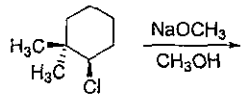
※ 注意：請於試卷上「選擇題作答區」依序作答。

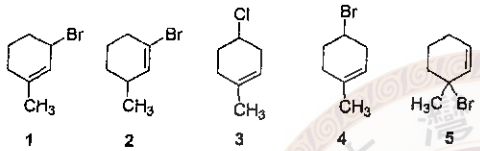
單選題 （75%）每題三分

1. Predict the most likely mechanism for the reaction shown below.



(A) S_N1 (B) S_N2 (C) E1 (D) E2

2. Rank the following molecules in order of increasing relative rate of S_N1 solvolysis with methanol and heat (slowest to fastest reacting).

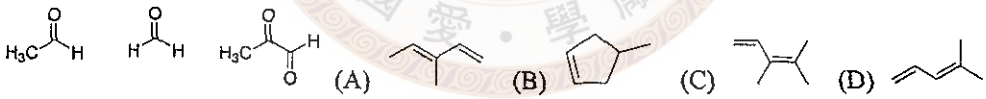


(A) 3 < 2 < 4 < 5 < 1 (B) 2 < 3 < 4 < 1 < 5 (C) 5 < 4 < 3 < 2 < 1 (D) 1 < 2 < 5 < 4 < 3

3. A newly isolated natural product was found to have the molecular formula $C_{15}H_{28}O_2$. By hydrogenating a sample of the compound, it was determined to possess one π bond. How many rings are present in the compound?

(A) 1 (B) 2 (C) 3 (D) 4

4. An unknown compound with empirical formula C_3H_5 was treated with Br_2/CCl_4. The bromine solution went from orangish/red to clear immediately at room temperature. Upon treatment with O_3 followed by work-up with dimethylsulfide the following products were identified. From the information provided what is the most likely structure for this unknown compound.



5. Which of the following compounds would contain characteristic IR stretches at 3300 and 2200 cm^{-1}?

(A) $CH_3CH{=}CHCH_2OH$ (B) $(CH_3)_2CHCN$ (C) $CH_3CH_2CH_2C{\equiv}CH$ (D) $CH_3C{\equiv}CCH_2CH_3$

6. The mass spectrum of alcohols often fail to exhibit detectable M peaks but instead show relatively large ____ peaks.

(A) M+1 (B) M-16 (C) M-17 (D) M-18

7. Consider the three isomeric alkanes n-hexane, 2,3-dimethylbutane, and 2-methylpentane. Which of the following correctly lists these compounds in order of increasing boiling point?

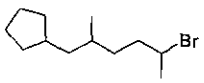
(A) 2,3-dimethylbutane < 2-methylpentane < *n*-hexane

(B) 2-methylpentane < *n*-hexane < 2,3-dimethylbutane

(C) 2-methylpentane < 2,3-dimethylbutane < *n*-hexane

(D) *n*-hexane < 2-methylpentane < 2,3-dimethylbutane

8. Identify the correct IUPAC name for the following structure.



(A) 6-bromo-1-cyclopentyl-3,6-dimethylhexane

(B) 1-bromo-5-cyclopentyl-1,4-dimethylpentane

(C) 2-bromo-6-cyclopentyl-5-methylhexane

(D) 5-bromo-1-cyclopentyl-2-methylhexane

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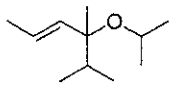
9. What is the complete systematic IUPAC name for the following compound?



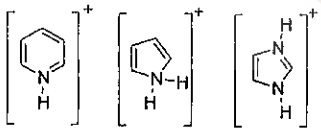
(A) 4-(1-methylethoxy)-4-isopropyl-4-methylpent-2-ene
(B) isopropyl-(4-isopropyl-4-methylbut-2-enyl) ether
(C) 4-isopropoxy-4,5-dimethylhex-2-ene
(D) 4-isopropyl-4-methylbut-2-en-isopropyl ether

10. Which pair of reagents would produce the highest yield of (*R*)-2-ethoxybutane?
(A) sodium (*S*)-2-butoxide + iodoethane (B) sodium (*R*)-2-butoxide + iodoethane
(C) sodium ethoxide + (*S*)-2-iodobutane (D) sodium ethoxide + (*R*)-2-iodobutane

11. What results when but-1-ene is subjected to the following reaction sequence:
(1) Cl_2, H_2O, (2) NaOH, (3) H_3O^+?
(A) a meso epoxide (B) a 1:1 mixture of enantiomeric epoxides
(C) a meso diol (D) a 1:1 mixture of enantiomeric diols

12. The Diels-Alder reaction is a concerted reaction; this means:
(A) a mixture of endo and exo products are formed.
(B) all bond making and bond breaking occurs simultaneously.
(C) the products contain rings.
(D) the reaction is highly endothermic.

13. Rank the following in order of increasing pKa (from lowest to highest pKa)



1 2 3

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

14. Which of the following compounds absorbs the longest wavelength of UV-visible light?
(A) (*E*)-but-2-ene (B) hex-1-ene (C) (*Z*)-1,3-hexadiene (D) (*E*)-1,3,5-hexatriene

15. In the addition of an electrophile to acetophenone, which of the following best describes the expected mode of reaction?
(A) The o,p-positions are most activated to attack by the electrophile.
(B) The m-positions are most activated to attack by the electrophile.
(C) The o,p-positions are most deactivated to attack by the electrophile.
(D) The m-positions are most deactivated to attack by the electrophile.

