal. Over time, you will condition yourself to put this time aside automatically, as it easily takes just as much time to worry about studying as it takes to actually study.</p> <p><b>CREATE A STUDY SPACE</b> • Make your own study space, whether it is alone at your own home, in a public setting, or somewhere outdoors. Maybe you find your bliss in a quiet room with soft lighting, a comfy sofa, and a steaming cup of herbal tea; maybe instead you hit your groove in a noisy coffee house sipping on extra super triple roasted fair-trade sustainable organic low-fat double raspberry-infused mocha lattes. Whatever your ideal studying space may be, make it yours.</p> <p><b>SET ATTAINABLE GOALS</b> • You are not going to make that website to help you study while you start a chat group and rewrite all of your notes and highlight all of your books and index your study cards and organize your backpack and read those two chapters and finish that lab report by tomorrow at seven in the morning. Break “studying” down into manageable tasks so you do not feel overwhelmed. Then, once you are caught up, you can get back to work on that homework color-coding project.</p> <p><b>LEARNING MODES</b> • To make the best use of your study time, you should know what modes of learning you tend to use: are you an <i>aural</i> learner, meaning you absorb material by hearing or speaking; a <i>mechanical</i> learner, meaning you learn by repetition, such as working problems or copying notes; or a <i>visual</i> learner, meaning you learn from seeing or drawing diagrams or pictures?</p> <p><b>BREATHE!</b> • Pay attention to all aspects of your well-being. The mind, body, and spirit can handle excessive stress for only so long before they break down, leading to exhaustion, depression, desperation, and worse. Make hot chocolate, listen to music, get outdoors, mediate, do something positive to release the stress, otherwise you will lose your balance before you know it.</p> <p><b>TEACH</b> • I can honestly say that I have learned more about chemistry in the years I have been teaching at De Anza than I ever learned during my doctoral program in graduate school. You may think you have mastered a topic, but as soon as you try to turn around and explain it to someone else, you may quickly find out you do not know as much about it as you thought you did. When you answer questions on assessments, it is as if you are teaching me. So, if you have tried every other study technique and find you are not making enough progress, trying teaching someone else and see how far you get. You may be surprised by the results.</p>	

3I	STUDENT LEARNING OBJECTIVES (SLOs)
<ol style="list-style-type: none"> <li>1 • Predict products in reactions of alkanes and haloalkanes by applying concepts from General Chemistry</li> <li>2 • Generate logical stepwise reaction mechanisms for simple organic reactions.</li> <li>3 • Construct molecular structures from IR and <sup>1</sup>H NMR data.</li> </ol>	



4A	<b>LAB SAFETY</b>
<p>The chemistry department has adopted the following rules from the <i>American Chemical Society Safety in Academic Laboratories Guidelines, 7th edition</i>, as mandatory for all chemistry lab classes:</p> <ol style="list-style-type: none"> <li>1 • Department-approved safety goggles must be worn at all times that chemicals or glassware are in use, including when obtaining items from the stockroom or moving equipment to or from your locker. Goggles may not be removed until all lab work has been completed and all chemicals and glassware have been stored.</li> <li>2 • Shoes that completely enclose the foot are to be worn at all times; no sandals, open-toed or open-topped shoes, or slippers, even with sock on, may be worn in lab.</li> <li>3 • Shorts, cut-offs, skirts, or pants exposing skin above the ankle, and sleeveless tops may not be worn in lab.</li> <li>4 • Hair reaching the top of the shoulders or below must be tied back securely.</li> <li>5 • Loose clothing must be constrained, while form-fitting items should be avoided as chemicals can be held against the skin.</li> <li>6 • Wearing jewelry (rings, bracelets, watches, etc.) is discouraged as chemicals can seep in between jewelry and skin.</li> <li>7 • Eating, drinking, or applying cosmetics in the laboratory room is forbidden at <i>all</i> times, including during lab lecture.</li> <li>8 • Headphones are prohibited in lab at all times as you must be able to hear any emergency announcements made.</li> <li>9 • Students are required to know the locations of the eyewash stations, emergency shower(s), and all exits.</li> <li>10 • You may not be in the laboratory, balance, or instrument rooms unless an instructor is present to supervise.</li> <li>11 • Students not enrolled in the course may not remain in the lab even for lecture once the add deadline has passed.</li> <li>12 • If you any reason you feel faint during the lab, notify an instructor before stepping out for air so you can be supervised.</li> <li>13 • Never point a heated system towards any person, including yourself.</li> <li>14 • Glass and needles must only be disposed of in the appropriate containers, never in the regular trash.</li> <li>15 • Except for soapy or clear rinse water from cleaning glassware, <i>no chemicals may be poured into any sink</i>; any remaining chemicals from an experiment must be poured into the appropriately labeled waste bottle.</li> <li>16 • Students must follow the Code of Conduct at all times while in the lab. Any behavior that could startle, frighten, or injure anyone in the lab is not allowed.</li> </ol>	

