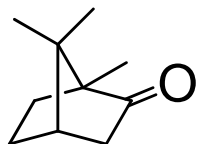


I. Choose one correct answer for the following questions.

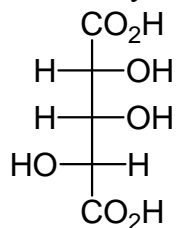
【單選題】每題 2 分，共計 40 分，未作答，不給分亦不扣分，並請依序註明題號，作答於答案卷上。

1. Camphor is an example of a \_\_\_\_\_.



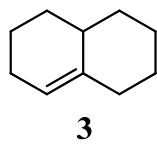
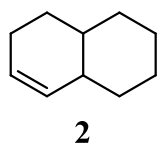
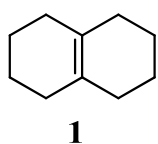
- (A) fused bicyclic molecule. (B) bridged bicyclic molecule. (C) fused tricyclic molecule.  
(D) bridged tricyclic molecule. (E) None of the above.

2. How many diastereomer(s) exist for the compound below?



- (A) 2 (B) 4 (C) 6 (D) 8 (E) 0

3. Arrange the following bicyclic alkenes in order of increasing stability (least stable to most stable).



- (A) 3 < 2 < 1 (B) 1 < 2 < 3 (C) 1 < 3 < 2  
(D) 2 < 3 < 1 (E) 3 < 1 < 2

4. Since the two chlorine atoms add to opposite faces of the cyclohexene double bond, we say that the reaction occurs with:

- (A) *syn* stereochemistry (B) *cis* stereochemistry (C) *anti* stereochemistry (D) retention of stereochemistry  
(E) conversion of stereochemistry.

5. Hydroboration/oxidation of alkenes occurs with:

- (A) *syn* stereochemistry (B) *trans* stereochemistry (C) *anti* stereochemistry (D) retention of stereochemistry  
(E) unpredictable stereochemistry.

6. In the reaction of an alkene with dichlorocarbene, the dichlorocarbene is the:

- (A) electrophile. (B) Lewis base. (C) nucleophile. (D) both (B) and (C). (E) None of the above.

7. (S)-(-)-Serine:

- (A) is dextrorotatory. (B) rotates plane-polarized light in a counterclockwise direction.  
(C) rotates plane-polarized light in a clockwise direction. (D) is racemic. (E) is diastereomer.

8. Which of the species below is less basic than acetylide?

- (A) *n*-BuLi (B) CH<sub>3</sub>ONa (C) CH<sub>3</sub>MgBr (D) Lithium diisopropylamide (LDA) (E) all of the above.

9. What descriptive term is applied to the type of diene represented by 2,4-hexadiene?

- (A) conjugated diene (B) cumulated diene (C) isolated diene (D) alkynyl diene (E) none of the above.

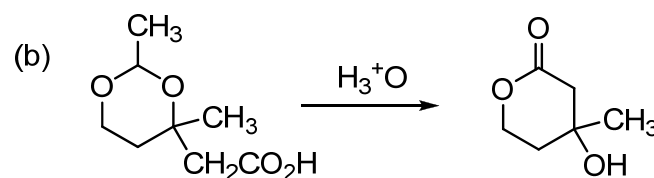
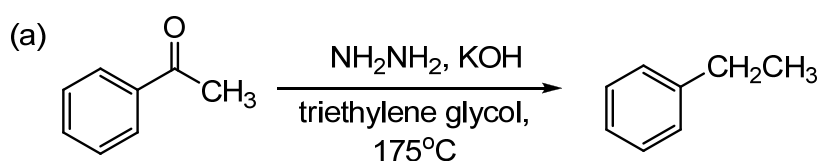
10. In the proton NMR, in what region of the spectrum does one typically observe hydrogens bound to the aromatic ring?

- (A) 1.0-1.5 ppm (B) 2.0-3.0 ppm (C) 4.5-5.5 ppm (D) 7.0-8.0 ppm (E) 9.0-10.0 ppm.

