

APOLLO

Functional groups: Classification of organic compounds

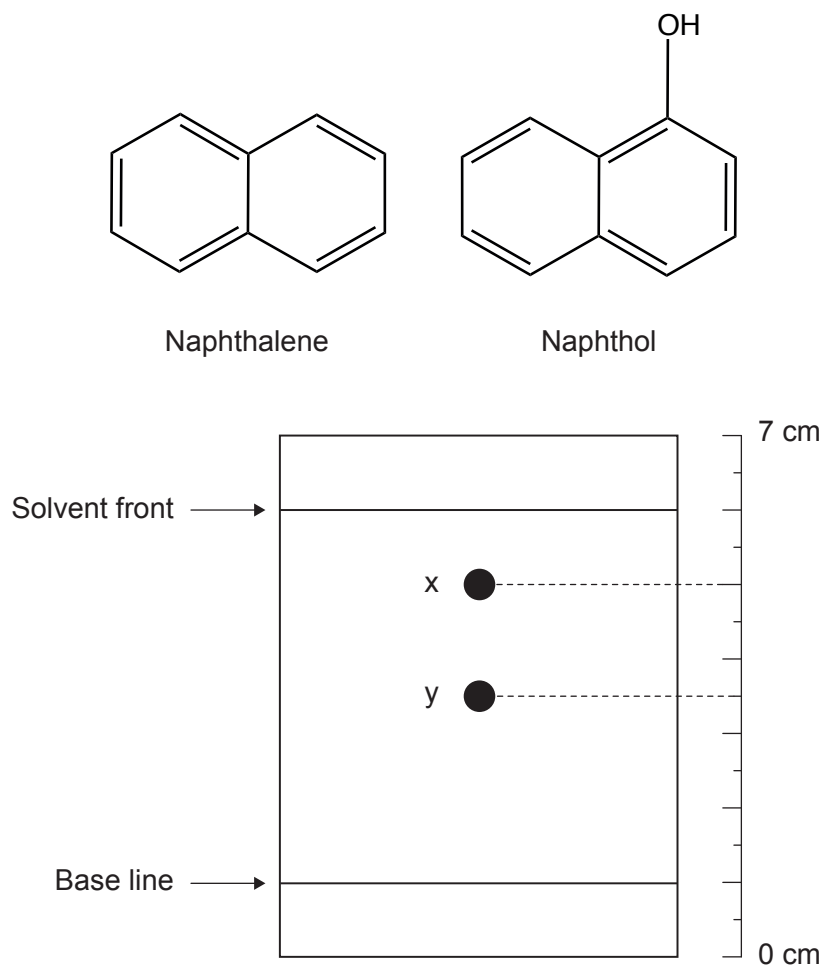
HL

Chemistry

First assessment 2025

20 questions | questions

12. The following thin-layer chromatogram was obtained from a mixture of naphthalene, $C_{10}H_8$, and naphthol, $C_{10}H_8O$. A polar silica was used as the stationary phase, and a non-polar hexane as the mobile phase.



What are the position and retardation factor (R_f) of naphthalene?

- A. y and 0.50
- B. y and 0.58
- C. x and 0.80
- D. x and 0.83

Turn over

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4420-0201

19. Which oxygen-containing molecule has this low-resolution ^1H NMR spectrum?

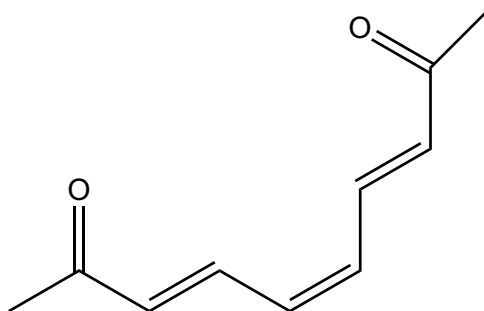
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- A. Butanoic acid
- B. Ethyl ethanoate
- C. Methyl propanoate
- D. Butanone

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4420-0201

20. Consider this molecule, deca-3,5,7-triene-2,9-dione.



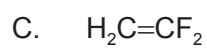
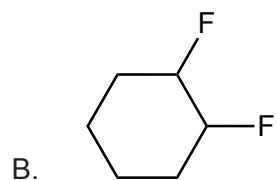
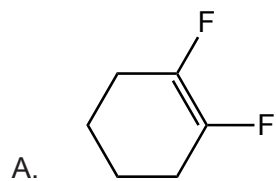
How many stereoisomers are possible for deca-3,5,7-triene-2,9-dione?