4B	<b>EYE SAFETY</b>
<p><b>EYE HAZARDS</b> • Although chemicals can certainly cause eye injury, it is often glassware that is the greater hazard in lab. For example, if a small chemical sample in a test tube explodes, the chemicals themselves might not cause much injury, but the flying pieces of broken glassware certainly have the potential to cause harm. In fact, it is often innocent bystanders that are injured since they may not be immediately aware of what is occurring next to them. As such, you must wear your goggle the <i>entire time</i> you are in the lab space, which includes the stockroom area – even if you are finished with lab and you are “just” chatting with your friends. <i>Refusal to wear your safety goggles during your entire time in lab will result in your expulsion from the course.</i></p> <p><b>TYPE OF GOGGLES</b> • Your safety goggles must be specifically designed for chemical lab work; goggles designed for yard work or industrial work may not be adequate. Your safety goggles must make a seal all the way around your eyes to prevent objects or chemicals from striking from the sides. If you wear prescription glasses, you must still wear safety goggles over your regular glasses, as most regular glasses are not shatter-proof and do have appropriate side shielding. If you wear prescription glasses and will be taking several lab classes, you may want to consider purchasing a pair of prescription safety goggles.</p> <p><b>CONTACTS</b> • There is some concern that certain types of contact lenses (particularly soft lenses) may potentially be hazardous to wear in the presence of some chemicals. Although there is no department policy against wearing contacts (as long as you also wear appropriate safety goggles) and there is unlikely any real risk, you should decide for yourself whether or not to wear them.</p>	

4C	<b>PERSONAL PROTECTIVE EQUIPMENT (PPE)</b>
<p>In addition to safety goggles, to reduce your chemical exposure it is highly recommended that you consider other forms of personal protective equipment (PPE), including nitrile disposable gloves and a chemically-resistant lab coat. You can also reduce your chemical exposure simply by wearing clothing appropriate for lab, such as a long-sleeve shirt instead of a t-shirt.</p>	

4D	<b>MEDICAL CONSIDERATIONS</b>
<p>Although your health and medical history is entirely confidential and you are in no way obligated to divulge any such private information to me, if you are aware that you have an allergy to a specific compound being used in an experiment, for your own safety you should inform me prior to the experiment so I can determine whether alternate arrangements should be made. Similarly, if you have a preexisting medical condition that may impact your ability to operate in a lab environment, I request (but cannot require) that you let me know so that I can assist you in the event of an emergency. Finally, if you are pregnant or feel that you may become pregnant, I urgently recommend that you consult with your doctor about being in enrolled this course. A list of chemicals used during the quarter is available upon request so that your doctor can advise you about your participation in lab.</p>	

4E	<b>EMERGENCIES</b>
<p><b>SPILLS</b> • Do not attempt to clean spills yourself. Notify me so that I can quarantine the area and begin mitigation procedures.</p> <p><b>CHEMICAL EXPOSURE</b> • Have someone alert me and immediately rinse the affected skin or clothing with large amounts of water.</p> <p><b>EYE EXPOSURE</b> • If chemicals splash in your eye, immediately flush your eyes at an eyewash station and have someone alert me.</p> <p><b>INJURY</b> • If you are cut or burned during a lab, please notify me immediately so I can send you for appropriate medical treatment.</p> <p><b>EVACUATION</b> • In the event the room must be evacuated, use only doors marked ‘exit’ and proceed to the track and field area.</p> <p><b>FIRE</b> • Do not attempt to put out any fires your self. Notify me immediately and prepare to evacuate the room if necessary.</p> <p><b>EARTHQUAKE</b> • Step away from equipment, duck under a desk until the shaking stops, then evacuate to the track and field.</p>	

