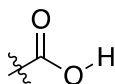


# Molecular Fragments And Functional Groups

## A. Introduction

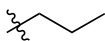
## B. Fragments

a *molecular fragment* connected to something else and *cannot* be isolated.

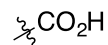


carboxyl

name of fragment

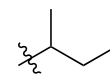


n-propyl

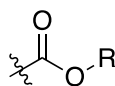


carboxyl

carboxylic acid

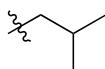


s-butyl

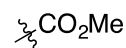


carboxyalkyl

ester



i-butyl

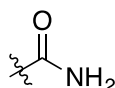


carboxymethyl

ester



i-propyl



carboxamide

amide



t-butyl

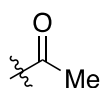


carboxamide

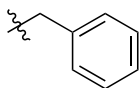
amide



ethyl



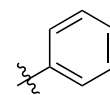
acyl



benzyl



acyl



phenyl



acyl



vinyl



acyl



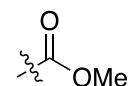
amine



acyl



carbonyl chloride



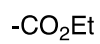
carboxyalkyl

acid chloride

ester



methoxy



carboxyethyl

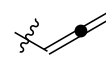
Ac

acyl

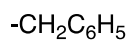
Bn



nitro



allene



benzyl



phenyl



acyl



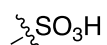
phenyl



methoxy



cyano or nitrile



sulfonic acid



epoxide



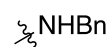
sulfonyl chloride



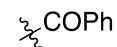
acetyl



phenoxy

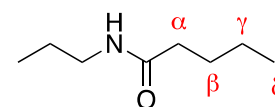
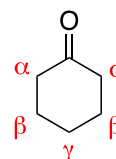
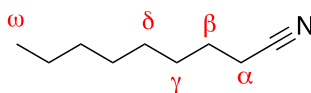
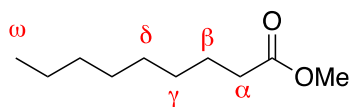


benzylamine



acyl

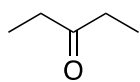
benzoyl



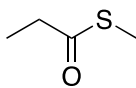
$\omega$  is last,  $\delta$  is more specific

In Greek,  $\omega$  means *last*.

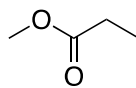
## C. Expanded Forms Of Functional Groups



ketone



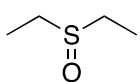
thioester



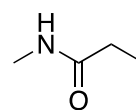
ester



aldehyde



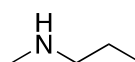
sulfoxide



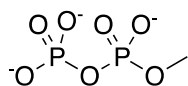
amide



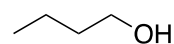
ester



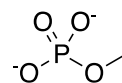
amine



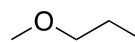
diphosphate



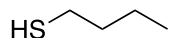
alcohol



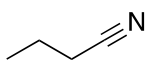
monophosphate



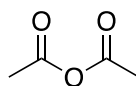
ether



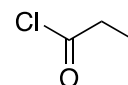
thiol



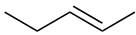
nitrile



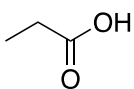
carboxylic acid anhydride



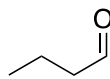
acid chloride



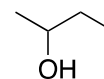
alkene



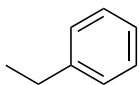
carboxylic acid



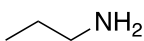
aldehyde



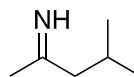
alcohol



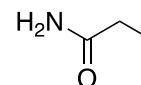
arene



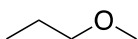
amine



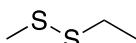
imine



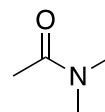
amide



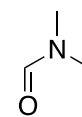
ether



disulfide

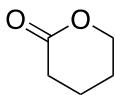


amide



amide

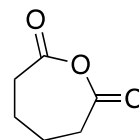
incidentally this is DMF



lactone



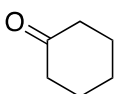
alkene



carboxylic acid anhydride



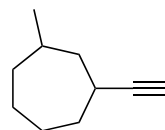
lactam



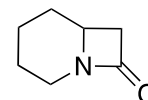
ketone



disulfide



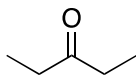
alkyne



lactam

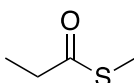
## D. Abbreviated Forms Of Functional Groups

