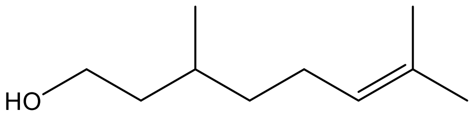
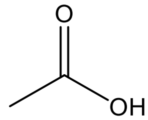
Applying Organic Chemical Reactions to the Perfume Industry

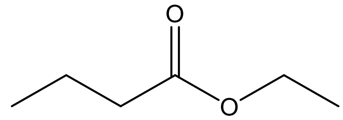
Perfumes have been used for thousands of years, dating back to ancient Egypt, the Roman Empire, Mesopotamia, and the Persian Empire where fragrances were all derived from plant-based sources.[1] Today the perfume industry relies on synthetic organic chemistry to synthesize a diversity of fragrant compounds that can be combined with water and alcohol to create perfumes.[2] When designing perfumes, every company has two main expectations: that their products have a desirable scent and a high tenacity (the scent lasts for a long time after application).

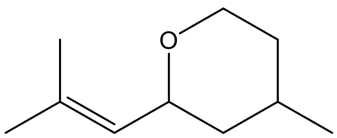
A group of organic chemists have been hired by the *Magical Spring Scents* perfume company to create a new fragrance. The company has provided them with a list of names and structures belonging to a variety of fragrant compounds available in the lab, from which they must choose only one to be the key fragrant ingredient. To narrow your search, begin by studying the 6 chemical compounds listed below which are all known to have a relatively high tenacity. Your task as the organic chemists is to complete each of the chemical equations listed below by matching the reactants to their corresponding product, which will be required for the manufacturing of each potential scent. This will allow you to identify each reaction type along with each product's scent to eliminate those compounds with undesirable scents. Next, you must label the functional groups of each of the remaining compounds with the desirable scents and then arrange them in order of increasing hydrophilicity to determine which scent will have the highest tenacity. Justify your answer by explaining the reasons behind your arrangement (*i.e.* why some compounds are more or less hydrophilic than other compounds) as well as the relationship between tenacity, hydrophilicity, and volatility.

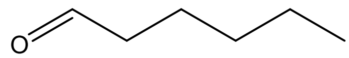
Organic Chemical Compounds

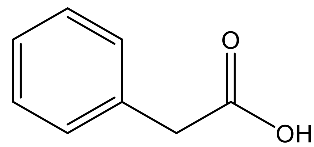

citronellol
logP = 2.82


acetic acid
logP = -0.31


ethyl butyrate
logP = 1.37


rose oxide
logP = 2.37


hexanal
logP = 1.33


phenyl acetic acid
logP = 1.54

Chemical Reactions with their Product's Associated Scent

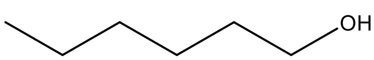
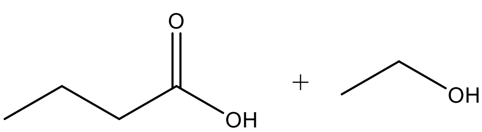
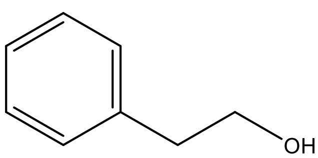
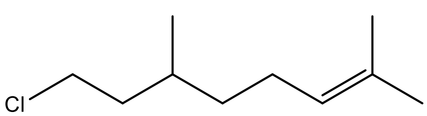
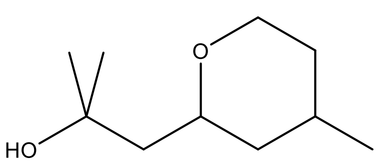
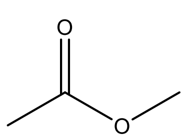
	oxidizing agent →	freshly cut grass scent
	HCl →	pineapple scent
	$KMnO_4$ →	sweet honey scent when dilute, urine scent when concentrated
 + OH^-	→	sweet, lemon scent
	H_2SO_4 → heat	metallic, rose scent
	HCl → H_2O	strong vinegar scent

Table 1. Characterizing chemical equations and identifying their product's scent.

Chemical Equation	Reaction Type	Product's Scent

Eliminated Compounds

1.
2.

Table 2. Identifying functional groups.

Product	Functional groups

Arrangement of Functional Groups by Order of Increasing Hydrophilicity

__________________ < __________________ < __________________ < __________________

Explanation

Based on your arrangement of the functional groups in order of increasing hydrophilicity, will their corresponding compounds have the same arrangement? Explain your answer and give the final arrangement of the compounds in order of increasing hydrophilicity.

__________________ < __________________ < __________________ < __________________

Explanation

Selected Key Fragrant Ingredient

Justification of Final Answer

References

1. Serras, L. The Fascinating History of Perfume, 2019. https://www.fragrancex.com/blog/history-of-perfume-and-cologne/ (accessed Mar 6, 2020).
2. The Chemistry of Perfume. http://www.chemistryislife.com/the-chemistry-of-perfume (accessed Mar 6, 2020).