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<td>8.15-8.17; 8.20; 11.13-11.15</td>
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<td>8.21; 10.10 [Review]</td>
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<td>9.1-9.2; 2.16</td>
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<td>F Dec 5</td>
<td>HWeb36</td>
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<td>Tu Dec 9</td>
<td>FINAL (2:50 p.m.)</td>
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POLICIES, GRADES AND PROCEDURES

GRADES
There are 5 mid-term exams (E1-5, 100 points each) and a final (200 points). HW, HWeb and PRS scores each count for a third of an exam. The lowest score from E1-5, and the combined HW+HWeb+PRS score will be dropped; the final can be exempted by doing very well on mid-terms. If you are required to take the final it cannot dropped.

The course will be graded on the basis of 700 points:

\[ \text{score (out of 700)} = (\text{HW+HWeb+PRS}) + E1 + E2 + E3 + E4 + E5 + \text{Final} - \text{(lowest E score or (HW+HWeb+PRS))} \]

-- 620 points will guarantee an "A"
-- 520 guarantees a "B"
-- 450 guarantees a "C"
-- 380 guarantees a "D"
-- See below for S/U and V requirements.

<table>
<thead>
<tr>
<th>Exam</th>
<th>Date</th>
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<th>Points</th>
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<tr>
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<td>F Aug 29</td>
<td>Topics 1 and 2</td>
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<td>Exam 2</td>
<td>F Sept 19</td>
<td>Topics 3 and 4</td>
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</tr>
<tr>
<td>Exam 3</td>
<td>W Oct 15</td>
<td>Topics 5 and 6</td>
<td>100</td>
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<tr>
<td>Exam 4</td>
<td>F Nov 5</td>
<td>Topics 7 and 8</td>
<td>100</td>
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<tr>
<td>Exam 5</td>
<td>F Nov 24</td>
<td>Topic 9 (75 points in class, 25 point take-home assignment)</td>
<td>75 points + 25 points take-home assignment</td>
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<td>F Dec 9, 2:50 p.m.</td>
<td>Comprehensive (multiple choice)</td>
<td>Required unless exempting final</td>
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<tr>
<td>HW + HWebs + PRS</td>
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<td>100 points</td>
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</tbody>
</table>

To avoid taking the final:
...with an "A": If you score a total of 450/500 points on Exams 1-5 and a score of \( \geq 75\% \) on each exam you will receive an "A" without taking the final.
...with a "B": A score of 415/500 on Exams 1-5 and a score of \( \geq 65\% \) on each exam you may elect to receive a "B" or take the final to improve your grade. You must notify the instructor if you wish to exempt the final with a "B".

LECTURE ATTENDANCE
You are strongly encouraged to attend lectures.

STUDENT ID NUMBERS
All work submitted for grading must include your name and class roll number (not SSN), which will be available on the class homepage at the end of the first week of classes.

REGRADES
If you want any work regraded you must make a request and return the assignment within one week to the instructor. Work will not be regraded after this deadline.

CLASS NOTES
Notes for each topic should be downloaded from the web (as PDF files) and printed prior to the first lecture dealing with the material. Topics correspond fairly closely to the chapters, with a little reorganization. These notes are not designed to be comprehensive. In fact, they are specifically designed to be incomplete. They will serve as the basis for lecture notes, not as a replacement for attending lectures. The notes should minimize the use of lecture time for information transfer, and allow time to work problems in class.

HOMEWORK
HWeb Assignments (33.33 points)
The textbook is exceptionally well-written and should be the primary source of information in the course. It is important to do the assigned reading before coming to lecture. This will provide you with some familiarity with the subject and allows us to spend more time in class illustrating concepts and solving problems. In order to encourage reading of the textbook, there is a multiple choice homework, "HWeb", based on the reading assignments before each class. Each assignment consists 3 multiple choice questions which require you to read ahead in the textbook. The questions must be answered using t-square by 10 a.m. prior to each lecture. Late answers will not be accepted. There will be 105 questions throughout the semester worth 0.33 point each. You can collect up to 33.33 points. Answers will be provided during the next lecture. Answers and scores will not be posted; you should keep a running tally of your points.
Use the Web syllabus to gain access to WebCT to answer the HWeb assignments (click on the appropriate HWeb link). The questions themselves can be downloaded from the Notes and HWebs page. Use the HWeb Record Sheet to record your answers.

