注意：本試題包含單選題及問答題兩部份

Part I. 單選題 （30 題，共 60 分）※ 注意：請於試卷內之「選擇題作答區」依序作答。

1. Which acid-base reaction would **NOT** take place as written?

(A) $CH_3Li + CH_3CH_2CH_2CH_2NH_2 \rightarrow CH_4 + CH_3CH_2CH_2CH_2NHLi$

(B) $CH_3C{\equiv}CH + NaOCH_3 \rightarrow CH_3C{\equiv}CNa + CH_3OH$

(C) $HC{\equiv}CNa + H_2O \rightarrow HC{\equiv}CH + NaOH$

(D) $CH_3OH + NaNH_2 \rightarrow CH_3ONa + NH_3$

(E) $CH_3CO_2H + CH_3ONa \rightarrow CH_3CO_2Na + CH_3OH$

2. Adding sodium hydride to ethanol would produce:

(A) $CH_3CH_2OCH_2CH_3 + H_2$ (B) $CH_3CH_2OCH_2CH_3 + NaOH$

(C) $CH_3CH_2ONa + H_2$ (D) $CH_3CH_2Na + NaOH$

(E) $CH_3CH_3 + NaOH$

3. What is the index of hydrogen deficiency of a compound with the molecular formula of $C_8H_3Br_5O_2$?

(A) 2 (B) 3 (C) 4 (D) 5 (E) 6

4. How is it possible to differentiate compounds in a racemic mixture?

(A) by distilling of one isomer from the other (B) chemical conversion to a diastereomeric mixture

(C) through the use of IR spectroscopy (D) how the mixture rotates in plane polarized light

(E) it is impossible to differentiate the two compounds

5. S_N1 reactions of the following type:

are favored

(A) by the use of tertiary substrates (as opposed to primary or secondary substrates).

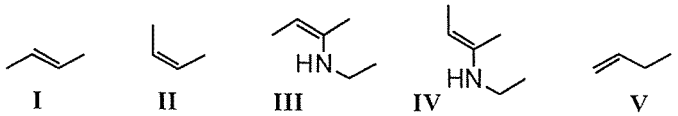
(B) by increasing the concentration of the nucleophile.

(C) by increasing the polarity of the solvent.

(D) by use of a strong base.

(E) by more than one of these choices.

6. The structure of the product obtained from 2-butyne and $Li/C_2H_5NH_2$ is:



I II III IV V

(A) I (B) II (C) III (D) IV (E) V

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7. Which of the following is **NOT** a good leaving group?

(A) $CH_3CH_2O^-$ (B) Cl^- (C) I^- (D) $CH_3CO_2^-$ (E) More than one of these

8. Which of the following reagents might serve as the basis for a simple chemical test that would distinguish between pure 1-pentene and pure pentane?

(A) Bromine in carbon tetrachloride
(B) Dilute aqueous potassium permanganate
(C) Concentrated sulfuric acid
(D) Two of the above reagents.
(E) All of these choices.

9. Which reaction would yield a racemic product?

(A) Cyclopentene + D_2/Pt →
(B) Cyclopentene + OsO_4, then Na_2SO_3 →
(C) Cyclopentene + Br_2/H_2O →
(D) Cyclopentene + cold, dilute $KMnO_4$ →
(E) Cyclopentene + dilute H_2SO_4 →

10. An alkene with the molecular formula C_8H_{16} undergoes ozonolysis to yield a mixture of $(CH_3)_2C{=}O$ and $(CH_3)_3CCHO$. The alkene is:

(A) 2,2-Dimethyl-2-hexene (B) 2,3-Dimethyl-2-hexene (C) 2,4-Dimethyl-2-hexene
(D) 2,4,4-Trimethyl-2-pentene (E) 2,3,4-Trimethyl-2-pentene

11. Consider the expected ^1H NMR spectrum of 2,4-dimethyl-1,4-pentadiene. Which of the following is likely to be observed?

(A) 7 signals (B) 6 signals (C) 5 signals (D) 4 signals (E) 3 signals

12. What is the relationship between the following two structures?

(A) conformers (B) constitutional isomers (C) diastereomers
(D) enantiomers (E) identical

13. When nucleophilic addition to a carbonyl group occurs, the carbon attacked undergoes this hybridization change:

(A) $sp^2 \rightarrow sp^3$ (B) $sp \rightarrow sp^2$ (C) $sp \rightarrow sp^3$
(D) $sp^3 \rightarrow sp^2$ (E) $sp^2 \rightarrow sp$

14. Grignard reagents react with oxirane (ethylene oxide) to form 1° alcohols but can be prepared in tetrahydrofuran solvent. Why is this difference in behavior observed?