- A. 3
- B. 6
- C. 8
- D. 9

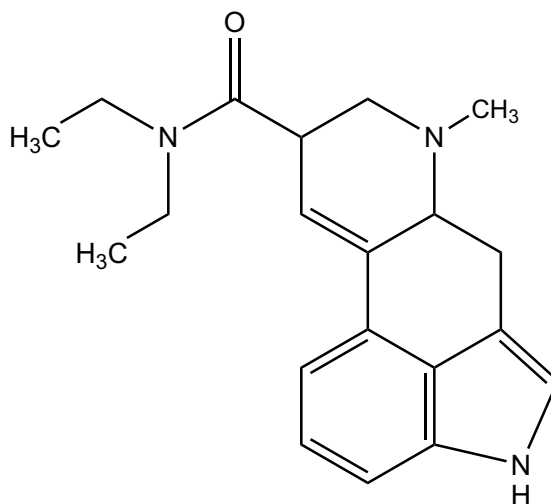
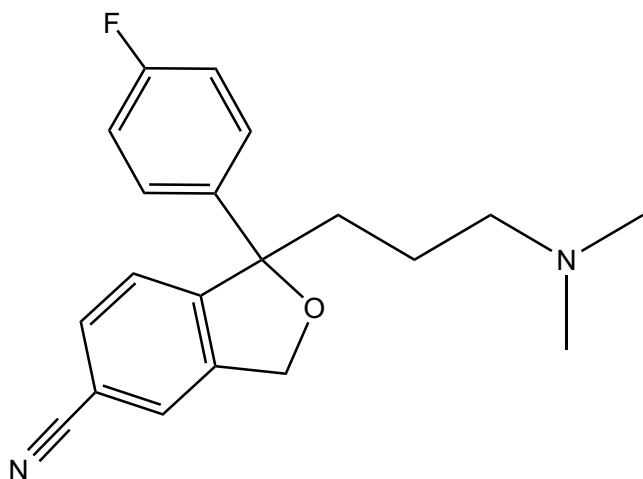
21. What is a disadvantage of using infrared (IR) spectroscopy as a technique?

- A. It cannot detect small atoms like H.
- B. It can only detect molar mass.
- C. It alters the chemical structure of the sample.
- D. It can only identify bonds, not their position.

17. Which compound shows *cis-trans* isomerism?



17. Which functional groups are present in both of these molecules?



- A. Amino and amido
- B. Amino and alkoxy
- C. Amino and carbonyl
- D. Amino and a benzene ring

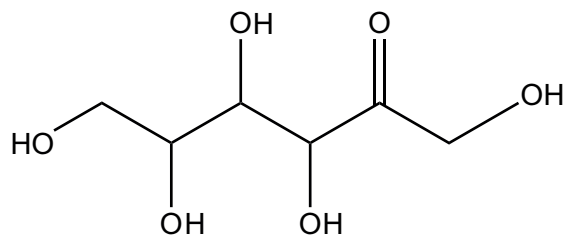
18. What is the identity of the alcohol with the molecular formula C_4H_9OH , with four peaks in the ratio 6:2:1:1 in its ^1H NMR spectrum?
- A. Butan-1-ol
 - B. Butan-2-ol
 - C. 2-methylpropan-1-ol
 - D. 2-methylpropan-2-ol

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Turn over

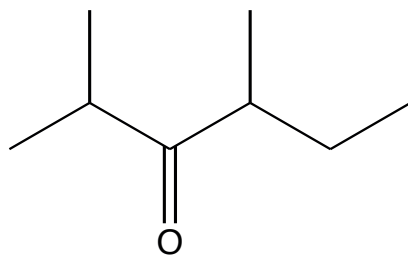
2225-0213

19. How many chiral centres are there in the following molecule?



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

13. What is the IUPAC name of the molecule below?



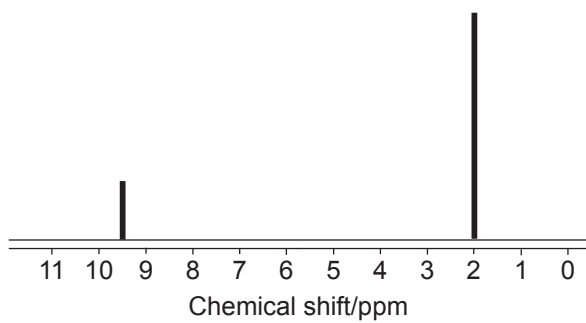
- A. 2-ethyl-4-methylpentan-3-one
- B. 4-ethyl-2-methylpentan-3-one
- C. 2,4-dimethylhexan-3-one
- D. 3,5-dimethylhexan-4-one