**Written Homeworaks (33.33 points)**

Ten written homework sets will be assigned, each worth 3.33 points. Answers must be submitted on the answer sheet provided using MSWord, ChemDraw and Chem3D. Handwritten answers will not be accepted (with the exception of HW1). Answers must be submitted at the lecture corresponding to the section in which you are enrolled. Late answers will not be accepted. You must PREPARE the homework assignment that you turn in for grading yourself, although you are encouraged to work with others to answer the questions. You may not use another person's electronic file, IN ANY WAY, for your homework. If you do this, you will receive a zero for that assignment and you will be referred to the Dean of Students. Graded assignments will be returned in the lecture corresponding to the section in which you are enrolled. If you do not collect the graded assignment at the lecture you may collect it from outside of the instructor's office door. Solutions will be posted on the www site. Homework assignments, answer sheets and solutions are available for download from the Homework page.

**Other Problems (not graded)**

You should work the problems in each reading assignment as you get to them. Problems at the end of the chapter are listed on the class notes (top right hand corner): You should work through as many of these as possible. These will serve as a guide for the types of questions to appear on examinations. DO THESE PROBLEMS, but do not submit answers to these problems, they will not be graded.

**LECTURE PARTICIPATION VIA PERSONAL RESPONSE SYSTEM (33.33 points)**

The Personal Response System (PRS) is a proven educational technology to enhance student involvement in the lecture setting. We will make extensive use of PRS after the first week of class. Questions will be posed throughout the lectures. The score you obtain using PRS will be scaled to 33.33 points. This score will be added to your HW and HWeb scores, and this combined score may be used to replace a low mid-term exam score. You must use your own PRD RF transmitter, programmed with your own GTID number.

**EXAMS: SCHEDULE, MAKE-UPS AND DROPS (Five mid-term exams - 100 pts, each)**

You must take the exam at the assigned time for the section in which you are enrolled. The only valid reasons for missing an exam are: illness, official Tech business and out-of-town job interviews. Make-ups can only be given if advance notification is given or upon presentation of a doctor's note. All make-up exams must be administered before the exams are returned to the class in the next lecture. Exams not made-up by this time for any reason will receive a score of zero and will be the drop grade for the class. The lowest score from Exam 1, 2, 3, 4, 5, and HW/HWeb will be dropped. If an exam is missed for any reason, that score (zero) will be dropped. However, do not miss an exam just because you know that you can drop it! Similarly, don't ignore the HW/HWeb assignments simply because you can elect to drop this score. With the options to drop your lowest mid-term score and for you to avoid taking the final, the final examination itself can account for 0 or 28 % of your grade for the course. Practice exams are available from the Exam webpage. Solutions to the exams will be posted on the Exam webpage. Additional multiple choice questions are available here.

**RETURNED WORK**

All graded assignments will be returned as soon as possible, usually at the next lecture. Work not picked up in lecture will be available from outside of Dr. Beckham's office door in the Boggs Chemistry Building.

**MATERIAL COVERED & STUDENT RESPONSIBILITIES**

You are responsible for all material presented in lectures and in assigned readings. You are also responsible for announcements made in class, which will also be posted on the www page or distributed by email You must check the web site and your mail.gatech.edu email account on a regular basis. Note: there are potential problems associated with automatic forwarding of messages from prism to other email addresses; check your prism account even if you have it set up to forward email elsewhere.

