Organic Chemistry I

I–a

Answer the following questions.

(a) Write the definitions of the acids and bases by Brønsted–Lowry acid-base theory.

Acid is [ ].
Base is [ ].

(b) For acetic acid in water, write the dissociation equilibrium.

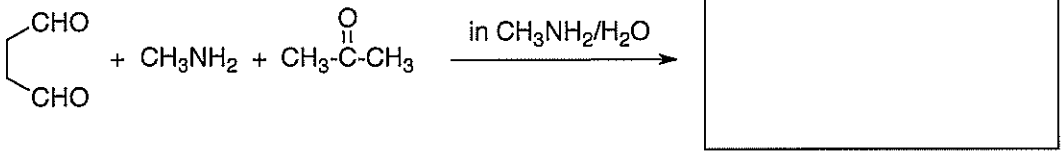
(c) The concentration of water remains essentially constant with dilute solutions of acids wherever the equilibrium may be. For acetic acid in water, define the acid dissociation constant K_a. In equilibrium, the concentration of each component is expressed with [ ] .

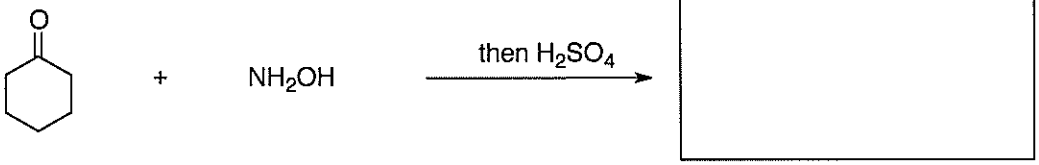
(d) Define the pK_a value by the acid dissociation constant K_a. Explain the relationship between the strength of an acid and it's pK_a value.

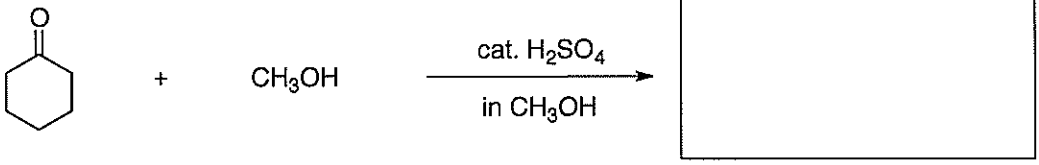
(e) For chloroacetic acid and acetic acid, suggest with explanations which of these acids is a stronger acid.

I–b

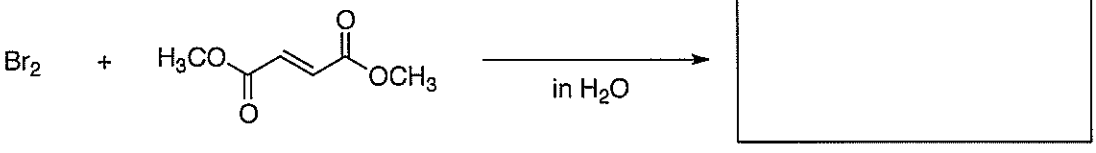
Give the structure of the product obtained from the following reactions.

(a) 

(b) 

(c) 

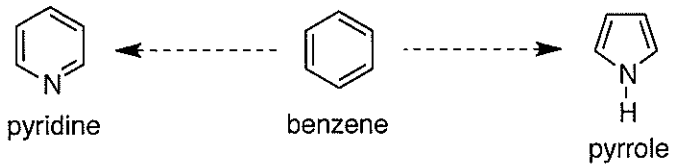
(d) 

(e) 

Organic Chemistry II

II–a

(1) Pyridine and pyrrole can be obtained from benzene by the substitution of carbon atoms to a nitrogen atom. Answer the number of π electrons of pyridine and pyrrole. Are they expected to show the aromaticity?



(2) How many signals are expected in ^{1}H and ^{13}C NMR spectra of pyridine and pyrrole?

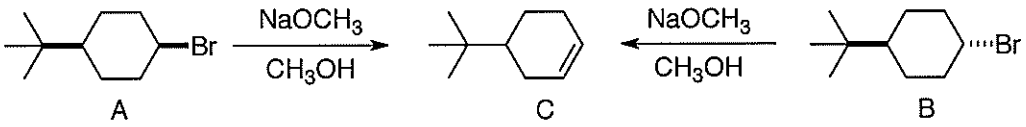
(3) Pyridine works as a base and gives stable pyridinium ion. Draw the structure of pyridinium ion and answer the number of π electrons. Is it expected to show the aromaticity?

(4) Explain why pyrrole is a much weaker base than pyridine? Draw the structure of protonated pyrrole ion.

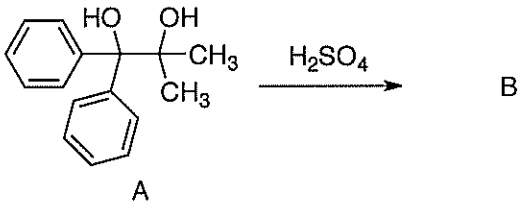
(5) Pyrrole exhibits a relatively strong acidity (pK_a = 17). Draw the structure of deprotonated pyrrole anion and answer the number of π electrons. Is it expected to show the aromaticity?

Ⅱ–b

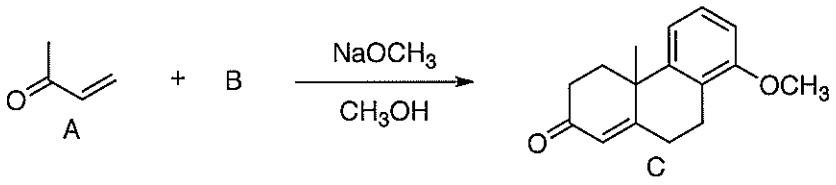
(1) Compounds A and B are converted to compound C by the elimination reaction, respectively. Answer which compound reacts faster with the reason.



(2) Compound A is converted to compound B by the pinacol rearrangement. Answer the structure of compound B.



(3) Robinson annulation between ketone A and compound B yields compound C. Answer the structure of compound B and the reaction mechanism.



(4) Compound A is converted to compound B by Baeyer–Villiger oxidation using *m*CPBA. Answer the structure of product B and the reaction mechanism.