

本試題是否可以使用計算機: 可使用, 不可使用 (請命題老師勾選)

1-33 (2 points for each; wrong answer will deduct 1point)

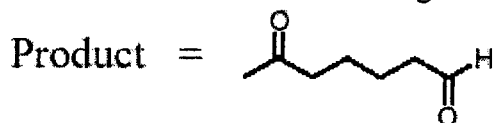
1. Which of the following compounds will react most rapidly with HCl?

- A. 5-methyl-1-hexene
- B. 4-methyl-1-hexene
- C. E-5-methyl-2-hexene
- D. E-2-methyl-3-hexene
- E. 2-methyl-2-hexene

2. The reagent needed to convert 2-butyne into trans-2-butene is:

- A. H_2 , Pd/C
- B. H_2 , Lindlar's catalyst
- C. Li, NH_3
- D. Na, NH_3
- E. C or D.

3. An unknown alkene was treated with ozone followed by CH_3SCH_3 to give the indicated product. The structure of the starting alkene was:



- A.
- B.
- C.
- D.
- E.

4. Which of the following reagents would be suitable for performing the transformation shown below.



- A. BH_3 , H_2O_2 , NaOH
- B. CH_3CO_3H
- C. CrO_3
- D. NBS, H_2O_2
- E. OsO_4 , pyridine

5. Which of the following alkenes has the smallest heat of hydrogenation (ΔH°)?

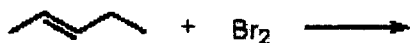
- A.
- B.
- C.
- D.
- E.

(背面仍有題目, 請繼續作答)

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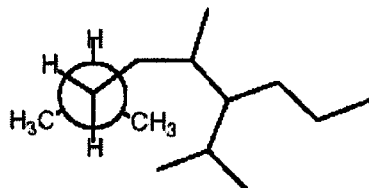
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6. How many stereoisomers would you expect to obtain upon treatment of *trans*-2-pentene with Br₂?



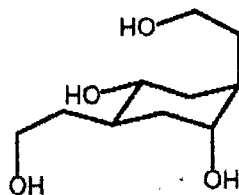
- A. 1 B. 2 C. 3 D. 4 E. 5

7. Give the IUPAC name for the following compound.



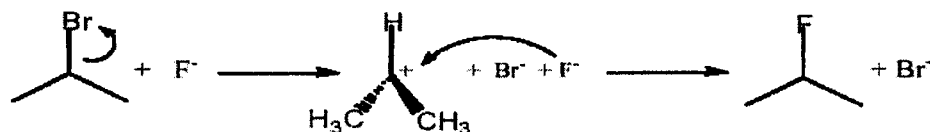
- A. 4-isopropyl-2,4-dimethylnonane
 B. 3-propyl-2,4,6-trimethylheptane
 C. 6-isopropyl-3,5-dimethyloctane
 D. 6-isopropyl-2,5-dimethylnonane
 E. 5-propyl-2,4,6-trimethylheptane

8. How many chiral centers are present in the following compound?



- A. 0
 B. 1
 C. 2
 D. 3
 E. 4

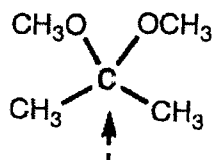
9. The mechanism of the following reaction is:



- A. Elimination
 B. Oxidation
 C. SN₁
 D. SN₂
 E. None of the above.

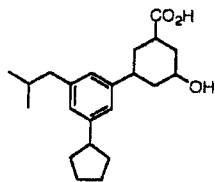
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10. What is the oxidation state for the indicated carbon in the molecule below?



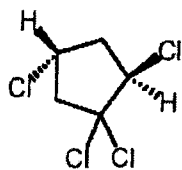
- A. -4 B. -2 C. 0 D. 2 E. 4

11. What is the maximum possible number of stereoisomers for the molecule below?



- A. 5 B. 6 C. 8 D. 9 E. 10

12. The Cahn-Ingold-Prelog stereochemical designations used for the compound below are:



- A. 2R,4S B. 2S,4R C. 2R,4R D. 2S,4S
E. The R,S terminology doesn't apply in this case.

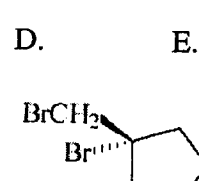
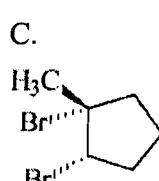
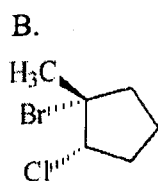
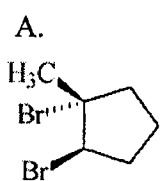
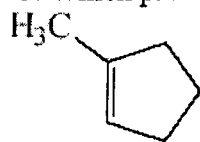
13. Thermodynamic control of a reaction means that

- A. The major product is the one that is formed first
B. The major product is the one that is formed slowly
C. The major product is the more stable one
D. The major product is the one with the lowest energy of activation (E_a or ΔG^\ddagger)
E. The major product is the one that smells better.