**THE TECH ACADEMIC HONOR CODE**

You are required to adhere to the Georgia Tech honor code (http://www.honor.gatech.edu/). The work you submit on examinations must be entirely your work without reference to notes or other materials. You may collaborate on developing approaches to solving problems in homework assignments, but you must prepare your own answer sheet using ChemBioDraw and MS Word - you must not cut-and-paste from someone else's work, or modify someone else's computer file. The take-home part of E5 must be worked on INDEPENDENTLY, with NO discussion with others.

**WORKING IN GROUPS**

Most learning takes place outside of the classroom. Although lectures should put things in perspective, working through the textbook, and solving the problems is when you will come to terms with the material. We encourage you to work together on these reading and problem assignments. For most students, it is actually unwise to try to work alone. Although you might study in groups, remember that you are ultimately responsible for your learning. Everybody can benefit from team work. If you are struggling with the material you stand to learn a lot; if you are an "Organic Whiz? you also stand to learn from the challenge of presenting your understanding to others. You will learn through teaching.
Office hours are available for individual instruction. In addition, there will be a series of optional problem solving sessions led by undergraduates who have succeeded in this class in the past. They can be a great resource to you. No new information will be introduced during office hours or problem solving sessions. Come prepared to ask and answer problems.

COMPETITION & GRADING
Formal education often puts students in competition with each other for good grades. We do not believe that competition for grades, and the exclusion of everything else, is the most effective way to foster student development. Although grades will be assigned based on a numerical score which judges attainment on exams, the course is structured such that if you show a desire to learn, put the effort in, and have some intellectual ability, you can get the grade you want. With this in mind, please take the time to read the Grades, Expectations and Minimum Requirements section, and decide what you want from the course.

“WORD”
If you want word just ask! All of the problems in the exam will be similar to those in the book. The processes by which you can solve the problems will be exactly the same as those in the book. Occasionally, an exam question be taken directly from the text. You must understand the processes required to answer assigned problems to do well on exams. An example for each exam, with answers, is available from the www site. The best use of these practice exams is to study for the exam, then try the practice exam, in one hour, undisturbed. THEN look at the answers, gauge your success, and assess your needs for further study.

TIME COMMITMENTS
We all have extensive demands on our time. For each lecture you should aim to put in at least another two hours of your own time. You will need to spend more time preparing for exams. Some students will require more, some less.

CLASS CANCELLATION
If Georgia Tech is officially closed at the time of a regular lecture a new syllabus will be posted. If campus is closed on a day that an exam is scheduled, the exam will take place in the lecture period immediately after re-opening.

GRADES, EXPECTATIONS, MINIMUM REQUIREMENTS
adapted from J. H. Williams in The Teaching Professor

"D" -50%- Some demonstration of detailed knowledge of organic reactions.
"C" -60%- Detailed knowledge of structure and bonding, be able to show movement of electrons during reactions, know individual organic reactions.
"B" -70%- Requirements for a "C", plus some demonstrated success of multistep synthesis of molecules, some success showing movement of electrons for multistep reactions. 
"A" -85%- Requirements for a "B", plus: write consistently good complete pathways for multistep reactions based on simple mechanistic concepts showing flow of electrons in each step. Propose good syntheses for molecules using a string of individual organic reactions.

"A" students have virtually perfect performance. Their commitment to the class resembles that of the teacher. They always read the assignment, and their attention to detail is such that the occasionally catch the teacher's mistakes (we all make them!). An "A" student is creative, committed, organized, and curious, has a retentive mind (and exercises it), has a winning attitude, and shows initiative.?

"V" audit - same as for "S"

"S"atisfactory (S/U) - Exams 1-5 to a "C" level (no drops), Final not required, or "D" including Final

If every student gets 85+%, everyone gets an "A"

SOME STUDY TIPS
Understand and Rationalize. Read the text, prepare your own summaries. Typically each section in the text can be generalized in one or two lines or equations. Read the chapter summaries. Do you understand each point? Can you apply each concept? Work as many of the problems in the book as possible. Do them in order. If you have no trouble with the first few parts of a multi-part question, you might want to pick a few of the latter parts at random.