17. Which molecule contains a chiral centre?

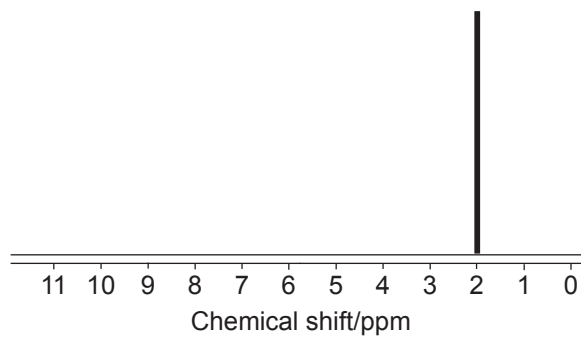
- A. $\text{CH}_3\text{CH}(\text{CH}_3)\text{CHO}$
- B. $\text{CH}_3\text{CHClCH}_2\text{CH}_3$
- C. $\text{CH}_3\text{C}(\text{CH}_3)_2\text{OH}$
- D. $\text{ClCH}_2\text{CH}_2\text{COOH}$

18. What is the low-resolution ^1H NMR spectrum of ethanal?

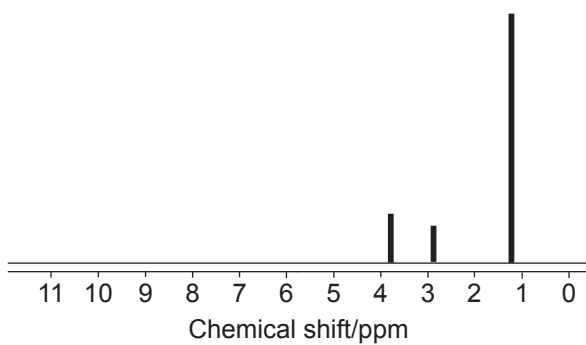
A.



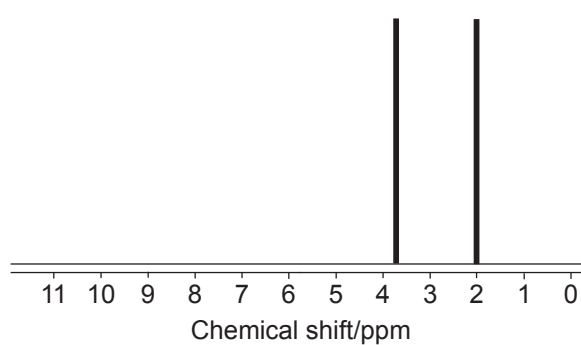
B.



C.



D.



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0020-0207

19. Which pair of compounds represents the correct type of isomerism?

Type of isomerism	Pair of compounds
A. Chain	$\text{H}_3\text{C}-\text{CH}_2-\text{CH}_2-\text{CH}_3$ and $\begin{array}{c} \text{CH}_3 \\ \\ \text{H}_2\text{C}-\text{CH}_2 \\ \\ \text{CH}_3 \end{array}$
B. Functional group	$\text{H}_3\text{C}-\text{O}-\text{CH}_2-\text{CH}_2-\text{CH}_3$ and $\begin{array}{c} \text{OH} \\ \\ \text{H}_3\text{C}-\text{CH}-\text{CH}_2-\text{CH}_3 \end{array}$
C. Positional	$\text{H}_3\text{C}-\text{O}-\overset{\text{O}}{\parallel}{\text{C}}-\text{CH}_2-\text{CH}_3$ and $\text{H}-\text{O}-\overset{\text{O}}{\parallel}{\text{C}}-\text{CH}_2-\text{CH}_2-\text{CH}_3$
D. <i>Cis-trans</i>	$\begin{array}{c} \text{H} \quad \text{H} \\ \diagdown \quad \diagup \\ \text{C}=\text{C} \\ \diagup \quad \diagdown \\ \text{H}_3\text{C} \quad \text{CH}_3 \end{array}$ and $\begin{array}{c} \text{H}_3\text{C} \quad \text{H} \\ \diagdown \quad \diagup \\ \text{C}=\text{C} \\ \diagup \quad \diagdown \\ \text{H}_3\text{C} \quad \text{H} \end{array}$

17. Which compounds could exist as stereoisomers?

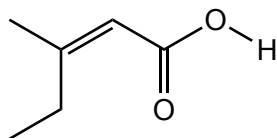
- I. CH_2CClBr
- II. CHBrICl
- III. CHBrCClBr