EtCOEt

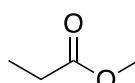


name of functional group  
\_\_\_\_\_ketone\_\_\_\_\_

EtCO(SMe)



name of functional group  
\_\_\_\_\_thioester\_\_\_\_\_

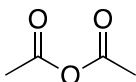
EtCO<sub>2</sub>Me

name of functional group  
\_\_\_\_\_ester\_\_\_\_\_

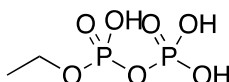
EtCOH



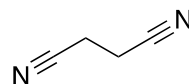
name of functional group  
\_\_\_\_\_aldehyde\_\_\_\_\_

MeCO<sub>2</sub>COMe

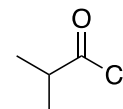
name of functional group  
\_\_\_\_\_carboxylic acid anhydride\_\_\_\_\_

EtOP(O)(OH)OP(O)(OH)<sub>2</sub>

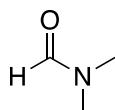
name of functional group  
\_\_\_\_\_diphosphate\_\_\_\_\_

NCCH<sub>2</sub>CH<sub>2</sub>CN

name of functional group  
\_\_\_\_\_nitrile\_\_\_\_\_

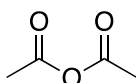
(CH<sub>3</sub>)<sub>2</sub>CHCOCl

name of functional group  
\_\_\_\_\_acid chloride\_\_\_\_\_

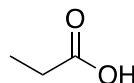
HCONMe<sub>2</sub>

name of functional group  
\_\_\_\_\_amide\_\_\_\_\_

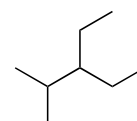
MeCOOCOMe



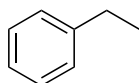
name of functional group  
\_\_\_\_\_carboxylic acid anhydride\_\_\_\_\_

CH<sub>3</sub>CH<sub>2</sub>CO<sub>2</sub>H

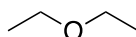
name of functional group  
\_\_\_\_\_carboxylic acid\_\_\_\_\_

(CH<sub>3</sub>)<sub>2</sub>CHCH(CH<sub>2</sub>CH<sub>3</sub>)<sub>2</sub>

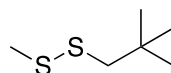
name of functional group  
\_\_\_\_\_alkane\_\_\_\_\_

C<sub>6</sub>H<sub>5</sub>CH<sub>2</sub>CH<sub>3</sub>

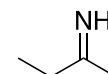
name of functional group  
\_\_\_\_\_arene\_\_\_\_\_

CH<sub>3</sub>CH<sub>2</sub>OCH<sub>2</sub>CH<sub>3</sub>

name of functional group  
\_\_\_\_\_ether\_\_\_\_\_

CH<sub>3</sub>S<sub>2</sub>CH<sub>2</sub>C(CH<sub>3</sub>)<sub>3</sub>

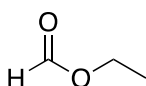
name of functional group  
\_\_\_\_\_disulfide\_\_\_\_\_

CH<sub>3</sub>CH<sub>2</sub>CNHCH<sub>3</sub>

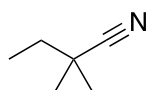
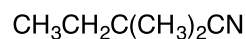
name of functional group  
\_\_\_\_\_imine\_\_\_\_\_



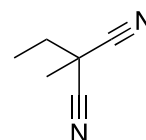
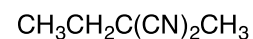
name of functional group  
 \_\_\_\_\_sulfoxide\_\_\_\_\_



