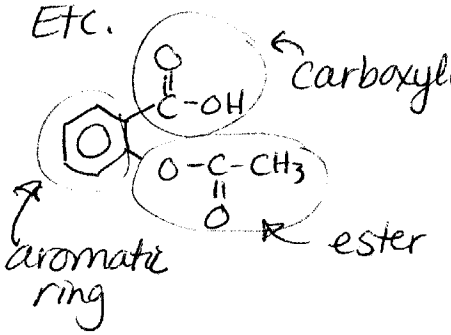
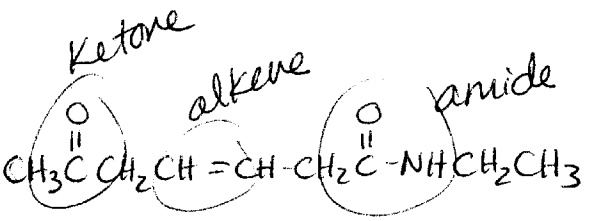
Answers - Organic Chem HW Problems

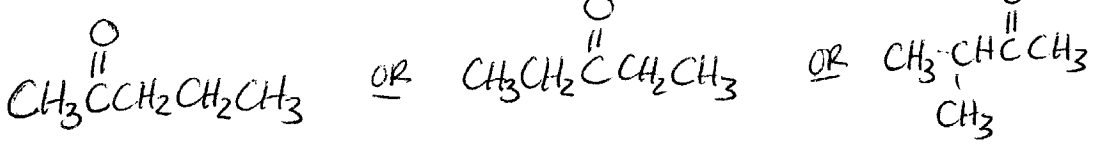
1. Carbon-carbon bonds are very stable (both thermodynamically and kinetically stable). Carbon atoms can form double or triple (or single) bonds. They can form long chains, rings, and branches.
2. Functional groups are specific groupings of atoms. Each functional group reacts in characteristic ways.
3. There are lots of possible ways of telling them apart.
   ① Mix a small amount of the unknown with tap water. If it mixes with the water, it can't be hexane!
   ② Smell the substance. If it has an odor, it's hexane.
   ③ Measure the density. Hexane and water have different densities.
   ④ See if it is flammable. Hexane burns, water doesn't.

   Etc.

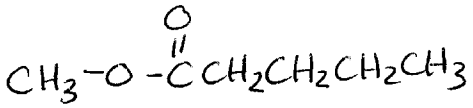
4. 



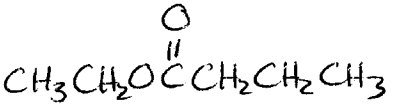
5. a. $C_5H_{10}O$ Ketone



5b. $C_6H_{12}O_2$ ester

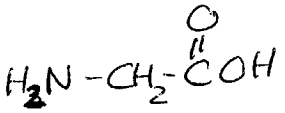


OR

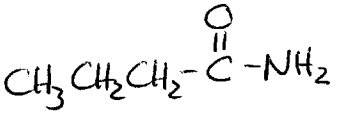


etc. (there are more possibilities)

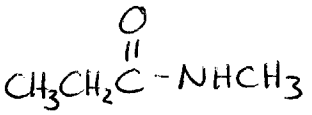
c. $C_2H_3NO_2$ amine, carboxylic acid



d. amide C_4H_7NO



OR



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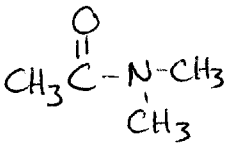
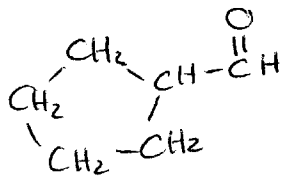
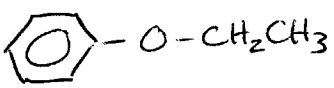


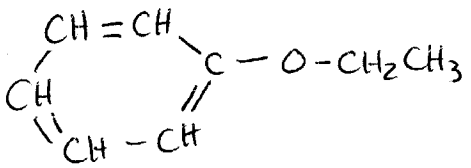
etc.

