1. Circle the letter on the right which corresponds to the answer to each question. There is only one correct answer for each question.

(i) Which of the following has the greatest equilibrium constant for enolization
   A. acetone   B. 2,4-cyclohexadienone   C. acetaldehyde   D. methanol

(ii) What would be the product of the following sequence of reactions?

(iii) How many aldols (different compounds, constitutional and stereoisomers) are theoretically possible when acetaldehyde and propanaldehyde and mixed together with dilute aqueous NaOH in the cold?
   I. 4    J. 8    K. 12    L. 16

(iv) Hydroxide is a poor leaving group in SN and E reactions. However, it is the leaving group in base catalyzed aldol condensations. Which of the following explains this observation?
   M. hydroxide departs to give a very stable cation
   N. the loss of hydroxide in the aldol condensation is not an SN or E reaction
   O. the product of the aldol condensation is a stable resonance stabilized enone
   P. the hydroxyl group is protonated prior to leaving in the aldol condensation

(v) Which of the following could not be formed as the major product of a mixed aldol reaction?

(vi) Which of the following is most acidic?

(vii) Which of the following halides could be used in the malonic ester synthesis?
   Y. only i   Z. only i and ii
   AA. only i and iv   BB. only ii and iii

(viii) Which of the following pairs of compounds would produce a high yield of a single compound in a Claisen condensation?
   CC. ethyl acetate and ethyl propionate   DD. ethyl acetate and propyl acetate
   EE. ethyl acetate and ethyl benzoate   FF. ethyl benzoate and ethyl formate
2. (a) Provide the structure of the major organic product obtained from each of the following reactions.

(b) The Claisen condensation reaction (NaOEt in EtOH) of ethylacetate gives a high yield of ethylacetoacetate. The Claisen condensation reaction of ethylpropionate gives a high yield of a β-ketoester, A. The Claisen condensation reaction of ethyl-2-methylpropionate gives a negligible yield (<1%) of β-ketoester. What is the structure of A? Why does ethyl-2-methylpropionate not give any Claisen condensation product?
3. (30 points) The following transformations cannot be completed in a single step. Provide a sequence of reactions to perform each transformation, showing the reagents and structures of all isolated synthetic intermediates. The synthesis must use the given starting materials; you may also use any other starting materials with 3 or fewer carbon atoms. You may use any reagents. Do not show mechanisms or the structures of reactive intermediates. Shorter, more efficient syntheses are preferred; overly long or inefficient sequences will lose some credit.

- **Starting Materials:**
  - OCH₃
  - O
  - N
  - EtO
  - OH

- **Transformations:**
  1. From ethyl malonate to 1-hexanol.
  2. From ethyl malonate to cyclopentane.
  3. From acrylonitrile to tert-butylamine.
  4. From any starting materials with ≤3 carbon atoms to methyl amyl ether.