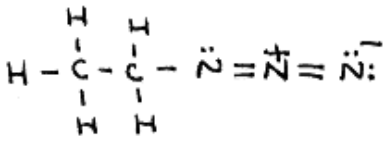
Question 1 (12 points) **Name** Key

Draw a Lewis structure for the following molecules. Include all lone pairs and formal charges, if necessary.

a. (4 pts)

$CH_3CH_2N_3$

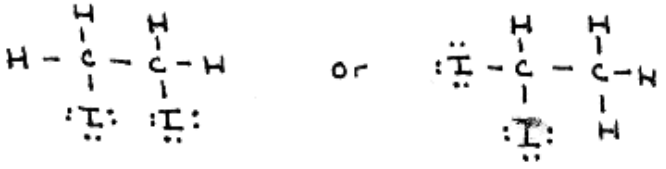


b. (4 pts)

HCCOH

c. (4 pts)

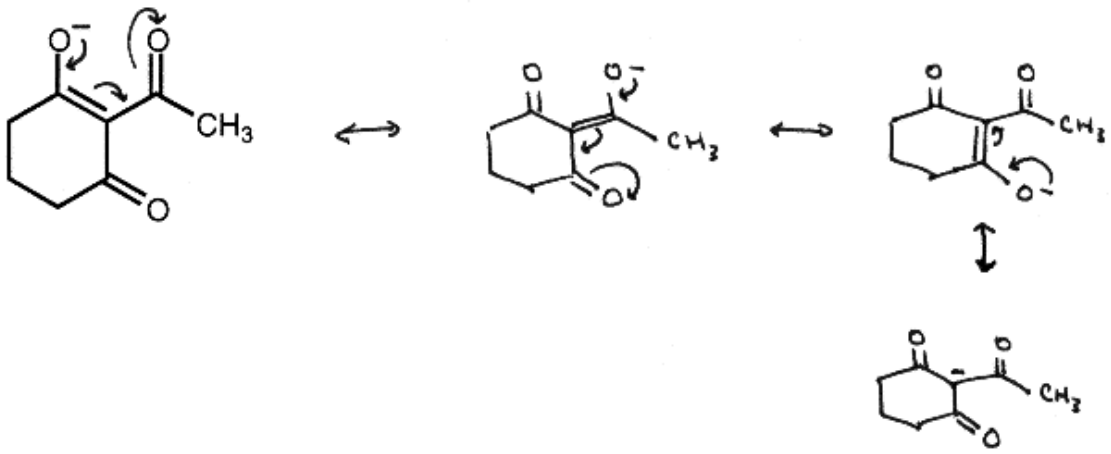
$C_2H_4I_2$



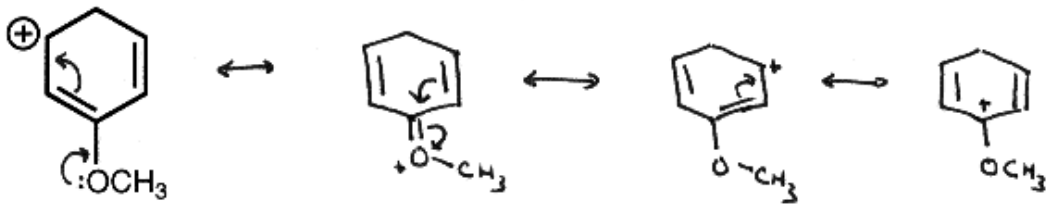
Question 2 (12 points) **Name** key

Draw the **three** other stable resonance structures for each of the following compounds below.

a. (6 pts)

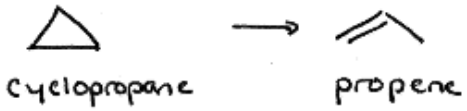


b. (6 pts)



Question 3 (10 points) **Name** Key

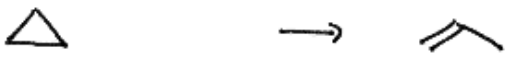
The heat of combustion of cyclopropane is 2092 KJ/mol; the heat of combustion of propene is 2058.1 KJ/mol. Calculate the enthalpy change for the conversion of cyclopropane into propene.



cyclopropane propene

C_3H_6 $+ \frac{9}{2} O_2 \longrightarrow 3CO_2 + 3H_2O \quad \Delta H^\circ_{rxn} = -2092 \text{ kJ/mol}$

