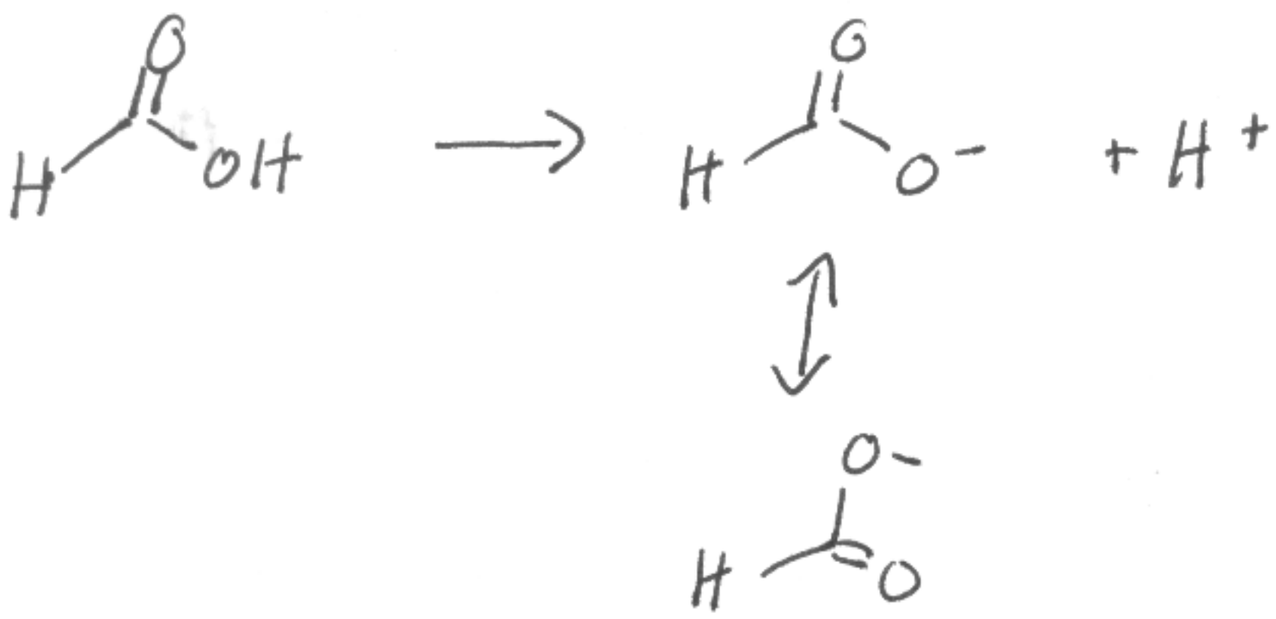
CH301H Fall 2011

Homework week 12, key

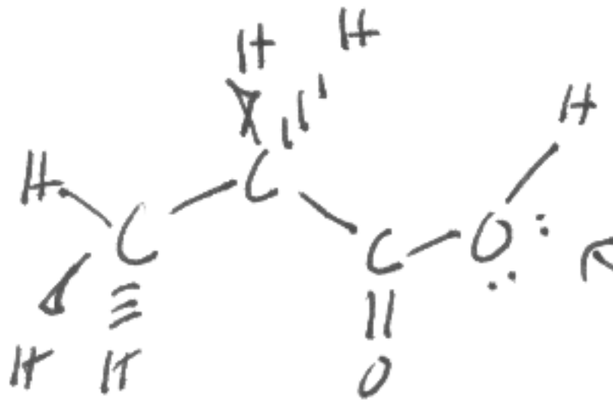
1.



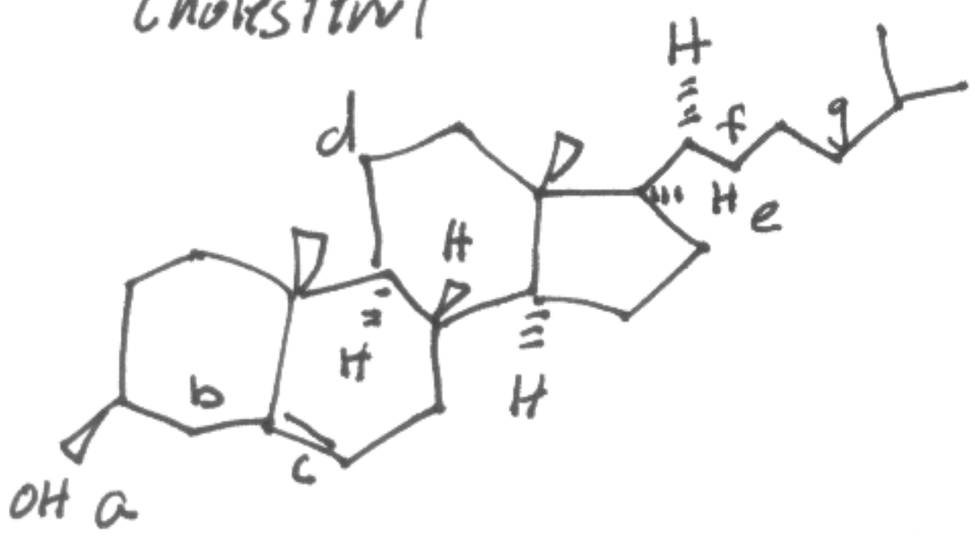
In both cases the C atom is sp^2 hybridized. In the acid, 1 O atom is sp^2 and the other is sp^3. However, in the ion, resonance structures flip the sp^2-sp^3 hybridization of the 2 O atoms. This means that both resonance structures will have some character of sp^2 hybridization, and that the  functional group will remain trigonal planar. This also means that the bond lengths of the C-O bonds will be intermediate between the two extremes of C-O and C=O. Assume the average, 1.8 Å.