11. Which of the following undergoes  $S_N2$  reaction with sodium methoxide most rapidly?  
 (A) PhBr      (B) Ph<sub>3</sub>CBr      (C) PhCH<sub>2</sub>Br      (D) PhCH<sub>2</sub>CH<sub>2</sub>Br      (E) PhCH<sub>2</sub>CH<sub>2</sub>CH<sub>2</sub>Br.
12. Which of the following is the same as the tropylium ion?  
 (A) cycloheptatrienyl cation    (B) cycloheptatrienyl anion    (C) cyclopentadienyl cation    (D) cyclopentadienyl anion  
 (E) cyclopropenyl anion.
13. Rank the following groups in order of increasing activating power in electrophilic aromatic substitution reactions:  
 -OCH<sub>3</sub>, -O(C=O)CH<sub>2</sub>CH<sub>3</sub>, -CH<sub>2</sub>CH<sub>3</sub>, -Br.  
 (A) -Br < -CH<sub>2</sub>CH<sub>3</sub> < -O(C=O)CH<sub>2</sub>CH<sub>3</sub> < -OCH<sub>3</sub>      (B) -Br < -OCOCH<sub>2</sub>CH<sub>3</sub> < -CH<sub>2</sub>CH<sub>3</sub> < -OCH<sub>3</sub>  
 (C) -OCH<sub>3</sub> < -CH<sub>2</sub>CH<sub>3</sub> < -O(C=O)CH<sub>2</sub>CH<sub>3</sub> < -Br      (D) -O(C=O)CH<sub>2</sub>CH<sub>3</sub> < -OCH<sub>3</sub> < -Br < -CH<sub>2</sub>CH<sub>3</sub>  
 (E) none of the above.
14. Which of the following compounds is least reactive in the nucleophilic aromatic substitution reaction with NaOH?  
 (A) 2,4-dinitrochlorobenzene    (B) *m*-nitrochlorobenzene    (C) *o*-nitrochlorobenzene  
 (D) *p*-nitrochlorobenzene      (E) 3,5-dinitrochlorobenzene
15. When the carbonyl group of a neutral ketone is protonated,:  
 (A) the resulting species becomes more electrophilic.  
 (B) the resulting species is activated toward nucleophilic attack.  
 (C) subsequent nucleophilic attack on the resulting species is said to occur under acid-catalyzed conditions.  
 (D) the resulting species has a positive charge.  
 (E) all of the above.
16. Which of the following is also known as a Schiff base?  
 (A) an imine      (B) a cyanohydrin      (C) a hydrate      (D) sodium hydroxide      (E) an aldehyde.
17. Which of the following amines can be resolved into enantiomers?  
 (A) trimethylamine    (B) 3-pentanamine    (C) 2-pentanamine    (D) dimethylammonium chloride  
 (E) 4-(dimethylamino) pyridine.
18. Which of the following amines is most basic?  
 (A) aniline    (B) *N*-ethylaniline    (C) *N,N*-diethylaniline    (D) piperidine    (E) pyrrole.
19. The  $\alpha$ -carbon atom bonded to the nitrogen of an alkylamine usually appears in what chemical shift ( $\delta$ ) range?  
 (A) 5-20      (B) 30-50      (C) 80-100      (D) 120-150      (E) 180-220 ppm.
20. The methyl ester of a carboxylic acid can be synthesized directly using:  
 (A) (CH<sub>3</sub>)<sub>2</sub>SO<sub>4</sub>      (B) CH<sub>3</sub>Cl      (C) (COCl)<sub>2</sub>      (D) CH<sub>2</sub>N<sub>2</sub>      (E) CH<sub>3</sub>NH<sub>2</sub>.

