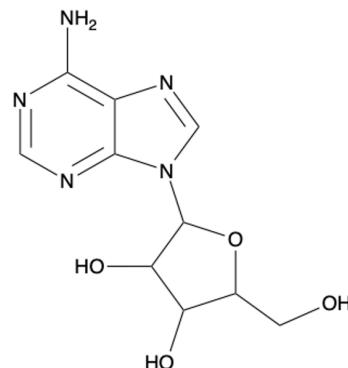
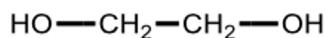
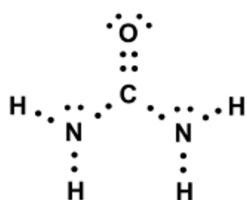


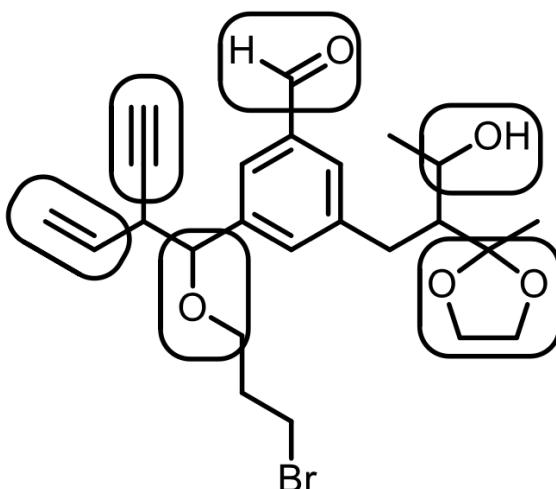
1.1 Drawing Organic Molecules

Organic compounds can be represented in different ways. Complete the examples of urea, ethylene glycol and pyrimidine below with the representations not shown in each case (Kekulé, Lewis, Line Structure).



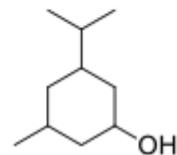
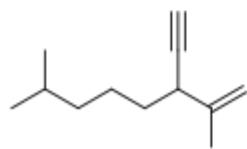
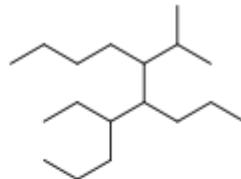
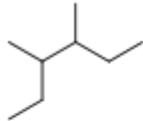
1.2 Functional Groups

Indicate the substance class associated with the circled functional groups.

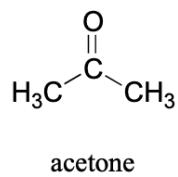
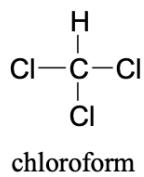
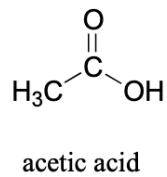


1.3 Nomenclature

a) Name the following molecules:



b) Give IUPAC names for acetic acid, chloroform, and acetone.



c) Draw line structures of the following compounds:

i. Methylcyclohexane

ii. 5-methyl-1-hexanol

iii. 2-methyl-2-butene

iv. 5-chloropentanal

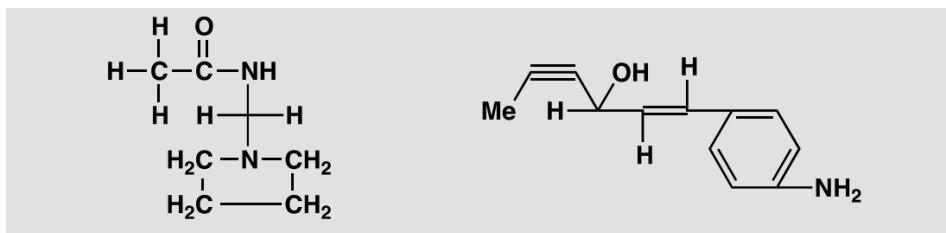
v. (2E)-3-(4-Chlorophenyl)prop-2-en-1-al

vi. (E)-4-Butyloct-6-in-2-en

vii. 5-methylhex-1-en-3-ol

1.4 Structure representation

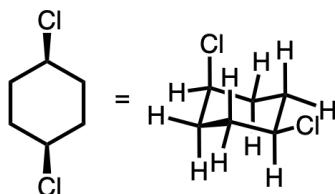
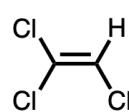
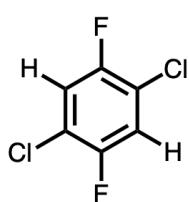
a) What is wrong with these structures? Suggest better ways to represent these molecules



b) Suggest at least four different structures that would fit the formula $\text{C}_4\text{H}_7\text{NO}$. Show good representations of each one and say which functional groups are present.

1.5 Dipole Moment

a) Which of the following molecules have a dipole moment?
 (Hint: Draw individual bond dipoles first.)



b) Which of the following molecules will **not** have a dipole moment?

- CH_3Cl
- CH_3OCH_3
- CH_2Cl_2
- CCl_4

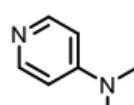
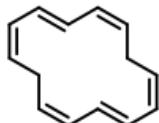
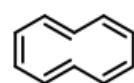
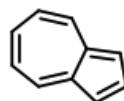
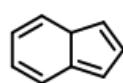
1.6 Ionization Potential / Electron affinity / Electronegativity

a) Explain why the Ionization Potential of Hydrogen (H) is higher than that of Lithium (Li).