e. aldehyde w/ring and $C_6H_{10}O$

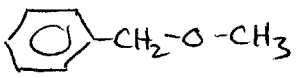


f. aromatic ether $C_8H_{10}O$ same →

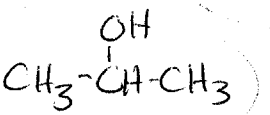




or



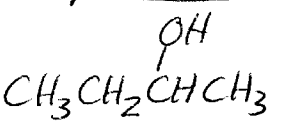
6. C_3H_8O $CH_3CH_2CH_2OH$

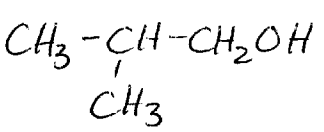


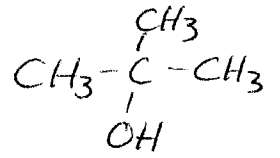
$CH_3-O-CH_2CH_3$

7. a. alcohols $C_4H_{10}O$ (4 possibilities)

$CH_3CH_2CH_2CH_2OH$

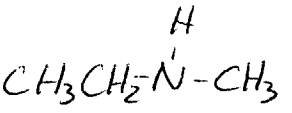


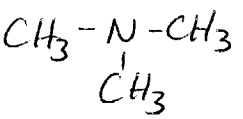


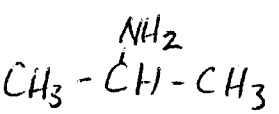


b. amines C_3H_9N (4 possibilities)

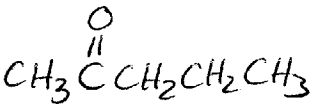
$CH_3CH_2CH_2NH_2$

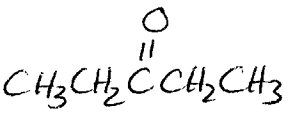


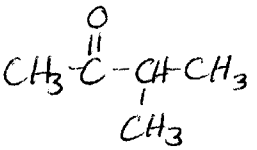




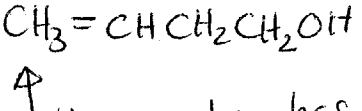
c. Ketones $C_5H_{10}O$ (3 possibilities)



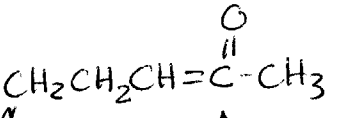




8. What's wrong?

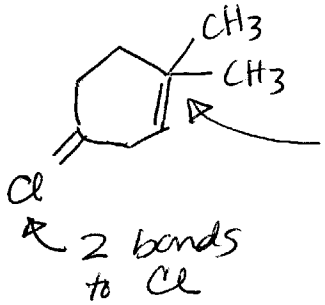


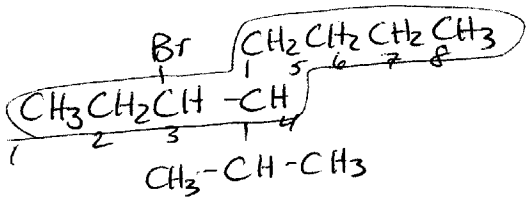
this carbon has 5 bonds - impossible.



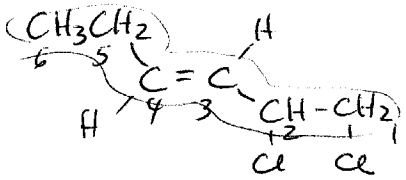
3 bonds to carbon

5 bonds to carbon

8. 

