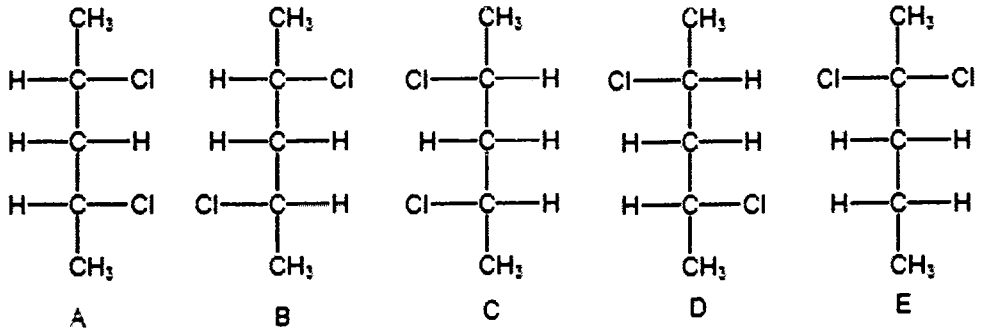
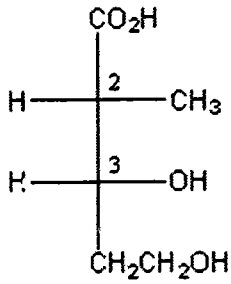
一、單選題 (答案請填於答案卡，答錯不倒扣，每題 2.5 分，共 70 分)

1. Identify all pairs of diastereomers.



(A) B and D, A and B, A and D, B and C, C and D
(B) A and B, A and D, B and C, C and D
(C) B and D
(D) B and D, A and C
(E) A and C

2. In the Fischer projection below, what are the configurations of the two asymmetric centers?

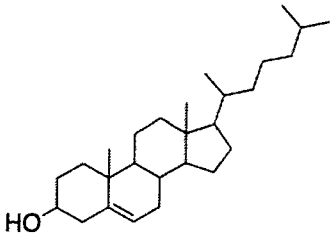


(A) 2*S*,3*R*　(B) 2*R*,3*S*　(C) 2*R*,3*R*　(D) 2*S*,3*S*　(E) cannot be determined from structure

3. Which of the following is a meso compound?
(A) *cis*-1,4-dimethylcyclohexane
(B) *trans*-1,4-dimethylcyclohexane
(C) *trans*-1,2-dimethylcyclohexane
(D) *trans*-1,3-dimethylcyclohexane
(E) *cis*-1,3-dimethylcyclohexane

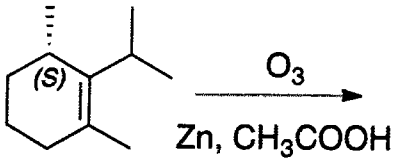
4. Keto-enol forms are
(A) enantiomers　(B) constitutional isomers　(C) conformational isomers
(D) diastereomers　(E) resonance structures

5. Structure of cholesterol is shown below. How many stereoisomers exist for this molecule?



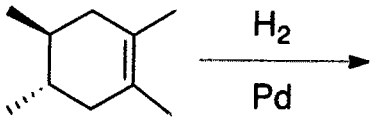
(A) 8　(B) 32　(C) 64　(D) 128　(E) 256

6. In the following ozonolysis reaction, if we start with optically pure *S*-enantiomer, the product obtained will be



(A) meso compounds.　(B) optically pure *S*-enantiomer.　(C) racemic mixture.
(D) diastereomers.　(E) unequal mixture of *R* and *S* enantiomers.

7. Hydrogenation of the following compound generates



(A) diastereomers.　(B) identical compounds.　(C) enantiomers.　(D) constitutional isomers.
(E) meso compounds.

