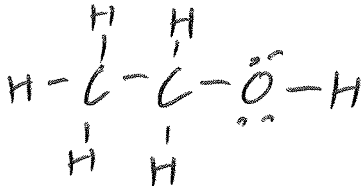
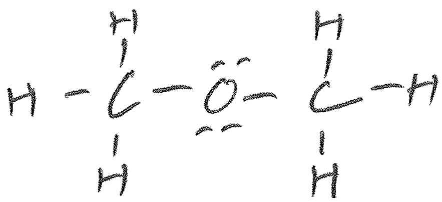
06/21/23

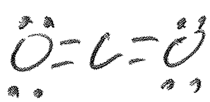
Draw the Lewis structure for ethyl alcohol which has a molecular formula of $C_2H_6O$ and a condensed formula of $CH_3CH_2OH$.



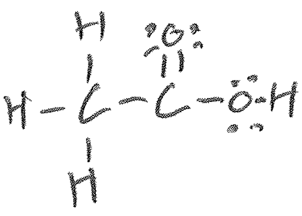
Draw the Lewis structure for acetone which has a molecular formula of $C_2H_6O$ and a condensed formula of $CH_3OCH_3$.



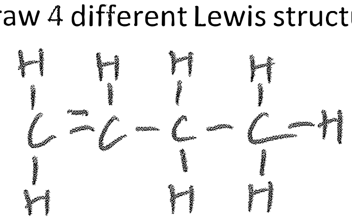
Draw the Lewis structure for carbon dioxide ($CO_2$)

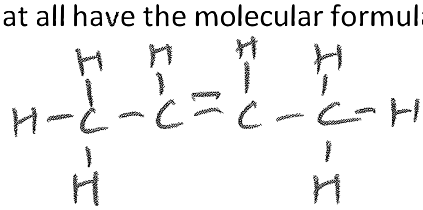


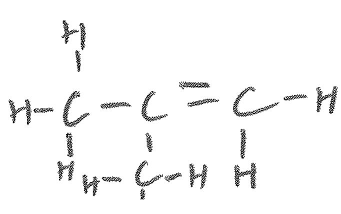
Draw the Lewis structure for acetic acid which has a molecular formula of $C_2H_4O_2$ and a condensed formula of $CH_3COOH$.

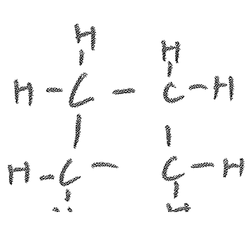


Draw 4 different Lewis structures that all have the molecular formula of $C_4H_8$

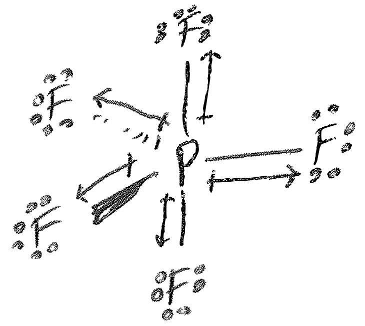






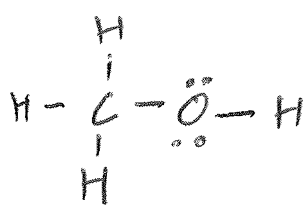


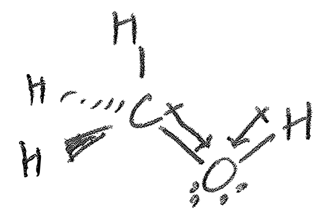
Draw the Lewis structure and then the 3-dimensional structure for the $PF_5$ molecule. Indicate any polar bonds and indicate whether the whole molecule is polar.



molecule is non-polar

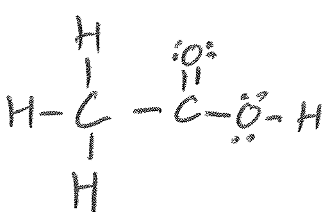
Draw the Lewis structure and then the 3-dimensional structure for the methanol ($CH_3OH$) molecule. Indicate any polar bonds and indicate whether the whole molecule is polar.