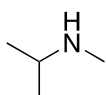
name of functional group  
 \_\_\_\_\_ester\_\_\_\_\_



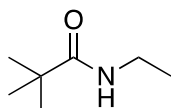
name of functional group  
 \_\_\_\_\_nitrile\_\_\_\_\_



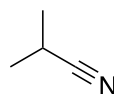
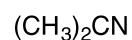
name of functional group  
 \_\_\_\_\_nitrile\_\_\_\_\_



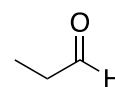
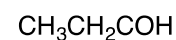
name of functional group  
 \_\_\_\_\_amine\_\_\_\_\_



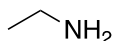
name of functional group  
 \_\_\_\_\_amide\_\_\_\_\_



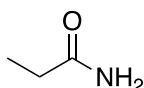
name of functional group  
 \_\_\_\_\_nitrile\_\_\_\_\_



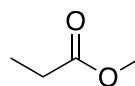
name of functional group  
 \_\_\_\_\_aldehyde\_\_\_\_\_



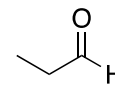
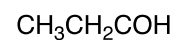
name of functional group  
 \_\_\_\_\_amine\_\_\_\_\_



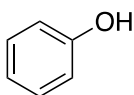
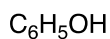
name of functional group  
 \_\_\_\_\_amide\_\_\_\_\_



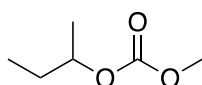
name of functional group  
 \_\_\_\_\_ester\_\_\_\_\_



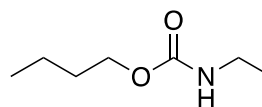
name of functional group  
 \_\_\_\_\_aldehyde\_\_\_\_\_



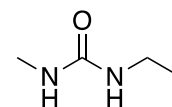
name of functional group  
 \_\_\_\_\_phenol\_\_\_\_\_



name of functional group  
 \_\_\_\_\_carbonate\_\_\_\_\_

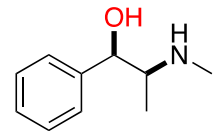
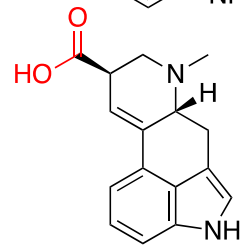
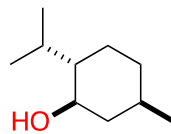
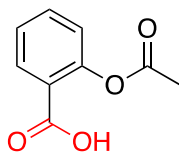
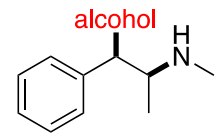
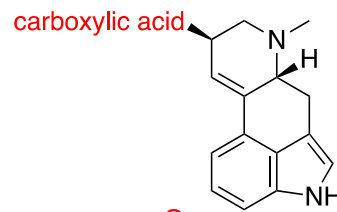
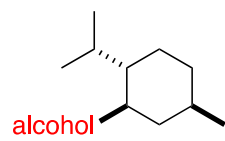
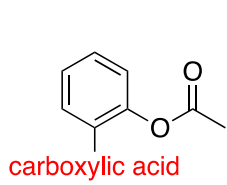


name of functional group  
 \_\_\_\_\_carbamate\_\_\_\_\_



name of functional group  
 \_\_\_\_\_urea\_\_\_\_\_

Find this question hard? Remember: go to the web and to figure out the answers for the maximum benefit (do not look at a key!).

