

Seat No. _____

Name _____
(Please print your name and **CIRCLE** your last name)

CHEMISTRY 331

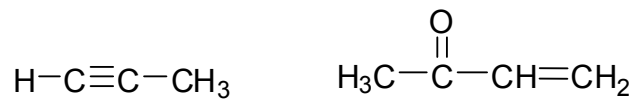
FINAL EXAM

Friday, May 9, 2008

- I. (7 points) _____
- II. (8 points) _____
- III. (30 points) _____
- IV. (10 points) _____
- V. (10 points) _____
- VI. (10 points) _____
- VII. (8 points) _____
- VIII. (20 points) _____
- IX. (20 points) _____
- X. (8 points) _____
- XI. (10 points) _____
- XII. (8 points) _____
- XIII. (1 point) _____

TOTAL (150 points) _____

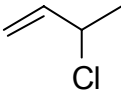
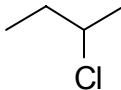
I. (7 pts.) Indicate the hybridization of each carbon in these two compounds.



II. (8 pts.) Using wedge and dashed line 3D structures draw the two stereoisomers of 1-chloro-2-methylbutane and label each as (R) or (S).

III. (30 pts.) Using structures and/or words briefly explain:

(A) Why phenol is a stronger acid than cyclohexanol (cyclohexyl alcohol)?

(B) Why  undergoes S_N1 reaction while  does not?

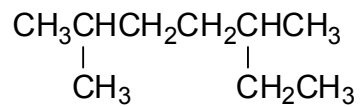
(C) Why acetone ($\text{Me}-\overset{\text{O}}{\parallel}{\text{C}}-\text{Me}$) is more acidic than propane?

- (D) Why $\text{H}_3\text{CO}^\ominus\text{K}^\oplus$ is a better nucleophile in an $\text{S}_{\text{N}}2$ reaction than $(\text{CH}_3)_3\text{CO}^\ominus\text{K}^\oplus$?
- (E) Why benzene does not add bromine across any of its three double bonds?
- ~~(F) Why cats sleep 17 hrs. / day?~~
- (F) Why *trans*-1,2-dimethylcyclohexane is more than the *cis*-isomer?
- (G) Why cyclohexane does not have C—C—C bond angles expected of a regular hexagon (120°)?
- (H) Why the ΔH of hydrogenation is less for *trans*-2-butene than for the *cis*-isomer?
- (I) Why 1-butene adds HCl in a Markovnikov orientation?
- (J) Why addition of Br_2 to cyclopentene affords the *trans*-1,2-dibromo product and not the *cis*-?

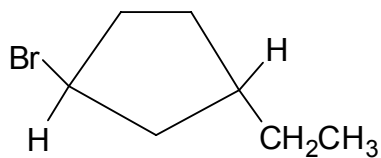
- (K) Why the substitution reactions of $\text{R}-\text{C}\equiv\text{C}^{\ominus} \text{Na}^{\oplus}$ are limited to methyl and primary substrates (CH_3X and RCH_2X)?
- ~~(L) Why a healthy dog's nose is cold?~~
- (L) Why *cis*-1-bromo-3-*t*-butylcyclohexane will not undergo an E2 elimination of HBr?
- (M) Why the ^1H -NMR chemical shift of $\text{H}_3\text{C}-\text{Br}$ is further downfield than that of CH_4 ?
- ~~(N) The answer is "stick".~~
- (N) Why addition of HCl to 1,3-butadiene affords two different chlorobutenes?
- (O) Why H_2O is a liquid at 25 °C but H_2S is a gas?

IV. (10 pts.) Provide proper names for the following compounds.

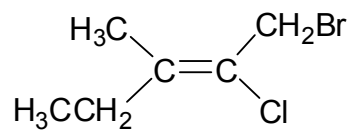
(A)



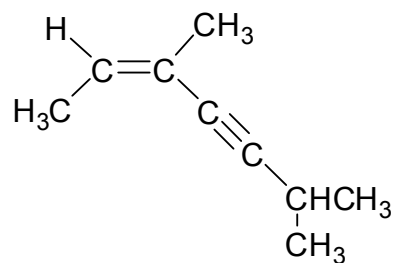
(B)



