

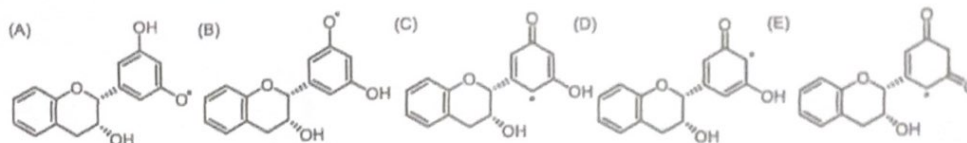
Organic Chemistry (2nd semester)

First term examination (Friday, Mar. 14th, 2025, 8:00 ~ 10:00)

Name: 賴政宏; Student ID number: 112023019; Score: 232/331

A. Select suitable conditions/reagents and/or products for each of the following transformation (每題 6 分共 156 分)

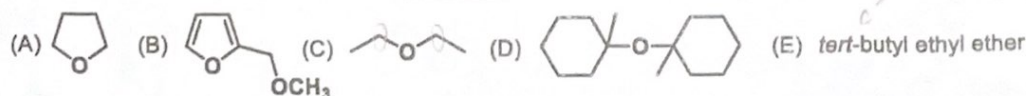
1. Which of the following resonance structures is not correct?



2. Which of the following is a correct active radical formed when CFCs reaches the stratosphere?

- (A) CF_2
- (B) CCl_2
- (C) Cl-O-O
- (D) F
- (E) Cl-O-Cl

3. Which of following compound is least apt to form a peroxide?



4. Regarding the use of Hammond Postulate to explain why free radical brominations are more selective than free radical chlorinations, which of the following statement is not correct?

- (A) The first propagation step in free radical bromination is endothermic.
- (B) The first propagation step in free radical chlorination is exothermic.
- (C) The transition state for the bromination is product-like (ie, radical-like).
- (D) The transition state for the chlorination is product-like (ie, radical-like).
- (E) The stability of the intermediate radical in the bromination determines the bromination selectivity.

6. A mass spectrum shows significant peaks at $m/z = 87, 115, 140$ (M-18), and 143 (M-15). Which of the following compounds is responsible for that mass spectrum?



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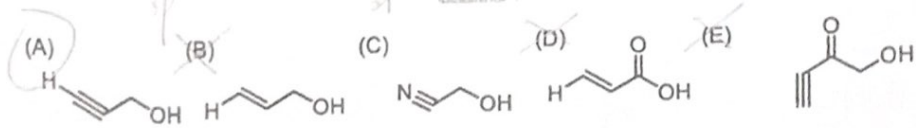
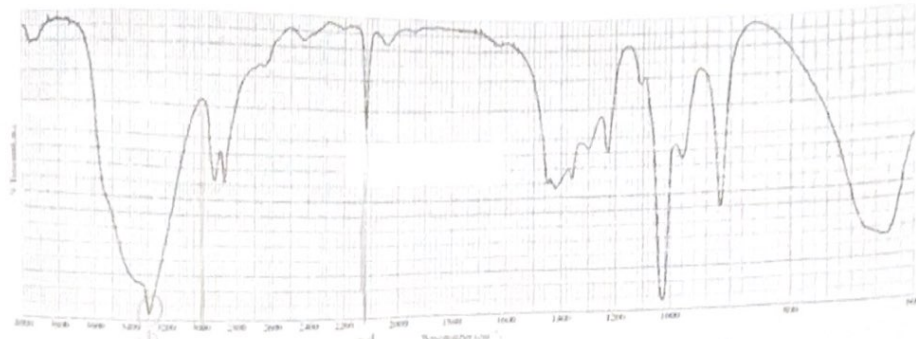
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Mass spectrum of C_4H_4 showing relative abundance versus m/z . The base peak is at m/z 78. Other significant peaks are labeled at m/z 52 ($M-36$) and m/z 77.

