Organic Chemistry Mid-semester exam. 02-Feb-2023, 12:00-12:45 (45 min)

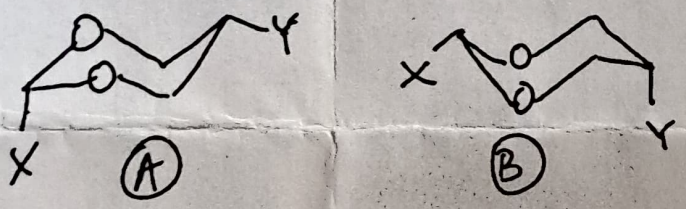
Exam is for 45 points; for the length of answers required, I suggest a guideline of 1 min per point. Read the whole paper quickly first; answer the whole question at one place.

1. (5 points) Give examples that demonstrate that resonance can be inhibited by (a) steric factors and (b) strain

2. (3 points) What is the effect of ring currents in proton NMR? Take the example of cyclohexane and benzene.

3. (3 points) $-CCH$ and $-CN$ have same group electronegativity; but the dipole moments of CH_3-CCH and CH_3-CN are 0.78 D and 3.93 D respectively. Explain the huge difference in dipole moments.

4. NOTE: This question has two parts:
   (a, 4 points) For substituted cyclohexane, each carbon of the ring has two hydrogens for such substitution (called equatorial and axial). Draw the various low energy configurations of 1,3-dimethyl cyclohexane, clearly indicating the order of stability. Give reason/s for the order
   (b, 3 points) Consider the following two conformations of the below cyclic molecule which will be in equilibrium. Which conformation dominates and why?



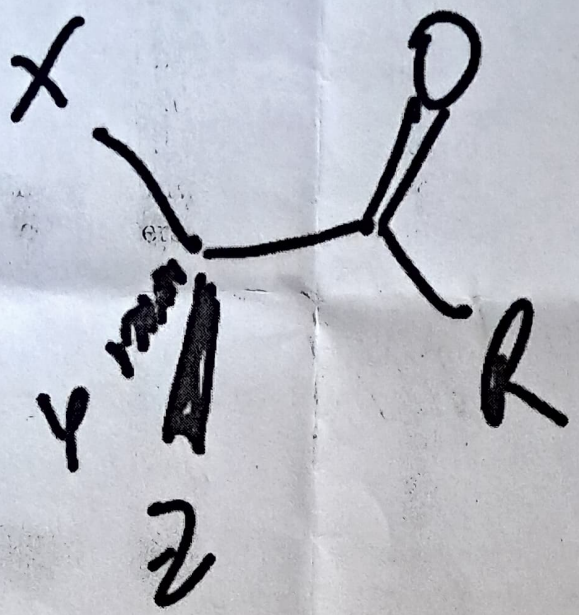
$X = CH_3$, $Y = C(CH_3)_3$.

5. (7 points) It is quite common to find that both S_N^1 and S_N^2 reactions are possible in the same system; discuss the idea of mechanistic borderline/crossover between these two mechanism. How would one go about using (a) kinetics and (b) sterochemistry to determine the crossover. You may do so with an example

6. (5 points) What is the effect of the solvent in determining (a) mechanism of reaction and (b) rate of reaction

7. (5 points) What are kinetic and thermodynamic control of a reaction? Explain clearly the differences and origin of these differences. Give real example/s which demonstrate the concept/s.

8. (6 points) In previous lecture, discussion on carbocations and their rearrangements to form new carbocations was started. Give reasons/ conditions for such rearrangements, illustrate each one with a suitable example.



9. NOTE: Two parts to the question

(a, 2 points) Draw the various stable configurations of the ketone in the figure below, where X, Y, Z are respectively the small, medium and large substituents on the α-carbon and R is any group (say CH_3); that is, draw Newman projections along the $C_\alpha - C$ bond. Show the order of stability of the conformers.

(b, 2 points) Clearly the carbonyl carbon is a site for nucleophilic attack (by strong nucleophile), making this carbon a chiral center. Draw sterographic diagram of the possible addition products, indicate which is the most likely product and give reason.