***Student Name* (first, last):**

_____

***Social Security Number*:**

_____

***TA Name*:**

_____

CHEMISTRY 3311 (100)

SECOND MIDTERM EXAMINATION

Josef Michl

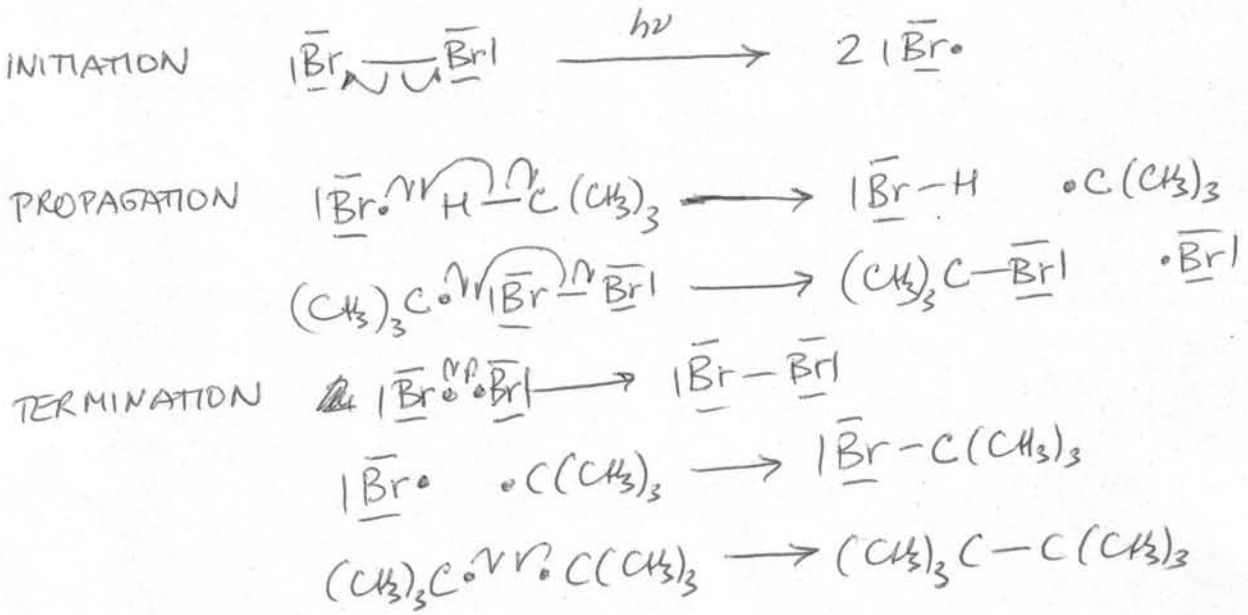
October 21, 2004

---

1. (40 points) Check the correct statements only and make no marks at the incorrect statements:

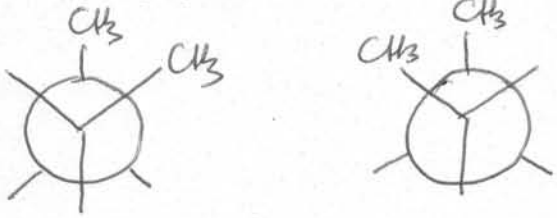
(X) As wavelength of monochromatic light increases, the energy of its photon decreases.
( ) In NMR spectroscopy a sample is placed in magnetic field and IR light is used to excite vibrations.
(X) The ^{1}H NMR spectrum of ethane contains a single line.
( ) Under the usual experimental conditions the ^{13}C NMR spectrum of propane contains three lines.
(X) Dimethyl ether and ethanol are constitutional isomers.
(X) 1 g of ethylcyclopropane generates more heat upon complete combustion than 1 g of cyclopentane.
( ) The twist boat is the most stable conformation of cyclohexane.
( ) At room temperature, *cis*-1,3-dimethylcyclohexane exists mostly as the axial,axial conformer.
(X) *Trans*-1,2-dichlorocyclohexane is chiral.
( ) The rotation observed for a 5-cm path length of a 0.01 M aqueous solution of glucose is the same as the rotation observed for a 10 cm path length of a 0.02 M solution.
(X) A meso compound is not chiral although it contains centers of chirality (stereogenic centers).
( ) A thermoneutral reaction cannot be exergonic.
( ) In a sample that is a 80:20 mixture of enantiomers, the enantiomeric excess is 40%.
(X) A carbene contains a divalent carbon atom.
( ) The rate of a thermoneutral reaction with $\Delta S^{\ddagger} = 0$ is always the same in forward and reverse directions.
(X) S_N2 substitution with the cyanide anion proceeds faster in methyl iodide than in ethyl iodide.
(X) S_N1 substitution with water proceeds faster in *t*-butyl iodide than in isopropyl iodide.
( ) A racemic mixture of enantiomers cannot be resolved into pure enantiomers.
(X) Ethylamine is a weaker acid than ethanol.
(X) Ethylamine is a stronger base than ethanol.