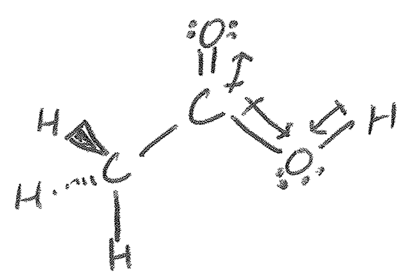




molecule is polar

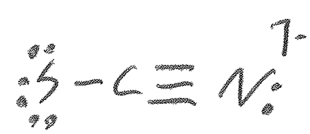
Draw the Lewis structure and then the 3-dimensional structure for the acetic acid ($CH_3COOH$) molecule. Indicate any polar bonds and indicate whether the whole molecule is polar.



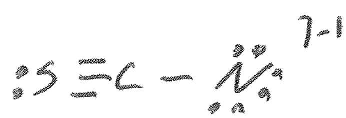


molecule is polar

Draw the possible resonance structures for the thiocyanate ion ($SCN^{-1}$) and use formal charges to decide which one is the best representation of the structure.




-1 0 0




+1 0 -2


0 0 -1

Best b/c fewest nonzero FC and -1 FC on more electroneg atom

Use the table of bond dissociation energies to determine the amount of energy released when 100.0 grams of ethyl alcohol ($CH_3CH_2OH$) is burned. Compare this to the amount of energy released when 100.0g of octane ($C_8H_{18}$) is burned.

$CH_3CH_2OH + 3O_2 \rightarrow 2CO_2 + 3H_2O$

| Break | Make |
| --- | --- |
| 5 C-H | 4 C=O |
| 3 O=O | 6 O-H |
| 1 C-C | |
| 1 C-O | |
| 1 O-H | |

$[(4 \times -745 \frac{kJ}{mol}) + (6 \times -463 \, kJ/mol)] = -5758 \frac{kJ}{mol\,rxn}$ Making

$[(5 \times 413 \frac{kJ}{mol}) + (3 \times 498 \frac{kJ}{mol}) + (1 \times 346 \frac{kJ}{mol}) + (1 \times 358 \frac{kJ}{mol}) + (1 \times 463 \frac{kJ}{mol})]$

$= 4726 \frac{kJ}{mol\,rxn}$ Breaking

$\Delta H = -1032 \frac{kJ}{mol\,rxn}$

$100.0g \, C_2H_6O \times \frac{1\,mol}{46g} \times \frac{-1032\,kJ}{mol} = -2243\,kJ$

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$C_8H_{18} + \frac{25}{2}O_2 \rightarrow 8CO_2 + 9H_2O$

| Break | Make |
| --- | --- |
| 18 C-H | 16 C=O |
| 7 C-C | 18 O-H |
| $\frac{25}{2}$ O=O | |

$[(16 \times -745 \frac{kJ}{mol}) + (18 \times -463 \frac{kJ}{mol})] = -20254 \frac{kJ}{mol\,rxn}$ Making

$[(18 \times 413\,kJ/mol) + (7 \times 346\,kJ/mol) + (12.5 \times 498 \frac{kJ}{mol})] = 16081 \frac{kJ}{mol\,rxn}$ Breaking

$\Delta H = -4173\,kJ/mol\,rxn$

$100.0g \, C_8H_{18} \times \frac{1\,mol}{114g} \times \frac{-4173\,kJ}{mol} = -3660\,kJ$

Ethyl alcohol is used as a fuel additive in gasoline (which is pretty much just octane). The density of ethyl alcohol is 0.79 g/cm$^3$ and the density of octane is 0.70 g/cm$^3$. Is an ethanol/gasoline mixture a better fuel than just pure gasoline? Explain.

Ethanol $\frac{0.79\,g}{cm^3} \times \frac{-2243\,kJ}{100\,g} = -17.72\,kJ/cm^3$

Octane $\frac{0.70\,g}{cm^3} \times \frac{-3660\,kJ}{100\,g} = -25.62\,kJ/cm^3$

Replacing octane w/ equal volume of ethanol decreases energy content of fuel