14. In UV spectroscopy, the closer the energies of the HOMO and the LUMO

- A. the longer will be λ_{max}
B. the lower will be the frequency of the absorbed light
C. when the system is highly conjugated
D. All of the above
E. None of the above

15. Which product is expected from the following reaction?



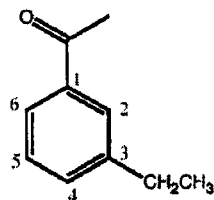
E. .none of them

(背面仍有題目,請繼續作答)

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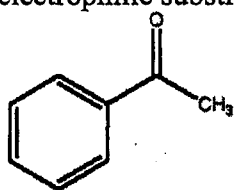
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16. At which carbon is the next substituent most likely to substitute during aromatic electrophilic substitution?

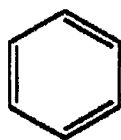


- A. Carbon 4 or 6 B. Carbon 5 C. All sites are equally reactive.
D. A 3rd substituent will not add to the ring. E. none of them

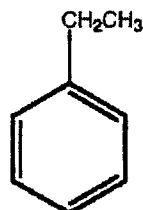
17. Rank the species in order of decreasing reactivity (most reactive first) toward aromatic electrophilic substitution.



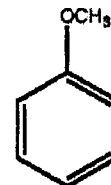
I



II



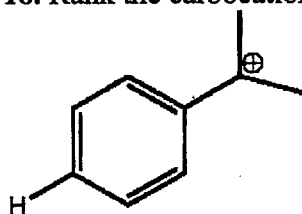
III



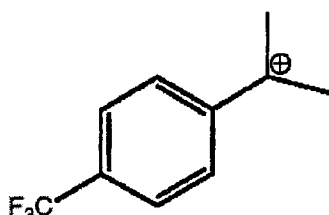
IV

- A. I > II > III > IV B. IV > III > II > I
C. III > I > II > IV D. IV > I > II > III
E. I > III > II > IV

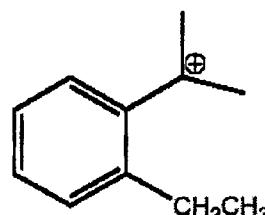
18. Rank the carbocations below from most to least stable.



I



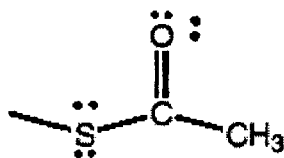
II



III

- A. I > II > III B. III > I > II
C. III > II > I D. II > III > I
E. II > I > III

19. The thioester group in the inset is a(n) _____ director and a(n) _____ group.



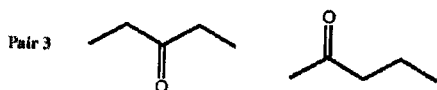
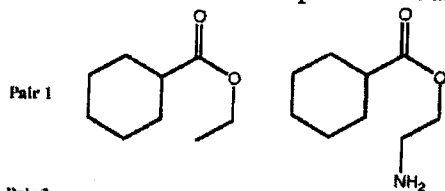
- A. o,p director ; activating B. m- director ; activating
C. o,p director ; deactivating D. m- director ; deactivating
E. none of them

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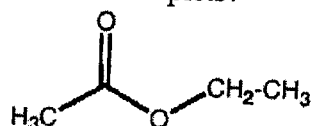
20. Which of the following would NOT differentiate benzoic acid from benzyl alcohol?
 A. ^{13}C NMR band near 200 ppm
 B. Solubility in in water pH > 7
 C. ^1H NMR band between 1-2 ppm
 D. IR band near 1600 cm^{-1} .
 E. None of them

21. Which pairs of compounds could be distinguished by UV spectroscopy?



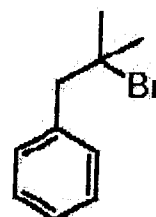
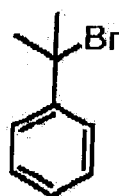
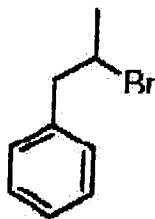
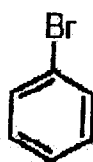
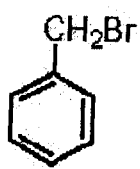
- A. Only Pair 1
 B. Only Pair 2
 C. Pairs 1 and 2
 D. Only Pair 3
 E. None of them

22. HOW MANY ^1H NMR peaks would the molecule below show and how many of the peaks would be triplets?



- A. 2 peaks and 1 triplet
 B. 2 peaks and 2 triplets
 C. 3 peaks and 2 triplets
 D. 3 peaks and 1 triplet
 E. None of them

23. Which of the following would react MOST RAPIDLY with cold, dilute NaOH solution via an $\text{S}_{\text{N}}2$ reaction mechanism?