Study in groups. Keep up to date! Ask Questions!!
TOPIC 1. STRUCTURE AND BONDING  
(Chapter 1)

These packages of notes are designed for use in conjunction with CHEM 2311 lectures. If you miss a lecture, get the completed notes from another student. Reading assignments (from Solomons) are given in the top right corner (S:#-#), along with relevant problems from the end of the chapter.

OBJECTIVES

1. Introduction to organic chemistry and review of terms
2. Describe distribution of electrons in organic molecules  
   (atomic electronic configurations, Lewis structures, resonance)
3. Describe bonding C-C and C-H bonds in organic  
   molecules (hybridization, overlap of atomic orbitals).
4. Describe molecular geometry.
ORGANIC CHEMISTRY:  
YESTERDAY, TODAY AND TOMORROW

Yesterday

Pre-1820: “Vitalism” - belief that “natural compounds” possessed special properties, could not be made by man

1828: Wöhler: preparation of urea (organic) from ammonium cyanate (inorganic)

\[
\text{NH}_4\text{OCN} \xrightarrow{\text{heat}} \text{CH}_3\text{N}_2\text{O}
\]

1908: First production of a synthetic plastic, Bakelite (1930s-50s: Commercialization of commodity plastics: nylon, polyester, PVC, polyethylene, polypropylene)

1928: Discovery of penicillin (1954: Celphalosporin)

1948: \(\alpha\)-helix of protein structure determined (1952: Determination of double helix structure of DNA)

1950s: Oral contraceptives

Today

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<th>(Annual US production)</th>
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<th>billion $</th>
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<td></td>
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</tbody>
</table>

Recently

Taxol (anticancer), C60-buckyball, nanoscience

Major Pharmaceuticals

Pristine (Astra Pharm Inc., acid reflux)

Lipitor (Parke-Davis, high cholesterol)

Propecia (anti-baldness)

AZT (Burroughs Wellcome, HIV)

Prozac (Fluoxetine) (Antidepressant, Lilly)

Viagra (Pfizer)

Zantac (Ranitidine) (Antulcer, Gastro)

Claratin (Schering, allergies)

Amoxicillin (Antibiotic, SKB, Squibb)

Acetaminophen

Ibuprophen
Tomorrow

**Better food:**
- Nutrients
- Pesticides
- Fertilizers

**Better health:**
- Pharmaceuticals
- Biomedical engineered implants/replacements

**Better environment:**
- Cleaner processes

**Better living….**

Better Living Through Chemistry

…through responsible care and stewardship.

---

**SOME BASIC STRUCTURAL FEATURES**

**Empirical Formula**
- Ratio of atoms in a compound.

**Molecular Formula**
- Number of each atom in a molecule.

**Valency**
- Elements form a fixed number of bonds (H 1, O 2, N 3, C 4).

**Structure**
- Arrangement of atoms and bonds in a molecule.

**Isomers**
- Different compounds with the same molecular formula.

**Constitutional isomers**
- Compounds with the same formula, but with different connectivities of atoms.
A VERY GOOD PLACE TO START:
ELECTRONIC CONFIGURATION OF ATOMS

H 1s¹
He 1s²
Li 1s², 2s¹
Be 1s², 2s²
B 1s², 2s², 2p¹  1s², 2s¹, 2p¹
C 1s², 2s², 2p²  1s², 2s¹, 2p¹, 2p²
N 1s², 2s², 2p³  1s², 2s¹, 2p¹, 2p², 2p³
O 1s², 2s², 2p⁴  1s², 2s¹, 2p¹, 2p², 2p³
F 1s², 2s², 2p⁵  1s², 2s¹, 2p¹, 2p², 2p³, 2p⁵
Ne 1s², 2s², 2p⁶  1s², 2s¹, 2p¹, 2p², 2p³, 2p⁵

BONDING: LEWIS STRUCTURES
AND FORMAL CHARGES

The Octet Rule
Atoms exchange or share electrons to complete the valence shell (adopt Noble gas electronic configuration)

Ionic Bonds
Atoms exchange electrons to form ions which are electrostatically attracted to one another.