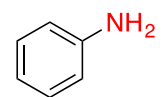
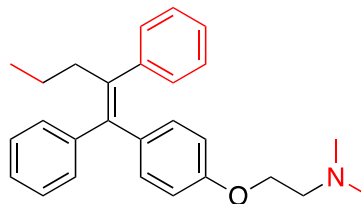
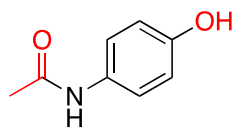
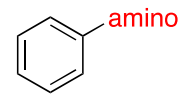
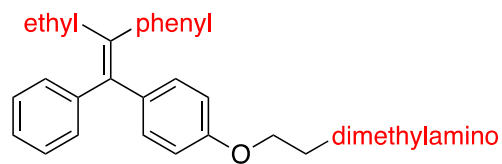
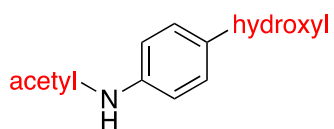


*aspirin*

*menthol*

*lysergic acid (LSD)*

*ephedrine*

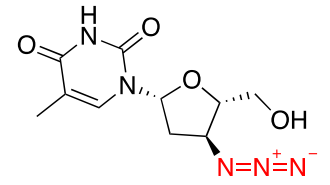
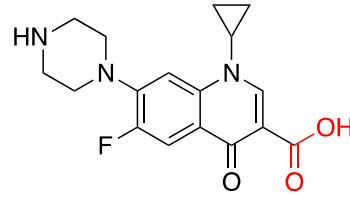
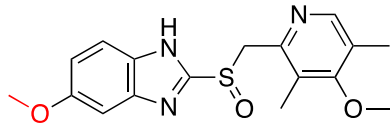
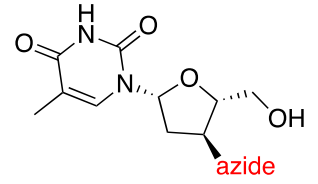
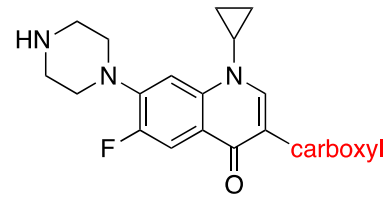
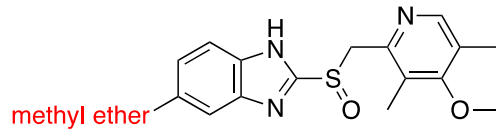


*acetaminophen (tylenol)*

*tamoxifen*

*aniline*

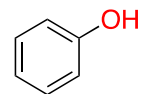
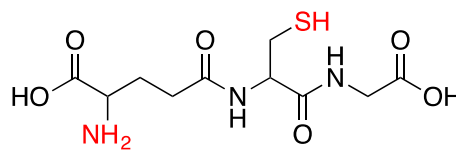
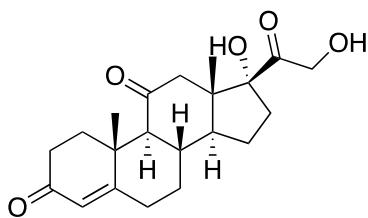
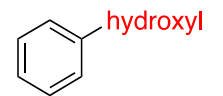
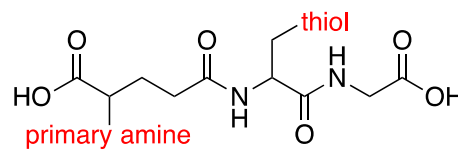
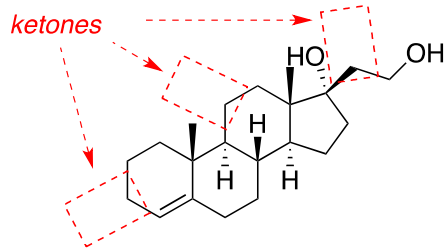




omeprazole

ciprofloxacin "cipro"

