

Chapter 12

Functional Groups – A Closer Look

Organic Functional Groups Part 5 – IMFs and H₂O Solubility

Hydrophilic

Hydrophobic

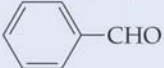

H-bond donors

vs

H-bond acceptors

Rule of Thumb for predicting water solubility of polar organic compounds

Explain the trend in water solubility shown below.

Structure	Name	Boiling Point (°C)	Water Solubility (g/100 mL H ₂ O)
HCHO	Formaldehyde	-21	55
CH ₃ CHO	Acetaldehyde	21	Soluble
CH ₃ CH ₂ CHO	Propanal	49	16
CH ₃ CH ₂ CH ₂ CHO	Butanal	76	7
CH ₃ CH ₂ CH ₂ CH ₂ CHO	Pentanal	103	1
	Benzaldehyde	178	0.3
CH ₃ COCH ₃	Acetone	56	Soluble
CH ₃ CH ₂ COCH ₃	2-Butanone	80	26
CH ₃ CH ₂ CH ₂ COCH ₃	2-Pentanone	102	6
	Cyclohexanone	156	2

Both THF and diethyl ether have 4 carbon atoms. THF is water soluble while diethyl ether is NOT water soluble. Explain this difference.



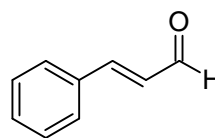
THF

Predict whether you the following compounds would be soluble in oil or water.

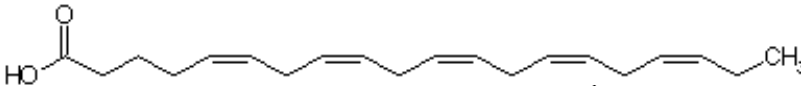
_____ ethanol ($\text{CH}_3\text{CH}_2\text{OH}$)

_____ hexane (C_6H_{14})

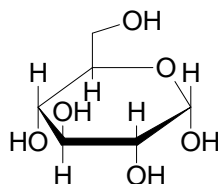
_____ cinnamaldehyde



_____ 1-octanol

_____ 
EPA – eicosapentaenoic acid

_____ glucose



Organic Functional Groups Part 6 – IMFs and Relative Boiling Points

What is the relationship between IMFs and Boiling Points?

Relative strength of IMF's

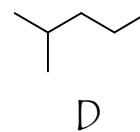
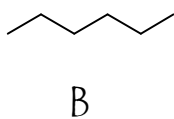
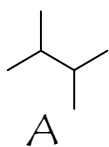
H-bonding

Dipole-dipole

London

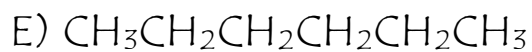
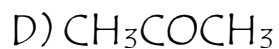
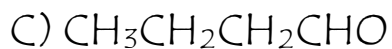
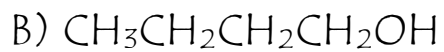
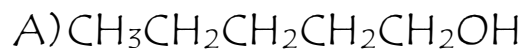
Tie Breakers – Other factors affecting boiling points (bp's)

Arrange the following compounds in order of decreasing bp.



What is the relationship between cpds A – D above?

Which compound has the **highest** boiling point?



Arrange the compounds above in order of decreasing boiling point.

Organic Functional Groups Part 7 – Combustion Reactions

Combustion Reactions: any reaction in which an organic compound reacts completely with oxygen to produce carbon dioxide and water.

Our cells burn sugars and fats as source of energy.



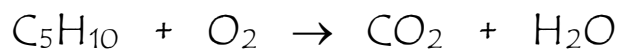
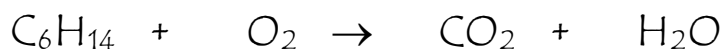
Balancing Combustion Reactions – a strategy

Step 1

Step 2

Step 3

Step 4



Organic Functional Groups Part 8

Carboxylic Acids: Acid-Base Chemistry & Its Effects on H₂O Solubility

Carboxylic acids can lose a proton to form Carboxylate ions.