2. CH_3CH_2COH:

Sp3 Sp3 Sp2

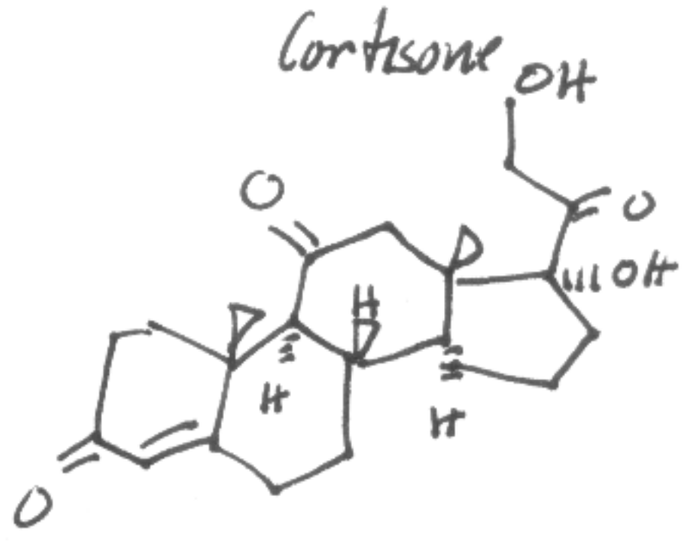


3. Cholesterol



(d)

Cortisone



a) convert alcohol to ketone

b) convert alkane to alkene

c) convert alkene to alkane

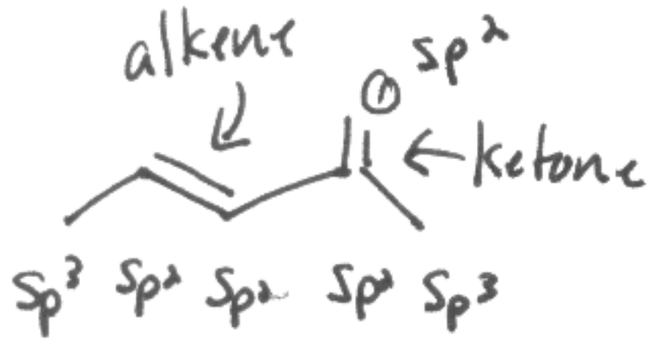
d) convert alkane to ketone

e) convert alkane to alcohol

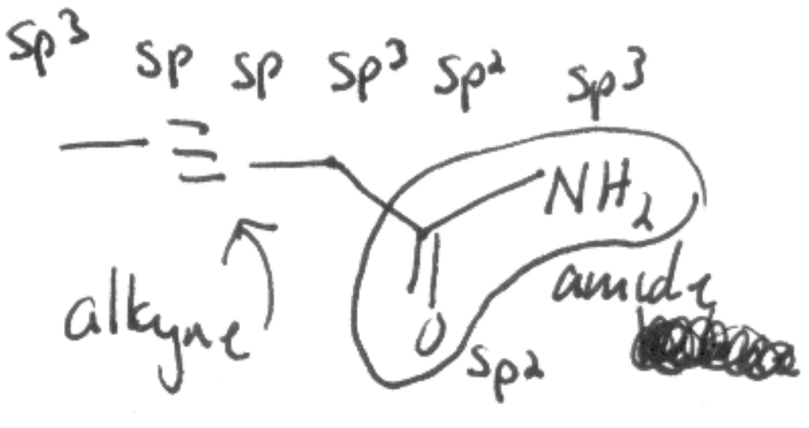
f) convert alkane to ketone

g) convert alkane to alcohol

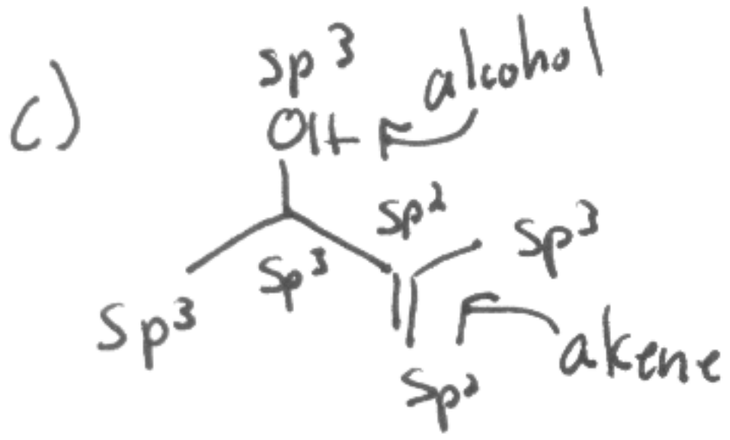
4. a)



b)