4F	<b>CHEMICAL HYGIENE</b>
<p><b>CHEMICAL SAFETY</b> • Most chemicals inherently have some form of health risk associated with them; sometimes the risk may be minor, sometimes it is life-threatening. A chemical might be a <i>irritant</i>, a <i>lachrymator</i> (causes you tear up or choke), a <i>carcinogen</i> (causes cancer), a <i>mutagen</i> (causes genetic mutations), a <i>teratogen</i> (cause fetal deformations), a <i>pyrophor</i> (spontaneously ignites upon contact with air), or a <i>neurotoxin</i> (attacks the nervous system). Although in relative terms many of the chemicals used in this course are not overly hazardous, others can be quite harmful and can cause truly hazardous reactions if mixed improperly, so you should always take appropriate precautions to protect yourself (see <b>SECTIONS 4B, 4C, and 4D</b>). Additionally, you should always wash your hands <i>immediately</i> after you exit the lab area, especially before eating or using the restroom.</p> <p><b>CHEMICAL STORAGE</b> • All stored samples must be clearly labeled with the English name(s), not formula(s), of the primary hazard(s) in the container, the date the sample was created, and your name. All liquids must be stored in containers sealed with the appropriate lid or stopper to prevent evaporation. Solids may be stored in open containers, for example when drying a precipitate, but all containers must be stored in secondary containment to prevent spillage.</p> <p><b>CHEMICAL SEGREGATION</b> • All substances or mixtures must be stored in appropriate, sealed containers, but those containers must themselves be placed into a larger storage bin that would prevent the materials from spreading if one of the bottles were to somehow break. This additional precaution is known as <i>secondary containment</i> and is intended to prevent an unintended chemical reaction in the event of a catastrophe like an earthquake. To further reduce the chances of an adverse chemical reaction, only compatible substances or mixtures may be stored together in the same secondary containment. For example, acids may only be stored with other acids and cannot be stored along with bases, and oxidizers and reducers must similarly be separated. Chemical waste must also be appropriately stored and segregated (see <b>SECTION 4G</b> for further details).</p>	

4G	<b>CHEMICAL DISPOSAL</b>
<p><b>GENERAL DIRECTION</b> • <i>No chemicals may ever be poured down the sink unless specifically directed.</i> All chemical waste must be disposed of in appropriately labeled waste containers. If you do accidentally pour a chemical down the sink, please notify me immediately so that I can quarantine the sink area initiate the appropriate protocol for mitigating the spill.</p> <p><b>TYPES OF WASTE</b> • There are three types of waste containers available in the lab: acidic aqueous, basic aqueous, and organic.</p> <p><b>RINSES</b> • When cleaning glassware, the first rinse with either water or another solvent should be treated as hazardous waste and disposed of in the appropriate container. Subsequent rinses with water can be disposed of down the drain if there is no obvious sign of chemical contamination remaining.</p> <p><b>LABELS</b> • All waste bottles are labeled with the type of waste they contain and the instructor who prepared the waste bottle. Always make sure you check that you are disposing of waste only in a bottle that I generated that corresponds to the correct waste type. Waste is also labeled according as to whether it contains solids or liquids. Solids may be disposed of in containers labeled for liquids, but liquids may not be disposed of in containers labeled for solids.</p> <p><b>FILL LEVEL</b> • Waste bottles should never be filled completely to the top; instead, a small amount of “head space” must be kept, so that the contents of the container have room to shift in the event the container is suddenly dropped or shaken violently. Please let me know right away whenever a new waste bottle is needed because the old one is full.</p> <p><b>DISPOSAL AREA</b> • With the large number of people needing to use the same waste bottle, it is easy for the area around the waste bottles to get contaminated if you are careless. Although the waste bottles are located within secondary storage, you must make a conscientious effort to keep the area around the waste bottles clean.</p>	

4H	<b>CHEMICAL SAFETY RULES</b>
<ul style="list-style-type: none"> <li>• Always read labels twice; for example, it is easy to misread “sodium nitrite” for “sodium nitrate” when you’re in a hurry.</li> <li>• Always refer to the Safety Data Sheet (SDS) for any substance or mixture for which you are uncertain of the hazards.</li> <li>• Always return any reagent bottles to their appropriate secondary containment after you are finished with them.</li> <li>• Never leave any substance or mixture uncapped after use, as it may potentially react with the surrounding environment.</li> <li>• Never return unused reagents to their original containers as you must assume they are contaminated once removed.</li> <li>• Never take a personal stock of reagents to use at your own bench since the excess cannot be returned so it will be wasted.</li> <li>• Never re-use the same pipette to transfer a substance or mixture once that pipette makes contact with another object.</li> <li>• Never consume any products made in any lab, as the reagents and techniques you will use are not pharmaceutical grade.</li> <li>• Never remove any chemicals from the laboratory as you are not licensed to transport hazardous materials.</li> <li>• Never use chemical refrigerators to store food or any other personal items.</li> <li>• All ethanol available in the lab has been intentionally poisoned so as to render it unfit for consumption.</li> </ul>	