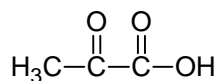
Why is H⁺ often referred to as a proton?

To name the carboxylate ions, replace the 'ic acid' with 'ate'.

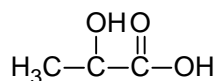
Draw the skeletal line structures and name the resulting carboxylates for the compounds below.

<u>Compound</u>	<u>Carboxylic Acid</u>	<u>Carboxylate w/ Name</u>
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Pyruvic acid



Lactic acid



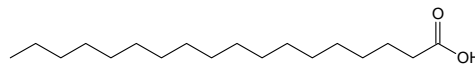
Carboxylates can form H₂O soluble salts with Na⁺ and K⁺ ions.

Draw the skeletal line structure for potassium propanoate.

Some interesting and useful Carboxylic Acids & the power of charge

Draw the skeletal line structure for stearic acid ($\text{CH}_3(\text{CH}_2)_{16}\text{CO}_2\text{H}$).

Video Lecture Correction: There is 1 carbon missing. Correct structure below.

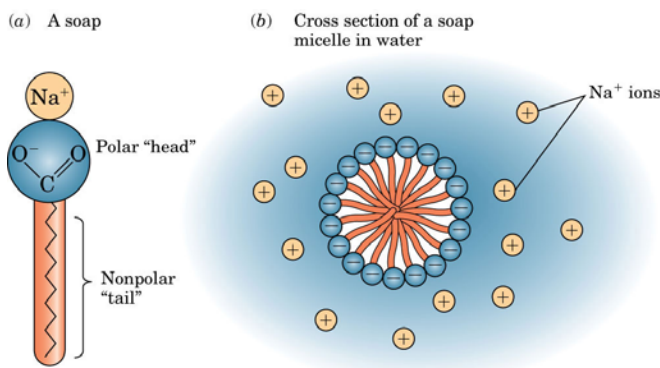


Would you expect this acid to be water soluble? Why?

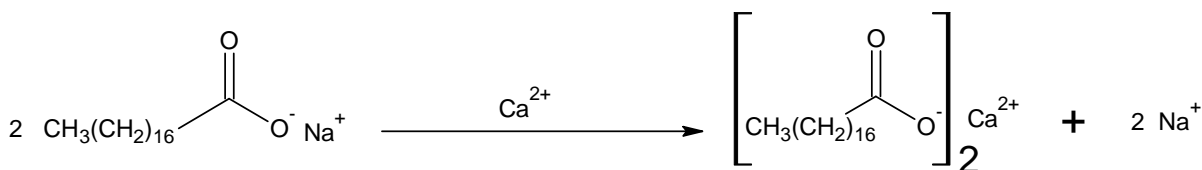
Draw the skeletal line structure for sodium stearate.

Would you expect this carboxylate salt to be water soluble? Why?

Soaps are H_2O soluble carboxylate salts



Soap scum is formed by H_2O insoluble carboxylate salts.



Hard water: water with Ca^{2+} , Mg^{2+} , and Fe^{2+} / Fe^{3+}

Organic Functional Groups Part 9

Amines – Acid Base Chemistry & its Effects on H₂O Solubility

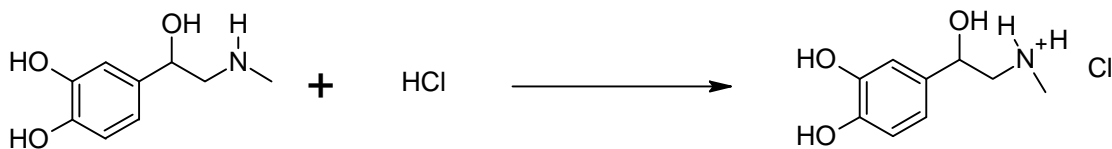
Amines are proton acceptors. Amines are weak bases.

Salts of amines

Useful for storing drugs and other biologically active amines

Why?

- less prone to decomposition
- minimize or reduces fish odor
- soluble in water (syrup & injectables)



Predict the products for the following reactions.