16. Which of the following represents the correct ranking in terms of increasing boiling point?
(A) *n*-butane < 1-butanol < diethyl ether < 2-butanone
(B) *n*-butane < 2-butanone < diethyl ether < 1-butanol
(C) *n*-butane < diethyl ether < 1-butanol < 2-butanone
(D) *n*-butane < diethyl ether < 2-butanone < 1-butanol

17. The common name for pentanedioic acid is:
(A) pimelic acid (B) glutaric acid (C) succinic acid (D) adipic acid

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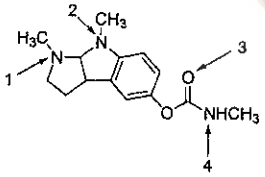
18. Which series of reactions described below will result in the formation of 2-methylpentan-3-one starting with 1-propanol?
(A) 1.$(CH_3)_2CHMgBr$/ diethyl ether 2.dilute H_3O^+ 3.PCC
(B) 1.$Na_2Cr_2O_7/H_2SO_4$ and heat 2.$SOCl_2$ 3. 2 $(CH_3)_2CHMgBr$/ diethly ether 4.H_3O^+
(C) 1.$Na_2Cr_2O_7/H_2SO_4$ and heat 2.$(CH_3)_2CHMgBr$/ diethyl ether 3.dilute H_3O^+ 4. $LiAlH_4$
(D) 1.PCC 2. $(CH_3)_2CHLi$/ diethyl ether 3.dilute H_3O^+ 4.$Na_2Cr_2O_7/H_2SO_4$ and heat

19. Which of the following is a secondary amine?
(A) cyclohexylamine (B) 3-pentanamine (C) *N,N*-dimethylaniline (D) *N*-ethyl-1-propanamine

20. Consider the equilbrium of each of the carbonyl compounds with HCN to produce cyanohydrins. Which is the correct ranking of compounds in order of increasing K_{eq} for this equilbrium?
(A) H_2CO < cyclohexanone < CH_3CHO < 2-methylcyclohexanone
(B) cyclohexanone < 2-methylcyclohexanone < H_2CO < CH_3CHO
(C) cyclohexanone < 2-methylcyclohexanone < CH_3CHO < H_2CO
(D) 2-methylcyclohexanone < cyclohexanone < CH_3CHO < H_2CO

21. Carboxylic acids boil at considerably higher temperatures than do alcohols, ketones, or aldehydes of similar molecular weights. This is because they:
(A) have a greater oxygen content. (B) are more acidic.
(C) form stable hydrogen-bonded dimers. (D) are hydrophobic.

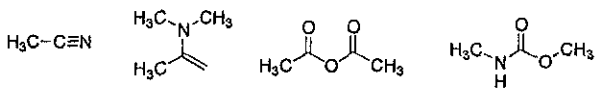
22. Physostigmine is used in the treatment of glaucoma. Within this structure, the atom indicated by _____ is most basic, while atom _____ is least basic.



(A) 1 (most basic), 4 (least basic) (B) 1 (most basic), 3 (least basic)
(C) 2 (most basic), 4 (least basic) (D) 2 (most basic), 3 (least basic)

23. Which sequence of steps below describes the best synthesis of 5-oxohexanoic acid starting with 1-methylcyclopentan-1-ol
(A) 1.Conc. $KMnO_4$ 2.Dry gaseous HBr 3.Mg/ether 4.CO_2
(B) 1.H_2SO_4 and heat 2.Conc. $KMnO_4$
(C) 1.Conc. $KMnO_4$ 2.CH_3MgBr/ether 3.H_3O^+
(D) 1.H_2SO_4 and heat 2. O_3 3.$(CH_3)_2S$ 4.PCC

24. Which of the following structures are carboxylic acid derivatives?



1 2 3 4

(A) 3 (B) 1 & 3 (C) 1, 2 & 3 (D) 4

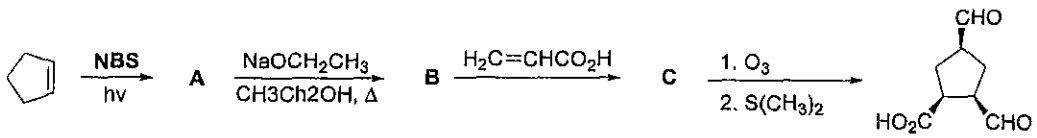
25. The aldol condensation is:
(A) an irreversible reaction. (B) an equilibrium reaction. (C) a tautomerization. (D) an isomerization.

接背面

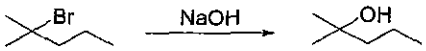
※ 注意：請於試卷上「非選擇題作答區」依序作答，並應註明作答之題號。

問答題 （25%）

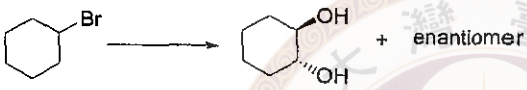
1. What are the structures of A, B, and C? （6%）



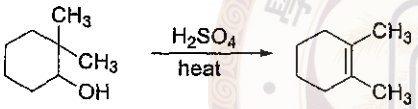
2. Explain why the synthetic route shown below would be unsuccessful.（4%）



3. Provide the reagents necessary to complete the following transformation. （5%）



4. Propose a detailed, step-by-step mechanism for the reaction pathway shown below. （5%）



5. Provide a Fischer projection of (2R,3R,4S)-2,3,4-trichloroheptane. （5%）

試題必須隨卷繳回