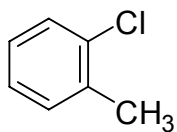
(C)



(D)



(E)



V. (10 pts.) Provide the structures that correspond to the following names.

(A) (S)-2-butanol

(B) 2-bromo-5-methylhexane

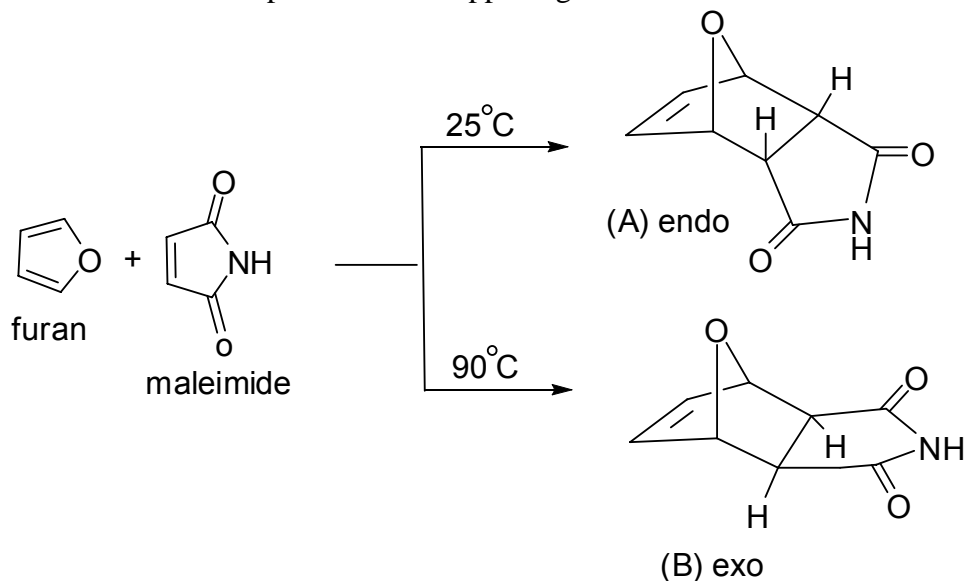
(C) *cis*-1-chloro-2-methylcyclohexane (use chair form)

(D) pyrrole

(E) p-bromotoluene

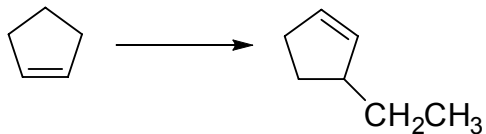
VI. (10 pts.) Using wedge and dotted line structures and arrows for electron pair movement provide a detailed mechanism of the S_N2 reaction of $\text{HC}\equiv\text{C}^- \text{Na}^+$ and (R)-2-bromobutane. Include structure(s) of any transition state(s) in your mechanism.

VII. (8 pts.) When furan and maleimide undergo a Diels-Alder reaction at 25 °C the major product is endo-adduct A, but when the reaction is conducted at 90 °C the major product is exo-adduct B. Explain what is happening here in no more than two sentences.

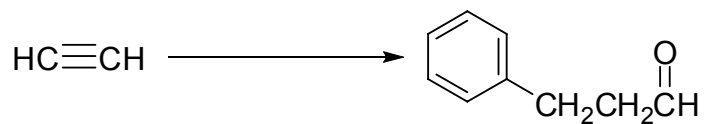


VIII. (20 pts.) Show how you would carry out the following synthetic transformations assuming the availability of all necessary reagents.

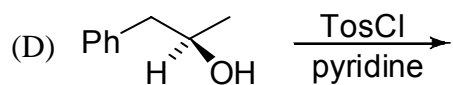
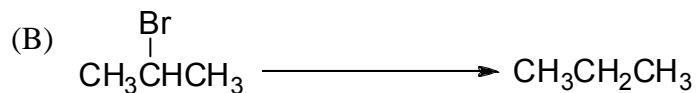
(A)