(A) Steric hindrance in the case of tetrahydrofuran precludes reaction with the Grignard.
(B) There is a better leaving group in the oxirane molecule.
(C) The oxirane ring is the more highly strained.
(D) It is easier to obtain tetrahydrofuran in anhydrous condition.
(E) Oxirane is a cyclic ether, while tetrahydrofuran is a hydrocarbon.

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15. Fundamentally, 2-methyl-2-pentanol does not undergo oxidation by H_2CrO_4 because:
(A) the alcohol undergoes dehydration.
(B) the intermediate chromate ester cannot lose hydrogen
(C) the intermediate chromate ester is not formed.
(D) the oxidant isn't in a sufficiently high oxidation state.
(E) Actually, this oxidation does occur.

16. Aniline is the name commonly assigned to:
(A) Hydroxybenzene (B) Aminobenzene (C) Methylbenzene
(D) Ethylbenzene (E) Methoxybenzene

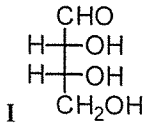
17. In the molecular orbital model of benzene, how many pi-electrons are in bonding molecular orbitals?
(A) 2 (B) 3 (C) 4 (D) 5 (E) 6

18. A glycoside is a compound which contains the structural features of these classes of organic compounds:
(A) Aldehydes and alcohols (B) Acetals and alcohols (C) Hemiacetals and alcohols
(D) Ketones and alcohols (E) Alcohols and carboxylic acids

19. Which of these is properly termed a "quaternary ammonium salt"?
(A) $(CH_3)_3CCH_2CH_2NH_3^+ Cl^-$ (B) $(CH_3CH_2CH(CH_3)CH_2)_2NH_2^+ Cl^-$ (C) $(CH_3CH_2CH_2)_3NH^+ Cl^-$
(D) $(CH_3CH_2CH_2)_4N^+ Cl^-$ (E) None of these choices.

20. The ^{13}C NMR spectrum of a compound with formula $C_7H_{14}O$ gives five signals. Which of these structures is a possible one for this compound?
(A) 2-Heptanone (B) 3-Heptanone (C) 2,2-Dimethyl-3-pentanone
(D) 2,4-Dimethyl-3-pentanone (E) None of the above.

21. Two sugars produce identical products when treated with $NaBH_4$. Which of the following are possible structures for the sugars?



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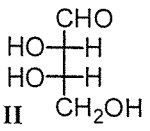

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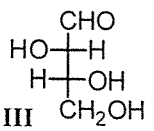
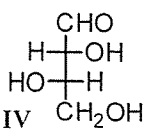


III



IV

(A) **I, II** (B) **I, III** (C) **I, IV** (D) **II, III** (E) **II, IV**

22. Which polymers are correctly matched to their primary use?
I) Kevlar and containers
II) Polymethylmethacrylate and Plexiglas
III) Polytetrafluoroethylene and nonstick coatings
IV) PET and bulletproof vests
(A) **I, III** (B) **II, III** (C) **I, II** (D) **II, IV** (E) **III, IV**

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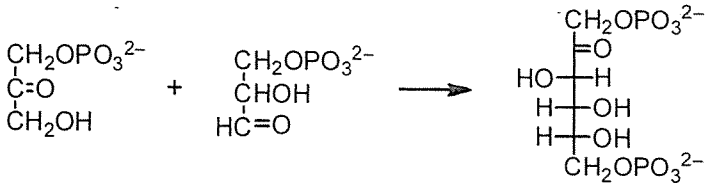
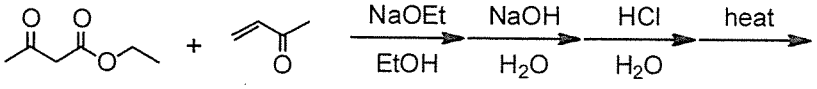
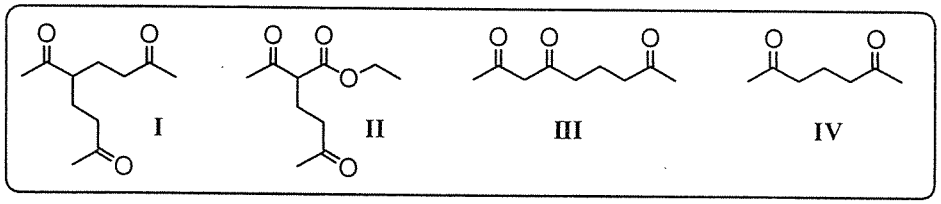
23. How would you characterize this reaction forming fructose 1,6-bisphosphate?



(A) Aldol addition (B) Aldol condensation (C) Claisen condensation
(D) Dieckmann Condensation (E) None of the above.