Li + F → Li⁺ + F⁻

Ionic bonds are typically formed between atoms which are highly electronegative and highly electropositive
Covalent Bonds
Atoms share valence shell electrons to form covalent bonds

\[ \text{C} \quad \text{H} \quad \text{H} \quad \text{H} \quad \rightarrow \]

\[ \text{O} \quad \text{H} \quad \text{H} \quad \rightarrow \]

Recommendation: ALWAYS explicitly show lone pairs of electrons

“Exceptions” to the Octet “Rule”

Octet rule is the tendency to have eight valance electrons - only applies strictly to second row elements

\[ \text{F} \quad \text{B} \quad \text{F} \]

\[ \text{HO} \quad \text{SO} \quad \text{OH} \]
Formal Charge

\[ F = Z - \left( \frac{S}{2} \right) - U \]

Always show all formal charges in all structures!

Some Common Valencies

Not:
Constitutional Isomers

Given the common valencies of atoms (C=4, H=1), there might be a number of possible arrangements. These different structures are called *constitutional isomers*. Draw all the constitutional isomers with molecular formula $\text{C}_4\text{H}_{10}$.

---

**Structure ⇒ Function**

*Physical Properties of $\text{C}_3\text{H}_8\text{O}$*

<table>
<thead>
<tr>
<th>isopropyl alcohol</th>
<th>ethyl methyl ether</th>
</tr>
</thead>
<tbody>
<tr>
<td>(CH$_3$)$_2$CHOH</td>
<td>CH$_3$CH$_2$OCH$_3$</td>
</tr>
<tr>
<td>water-miscible</td>
<td>water-insoluble</td>
</tr>
<tr>
<td>bp = 82 °C</td>
<td>bp = 8 °C</td>
</tr>
</tbody>
</table>

*Reactivity of $\text{C}_6\text{H}_{12}$*

<table>
<thead>
<tr>
<th>1-hexene</th>
<th>cyclohexane</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\downarrow \text{Br}_2$</td>
<td>$\downarrow \text{Br}_2$</td>
</tr>
<tr>
<td>$\text{C}<em>6\text{H}</em>{13}\text{Br}$</td>
<td>no reaction</td>
</tr>
</tbody>
</table>
RESONANCE THEORY

*e.g.*, Carbonate, $\text{CO}_3^{2-}$: A single Lewis structure does not accurately describe the structure of the carbonate dianion.

Molecules and ions that can be represented by more than one valid Lewis structure *which differ only in the position of non-bonding electrons and double bonds* exist as a hybrid of each contributing resonance structure.

Resonance structures ("contributors")

The hybrid is a combination (average) of all the contributing Lewis structures. It is more stable than the individual structures.
Problem: Which of the following are valid resonance structures?

Guidelines for Recognizing and Drawing Resonance Structures

- Individual resonance structures do not exist - the hybrid does. The energy of the actual molecule is lower than what might be predicted for any of the contributing structures.

- Resonance structures which possess features that impart stability contribute more to the hybrid structure. Stability is enhanced by:
  - Equivalent resonance structures contribute particular stability to the molecule
  - More bonds, stronger bonds
  - Complete valence shells (as opposed to incomplete valence shells)
  - Little (no) charge separation (separating charges costs energy!)
  - Negative charge on electronegative atoms (and visa versa)
Which structure in each pair is the more stable major contributor to the resonance hybrid? [Consider the factors that contribute to the stability/instability of each resonance structure]

\[
\begin{align*}
\text{H}_2\text{C} = \text{C} \text{H} & \quad \text{H}_2\text{C} = \text{C} \text{H} \\
\text{H}_2\text{C} = \text{C} \text{H} & \quad \text{H}_2\text{C} = \text{C} \text{H} \\
\text{H}_2\text{C} = \text{O} \text{CH}_3 & \quad \text{H}_2\text{C} = \text{O} \text{CH}_3 \\
\text{O} = \text{C} = \text{N} & \quad \text{O} = \text{C} = \text{N} \\
\end{align*}
\]