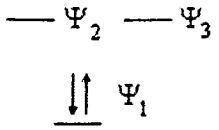
8. Which of the following has two equatorial alkyl substituents in its most stable conformation?
(A) *trans*-1,3-diethylcyclohexane
(B) *cis*-1,2-dimethylcyclohexane
(C) *cis*-1,4-diethylcyclohexane
(D) 1,1-dimethylcyclohexane
(E) *cis*-1,3-diethylcyclohexane

9. Which is the correct order of decreasing acidity in the following compounds?

H_2O	CH_3CH_3	NH_3	$CH_2=CH_2$	$HC\equiv CH$
A	B	C	D	E

(A) E > D > B > A > C　(B) A > E > C > D > B　(C) A > E > D > B > C
(D) A > C > E > D > B　(E) E > A > C > B > D

10. Which species is represented by the following distribution of p electrons in the molecular energy diagram?



I.  II.  III.  IV.  V. 

(A) I　(B) II　(C) III　(D) IV　(E) V

11. Indicate the compound that has the shortest bond length between the two middle carbon atoms.

(A) CH≡C-C≡CH　(B) CH_3CH_2-CH=CH_2　(C) CH_2=CH-C≡CH

(D) CH_3CH_2-C≡CH　(E) CH_2=CH-CH=CH_2

12. Which of the following alkyl bromides is likely to undergo rearrangement by a 1,2-methyl shift?

(A) 2-bromo-3, 3-dimethylpentane

(B) 3-bromo-3-methylpentane

(C) 3-bromo-2, 3-dimethylpentane

(D) benzyl bromide

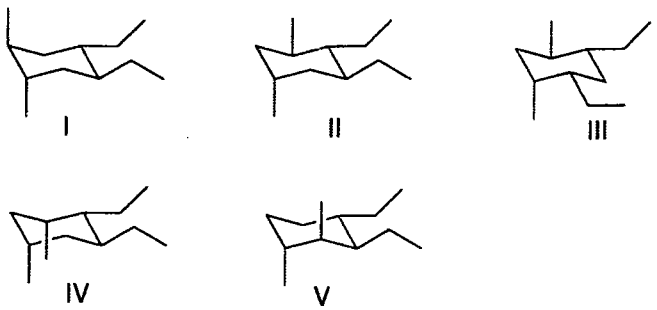
(E) 2-bromo-3-ethylpentane

13. What is the major product which results when (2*R*,3*S*)-2-chloro-3-phenylbutane is treated with sodium methoxide in methanol?

(A) (*S*)-3-phenyl-1-butene　(B) (*R*)-2-methoxy-2-phenylbutane　(C) (*E*)-2-phenyl-2-butene

(D) (Z)-2-phenyl-2-butene　(E) (*R*)-3-phenyl-1-butene

14. Which of the following represents the ring flipped structure of the molecule below?



(A) I　(B) II　(C) III　(D) IV　(E) V

15. H-A is an acid with a pK_a of 4.5. Which of the following statements about an aqueous solution of H-A is true?

(A) At pH = 3.5, the solution contains about 90% A- and 10% H-A.

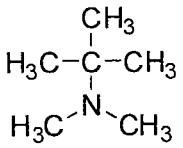
(B) At pH = 5.5, the solution contains about 90% A- and 10% H-A.

(C) At pH = 4.5, the solution contains much more A- than H-A.

(D) At pH = 4.5, the solution contains much more H-A than. A-.

(E) At pH = 6.5, the solution contains about 80% A- and 20% H-A.

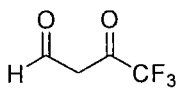
16. Provide the IUPAC name of the compound.

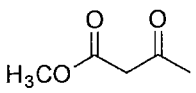


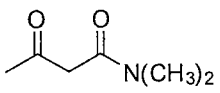
(A) *N*,*N*,2-trimethyl-1-propanamine (B) *N*,*N*-dimethyl-2-butanamine (C) *N*,*N*,2-trimethylpropanamine

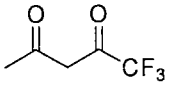
(D) *N*,*N*,1,1-tetramethylethanamine (E) *N*,*N*,2-trimethyl-2-propanamine

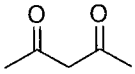
17. Which of the following compound is most acidic?