- A. I and II only
- B. I and III only
- C. II and III only
- D. I, II and III

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0025-0215

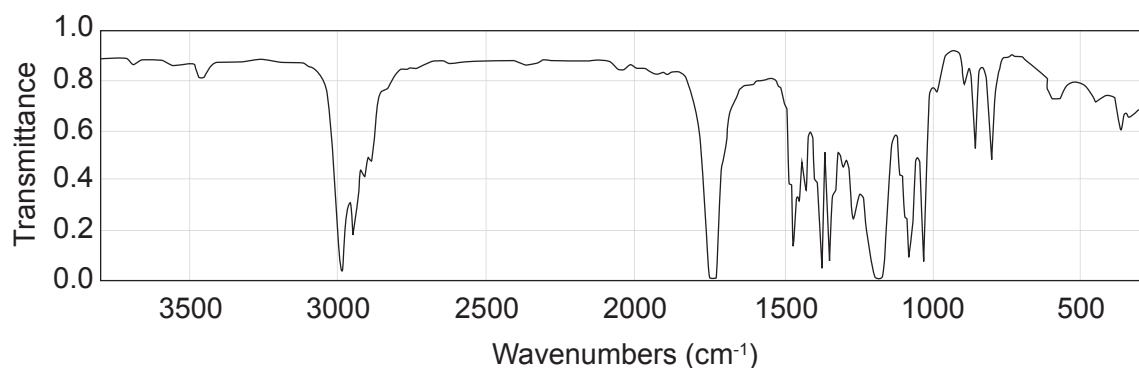
18. What is the IUPAC name of this compound?



- A. 3-methylpent-2-enoic acid
- B. 3-ethylbut-2-enoic acid
- C. 2-ethylbut-2-en-4-oic acid
- D. 2-methylpent-3-en-5-oic acid

4. Another ester was made following a similar reaction sequence.

(a) The infrared spectrum of the final product is shown below.



[Source: Used with permission. © United States of America as represented by the Secretary of Commerce.]

(i) Deduce the identity of two peaks that confirm the product is an ester. Use section 20 of the data booklet. [2]

Peak 1 wavenumber: bond:
 Peak 2 wavenumber: bond:

(ii) Deduce the absorption ranges and the bond(s) responsible for these absorptions that would be present in the IR spectra of alcohols and the carboxylic acids but not in the IR spectrum in part (a). Use section 20 of the data booklet. [1]

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(b) The mass spectrum shows a molecular ion peak with m/z 102.

(i) Deduce the molecular formula of this ester if it contains no multiple C–C bonds or rings. Use section 7 of the data booklet. [2]

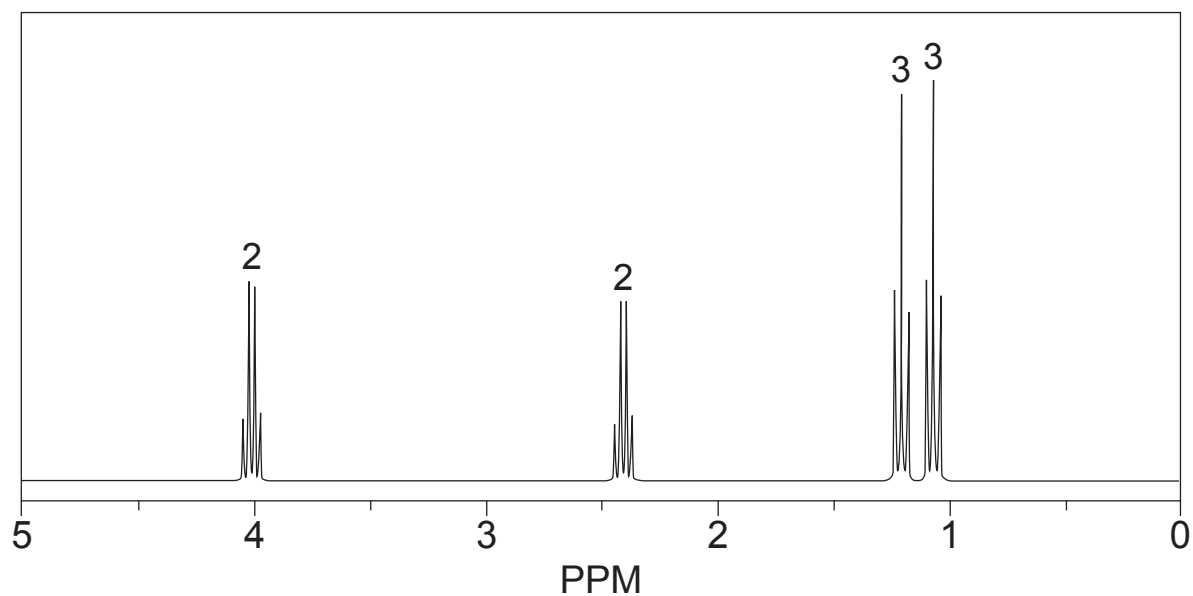
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(This question continues on the following page)



(Question 4 continued)

The high-resolution ^1H NMR spectrum of the ester is shown. The integration is indicated above the signals on the trace.