$+ \quad 3CO_2 + 3H_2O \longrightarrow \frac{9}{2} O_2 +$  $C_3H_6 \quad \Delta H^\circ_{rxn} = +2058.1 \text{ kJ/mol}$



$\Delta H^\circ_{rxn} = -2092 \text{ kJ/mol} + 2058.1 \text{ kJ/mol}$

$\boxed{\Delta H^\circ_{rxn} = -33.9 \text{ kJ/mol}}$

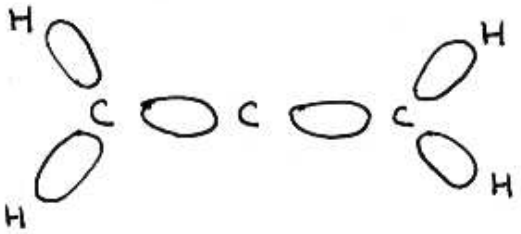
Question 4 (12 points) **Name** key

Determine a molecular orbital picture for allene ($H_2C=C=CH_2$) as follows:

a. (4 pts) List and sketch the atomic orbitals:

Atom	orbital type	number	picture
H	s	4	
C	sp^2	6	
C	sp	2	
C	p	4	

b. (4 pts) Sketch the σ orbitals:

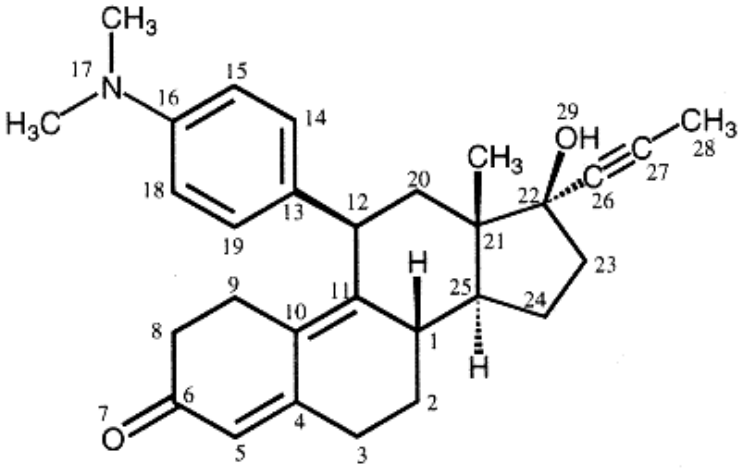


c. (4 pts) Sketch the π orbitals:

π bonds are perpendicular to each other.

Question 5 (18 points) **Name** Key

RU-486 (mifepristone) is a synthetic steroid that blocks the affects of progesterone. Using the numbering system shown on the drawing below, answer the following questions:



Carbon-12 is a tertiary carbon. (primary, secondary, tertiary, quaternary)

The hybridization state of C-26 is sp.

The hybridization state of C-4 is sp^2.

The hybridization state of N-17 is sp^3.

The hybridization state of O-29 is sp^3.

The functional group containing C-6 and O-7 is a/an ketone or carbonyl.

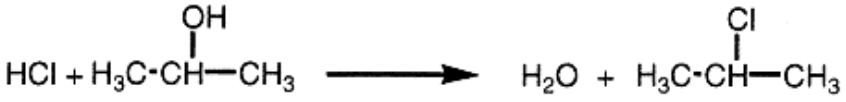
The functional group containing N-~~16~~ 17 is a/an amine.

The methyl group on C-21 is trans to the hydrogen on C-25. (cis, trans)

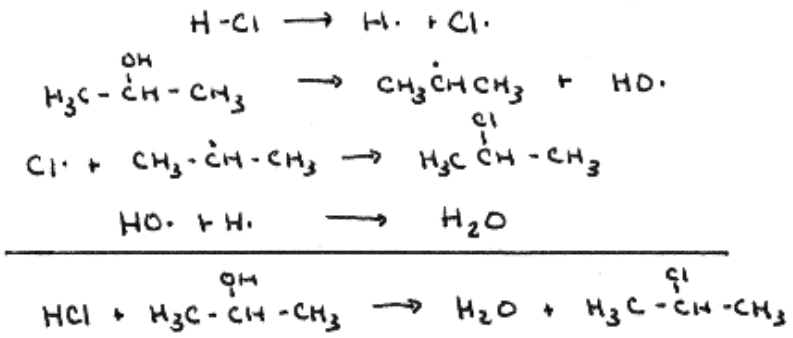
The hydrogen on C-1 is cis to the methyl group on C-21. (cis, trans)

Question 6 (12 points) **Name** Key

Using bond dissociation energies, calculate the ΔH°_{rxn} for the reaction shown below. Draw a potential energy diagram for the process. Some useful BDE's are listed below.