A.

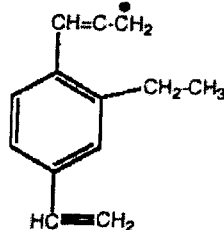
B.

C.

D.

E.

24. How many carbon atoms "share" the radical through resonance stabilization? (Count the carbon in the starting resonance form in the box as the first sharing the radical)



A. 2

B. 4

C. 6

D. 8

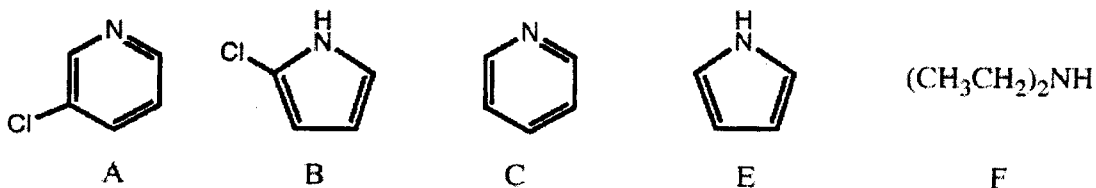
E. 10

(背面仍有題目,請繼續作答)

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25. Which is the strongest base among the following amines?



26. Which compound will reduce C=O but not C=C (at least not much)?

- A. Jones' Reagent B. PCC C. LiAlH₄
D. NaBH₄ E. Chromic Acid

27. Alkoxymercuration followed by borohydride reduction would be used to produce

- A. an alcohol from an alkene. B. an aldehyde from alcohol.
C. an acid from an alkyne. D. an ether from an alkene.
E. an alkene from an aryl halide.

28. Which of the following is not a common reaction of aldehydes?

- A. Nucleophilic acyl addition. B. Nucleophilic acyl substitution
C. alpha Substitution D. Carbonyl condensation
E. Reduction to a ketone

29.

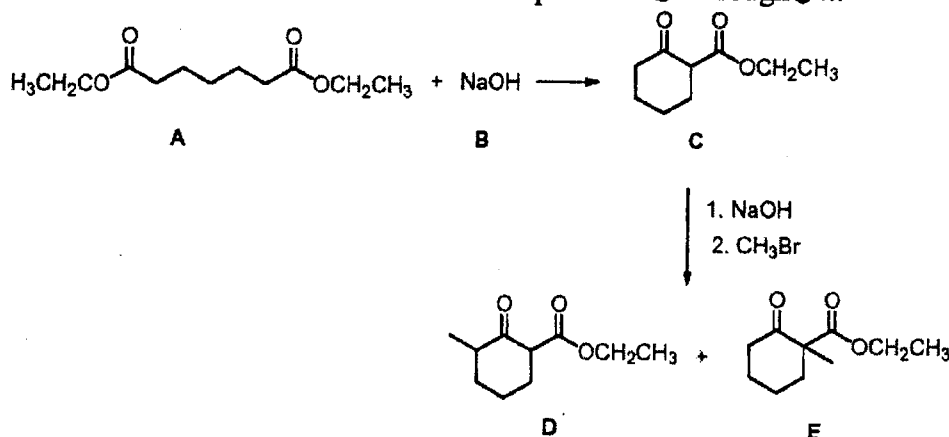
In proton NMR, which compound or groups will show a characteristic peak near 10 ppm?

- A. Alcohols B. Aldehydes C. Ketones D. C=O E. Methyl on a carbonyl

30. Hemiacetals and acetals are often found in

- A. carbohydrates. B. proteins. C. fats. D. oils. E. DNA.

31-34. Consider the reaction below to answer questions 31 through 34..



31. Compound A is best described as:

- A. diketo ester
B. α -carboethoxy ketone
C. diester
D. malonic ester
E. none of them