(A) 

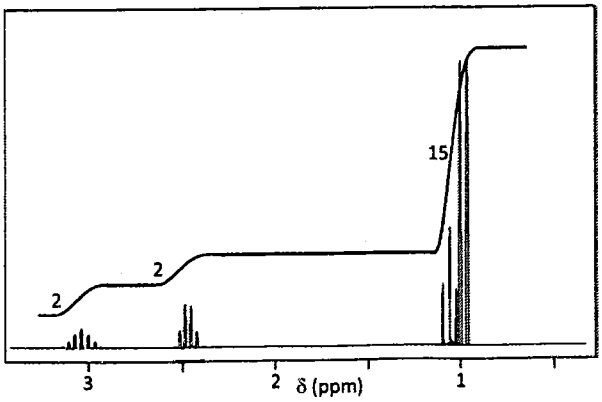
(B) 

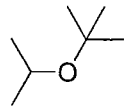
(C) 

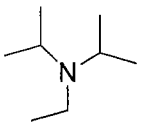
(D) 

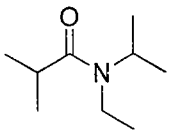
(E) 

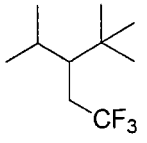
18. Which of the following compounds has the ^{1}H-NMR spectrum shown below (all ^{1}H signals are shown)?

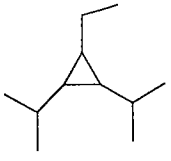


(A) 

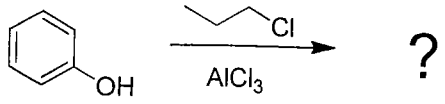
(B) 

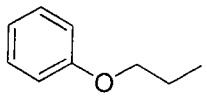
(C) 

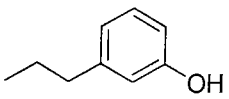
(D) 

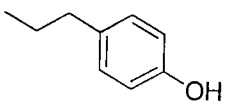
(E) 

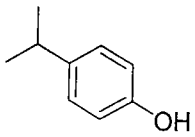
19. What is the major product for the following reaction?

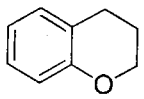


(A)


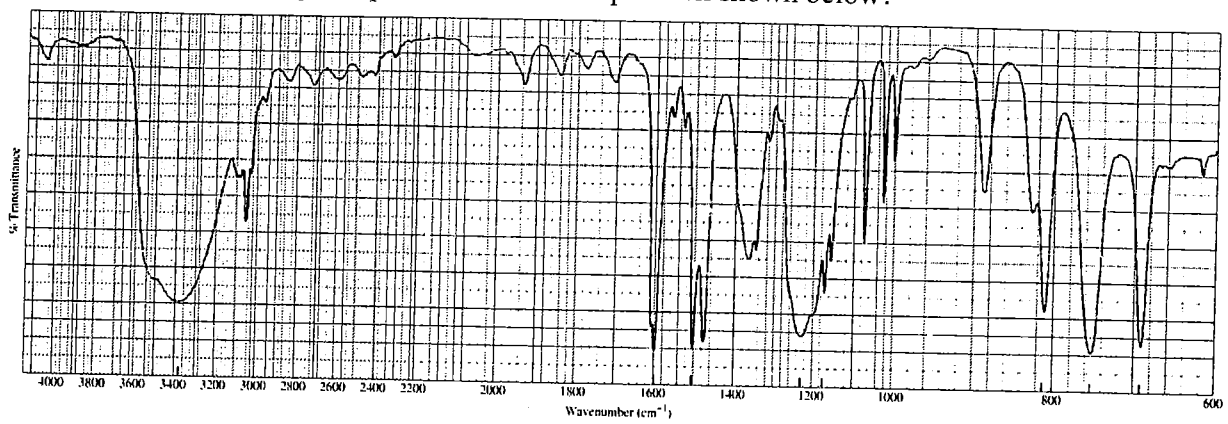
(B)


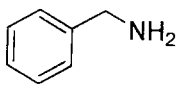
(C)


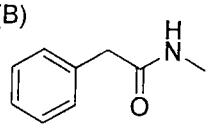
(D)


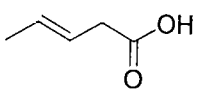
(E)


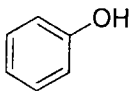
20. Which of the following compounds has the IR spectrum shown below?

