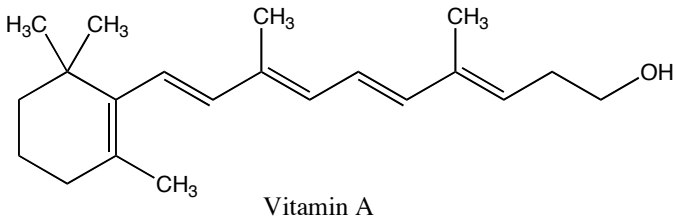
Problem Set #3

Question 1. The chemical structure for vitamin A, a highly unsaturated hydrocarbon (with one oxygen atom) is shown below. Use this structure to answer the following questions.



Vitamin A

a) How many degrees of unsaturation are there in vitamin A?

b) How many atoms are sp^3-hybridized?

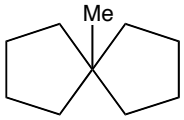
c) How many atoms are sp^2-hybridized?

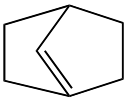
d) How many atoms are sp-hybridized?

e) Label each double bond in vitamin A as (*E*), (*Z*), or "not applicable."

Question 2. For each compound below, briefly describe why the structure is unstable or cannot exist.

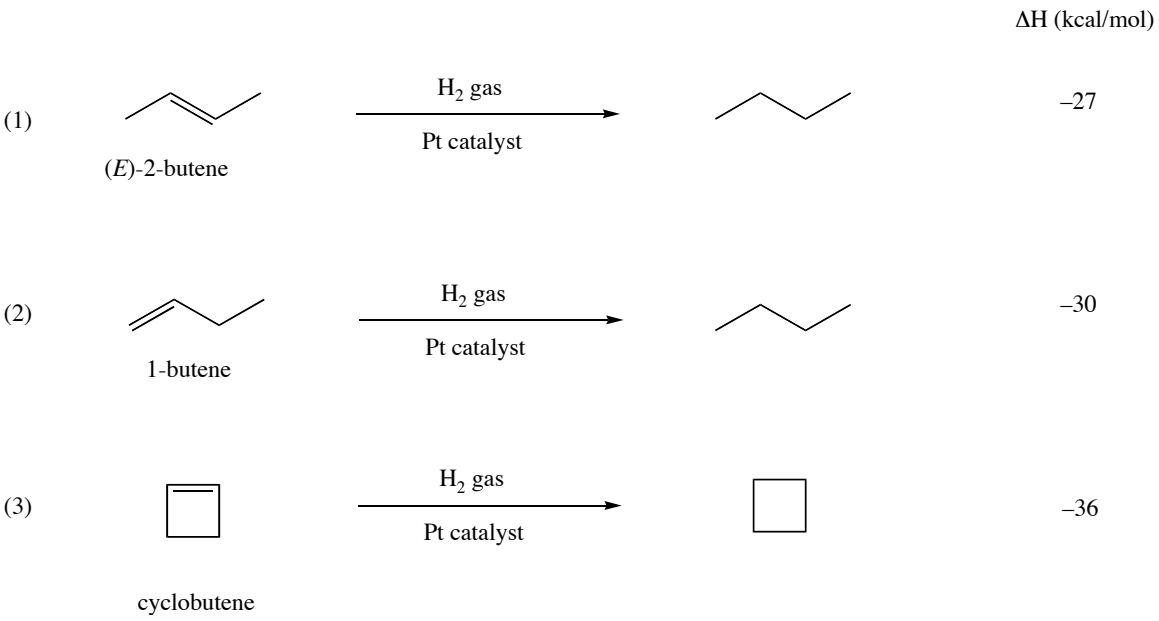
a) 

b) 

c) 

d) 

Question 3. Use the data from equations 1-3 to answer the questions below.



a) Estimate the bond dissociation energy of each double (π) bond in the starting materials above (BDEs: H–H = 104 kcal/mol; C–H = 100 kcal/mol).

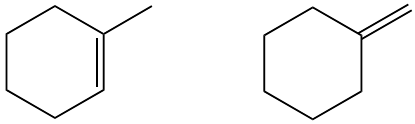
b) What is the cause of the 6 kcal/mol difference in energy between the C–C double bond in 1-butene and cyclobutene?

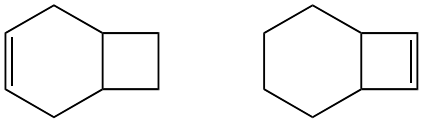
c) How many signals for carbon are there in the NMR spectrum of 1-butene? Of *(E)*-2-butene? How many hydrogen atom signals are observed for each of these compounds?

Question 4. For the following pairs of compounds, circle the molecule that is **more stable**.

a) 

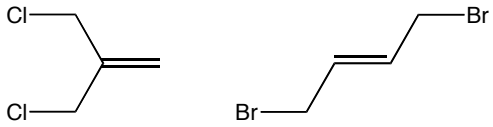
b) 

c) 

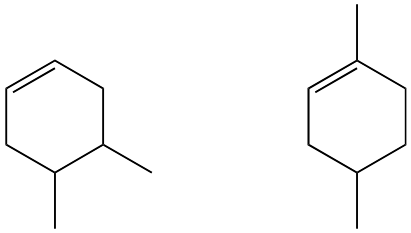
d) 

Question 5. How would you tell the following pairs of compounds apart by carbon (^{13}C) NMR spectroscopy?

a)



b)



c)