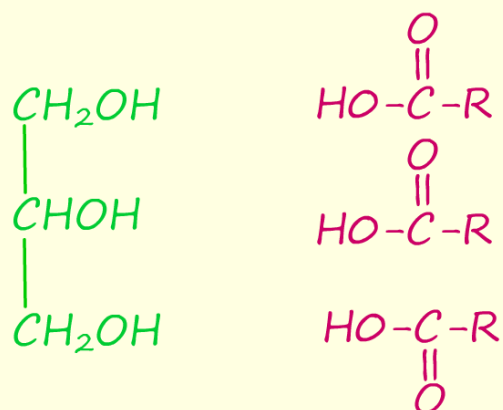


Fats and Oils

Answer all the questions below as fully as you can then check your answers

1. Fats and oils consist of triglyceride molecules. What is a triglyceride?
2. Draw the displayed formula for the triol found in fats and oils?
3. Triglycerides are triesters of what alcohol and what type of carboxylic acid?
- b. Complete the diagram below to show how a triglyceride molecule is formed.

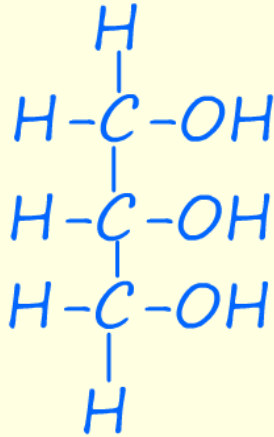


- 3c. Circle the three ester function groups in triglyceride molecule formed.
4. Two of the long chain saturated carboxylic acids found in fats are hexadecanoic (palmatic) and octadecanoic (stearic) acids. Draw the skeletal formula for these two acids.
5. octadec-9-enoic and octadeca-9-12-dienoic acids are two long unsaturated acids found in fats and oils. Draw the skeletal formula for these two unsaturated acids.

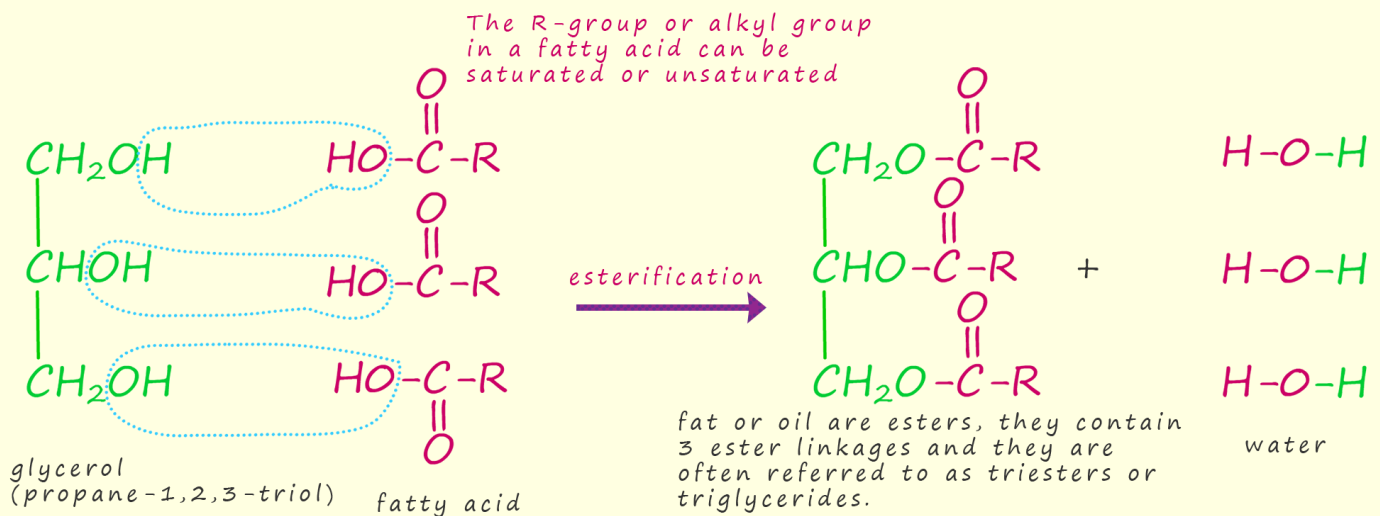
- 5b. Octadec-9-enoic exists as a pair of geometric isomers. Draw and name these two geometric isomers.
- 5c. Which of the isomers is likely to be found in fats and which in an oil? Give a reason for your answer.
6. What is the physical difference between a fat and an oil?
7. Why are some triglycerides fats and some oils?
8. What is a partially unsaturated vegetable oil?
9. What do you understand by the term trans fats and explain how trans forms are formed.