2. (20 pts) Write the mechanism of free-radical bromination of isobutane under UV irradiation with just enough elemental bromine to produce monosubstitution. Show all reaction steps and structure of the main organic product and of all intermediates, if any. Use curved arrows to indicate how electrons move in the individual elementary reaction steps. Label reaction steps or groups of reaction steps with names, if they have any.

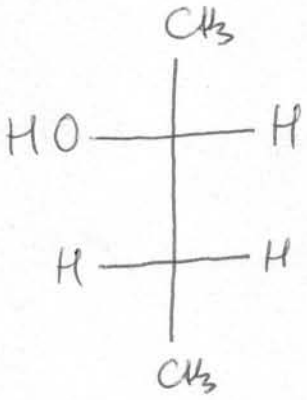


3. (20 pts) (a) (3 points) Draw a Newman projection of the anti conformer of 1,2-dichloroethane.

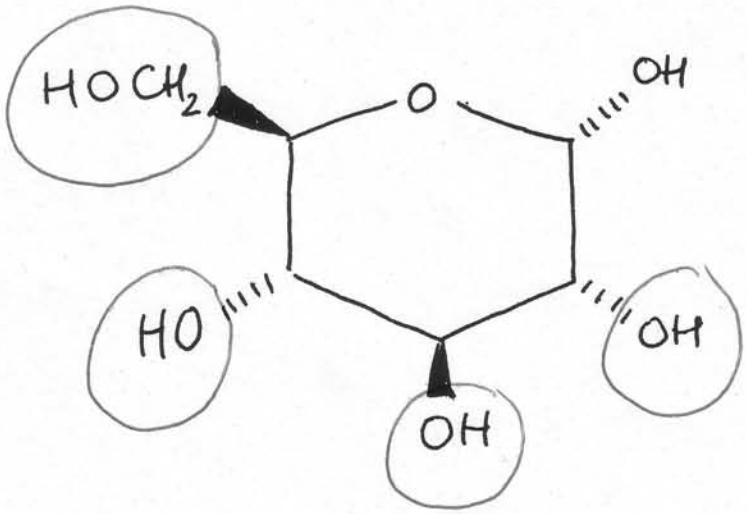
(b) (4 points) Draw Newman projections of both enantiomers of the gauche conformer of *n*-butane.



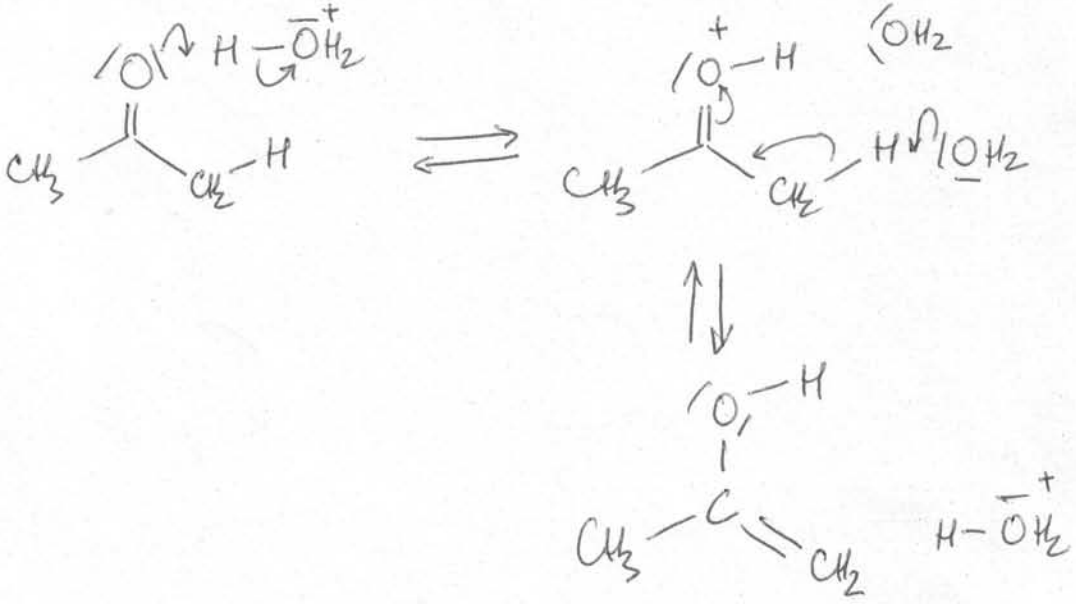
(c) (8 points) Draw the Fischer projection of (*R*)-2-butanol.