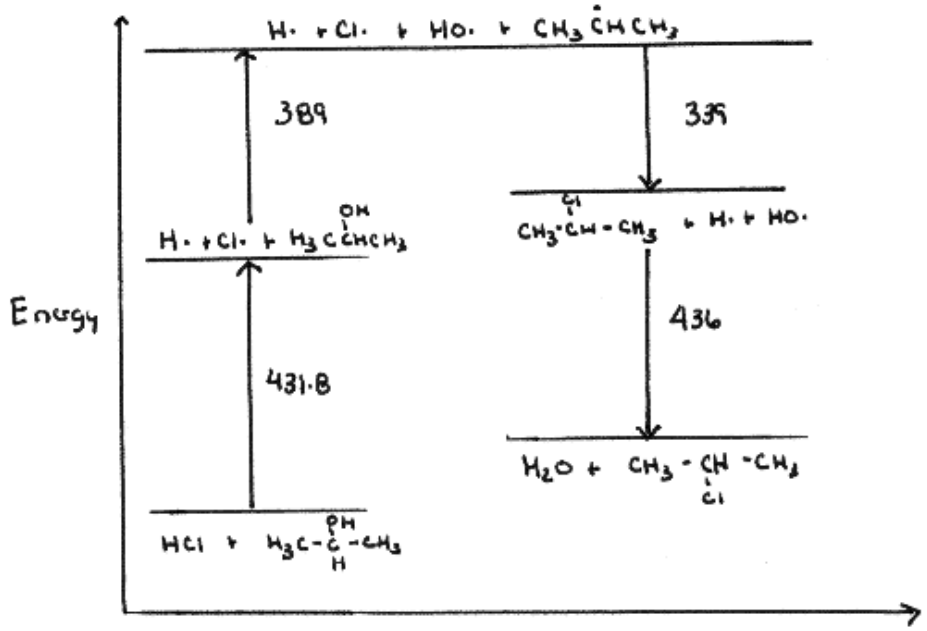
Bond	Energy (KJ/mol)
H-Cl	431.8
H-OH	436
C-H	410
C-C	397
C-OH	389
C-Cl	339



ΔH°_{rxn} = BDE (H-Cl) + BDE (C-OH) - BDE (C-Cl) - BDE (H-OH)

ΔH°_{rxn} = 431.8 + 389 - 339 - 436

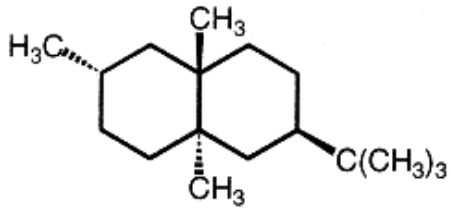
ΔH°_{rxn} = + 45.8 kJ/mol

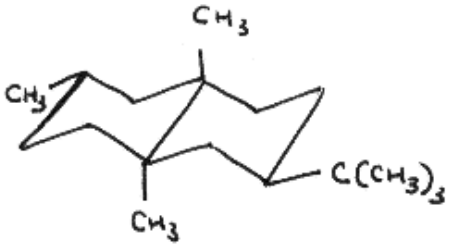


Question 7 (10 points) **Name** key

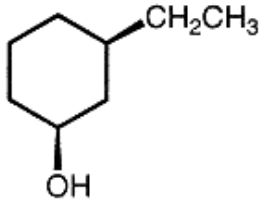
Draw a three dimensional representation in the **lowest energy** conformation of the following molecules.

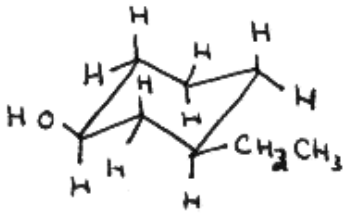
a. (5 pts) You do not need to show the hydrogens on the ring in your drawing.





b. (5pts) Show the hydrogens on the cyclohexane ring.





Question 8 (14 points) **Name** key

Consider 2,2-dimethylpentane. Draw the Newman projection for each 60° conformation from 0° to 360° looking down the **C3-C4** bond. Sketch an approximate potential energy diagram for rotation about the C3-C4 bond with **the highest energy conformation at 0°**.