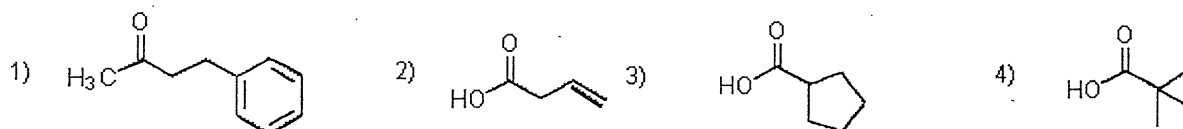


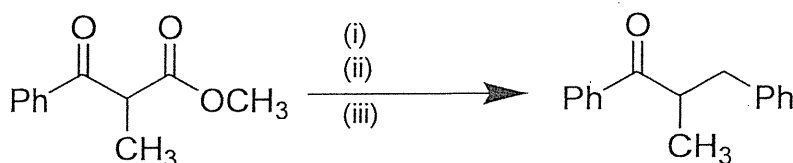
※ 考生請注意：本試題不可使用計算機。請於答案卷(卡)作答，於本試題紙上作答者，不予計分。

每題 10 分，共 10 題。

(1) (a) Which of the following structures could be constructed by way of a malonate ester alkylation?



(b) Complete the following synthesis by filling in the missing reagents.



(2) (a) Suggest a sequence of synthetic steps through which phenylacetic acid can be prepared from toluene via phenylacetonitrile.

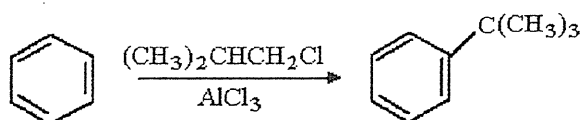
(b) Provide a detailed, stepwise mechanism to show how PhCHO is formed by the reaction of PhCOCl with  $\text{LiAlH}[\text{O}(\text{CH}_3)_3]_3$ .

(3) (a) Propose a synthesis of 4-phenylbutan-2-ol from 3-phenylpropanal.

(b) Provide a detailed, stepwise mechanism for the acid-catalyzed condensation reaction between cyclohexanone and  $\text{H}_2\text{NOH}$ .

(4) (a) List two of the three limitations usually associated with the Friedel-Crafts alkylation reaction.

(b) Provide a detailed, stepwise mechanism for the following reactions.



(5) (a) Classify cyclopentadienyl cation as aromatic, antiaromatic, or nonaromatic. Assume planarity of the  $\pi$  network.

(b) How many peaks are in the proton spin decoupled  $^{13}\text{C}$  NMR spectrum of *p*-dichlorobenzene?

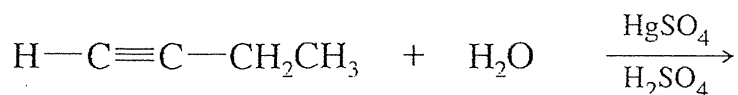
(6) (a) Give a representation of the antibonding  $\pi$  molecular orbital of the allyl cation.

(b) Provide the major organic product of the following reaction.

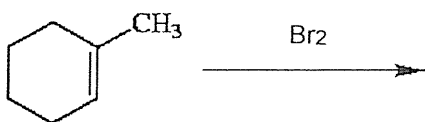


(7) (a) Why are terminal alkynes more acidic than other hydrocarbons?

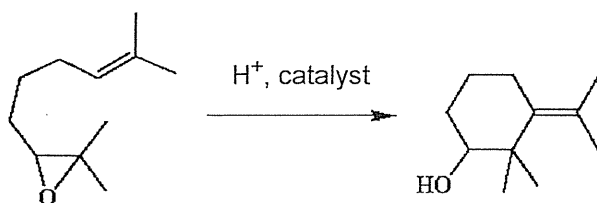
(b) What is the major product of the following acid/catalyzed hydration reaction?



(8) (a) Complete the following reaction and provide a detailed, step-by-step mechanism for the process.

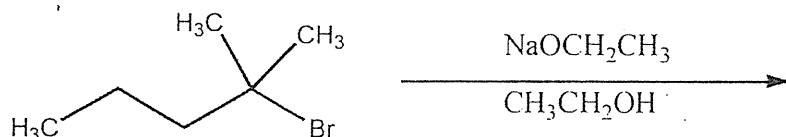


(b) Provide a detailed, step-by-step mechanism for the reaction shown below.



(9) (a) Compare the relative heats of hydrogenation of cyclobutene and cyclopentene and explain the difference in magnitude.

(b) Provide the structure of the major organic product of the reaction below.



(10) (a) Would a 50:50 mixture of (2*R*,3*R*)-2,3-dibromobutane and (2*R*,3*S*)-2,3-dibromobutane be optically active? Explain.

(b) Provide a Fischer projection of (2*R*,3*R*,4*S*)-2,3,4-trichloroheptane.