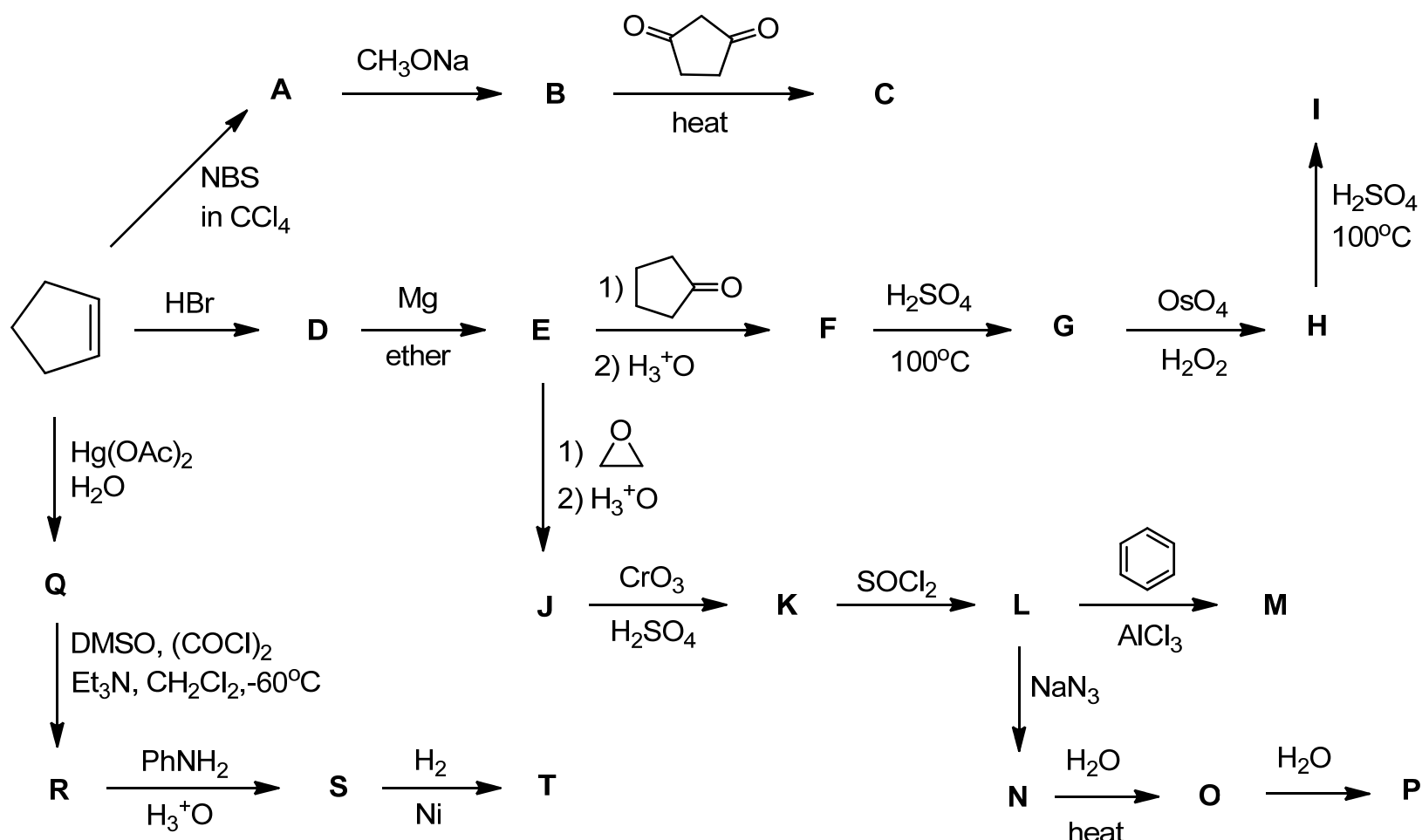
II. Propose mechanism for the following reactions.

反應機轉，每題 5 分，共計 10 分



III. Complete the following road-map problem by drawing the structures for compounds A through T.

請依序 (A 至 T) 標示於於答案卷上作答，每題 2 分，共計 40 分，未作答，不給分亦不扣分。



IV. Each of the following reactions has been reported in the chemical literature and gives a **predominance of a single product** in synthetically acceptable yield. Give the structure of the product formed in each reaction.

請依題號標示作答，每題 2 分，共計 10 分，未作答，不給分亦不扣分。