4I	<b>LOCKER POLICY</b>
<p>If you are provided a lab locker for the quarter, you are required to officially check out of that locker, whether you complete the course or not. If you drop the course before the official <i>add</i> deadline (see <b>TABLE 4</b>) your locker may be cleared and reassigned to another student without your being present if there are students on the wait list attempting to add into the course. After the official add deadline, you must check out by the assigned checkout date for the lab section. If you drop or withdraw from the course, you may make arrangements to check out of your locker at an earlier time. Failure to check out of your lab locker by the official checkout date may result in a fee being imposed, your grades being held, and/or a block being placed on future registration.</p>	

**5A****LAB NOTEBOOKS**

A laboratory notebook is not just a simple notebook; it is a crucial legal document that never leaves the lab. Many research projects, such as the synthesis of naturally-occurring molecules, cannot be accomplished by a single researcher within a single year. The discoveries made must therefore be passed down in a way that the results can be reliably duplicated; that vehicle is the laboratory notebook. Research can be a competitive endeavor, with academic, industrial, or governmental groups often competing for limited economic resources. In a patent dispute, a well-annotated notebook can make the difference in winning or losing the case (and maybe your job). In fact, it is common practice for researchers to sign each page of a notebook to affirm it is legitimate. Obviously you will not invent any patents in this class, but you will learn the habits for properly maintaining a laboratory notebook.

**5B****LAB NOTEBOOK FORMAT**

**GENERAL** • Never erase, write in pencil, or use white-out in a lab notebook! In legal cases, any alterations may be considered forms of forgery. Always write in pen. Mistakes should be corrected by drawing a single thin line through the original data, leaving them still legible; this way you can still recover your original result if it turns out it was correct! Finally, any data you collect should be immediately recorded directly into your lab notebook, not stored on a post-it note (or the back of your hand) for copying later.

**TABLE OF CONTENTS** • Any organized lab notebook begins with a table of contents. Each entry might include the page number(s), experiment title, and the date the experiment was performed. You might not see the usefulness of a table of contents in a class such as this that generates such few experiments, but if you are in a research lab where literally hundreds of reactions might be run, a table of contents is absolutely necessary.

**EXPERIMENTS** • At the very minimum, each experiment must include a title, a completed pre-lab (see [SECTION 5C](#)), and any data you directly acquired during the lab. If you are a science major and/or you are otherwise interested in maintaining a more complete laboratory notebook, additional suggestions for experiment formatting can be found in [SECTION 5E](#).

**5C****PRE-LABS**

Before each new experiment, you are required to prepare a pre-lab. On the first day of a new experiment, I will verify whether you have completed the pre-lab satisfactorily. If your pre-lab is not complete, you will not be allowed to perform the experiment and will therefore receive a zero for that lab. There are four reasons why I insist you complete a pre-lab ahead of time:

**SAFETY** • If you are unfamiliar with the procedure for an experiment before coming to class, you are not aware of the hazards you might encounter. You are therefore a danger to both yourself and the other students in the class.

**COURTESY** • If you are not prepared for an experiment and you constantly ask people around you for help, you are a distraction to those who took the time to properly prepare for their lab.

**EFFICIENCY** • If you do not prepare for an experiment before coming to lab, you will waste a lot of time trying to figure out how to conduct the experiment, which means you may not be able to complete the experiment in time.

**LEARNING** • Whether or not chemistry is your favorite subject, you have signed up for this course, so you might as well take the time to benefit from it. If you prepare before an experiment, you are far more likely to gain something from it.

**5D****PRE-LAB FORMAT**

Pre-labs should be prepared directly in your lab notebook. Unless otherwise directed, you do not need answer any pre-lab or post-lab questions in the laboratory manual. Your pre-lab should include at a minimum the following three items:

**CHEMICAL HAZARDS** • List any important safety information about the chemicals you are using that is given in your experimental procedure. If the procedure does not give any specific chemical safety information for a particular compound, you can find more information online by searching for that compound's Safety Data Sheet (SDS).