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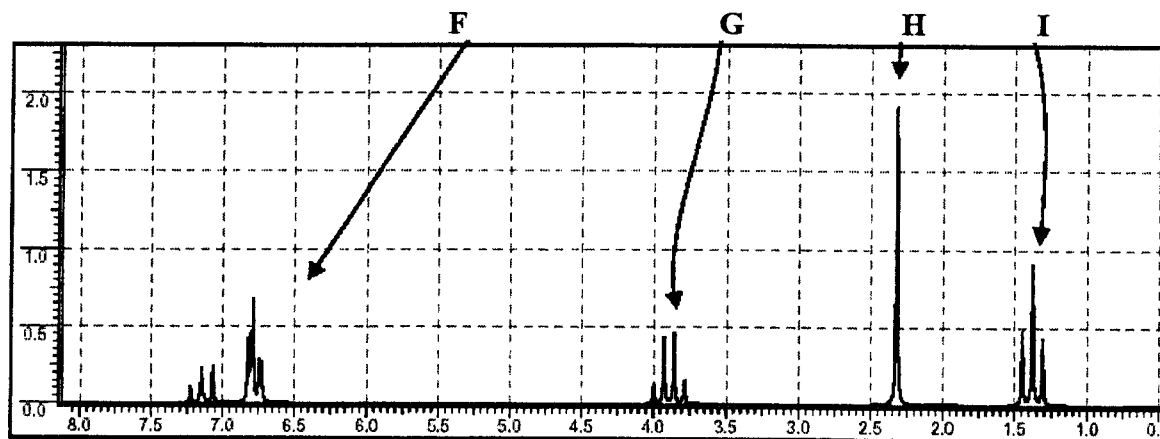
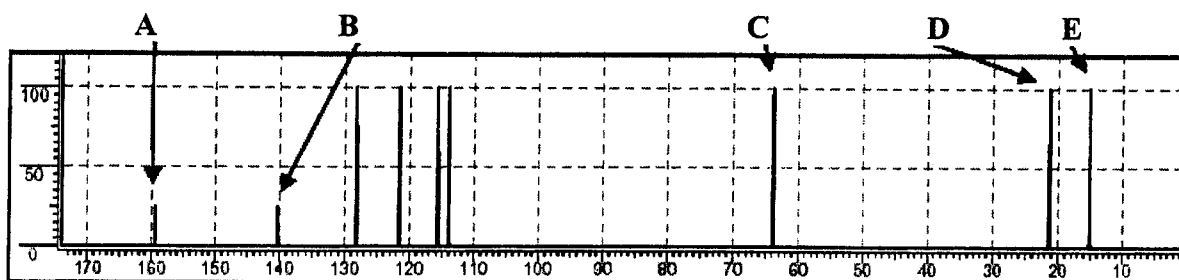
32. Compound C is best described as:

- A. β -keto ester
- B. α -carboethoxy ketone
- C. malonic ester
- D. acetoacetic ester
- E. none of them

33. Redraw compound C and then label two acidic protons in compound C.

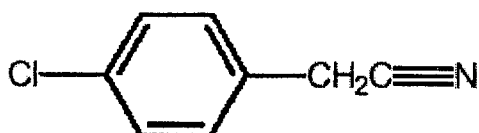
34. Which of compounds D and E would be formed in the greatest amounts? Explain. (4 points)

35. Defend your choice by referring to specific features of BOTH spectra. Assign the identities of A-I peaks. (6 points)



36. Draw chemical structure and the ¹H NMR spectrum of tyrosine amino acid. Show your work and show the relative areas under each peak (6 points)

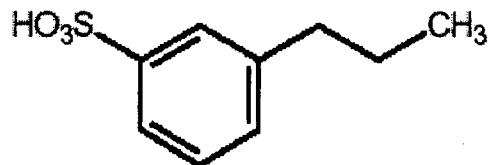
37. Propose a synthetic route to the following compound starting with benzene, and using any other needed reagents. (5 points)



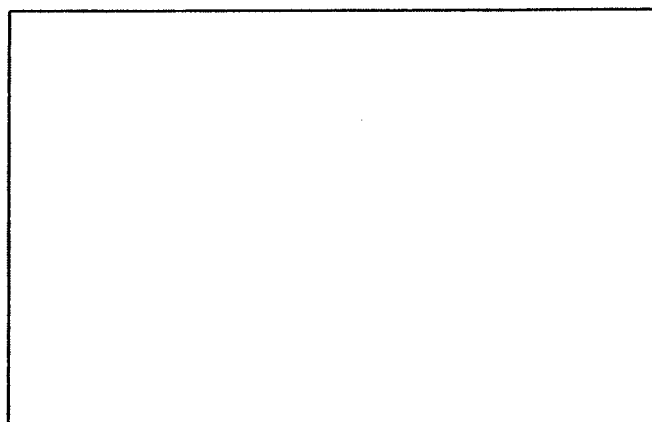
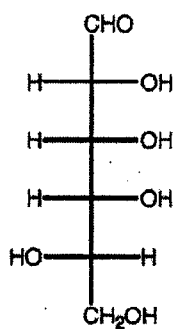
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38. Propose a synthetic route to the following compound starting with benzene and using any other needed chemicals. (5 points)



39. Draw the structure of the α -pyranose (Haworth formula) for the following sugar. (4 points)



α -Pyranose Form

40. The pKa values of oxaloacetic acid are 2.22 and 3.98. Assign each pKa value to the corresponding carboxyl group. (4 points)