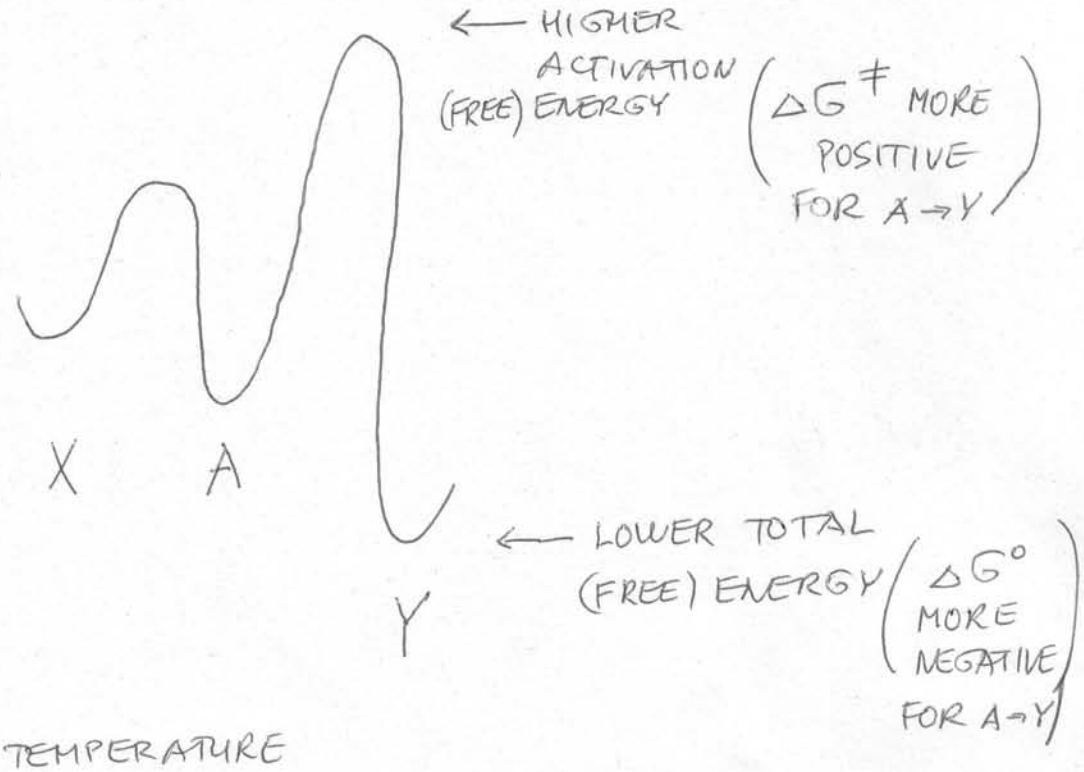
(d) (5 points) Circle the substituents that are equatorial in the more stable conformer:



4. (12 pts) Write the mechanism of acid-catalyzed keto-enol tautomerization of acetone in aqueous solution. Show all reaction steps and structures of all intermediates, if any. Use curved arrows to indicate how electrons move in the individual elementary reaction steps.



5. (8 pts) Draw a reaction profile diagram for a system in which reagent A is capable of producing a product X under kinetic control or a product Y under thermodynamic control. State two reaction conditions that you would select if you wished to assure kinetic control.



1. LOW TEMPERATURE
2. SHORT REACTION TIME