*Problem:* Which of the following sets of curved arrows accurately represents resonance? [Draw the structures implied by the movement of electrons shown by the arrows, which of the species is a valid Lewis structure?]
Electrons are contained in atomic orbitals

Atomic orbitals overlap to form molecular orbitals

$E \quad H \ 1s^1$
Carbon:

Filling Orbitals
maximum of two $e^-$ per orbital
Aufbau Principle: $e^-$ fill lower energy orbitals
Pauli Principle: $e^-$ in same orbitals have different spins
Hund’s rule: degenerate orbitals are filled equally

METHANE AND ETHANE:
sp$^3$ HYBRIDIZATION

e.g., methane, CH$_4$
Hybridization

Orbital overlap

$s + sp^3$ orbital overlap

methane, CH₄: gas (bp= -161 °C). Used as natural gas, for synthesis of other compounds

e.g., ethane, C₂H₆

ALKENES: sp² HYBRIDIZATION

e.g., ethene (ethylene)

1.34 Å
146 kcal/mol

approx. 120°

ethene (ethylene), C₂H₄; gas (bp= -102 °C). Monomer for preparation of polyethylene, used for synthesis of ethylene oxide.
Alkenes are thermally stable and do not undergo rotation around the C=C bond.

Constitutional and Geometric Isomers of Alkenes

**Geometric isomers** have the same connectivity of atoms, but different spatial arrangements.

\[ \begin{array}{c}
\text{cis} & \text{trans} \\
\text{bp/°C} & 4 & 1 \\
\text{mp/°C} & -139 & -104
\end{array} \]

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ALKYNES:
sp HYBRIDIZATION

e.g., ethyne (acetylene)

\[ \text{CH} \equiv \text{CH} \]

1.20 Å
200 kcal/mol

180°

ethyne (acetylene), \( \text{C}_2\text{H}_2 \): gas (bp = -81 °C). Used in oxy-acetylene welding torches, for manufacturing of acetic acid.
Comparing C-H Bond Lengths in Alkanes, Alkenes and Alkynes

C-H bond lengths

- $1.10 \text{ Å}$
- $1.08 \text{ Å}$
- $1.06 \text{ Å}$

$\text{Csp}^3 + \text{H1s}$

$\text{Csp}^2 + \text{H1s}$

$\text{Csp} + \text{H1s}$

VALENCE SHELL ELECTRON PAIR REPULSION THEORY

VSEPR Theory — use to predict shape of molecules

Pairs of valence e$^-$ (in bonds and lone pairs) repel each other
BOND STRENGTHS

Orbital Energy Diagrams

Strong bonds are formed between atoms with similar size. Long bonds are often weak.

Representative Bond Lengths and Strengths

<table>
<thead>
<tr>
<th>bond length</th>
<th>bond strength</th>
</tr>
</thead>
<tbody>
<tr>
<td>Å</td>
<td>kcal/mol</td>
</tr>
<tr>
<td>H-H</td>
<td>0.74</td>
</tr>
<tr>
<td>H-F</td>
<td>0.92</td>
</tr>
<tr>
<td>H-Cl</td>
<td>1.27</td>
</tr>
<tr>
<td>H-Br</td>
<td>1.41</td>
</tr>
<tr>
<td>H-I</td>
<td>1.61</td>
</tr>
<tr>
<td>H-O</td>
<td>0.97</td>
</tr>
<tr>
<td>H-C</td>
<td>1.10</td>
</tr>
<tr>
<td>C-C</td>
<td>1.55</td>
</tr>
<tr>
<td>C=C</td>
<td>1.33</td>
</tr>
<tr>
<td>C≡C</td>
<td>1.20</td>
</tr>
<tr>
<td>C-O</td>
<td>1.43</td>
</tr>
<tr>
<td>C=O</td>
<td>1.21</td>
</tr>
<tr>
<td>C-F</td>
<td>1.38</td>
</tr>
<tr>
<td>C-Cl</td>
<td>1.77</td>
</tr>
<tr>
<td>C-Br</td>
<td>1.95</td>
</tr>
<tr>
<td>C-I</td>
<td>2.14</td>
</tr>
</tbody>
</table>