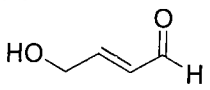


(A)


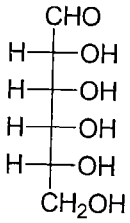
(B)


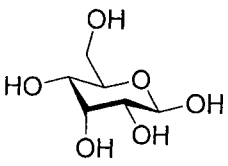
(C)


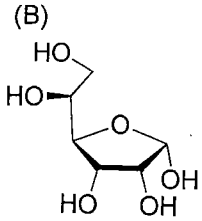
(D)


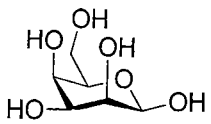
(E)


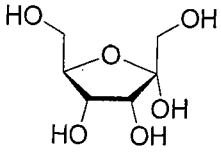
21. Which of the following carbohydrate structure is the cyclized form of the hexose in Fischer projection?

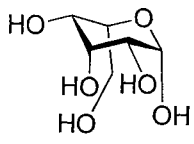


(A)


(B)


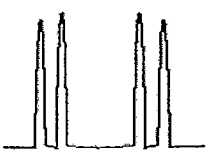
(C)


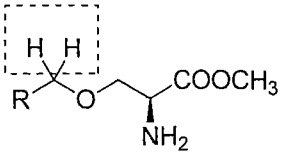
(D)


(E)


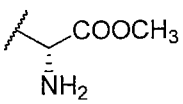
注意:背面有試題

22. The signal peaks in the figure are entirely and the only ^{1}H-NMR signals of indicated protons of the shown compound. What is the R group?



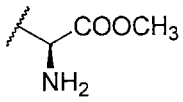


(A) R = H

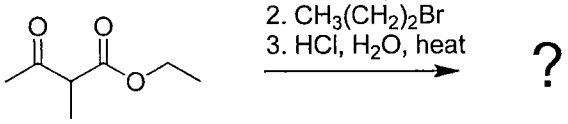
(B) R = 

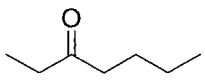
(C) R = CH_2OH

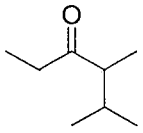
(D) R = Ph

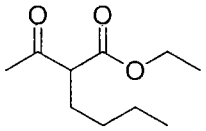
(E) R = 

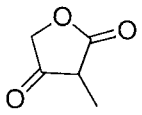
23. What is the major product of the reaction shown below?

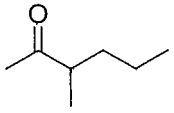


(A) 

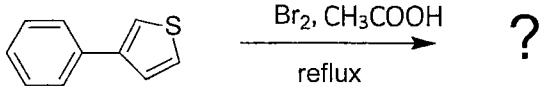
(B) 

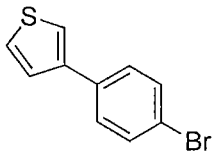
(C) 

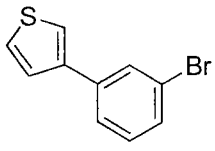
(D) 

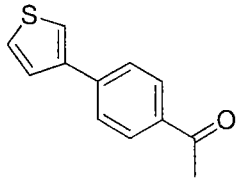
(E) 

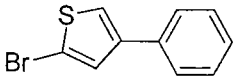
24. What is the major product of the reaction shown below?

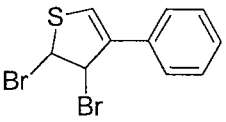


(A) 

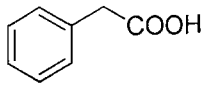
(B) 

(C) 

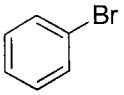
(D) 

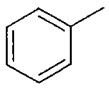
(E) 

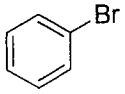
25. Which set of reactions can lead to the shown compound as major product?