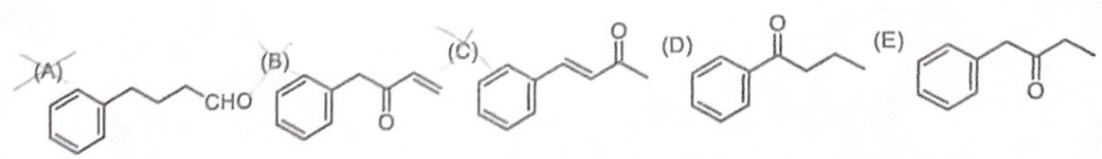
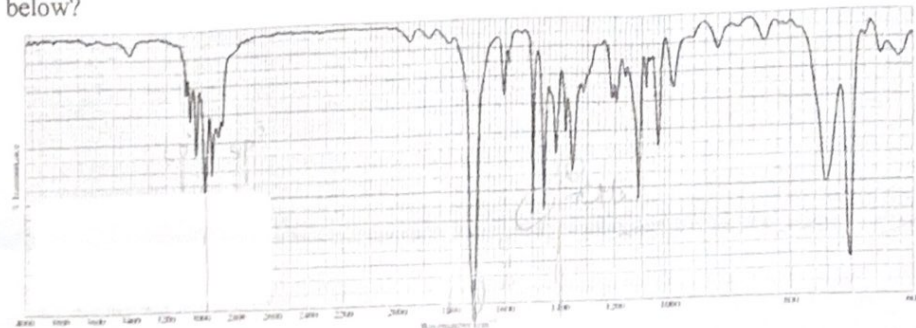


9. Which one of the following five compounds produced the IR spectrum shown below?

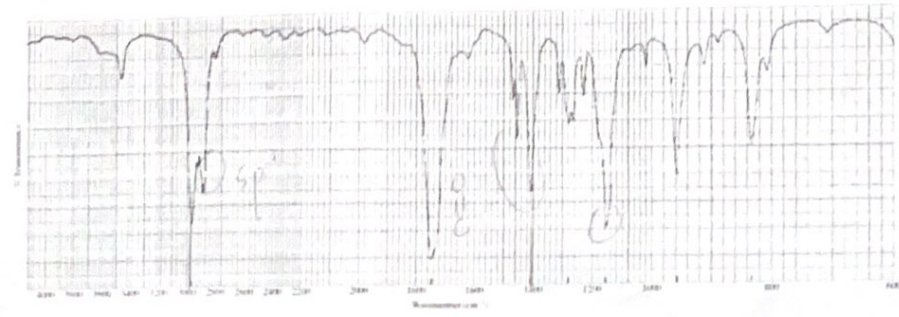


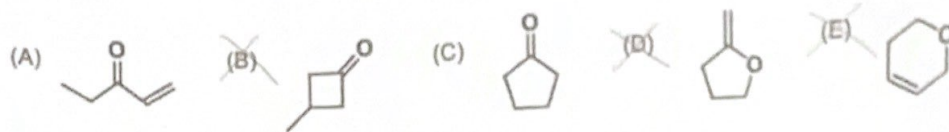
~~D~~
E

10. Which one of the following five compounds produced the IR spectrum shown below?

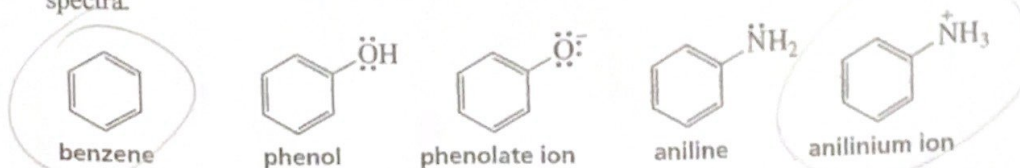


C 11. Which compound produced the IR spectrum shown below?



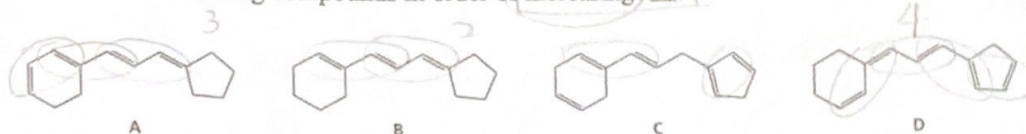


12. Which of the following pair of compounds would show a similar λ_{\max} in UV-Vis spectra.



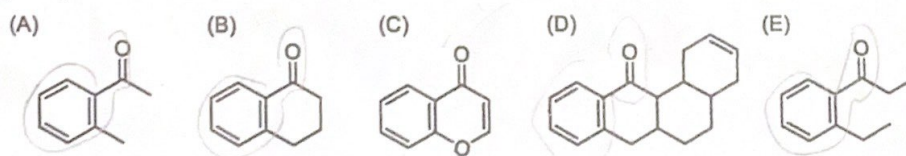
- (A) Benzene and anilinium ion (B) phenol and aniline (C) phenolate ion and aniline
(D) benzene and aniline (E) phenolate ion and anilinium ion