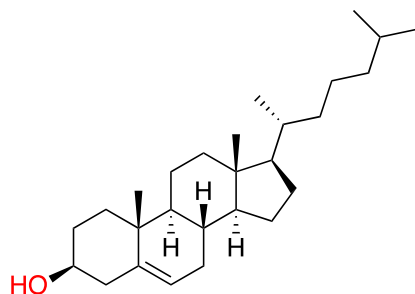
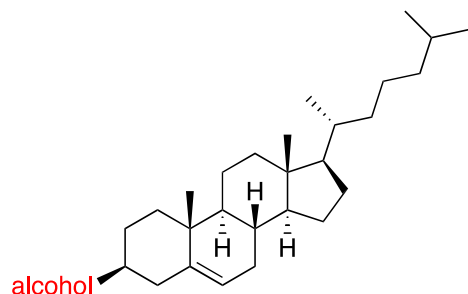
azidothymidine



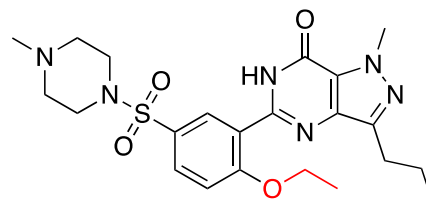
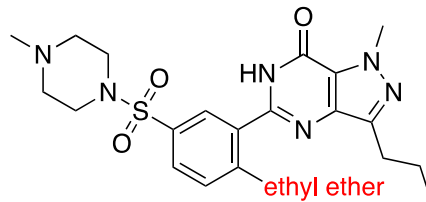
cortisone

glutathione

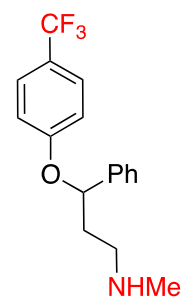
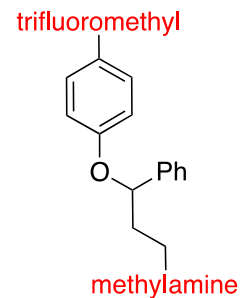
phenol



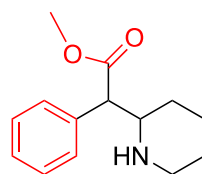
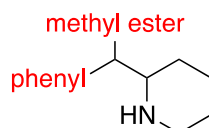

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*cholesterol*


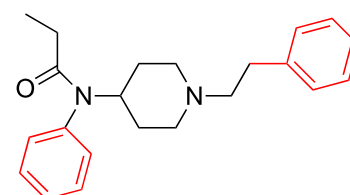
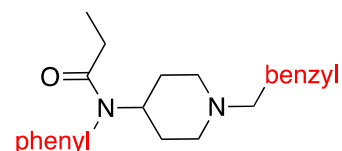

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*viagra*



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*prozac*



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*methylphenidate*


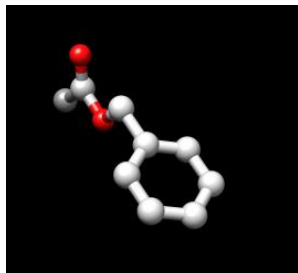

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*fentanyl*

My chemistry instructor might like me to take methylphenidate (other name: **Retalin**) to improve my *attention*.

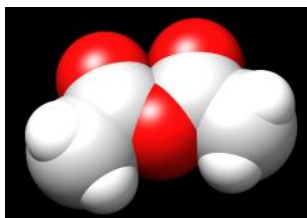
Use molecular models to construct: cyclohexane, cyclopentene, ethyl acetate, acetone, toluene, ethanol, diethyl ether, acetonitrile, ethanal, 2-butyne. Look them up on the web (eg Google images or Wiki) if you do not know the structures of these molecules. Pay attention to the hybridization state of each atom and make sure the geometries in your model correspond. In models, carbon is black, hydrogen is **white**, oxygen is **red**, nitrogen is **blue**, halogens are **green**, and sulfur is **yellow**.

Make models of the following compounds and draw their structures below without using C or H. Some of the structures are labeled so you can do a web-search if you need help. Can you name any of the functional groups?