**CHEMICAL DISPOSAL** • List each chemical mixture generated during the experiment and the appropriate waste container – acidic aqueous, basic aqueous, or organic – is should be disposed in. If you are unsure how a chemical or mixture should be properly disposed, leave space so that you can fill in that information during lab lecture.

**PROCEDURE** • You must rewrite the full procedure in your own words with enough detail that you can perform the lab successfully without using your laboratory manual. Do not simply copy the procedure verbatim. You do not have to include any portions of the experiment that are related only to theory, only the procedure itself.

**5E****ADVANCED FORMATTING**

**REACTION SCHEME** • If you are running a more complex experiment, I highly recommend you include a reaction scheme. This might take the form of an abstract, a flowchart, a series of diagrams, a set of mechanisms, or a set of synthesis steps. You might include key reagents, solvents, environmental conditions, or hazards.

**REAGENTS** • Reagent preparation alone can sometimes consume large quantities of time, since some reagents may be air- or water-sensitive or might have to be isolated or purified before use. Preparing a table of reagents can sometimes therefore be critical in planning for an experiment since you can therefore determine how much of each substance or mixture you will need. For each reagent you are going to use, you might include its name and/or formula, molar mass, the mass or volume to be used (with units!), moles (if appropriate) or molarity (for solutions). Any hazards should already be included as part of your pre-lab.

**PROCEDURE** • For your pre-lab procedure, I recommend using a two-column format, the left column wide, the right column narrow. In the first column, you can list your step-by-step procedure, while in the second column you can record any data you obtain, such as the mass of a sample. Since your results will be located right next to the corresponding procedure step, you will be able to more easily find your results when you write your lab reports.

<b>6A</b>	<b>LAB REPORTS</b>
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Chemical research is usually published in the format of a peer-reviewed journal article. This means the research has been submitted to an academic journal that vetted the research through a panel of reviewers before it was published. These articles usually follow a standard format: (i) relevant background information and the justification for the research; (ii) the goal of the; (iii) a vividly detailed experimental procedure; (iv) all relevant data, calculations, and interpretations; and (v) all conclusions drawn from the data, along with hints at future research possibilities. The format for lab reports in this class will follow the same spirit as these journal articles, although the implementation will be dramatically shortened in consideration of the workload for this course.

<b>6B</b>	<b>LAB REPORT STRUCTURE</b>
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**TITLE** • The title should be short and to the point. Please number your reports in chronological order, meaning the first report should be titled “Lab 1: ...”, the second report “Lab 2: ...”, and so forth.

**OBJECTIVE** • Clearly state each key quantitative or qualitative result you of the experiment; for example: “The purpose of this experiment is to determine the concentration of acetic acid in household vinegar.” The fact that you learned from the experiment, while important, should not be mentioned at all in the objective, since the report is about the results, not you.

**PROCEDURE** • Do not include the procedure in your report. You have already prepared the procedure for your pre-lab, so there is no reason to spend the time writing the procedure again for your report.

**DATA AND CALCULATIONS** • More information about formatting data and calculations can be found in [Section 6x](#).

**CONCLUSION** • Your conclusion should exactly parallel your objective – meaning you should state exactly those qualitative or quantitative results that were the focus of the experiment. This means that the conclusion could potentially be just a one-sentence statement, such as: “The concentration of acetic acid in the unknown solution is 0.0270 M.”

**DISCUSSION** • When appropriate, you should include a brief discussion of how your observations led to your conclusion, or you compare your results to accepted. For example, if a lab involves the synthesis of a compound, your discussion could contain your interpretation of your spectra. Alternately, if a lab involves measuring the molarity of a standardized solution, your discussion should include a calculation of the percent error. Finally, you should describe any specific, significant sources of error.

<b>6C</b>	<b>LAB REPORT FORMATTING</b>
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**DIGITAL FORMAT** • All lab reports must be typed and all tables, graphs, and diagrams must be electronically generated. Handwritten work, such as worksheets you printed, must be converted into digital format (see [SECTION 3F](#)). If you do not have regular access to a computer, the Library West Computer Lab is available for any De Anza student to use. There is no charge to use the computers, and since you will be submitting your reports electronically (see [SECTION 6D](#)), you will not need to print anything.