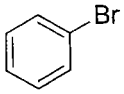


(A)  1. CH_3CH_2Cl, $AlCl_3$ 2. $KMnO_4$ →

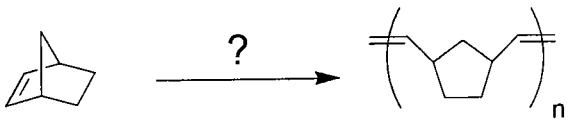
(B)  1. Mg 2. $ClCH_2COOH$ →

(C)  1. Br_2, hν 2. NaCN 3. HCl, H_2O, heat →

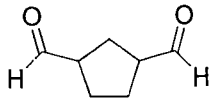
(D)  1. CH_2CH_2, $PdCl_2$ 2. O_3, -78°C 3. $(CH_3)_2S$ →

(E)  1. Li 2. CuI → 3.  4. $SOCl_2$

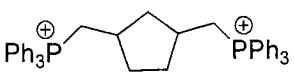
26. Which set of conditions lead to the shown reaction?

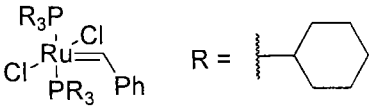


(A) O_3, -78°C then $(CH_3)_2S$

(B) 

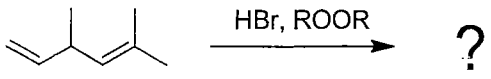
(C) CH_2CH_2, $PdCl_2$

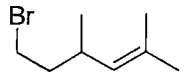
(D)  + *n*-BuLi

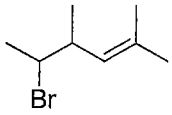
(E) 

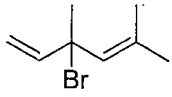
注意:背面有試題

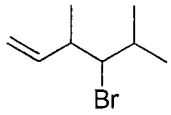
27. What is the major product of the reaction shown below?

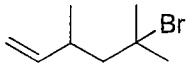


(A) 

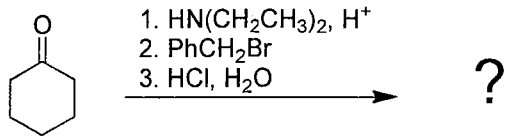
(B) 

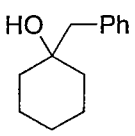
(C) 

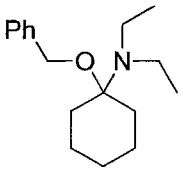
(D) 

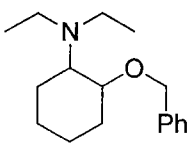
(E) 

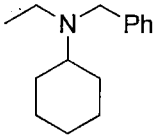
28. What is the major product of the reaction shown below?

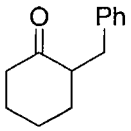


(A) 

(B) 

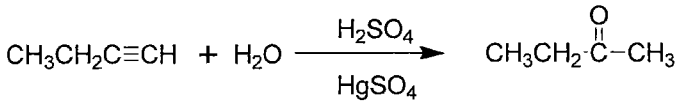
(C) 

(D) 

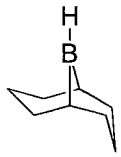
(E) 

二、問答題 (共 30 分)

1. Show detailed step-by-step mechanism for the following **Hg^{2+} catalyzed hydration** for a terminal alkyne. (5%)

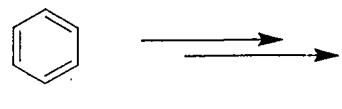


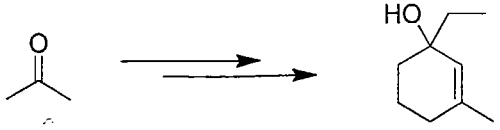
2. Nomenclature. Give the IUPAC name or draw the structure (5%)

(a) 

(b)(5*E*)-4-ethynylocta-5,7-dien-2-yn-1-ol

3. Provide reagents (no more than 5 steps) for the following synthesis: (10%)

(a) 

(b) 

4. To synthesize 3-hydroxypentanal from propanal, acetaldehyde and lithium diisopropylamide, what is the suitable order to add the above reagents to the reaction flask? (5%)

5. Predict the major product for the following reaction? (5%)