13. Rank the following compounds in order of increasing λ_{\max} :

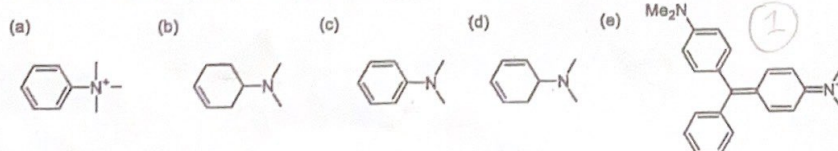


- (A) $A > B > C > D$ (B) $D > A > B > C$ (C) $D > C > A > B$
(D) $A > D > B > C$ (E) $B > D > A > C$

14. Which of the following compounds does not possess the same chromophore? (5-point)



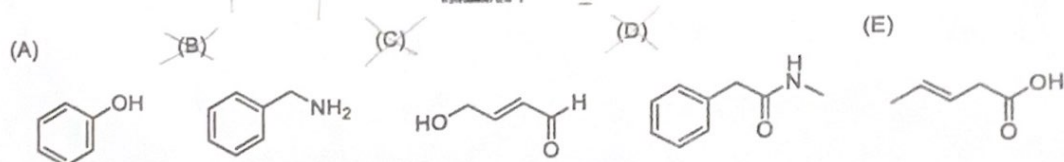
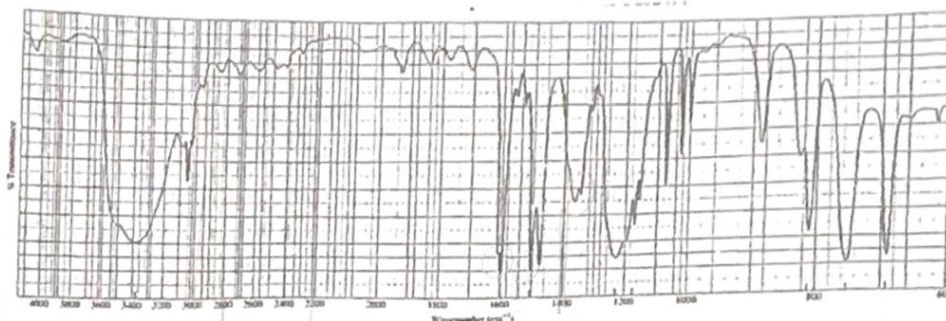
15. Rank a set of compounds in order of decreasing λ_{\max} :



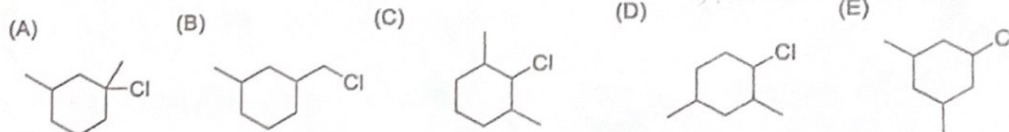
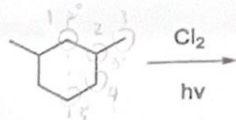
- (A) $e > c > a > d > b$ (B) $c > e > a > d > b$ (C) $e > d > a > c > b$
(D) $a > e > c > d > b$ (E) $d > e > a > c > b$

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

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



18. Predict the major product of



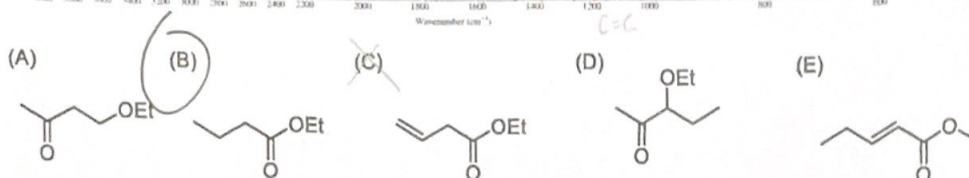
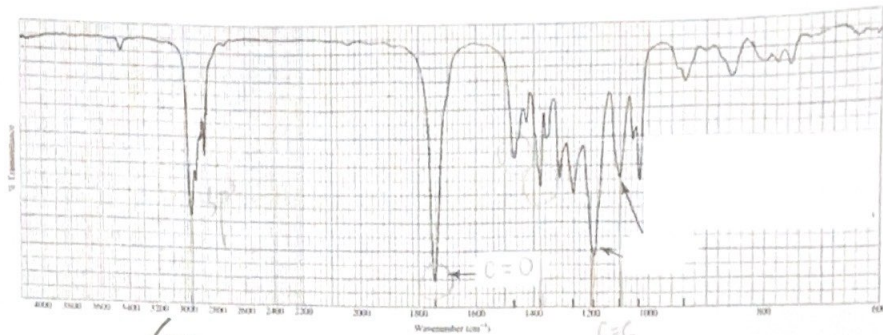
19. The chlorination of 2-methylpentane would produce how many isomeric monochloro compounds?