(ii) Deduce the identity of the ester. Use section 21 on the data booklet.

[1]

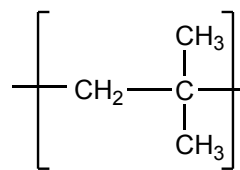
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Turn over

1. What is thin-layer chromatography best used for separating?
- A. molecules of varying polarity
 - B. molecules of similar polarity
 - C. metals in an alloy
 - D. water of crystallization from hydrated salts

12. The structure shows the repeating unit of a polymer found in some plastics.



Which monomer is used to form this plastic?

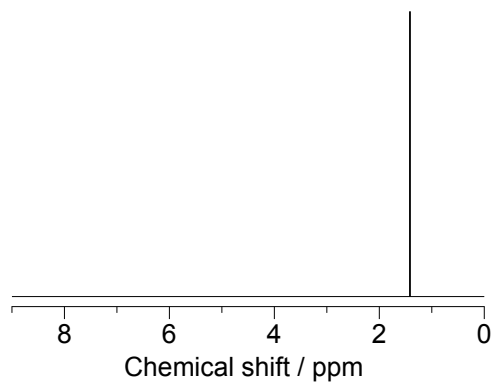
- A. $\text{H}_2\text{C}=\text{C}(\text{CH}_3)_2$
- B. $\text{CH}_3\text{CH}(\text{CH}_3)_2$
- C. $(\text{H}_3\text{C})_2\text{C}=\text{C}(\text{CH}_3)_2$
- D. $(\text{H}_3\text{C})_2\text{C}=\text{CHCH}(\text{CH}_3)_2$

14. Which molecule has a carbonyl functional group?

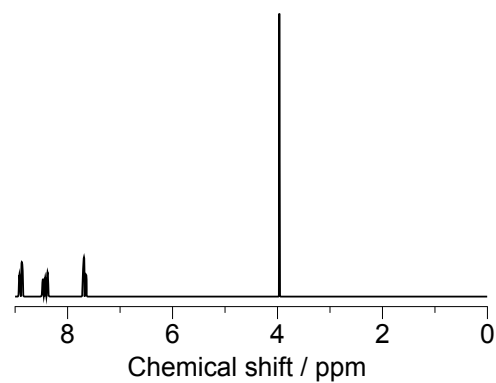
- A. CH_3OCH_3
- B. CH_3COCH_3
- C. $\text{CH}_3\text{CH}_2\text{OH}$
- D. $\text{CH}_3\text{CH}_2\text{NH}_2$

18. Which is the ^1H NMR spectrum of cyclohexane?

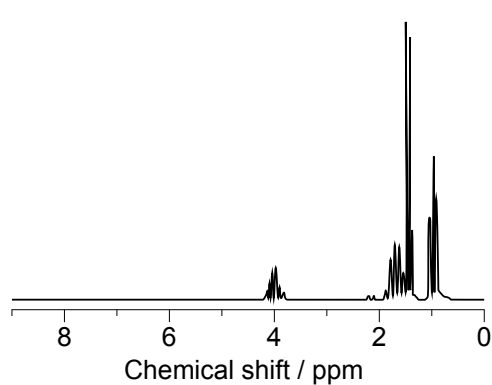
A.



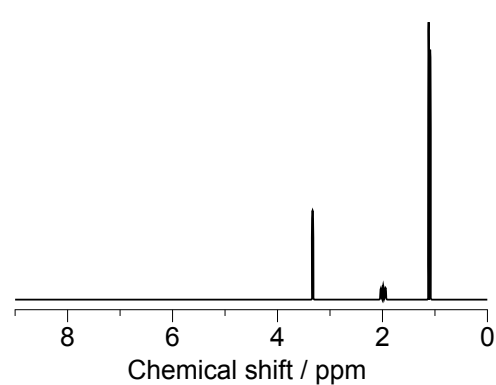
C.



B.



D.



19. Which is the mass spectrum of butanal?