24. Which is the major product of the following series of reactions?

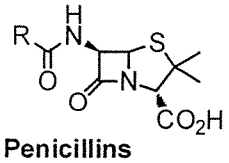




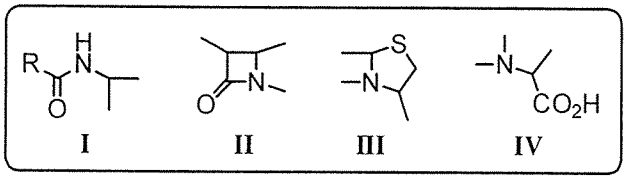
(A) **I** (B) **II** (C) **III** (D) **IV** (E) None of the above.

25. Which compounds will yield benzoic acid when hydrolyzed?
I) benzyl ethanoat II) benzamide
III) phenyl ethanoate IV) methyl benzoate
(A) **I, II** (B) **I, III** (C) **II, III** (D) **II, IV** (E) **I, IV**

26. Which detail of the structure of penicillin is the "lactone-unit"?



Penicillins
R = variable groups in different penicillins



(A) **I** (B) **II** (C) **III** (D) **IV** (E) None of the above.

27. Why are the amino acids in proteins connected by means of amide and not ester bonds?
I) Amides are more stable than esters. II) Esters are more stable than amides.
III) Amides can be easily transformed into carboxylic acids and amines.
IV) Amides are resistant to hydrolysis in the absence of enzymes
(A) **II, III** (B) **I, III** (C) **I, IV** (D) **II, IV** (E) **III, IV**

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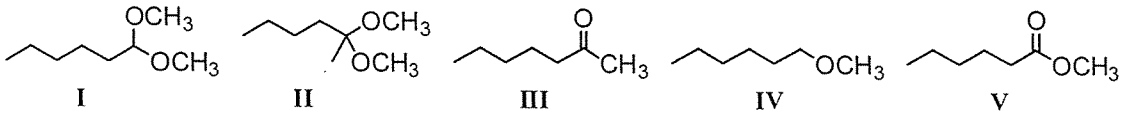
28. The following product can be made from the reductive amination of which combination of compounds?

(A) benzaldehyde and benzylamine
(B) benzaldehyde and aniline
(C) benzophenone and ammonia
(D) acetophenone and ammonia
(E) benzaldehyde and methylamine

29. Which reaction does not lead to 3-methyl-3-hexanol?

(A) 2-butanone + propylmagnesium bromide
(B) 3-pentanone + ethylmagnesium bromide
(C) 3-hexanone + methyl magnesium bromide
(D) 2-propanone +butylmagnesium bromide
(E) None of the above.

30. 1-Hexene was treated with dilute sulfuric acid. The product of that reaction was reacted with potassium dichromate in sulfuric acid. This product was then treated with HCl/methanol. What is the major product of this series of reactions?



I II III IV V

(A) I (B) II (C) III (D) IV (E) V

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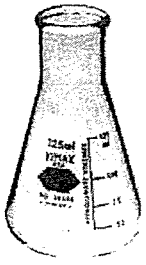
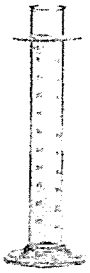
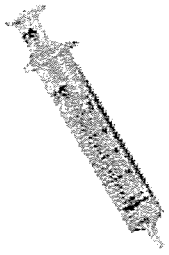
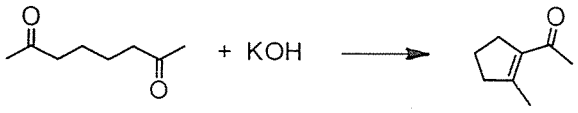
注意：請於試卷內之「非選擇題作答區」作答，並應註明作答之題號。
Part II. 問答題 （3 題，共 40 分）

1. Please name the following items in English. (5 points)

(a)  (b)  (c)  (d)  (e) 

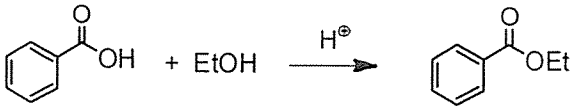
2. Give a detailed reaction mechanism for the following reactions. (16 points)

(a)



(8 points)

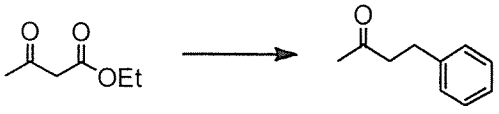
(b)



(8 points)

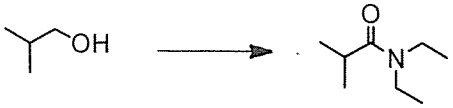
3. Show how each of the following transformations could be accomplished. You may use any other required reagents. **Note:** most will require more than one step. (19 points)

(a)



(7 points)

(b)



(6 points)

(c)

(6 points)

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