

2010 AP[®] CHEMISTRY FREE-RESPONSE QUESTIONS

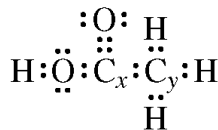
Answer Question 5 and Question 6. The Section II score weighting for these questions is 15 percent each.

Your responses to these questions will be scored on the basis of the accuracy and relevance of the information cited. Explanations should be clear and well organized. Examples and equations may be included in your responses where appropriate. Specific answers are preferable to broad, diffuse responses.

5. Use the information in the table below to respond to the statements and questions that follow. Your answers should be in terms of principles of molecular structure and intermolecular forces.

Compound	Formula	Lewis Electron-Dot Diagram
Ethanethiol	$\text{CH}_3\text{CH}_2\text{SH}$	$\begin{array}{c} \text{H} \quad \text{H} \\ \text{H}:\ddot{\text{C}}:\ddot{\text{C}}:\ddot{\text{S}}:\text{H} \\ \text{H} \quad \text{H} \end{array}$
Ethane	CH_3CH_3	$\begin{array}{c} \text{H} \quad \text{H} \\ \text{H}:\ddot{\text{C}}:\ddot{\text{C}}:\text{H} \\ \text{H} \quad \text{H} \end{array}$
Ethanol	$\text{CH}_3\text{CH}_2\text{OH}$	$\begin{array}{c} \text{H} \quad \text{H} \\ \text{H}:\ddot{\text{C}}:\ddot{\text{C}}:\ddot{\text{O}}:\text{H} \\ \text{H} \quad \text{H} \end{array}$
Ethyne	C_2H_2	

- (a) Draw the complete Lewis electron-dot diagram for ethyne in the appropriate cell in the table above.
- (b) Which of the four molecules contains the shortest carbon-to-carbon bond? Explain.
- (c) A Lewis electron-dot diagram of a molecule of ethanoic acid is given below. The carbon atoms in the molecule are labeled x and y , respectively.



Identify the geometry of the arrangement of atoms bonded to each of the following.

- (i) Carbon x
- (ii) Carbon y
- (d) Energy is required to boil ethanol. Consider the statement “As ethanol boils, energy goes into breaking C–C bonds, C–H bonds, C–O bonds, and O–H bonds.” Is the statement true or false? Justify your answer.
- (e) Identify a compound from the table above that is nonpolar. Justify your answer.
- (f) Ethanol is completely soluble in water, whereas ethanethiol has limited solubility in water. Account for the difference in solubilities between the two compounds in terms of intermolecular forces.