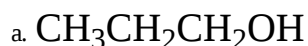


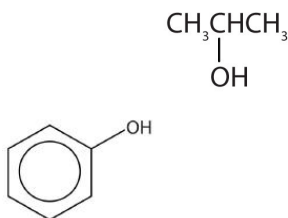
## 3.E: Functional Groups (Exercises)

### Additional Exercises

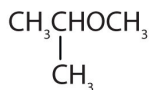
1. Identify each compound as an alcohol, a phenol, or an ether. Classify any alcohols as primary ( $1^\circ$ ), secondary ( $2^\circ$ ), or tertiary ( $3^\circ$ ).



b.

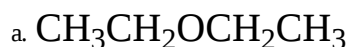


c.

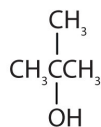


d.

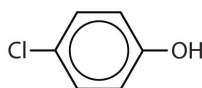
2. Identify each compound as an alcohol, a phenol, or an ether. Classify any alcohols as primary, secondary, or tertiary.



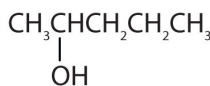
b.



c.



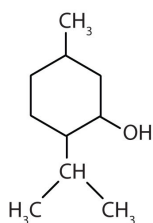
d.



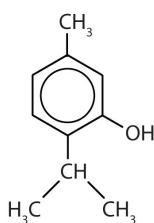
3. In addition to ethanol, the fermentation of grain produces other organic compounds collectively called fusel oils (FO). The four principal FO components are 1-propanol, isobutyl alcohol, 3-methyl-1-butanol, and 2-methyl-1-butanol. Draw a structure for each. (FO is quite toxic and accounts in part for hangovers.)

4. Draw and name the isomeric ethers that have the formula  $\text{C}_5\text{H}_{12}\text{O}$ .

5. Menthol is an ingredient in mentholated cough drops and nasal sprays. It produces a cooling, refreshing sensation when rubbed on the skin and so is used in shaving lotions and cosmetics. Thymol, the aromatic equivalent of menthol, is the flavoring constituent of thyme.

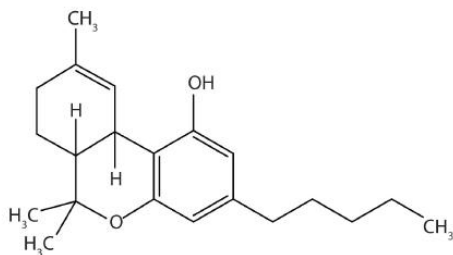


Menthol



Thymol

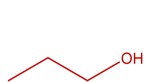
- a. To what class of compounds does each belong?
  - b. Give an alternate name for thymol.
6. The amino acid cysteine has the formula  $\text{HSCH}_2\text{CH}(\text{NH}_2)\text{COOH}$ . What is the sulfur-containing functional group in the cysteine molecule?
  7. The amino acid methionine has the formula  $\text{CH}_3\text{SCH}_2\text{CH}_2\text{CH}(\text{NH}_2)\text{COOH}$ . What is the sulfur-containing functional group in methionine?
  8. Tetrahydrocannabinol is the principal active ingredient in marijuana. What functional groups are present in this molecule?



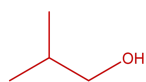
- a. Name each compound.
  - a.  $(\text{CH}_3\text{CH}_2)_3\text{N}$
  - b.  $(\text{CH}_3\text{CH}_2)_2\text{NCH}_3$
10. Draw the structure for each compound.
    - a. dimethylammonium chloride
    - b. anilinium chloride
  11. Name each compound.
    - a.  $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{OCH}_3$
    - b.  $\text{CH}_3\text{CH}_2\text{OCH}_2\text{CH}_2\text{CH}_3$
  12. Draw the structure for each compound.
    - a. methyl ethyl ether
    - b. diisopropyl ether
  13. Draw the structure for each alcohol.
    - a. cyclopentanol
    - b. 4-methyl-2-hexanol
    - c. 4,5-dimethyl-3-heptanol

## Answers

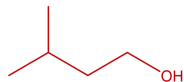
1. a. primary alcohol  
b. secondary alcohol  
c. phenol  
d. ether



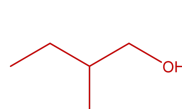
1-propanol



isobutyl alcohol



3-methyl-1-butanol



2-methyl-1-butanol

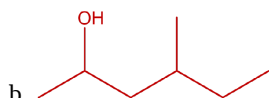
- 3.
5. a. Menthol is a cyclic alcohol (secondary) and thymol is a phenol.  
b. 2-isopropyl-5-methylphenol

## 7. Thioether

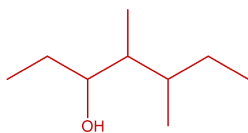
9. a. triethylamine  
b. diethylmethanamine
11. a. butyl methyl ether  
b. ethyl propyl ether



13. a.



- b.



- c.

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