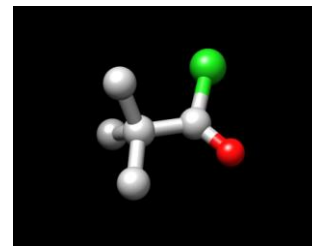
ester, phenyl

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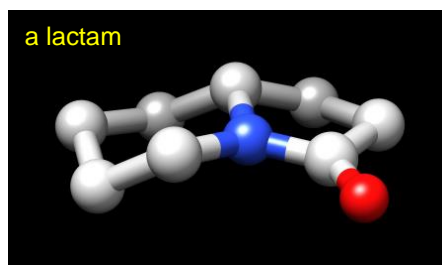
carboxylic acid anhydride

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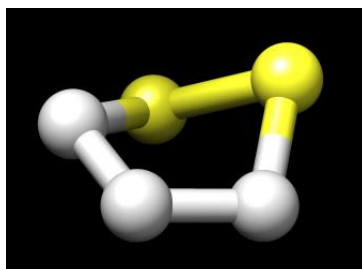
acid halide

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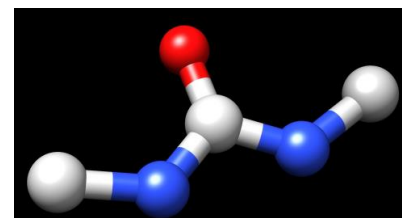
lactam (amide)

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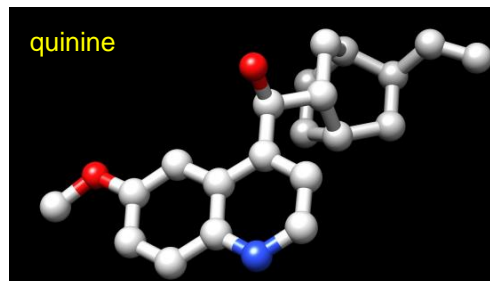
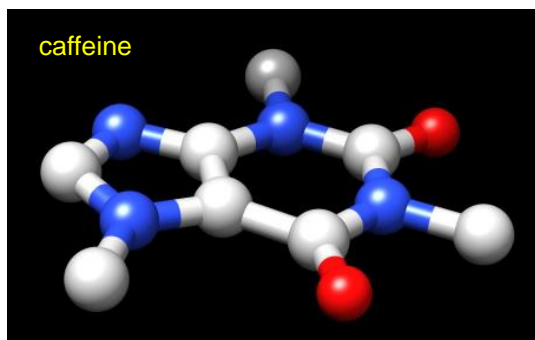
disulfide

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amide (urea)

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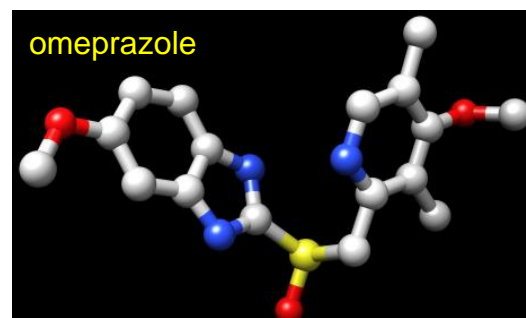
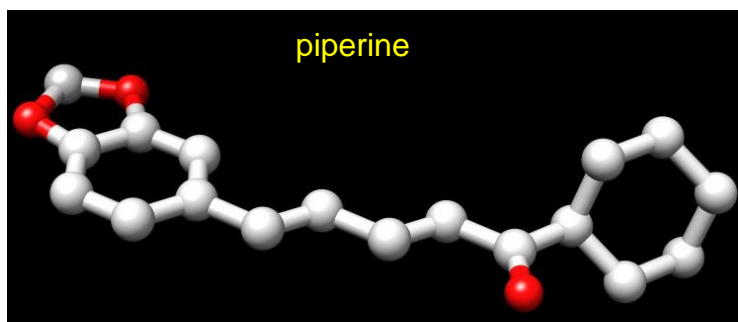


amide, arene (aromatic)

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ether, arene, alcohol, alkene

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ether, arene, alkene, amide

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ether, arene, sulfoxide

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