**THIRD PERSON** • Research articles in the field of chemistry are almost universally written entirely in third person, meaning that you should never use first person (‘I’, ‘me’, ‘my’, ‘mine’, ‘we’, ‘us’, ‘our’, ‘ours’) or second person (‘you’, ‘your’, ‘yours’), and you should never use the oblique ‘one’ as a subject. For example, instead of writing “I measured the temperature every ten seconds”, you should use a passive construction: “The temperature was measured every ten seconds”. It is exactly because this passive writing style is impersonal that it is used, since the focus of most articles is the science, not the scientists.

<b>6D</b>	<b>SUBMITTING LAB REPORTS</b>
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All lab reports must be submitted through the Canvas system (see [SECTION 3F](#)) in PDF format. If you generate spectra or other printed data during an experiment, your data should be converted into digital format and included as part of your report.

<b>6E</b>	<b>DATA VERSUS CALCULATIONS</b>
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Data are the specific numerical or qualitative observations directly obtained during an experiment. Any form of manipulation of these data, no matter how small, is a form of calculation. For example, imagine you want to measure the mass of powdered solid. You could first measure the mass of a beaker, followed by the combined mass of the beaker and the powder. These two measurements would be considered data, since they were directly observed. The mass of the powder itself could only be obtained by subtracting one of the measurements from the other, so the mass of the powder would be considered a calculation. Although it is generally good practice to separate data and calculations, there are times it makes perfect sense to present them together, as in the case of measuring the mass of a solid by difference as described above. You should use your best judgment in determining how to logically present your data and calculations in your report.

<b>6F</b>	<b>FORMATTING DATA</b>
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**LABELS AND UNITS** • Every piece of data should have an intelligible label such as “mass of crucible” or “sample number”, and any numerical piece of data must always be written with the appropriate unit(s) of measure.

**VARIABLES** • It is often helpful to define a variable name for a piece of data, an abbreviation that can be used to represent that datum in mathematical equations. For example, the temperatures of three different samples might be labeled  $T_1$ ,  $T_2$ , and  $T_3$ . Make sure that your variable names make intuitive sense and/or they are clearly explained.

**TYPOGRAPHY** • Chemical formulas must be written with subscripts and superscripts. For example, the formula for magnesium phosphate must be written “ $Mg_3(PO_4)_2$ ”, not “ $Mg3(PO4)2$ ”, and the copper (II) ion should be written  $Cu^{+2}$ , not  $Cu+2$ . Remember spell checkers are not logic checkers; for example, you likely mean “trial 1” instead of “trail 1”, and “molarity” instead of “morality”. Learn how to properly create a degree symbol ( $^\circ$ ), and remember water is ‘ $H_2O$ ’ (with the letter ‘O’), not “ $H_20$ ” (with a zero)!

**TABLES** • Any large or related sets of data must be presented in the form of a table when it makes sense to do so.

**LABELS, UNITS, AND VARIABLES** • All calculations must include appropriate labels and units just as with data. Be sure to clearly define any variable names used in your calculations; for example, do not use the variable 'x' unless you define what 'x' is.

**PROTOTYPE FORMULA** • For each unique calculation you perform, you must write out the mathematical formula corresponding to that particular calculation once. For example, calculating the number of moles of water used in a reaction can be expressed in words (*moles of water = mass of water ÷ molar mass of water*) or by using logical abbreviations ( $n_{\text{water}} = m_{\text{water}} \div MM_{\text{water}}$ ). This way, if you arrive at an incorrect result in your calculations, I can at least verify whether you used the correct formula and simply made a computational mistake, or whether instead you made a conceptual mistake and used the wrong formula.

**SUBSTITUTED FORMULA** • Following a prototype formula, each unique calculation must include one example of the equation substituted with your own data. For example, the number of moles of water obtained from 10.00 g of water can be written as  $n_{\text{water}} = 10.00 \text{ g H}_2\text{O} \div 18.01 \text{ g/mol H}_2\text{O} = 0.5552 \text{ mol H}_2\text{O}$ . This way I can tell if you substituted the wrong piece of data in the wrong spot in the equation. If you performed multiple trials, you should state which trial the substituted data came from.

**TABLES** • If you performed the same calculation multiple times – for example, if you calculated the densities of six solutions – **do not** include full calculations for each trial. Each unique calculation only requires one prototype formula and one substituted formula. To display the results of the results of your calculations, all of the results can be summarized in a table.

**AVERAGE VALUES** • If you perform multiple trials of an experiment, you should calculate the overall result from each trial separately and then average the overall results from all of the trials together.