1 Å = 10^{-10} m = 100 pm 1 kcal = 4.18 kJ
REPRESENTING ORGANIC MOLECULES IN 2D AND 3D

e.g., Propane (C\textsubscript{3}H\textsubscript{8})

\[
\begin{array}{c}
\text{H} \\
\text{H} \\
\text{H} \\
\text{C} - \text{C} - \text{C} - \text{H} \\
\text{H} \\
\text{H} \\
\text{H}
\end{array}
\]

- dash condensed bond-line 3-D structure
- line = bond
- bond end, angles, nodes = carbon
- Do not show H on C; do show H on other atoms
- Assume C is tetravalent unless charges/electrons are shown

Remember you must always show heteroatoms and hydrogen atoms on heteroatoms. It is recommended that you always show lone pairs, however sometimes lone pairs are not shown. Even if lone pairs are not shown, you need to be able to identify when they are present (consider octet rule and presence of charges)
Problem. What is the molecular formula of each of the following compounds shown as bond-line structures?

\[
\begin{align*}
\text{O} & \quad \text{O} \\
\text{sp}^3 \text{ carbon atoms are tetrahedral: Practice drawing tetrahedra!}
\end{align*}
\]
You know a lot about organic structures!

**Problem.** Norethindrone, a steroidal oral contraceptive. Identify the hybridization and geometry of each atom, and the length and overlap of atomic orbitals for each bond.

- What is the empirical formula?
- What is the molecular formula?
- What is the molecular weight?

**SUMMARY: MOLECULAR STRUCTURE CONCEPTS, MODELS, RULES AND THEORIES**

<table>
<thead>
<tr>
<th>Concept</th>
<th>Prediction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Valency/ Octet rule</td>
<td>Presence of lone pairs</td>
</tr>
<tr>
<td></td>
<td>Formal charges</td>
</tr>
<tr>
<td>Bonding</td>
<td>Covalent bonds between atoms of similar electronegativity</td>
</tr>
<tr>
<td></td>
<td>Ionic bonds between atoms of different electronegativity</td>
</tr>
<tr>
<td>VSEPR</td>
<td>Molecular geometry</td>
</tr>
<tr>
<td>Hybridization</td>
<td>Molecular geometry</td>
</tr>
<tr>
<td>Resonance</td>
<td>Charge distribution</td>
</tr>
</tbody>
</table>
ORGANIC CHEMISTRY

Some **GOLDEN** Rules

Molecular shape and electronic structure control reactivity
- orbitals
- formal charge
- hybridization
- non-bonding electrons
- VSEPR theory
- electronegativity

Opposites attract

Molecules want to lower their potential energy

Always be on the lookout for reasons why a molecule or ion might be stable or unstable

Think mechanistically!

---

**TOPIC 1 ON EXAM 1**

**Types of Questions**
- Identify formal charges, geometry (bond lengths, angles), hybridization.
- Draw and recognize resonance structures, constitutional isomers, atomic and molecular orbitals.
- Do the problems in the book; they are great examples of the types of problems on the exam!

**Preparing for Exam 1**
- Get up-to-date *NOW!*
- Work as many problems as possible. Do the problems first, then consult the solutions manual.
- Work in groups, discuss chemistry, teach and test each other.
- Do the “Learning Group Problem” at the end of the chapter.