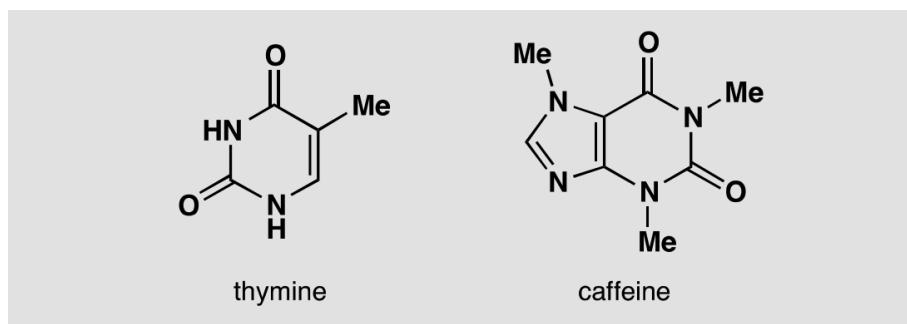
b) Why do Fluorine bonds have a more ionic character than Chloride bonds, despite Cl having a higher electron affinity than F?

1.7 Aromaticity

a) Which of the following molecules are aromatic, anti-aromatic or non-aromatic?

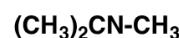
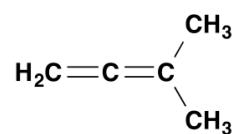


b) Do you consider that thymine and caffeine are aromatic compounds?
Explain. (*Tricky*)

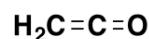


1.8 Hybridization

a) Indicate the hybridization of each nitrogen, oxygen and carbon of the following compounds.

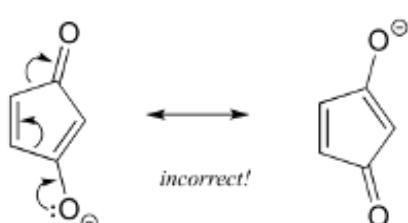
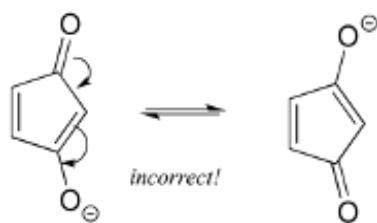
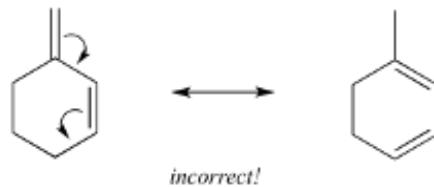
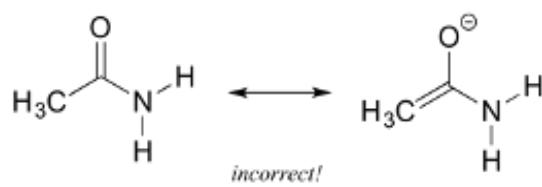
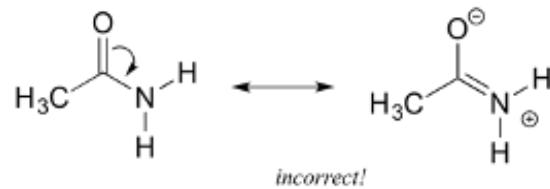
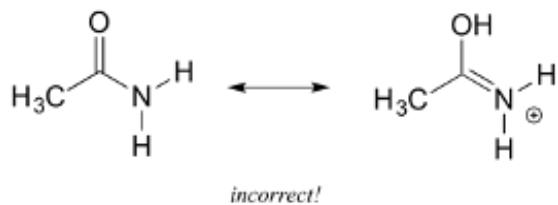


b) Draw all orbitals of the following two molecules and indicate the hybridization, the angles and the type of bond (σ or π).



1.9 Resonance

a) Each of the 'illegal' resonance expressions below contains one or more mistakes. Explain what is incorrect in each.



b) Draw three resonance contributors of methyl acetate (an ester with the structure $\text{CH}_3\text{COOCH}_3$), and order them according to their relative importance to the bonding picture of the molecule. Explain your reasoning.

1.10 Biomolecules

a) (True/False) Aldehydes, amides, carboxylic acids, esters, and ketones all contain carbonyl groups.

b) By definition, carbohydrates contain which elements?

- carbon and hydrogen
- carbon, hydrogen, and nitrogen
- carbon, hydrogen, and oxygen
- carbon and oxygen

c) Monosaccharides may link together to form polysaccharides by forming which type of bond?

- hydrogen
- peptide
- ionic
- glycosidic

d) Microorganisms can thrive under many different conditions, including high-temperature environments such as hot springs. To function properly, cell membranes have to be in a fluid state. How do you expect the fatty acid content (saturated versus unsaturated) of bacteria living in high-temperature environments might compare with that of bacteria living in more moderate temperatures?

e) Which of the following groups varies among different amino acids?

- hydrogen atom
- carboxyl group
- R* group
- amino group