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

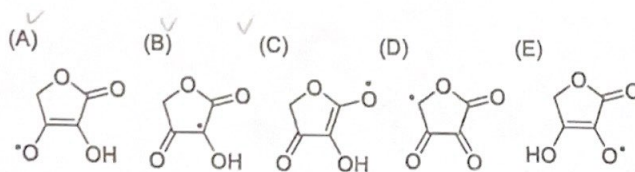
20. How many percentage of the radical cation peak of (M+1) relative to that of M will be observed approximately when the pure compound C_{60}^{59} was detected in the mass spectrometer?

(A) 60% (B) 66% (C) 70% (D) 77% (E) 80%

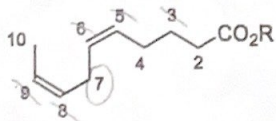
21. Which of the following compounds has the IR spectrum shown below?



22. Which of the following resonance structures is not correct?



23. Which C-H bond of the following compound gets reacted first with a radical source upon heating?



(A) C7 (B) C10 (C) C4 (D) C2 (E) C3

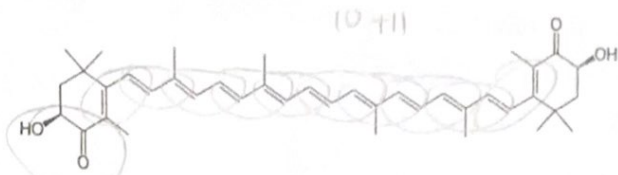
24. Cytochrome P₄₅₀ is responsible for converting a toxic non-polar compound to the corresponding alcohol-containing product. What the reactive site responsible for C-H activation?

(A) Fe-OH (B) Fe-OOH (C) Fe=O (D) Fe-CO (E) Fe=O

24. The λ_{\max} of lycopene is around 474 nm. What would be the expected λ_{\max} of Astaxanthin (蝦紅素)?



lycopene
 $\lambda_{\max} = 474 \text{ nm}$



- (A) 575nm (B) 495nm (C) 455nm (D) 625nm (E) 475nm

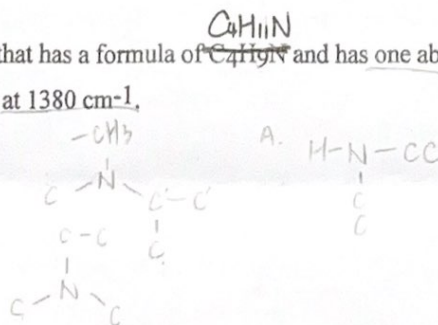
25. In the UV-visible spectrum of (E)-1,3,5-hexatriene, the lowest energy absorption corresponds to

- A) a π to π^* transition.
 B) a σ to π^* transition.
 C) a π to σ^* transition.
 D) a σ to σ^* transition.
 E) a σ to π transition.

- (A) 525 nm (B) 500 nm (C) 455 nm (D) 625 nm (E) 475 nm

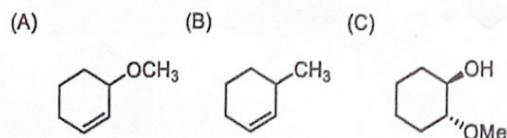
26. Identify the compound that has a formula of $C_4H_{11}N$ and has one absorption band at 3400 cm^{-1} and a doublet at 1380 cm^{-1} .