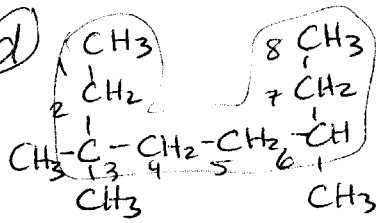
9. (A) 

3-bromo-4-isopropyloctane

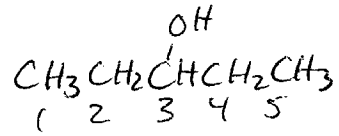
(B) 

trans-1,2-dichloro-3-hexene

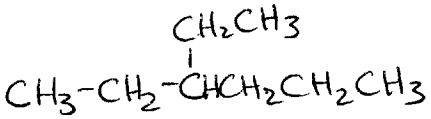
(C)  cyclopentane

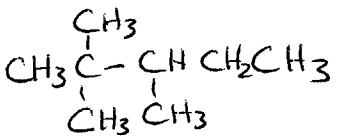
(D) 

3,3,6-trimethyloctane

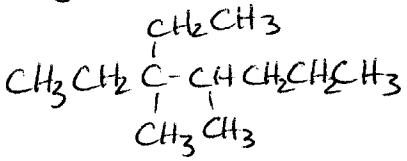
(E) 

3-pentanol

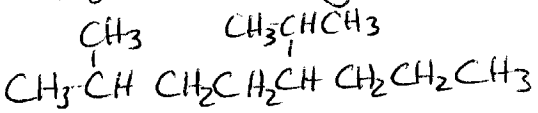
10. a. 3-ethylhexane 

b. 2,2,3-trimethylpentane 

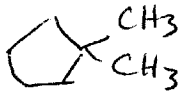
10. c. 3-ethyl-3,4-dimethylheptane



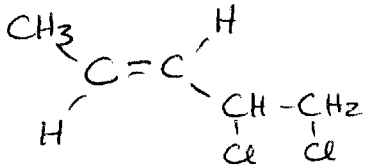
d. 5-isopropyl-2-methyloctane



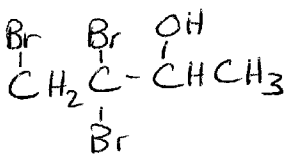
e. 1,1-dimethylcyclopentane



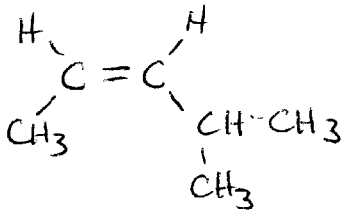
f. trans-4,5-dichloro-2-pentene



g. 3,3,4-tribromo-2-butanol

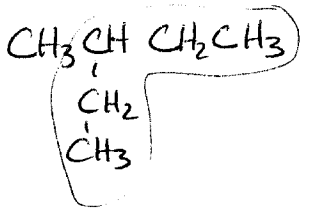


h. cis-4-methyl-2-pentene



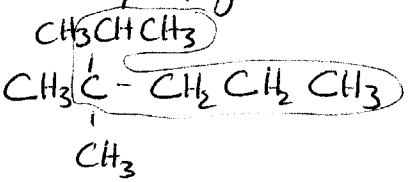
organic

11. a. 2-ethylbutane



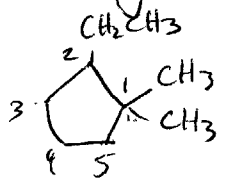
3-methylpentane

b. 2-isopropyl-2-methylpentane



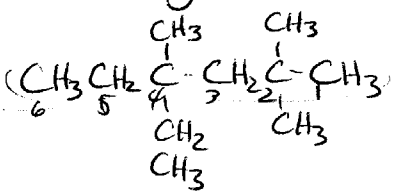
2,3,3-trimethylhexane

c. 5-ethyl-1,1-methylcyclopentane



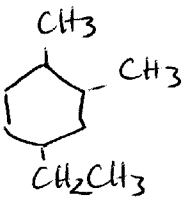
2-ethyl-1,1-dimethylcyclopentane

d. 3-ethyl-3,5,5-trimethylhexane



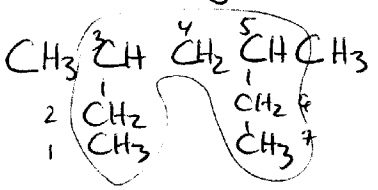
4-ethyl-2,2,4-trimethylhexane

X e. 1,2-dimethyl-4-ethylcyclohexane



nothing wrong with this name.