While it is perfectly acceptable for you to work together with others from the class to analyze the data from an experiment, you must prepare and submit your own individual lab report. No portion of a report, including any text, tables, graph, or formatting styles, may be shared from one person to another. Any such sharing will be considered a form of plagiarism (see [SECTION 3E](#)).

7A	<b>SAFETY ENFORCEMENT</b>
<p><b>RESPONSIBILITY</b> • Maintaining a clean and safe laboratory environment is the responsibility of every single student in the class. Unfortunately, each quarter there are always a few students who do not take these responsibilities seriously. Too many times, I find counter tops with chemicals spilled, balances left a mess, reagents bottles left open with their contents evaporating, pipettes left dripping outside of their bottles, bits of contaminated pH paper scattered around the lab, and so on. Even though this is not a research lab, there are still very clear hazards present, so any amount of unnecessary chemical exposure is unacceptable. Failure to clean a chemical spill because you cannot be bothered to spend the minute or two necessary demonstrates you have no concern for the environment around you or the safety of yourself or others, and it runs counter to the legal requirements for proper storage, segregation, and disposal of chemicals. It is not the job of faculty or staff to maintain a clean laboratory; it is the user of the space – you – who is totally responsible.</p> <p><b>ENFORCEMENT</b> • Violations of lab safety and cleanliness are grouped into three categories: chemical safety (<b>SECTION 7B</b>), chemical disposal (<b>SECTION 7C</b>), and lab cleanliness (<b>Section 7d</b>). At the beginning of each lab period, both you and I will assess the condition of the laboratory space. Any violations that we find will be remedied before continuing with the lab. If at any point during the lab I discover a violation has occurred, a penalty of up to ten (10) points will be deducted from the total number of lab points, depending on the seriousness of the violation, excluding any points designated for lab exams. If the violations occur in a common area, this penalty will apply to everyone in the section, as this is unfortunately the only recourse I have to ensure the common areas are kept clean.</p>	

7B	<b>CHEMICAL SAFETY VIOLATIONS</b>
<p><b>SPILLS</b> • All spills must be cleaned up immediately, particularly in the balance room. This includes sand spilled in fume hoods.</p> <p><b>SECURED REAGENTS</b> • All reagents bottles must be kept properly sealed when not in active use.</p> <p><b>SECONDARY CONTAINMENT</b> • All chemicals must be kept in secondary containment when not in active use.</p> <p><b>SEGREGATED CONTAINMENT</b> • All chemicals and waste must be segregated by these classes: <i>acid, base, organic, or oxidizer</i>.</p> <p><b>SEALED STORAGE</b> • All chemicals must be stored in sealed containers, except for non-reactive solid products being dried.</p> <p><b>LABELING</b> • Stored samples must be labeled with the full name of the primary hazard(s), the date, and the name of the preparer.</p>	

7C	<b>CHEMICAL DISPOSAL VIOLATIONS</b>
<p><b>SINKS</b> • Absolutely no chemicals may be poured down the sink, with the exception of the rinse water from cleaning glassware.</p> <p><b>DISPOSAL AREA</b> • The secondary containment area where waste bottles are stored must be kept clean from any spills.</p> <p><b>CHEMICAL COMPATIBILITY</b> • All waste must be disposed according to the following classes of compatibility: <i>acid, base, or organic</i>.</p> <p><b>DESIGNATED CONTAINER</b> • Unless otherwise directed, you may only use waste containers labeled with my initials (DHG).</p> <p><b>FILL LINE</b> • All waste containers must be maintained with some empty space at the top. Never completely fill a waste container.</p>	

7D	<b>LAB CLEANLINESS VIOLATIONS</b>
<p><b>COMMON AREAS</b> • Items from common areas, such as filter papers, pipettes, and pH paper, should be properly disposed of.</p> <p><b>FUME HOODS</b> • Any spills in fume hoods, including sand or residues left over from evaporation, should be clean up during lab.</p> <p><b>SINKS</b> • No solid debris should be left in any of the sinks. Please help to ensure the strainers in the drains are also kept clean.</p> <p><b>GLASS AND NEEDLES</b> • Broken glass and needles should only be disposed of in appropriate containers, never in regular trash cans.</p> <p><b>EQUIPMENT</b> • Any equipment used during a lab, such as hotplates or stands, must be properly stored before leaving lab.</p>	