

SI GOB - Full Discipline Demo

GOB-Synthesis of Fragrant Esters

Final Report - Answer Guide

Institution	Science Interactive University
Session	SI GOB - Full Discipline Demo
Course	SI GOB - Full Discipline Demo
Instructor	Sales SI Demo

Test Your Knowledge

An ester is formed from which two functional groups?

1

⚙ Carboxylic Acid

⚙ Water

⚙ Alcohol

⚙ Amine

Correct answers:

1 Carboxylic Acid Alcohol

Match the IUPAC nomenclature for each ester with the correct alcohol and carboxylic acid combination.

⌘ octyl ethanoate	▶	Ethanol and Butyric Acid	1
⌘ methyl-2-hydroxybenzoate		Octanol and Acetic acid	2
⌘ ethyl butanoate		Methanol and 2-hydroxybenzoic acid	3

Correct answers:

1 ethyl butanoate 2 octyl ethanoate 3 methyl-2-hydroxybenzoate

Classify the following compounds as either soluble or insoluble in water.

Water Soluble	Water Insoluble
1	2

⌘ Acetic Acid

⌘ Ethanol

⌘ Ethyl Acetate

Correct answers:

1 Acetic Acid Ethanol 2 Ethyl Acetate

Exploration

Ethyl acetate has how many hydrogen bond donors?

- ☒ 0 ✓
- ☐ 1
- ☐ 2
- ☐ 3

An ester is more polar than a carboxylic acid.

- ☐ True
- ☒ False ✓

Esterification is a chemical reaction between a carboxylic acid molecule and an alcohol molecule and it forms an ester and water.

- ☒ True ✓
- ☐ False

The IUPAC nomenclature of ethyl butanoate is derived from ethanol and butanoic acid.

- ☒ True ✓
- ☐ False

Exercise 1

Data Table 1: IUPAC Nomenclature of Esters
(SAMPLE ANSWER BELOW)

	IUPAC of Alcohol	IUPAC of Carboxylic acid	IUPAC of Ester
Ester 1	Ethanol	Hexanoic Acid	ethyl hexanoate
Ester 2	Methanol	Benzoic Acid	methyl benzoate
Ester 3	Butanol	Butanoic Acid	butyl butanoate
Ester 4	Hexanol	Ethanoic Acid	Hexyl ethanoate
Ester 5	Pentanol	Butanoic Acid	pentyl butanoate

Exercise 2

What role does sulfuric acid play in the production of the esters in this experiment?

Sulfuric acids play the role of the catalyst in the production of esters.

The active aromatic ester in oranges is octyl ethanoate. Is there any structural difference between the naturally-produced ester in oranges and the ester produced in this exercise?

The esters made in this experiment are not pure, but they could be if needed. Any chemical made in a teaching experiment should never be tasted. That being said, oranges do contain octyl ethanoate and in the experiment we made octyl ethanoate, so structurally they are identical.

Given that ethanol and propanoic acid are soluble in water, was the ester formed when these chemicals reacted soluble in water, based on your experimental results? If yes, explain why, describing the property that would makes it soluble. If no, explain why it would be insoluble and what property makes the ester insoluble.

The ester that would form from ethanol and propanoic acid is ethyl propanoate. That compound has 5 carbons and no hydrogen bond donors. That ester will not be soluble in water because of the lack of hydrogen bond donors.

Perfumes are often made up of a mixture of different esters. Name two reasons that esters would good chemicals to use in perfumes.

Esters make good compounds for perfumes because

- 1) They have a low boiling points, making them volatile
- 2) Most esters have a pleasant aroma, including fruit, mint and flowers.

Data Table 2: IUPAC Nomenclature, Aromas and Solubilities of Synthesized Esters
(SAMPLE ANSWER BELOW)

Alcohol	Carboxylic Acid	IUPAC Ester Name	Aroma	Solubility of ester in water
n-Butanol	Acetic Acid	Butyl ethanoate	Apple	Insoluble
1-Octanol	Acetic Acid	Octyl ethanoate	Orange	Insoluble
Isoamyl alcohol	Acetic Acid	3-methylbutyl ethanoate	Banana	Insoluble
Isobutyl alcohol	Acetic Acid	2-methylpropyl ethanoate	Cherry	Insoluble
denatured Ethanol	Propanoic Acid	ethyl propanoate	Pineapple	Insoluble
Methanol	Salicylic Acid	methyl 2-hydroxybenzoate	Mint	Insoluble

Competency Review

Esters are organic compounds formed by the reaction between ____.

- ☒ carboxylic acids and alcohols
- ☐ alcohols and amines
- ☐ carboxylic acids and water
- ☐ amines and carboxylic acids



Esters will have a lower boiling point than carboxylic acids with the same molecular formula.

- ☒ True
- ☐ False



What is the correct IUPAC name for the ester that forms from ethanol and pentanoic acid?

- ☐ pentyl ethanoate
- ☒ ethyl pentanoate ✓
- ☐ ethyl ethanoate
- ☐ pentyl pentanoate

Esters are soluble in water.

- ☐ True
- ☒ False ✓

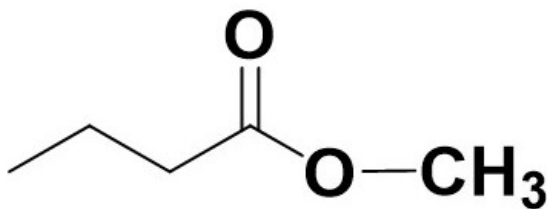
The aroma of esters is associated with ____.

- ☐ Fruit
- ☐ Mint
- ☐ Flowers
- ☒ All of the above ✓

The ester methyl hexanoate could be made by the esterification reaction between ____ and ____.

- ☐ methanol; benzoic acid
- ☐ ethanol; hexanoic acid
- ☒ methanol; hexanoic acid ✓
- ☐ propanol; butanoic acid

For the ester pictured below, the alcohol's IUPAC name component is ____ and the carboxylic acid's IUPAC name component is ____.



- ☐ methyl; propanoate
- ☒ methyl; butanoate
- ☐ butyl; methanoate
- ☐ propyl; ethanoate

✓

Extension Questions

Waxes are esters that are synthesized by plants and animals. These esters are made from fatty acids (a carboxylic acid made up of 10 or more carbons) and alcohols with alkyl chains of eight or more carbons.

a) Do you hypothesize that waxes are soluble or insoluble in water?

b) What property determines a wax's solubility in water?

c) Triacontanyl palmitate is one of the main components of beeswax. Based on the melting point of beeswax, is it a solid or liquid at room temperature (23.0°C)?

(SAMPLE ANSWER BELOW)

A) Waxes are insoluble in water.

B) The long hydrophobic carbon chains make them insoluble as well as the lack of hydrogen bond donors.

C) Beewax has a melting point of 62 to 64 °C, which is higher than room temperature, and would therefore be a solid at room temperature.