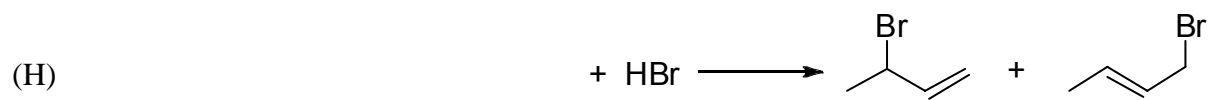
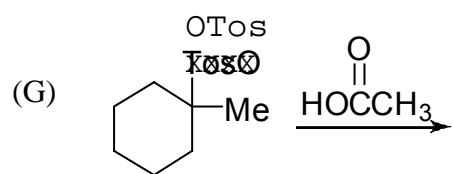
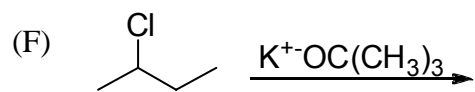
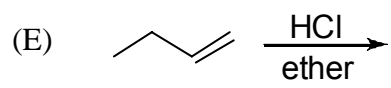


(B)

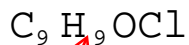
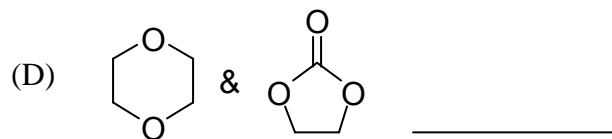
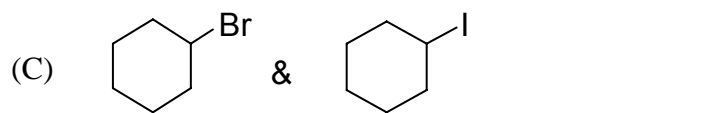
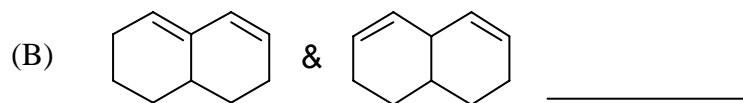
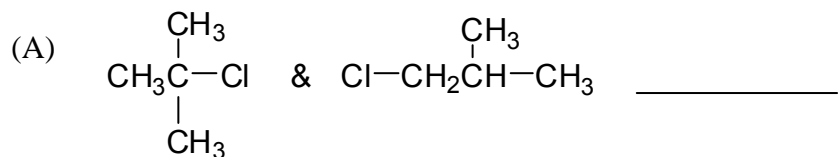


IX. (20 pts.) Complete the following reactions.



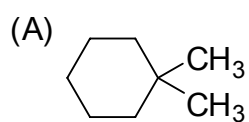


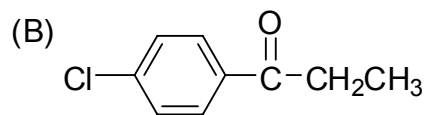
X. (8 pts.) Indicate which spectral technique, NMR, IR, UV or MS, would most readily allow differentiation between the compounds in each pair of compounds below.

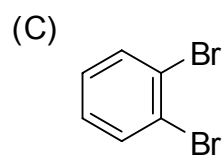


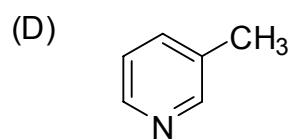
XI. (10 pts.) A compound of unknown structure is found from its mass spectrum to have a molecular formula of ~~$\text{C}_9\text{H}_9\text{OCl}$~~ $\text{C}_9\text{H}_9\text{OCl}$. Its IR shows a strong absorption at 1691 cm^{-1} and the $^1\text{H-NMR}$ consists of a triplet at $1\ \delta$ (3H), a quartet at $2.6\ \delta$ (2H) and two doublets (each 2H's) centered at $7.6\ \delta$. What is the structure?

XII. (8 pts.) How many ^{13}C resonance peaks would you observe in the broadband-decoupled spectra of each of the following compounds?



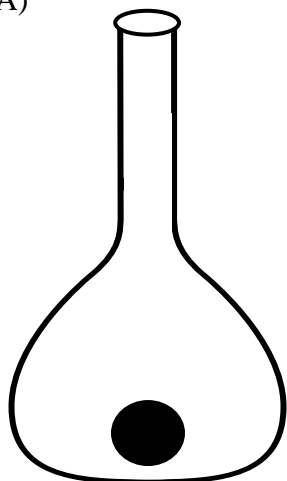






XIII. (1 pt.) Guess how many marbles there are in the jar.

(A)



(B) What do you call a boomerang that doesn't work? (See 3N)