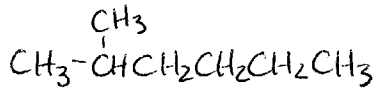
f. 2,4-diethylpentane

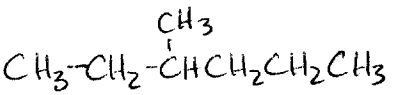


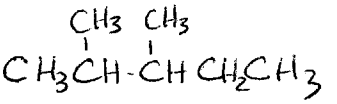
3,5-dimethylheptane

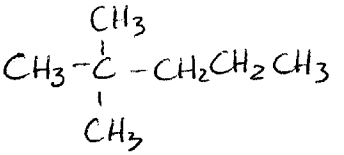
organic

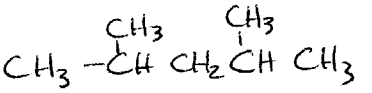
12. C_7H_{16} $CH_3CH_2CH_2CH_2CH_2CH_2CH_3$ heptane

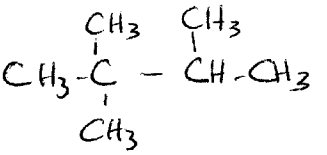

2-methylhexane

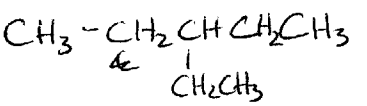

3-methylhexane

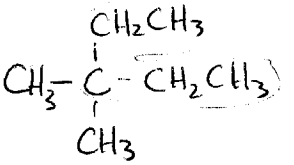

2,3-dimethylpentane


2,2-dimethylpentane


2,4-dimethylpentane

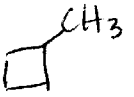

2,2,3-trimethylbutane


3-ethylpentane

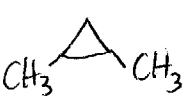

3,3-dimethylpentane

13. C_5H_{10}


cyclopentane


methylcyclobutane


ethylcyclopropane


1,2-dimethylcyclopropane


1,1-dimethylcyclopropane

14. Cyclopropane is unstable because it very strained angles — 60° instead of the normal 109.5°. "ring strain"

15. CH_4 bp = -164°C
CH_3CH_3 bp = -89°C
$C_{16}H_{34}$ bp = +287
} all of these are nonpolar. The only type of intermolecular force they have is London forces. London forces depend on molar mass — higher MM, stronger London forces. Ethane is about twice as heavy as methane, and it's bp is significantly higher. Hexadecane has a much higher MM and a much higher bp than ethane or methane. (Stronger IMF's — harder to separate molecules — higher bp)

16. (A) is polar, (B) is polar and can hydrogen-bond, (C) is nonpolar. They all have very similar molar masses. (so similar London forces)
Lowest bp (C) (A) (B) highest bp
(C): only has London forces
(A): ↑ polar d-d forces
(B): ↑ polar + can H-bond; stronger IMF's overall

17. (C) is least soluble in water, since it is nonpolar.
(A) is polar, but can't H-bond. It will be somewhat soluble in water.
(B) is polar and can hydrogen bond with water. It will be the most soluble in water.

18. Cyclohexane is a nonpolar solvent. Therefore, nonpolar substances will be soluble in

cyclohexane - this will have the opposite order compared to solubility in water.

(B) least soluble - most polar
(A) medium
(C) most soluble - nonpolar

19. (A) MM = 45 g/mol, has London forces, can H-bond
(B) MM = 74 g/mol, London forces stronger than (A), can H-bond
(C) MM = 44 g/mol, only London forces (nonpolar)
(D) MM = 142 g/mol, nonpolar - only London forces, but its London forces are much stronger than any of the other molecules, since its molar mass is ~~over~~ 2x or more the molar mass of the others.

Lowest bp: C, A, B, D highest bp

20. C and D would have approximately equal solubility in water: none. C might be a little more soluble in water, because it is smaller. Both A and B can hydrogen bond, but the hydrocarbon part of B is longer, so it is less soluble in water

lowest solubility in water: D ≈ C, B, A highest solubility in water.

21. The second one should be more soluble in water - it has 3 hydrogen bonding groups, whereas the first one only has one H-bonding group, and a significant hydrocarbon chain.