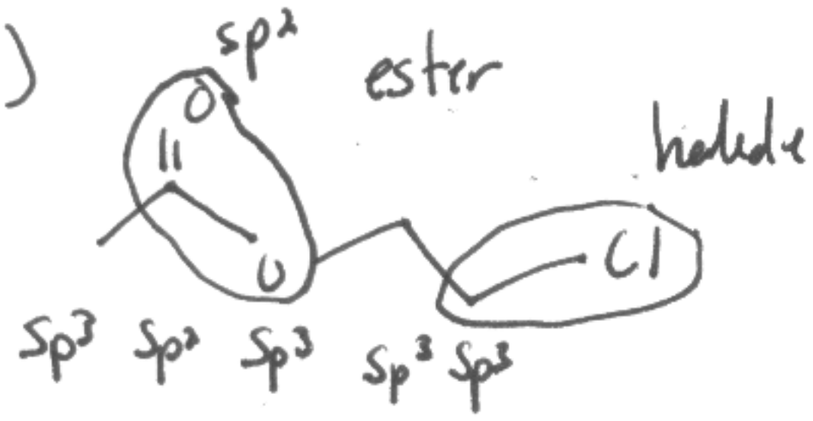
c)



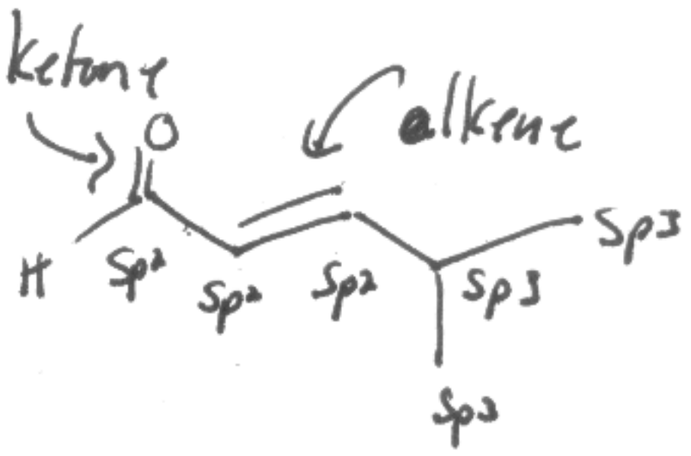
d)

all atoms are sp^2

e)



f)



5. $m = 250\,g$ of CO_2

$FW(CO_2) = 44.019\,g/mol$

$V = 1.5\,dm^3 = 1.5\,L$

$T = 25^\circ C = 298\,K$

$$n_{CO_2} = \frac{250\,g}{44.019\,g/mol} = 5.68\,mol$$

If ideal: $PV = nRT$

$$P = \frac{nRT}{V} = \frac{(5.68\,mol)(8.20\times10^{-2}\,L\,atm/mol\,K)(298\,K)}{1.5\,L}$$

$$P = 92.7\,atm$$

If vdw: $P = \frac{nRT}{V-nb} - \frac{an^2}{V^2}$

$a = 3.6073\,L^2\,atm/mol^2$

$b = 0.0428\,L/mol$

$$P = \frac{(5.68\,mol)(8.206\times10^{-2}\,L\,atm/mol\,K)(298\,K)}{1.5\,L - (5.68\,mol)(0.0428\,L/mol)} - \frac{(3.6073\,L^2\,atm/mol^2)(5.68\,mol)}{1.5\,L}$$

$$P = 58.8\,atm$$

Under these conditions, attractive forces dominate the gas.

6. $V_i = 2.0L$

$P_i = 3.0 atm$

$V_f = 2.0L + 5.0L = 7.0L$

$P_i V_i = P_f V_f$; $P_f = \frac{P_i V_i}{V_f} = \frac{(3.0 atm)(2.0L)}{7.0L}$

$P_f = 0.86 atm$

7. Hc:

$C_{rms} = \sqrt{\frac{3RT}{FW}} = \sqrt{\frac{3(8.31\ J/kmol)(6000k)}{0.004003\ kg/mol}} = 6100 m/s \quad (6000k)$

@ 100k: $C_{rms} = \sqrt{\frac{3(8.31\ J/kmol)(100k)}{0.004003\ kg/mol}} = 790\ m/s$

Since C_{rms} increases as $\propto \sqrt{T}$, even though T has gone up by a factor of 60, C_{rms} has increased by a factor of <8.