- A) diethylamine
 B) methylpropylamine
 C) isopropylmethylamine
 D) butylamine
 E) dimethylethylamine

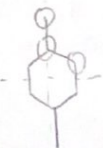


B. Provide suitable products or reagent for each of the following transformation (共 65 分)

1. Starting with cyclohexane, how could the following compounds be prepared? (15 points)

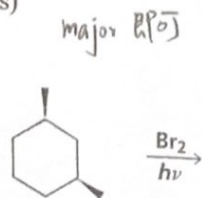


2. 1,4-dimethylcyclohexane will undergo a chlorine radical reaction. Please predict all the monochlorination product(s) and the ratio of each product, reaction is carried out at room temperature. (10 points)

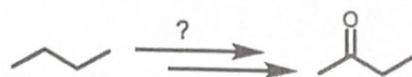


3. Please predict the product, reagent or starting material

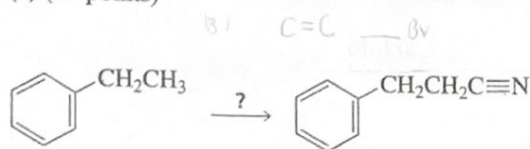
(a) (10 points)



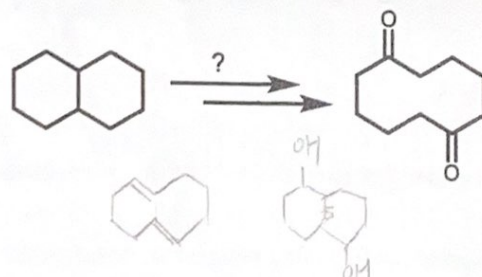
(b) (10 points)



(c) (10 points)

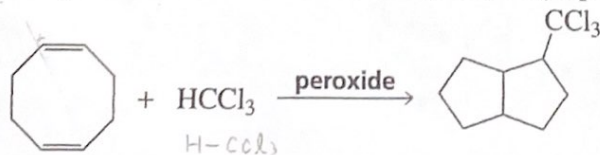


(d) (10 points)



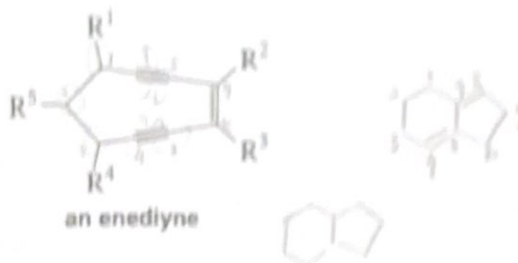
C. Propose the suitable mechanism for the following reaction (共 50 分)

1. Propose a mechanism for the following reaction (10 points)

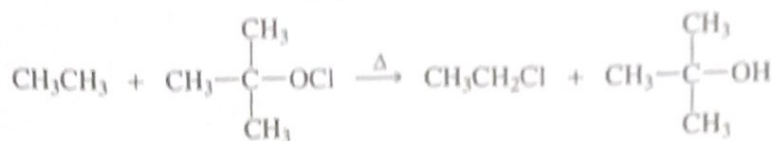


2. Enediynes are natural products with potent antitumor properties because they are able to cleave DNA (page 288). Their cytotoxic properties are due to the enediyne undergoing a cyclization to form a highly reactive diradical intermediate. The intermediate abstracts hydrogen atoms from the backbone of DNA, which triggers its

damage. Draw the structure of the diradical intermediate (10 points)



3. Propose two different propagation steps for the following reaction (15 points)

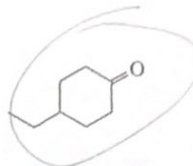
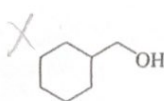
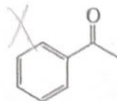
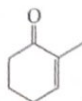
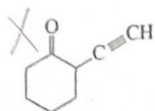
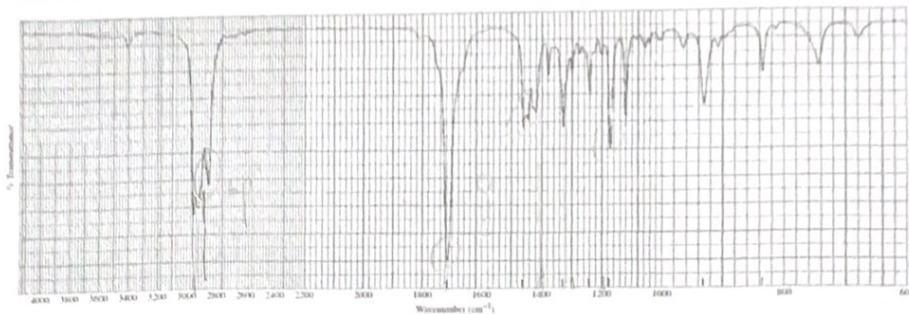


4. The absorbance of an acid solution under the conditions at a series of pH values. Its conjugate base is the only species in the solution that absorbs UV light at the wavelength used. Estimate the pKa of the acid from the data obtained. (10 points)

pH	1.0	2.0	3.0	4.0	5.0	6.0	7.0	8.0	9.0	10.0
Absorbance	0	0	0.10	0.50	0.80	1.10	1.50	1.60	1.60	1.60

$$\text{pKa} = \text{pH} \quad \text{at } \epsilon$$

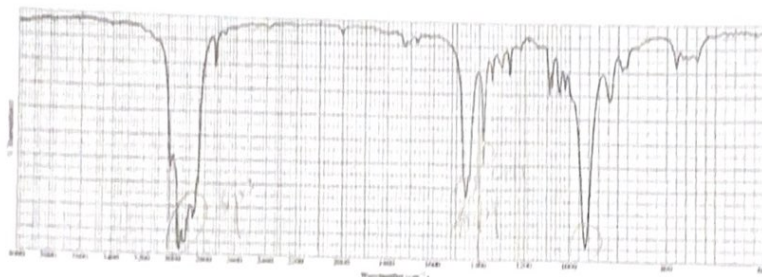
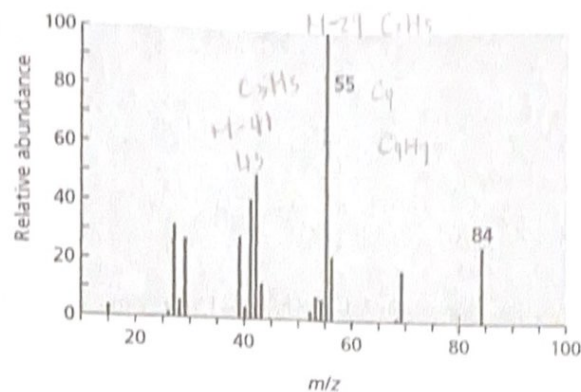
5. Indicate which of the compound is responsible for the spectrum? (5 points)



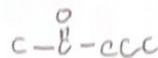
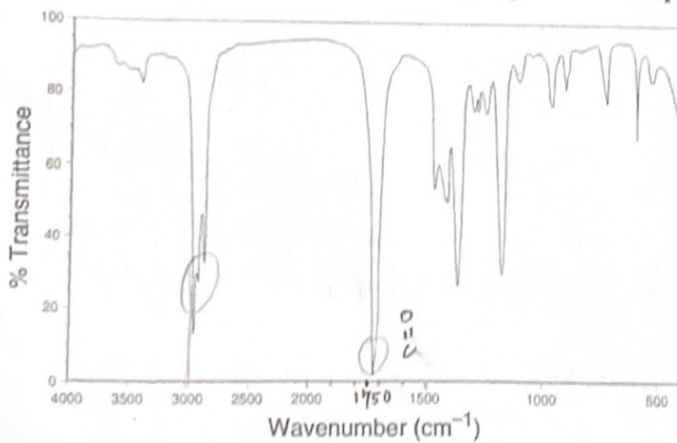
D. Predict the structure based on the following MS and IR spectra.

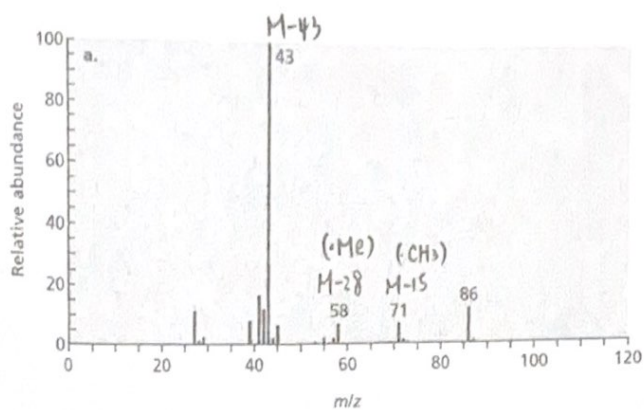
(每題20分 共60分)

1. Predict the structure based on the following MS and IR spectra



2. Predict the structure based on the following MS and IR spectra





3. The IR and mass spectra for an unknown compound are shown below. Identify the structure of the compound