Answers

1. Fats and oils consist of triglyceride molecules. What is a triglyceride?
A triglyceride is an ester or to be specific an triester formed from the alcohol glycerol (propane-1,2,3-triol) and three long chain fatty acid molecules.
2. Draw the displayed formula for the triol found in fats and oils?



3. Triglycerides are triesters of what alcohol and what type of carboxylic acid?
Glycerol or propane-1,2,3-triol and three fatty acid molecules
- b. Complete the diagram below to show how a triglyceride molecule is formed.



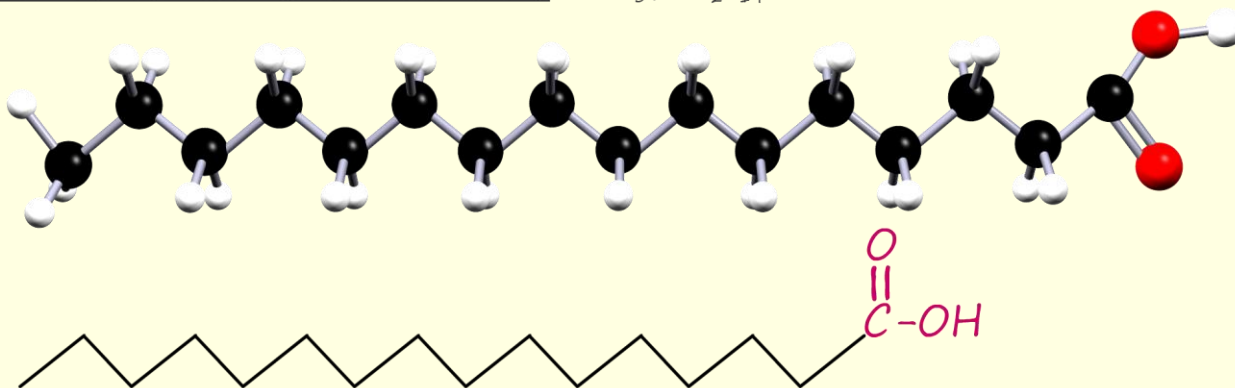
3c. Circle the three ester function groups in triglyceride molecule formed.

See diagram above

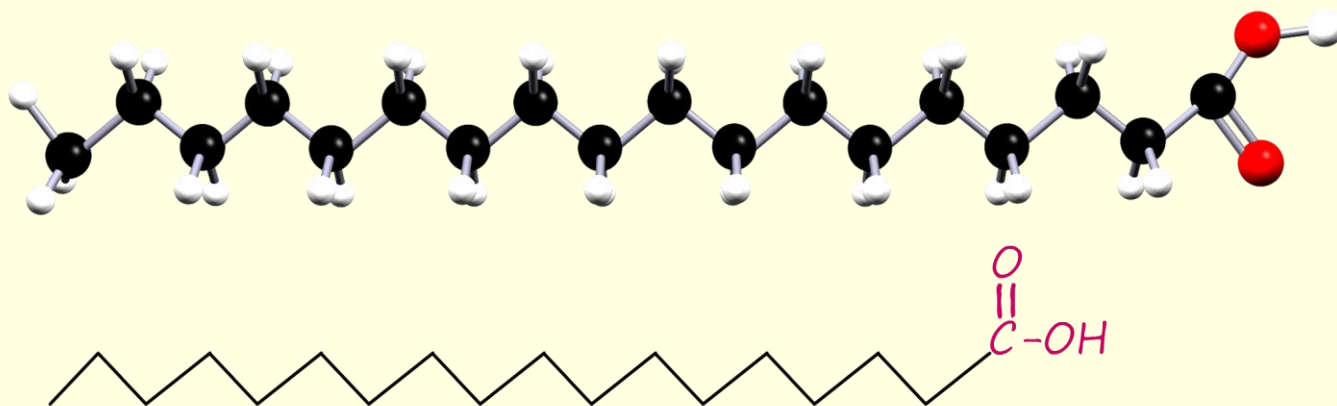
4. Two of the long chain saturated carboxylic acids found in fats are hexadecanoic (palmatic) and octadecanoic (stearic) acids. Draw the skeletal formula for these two acids.

3D model and skeletal formula for stearic and palmatic oil

Hexadecanoic acid (Palmatic acid) - $\text{CH}_3(\text{CH}_2)_{14}\text{COOH}$



Octadecanoic acid (Stearic acid) - $\text{CH}_3(\text{CH}_2)_{16}\text{COOH}$

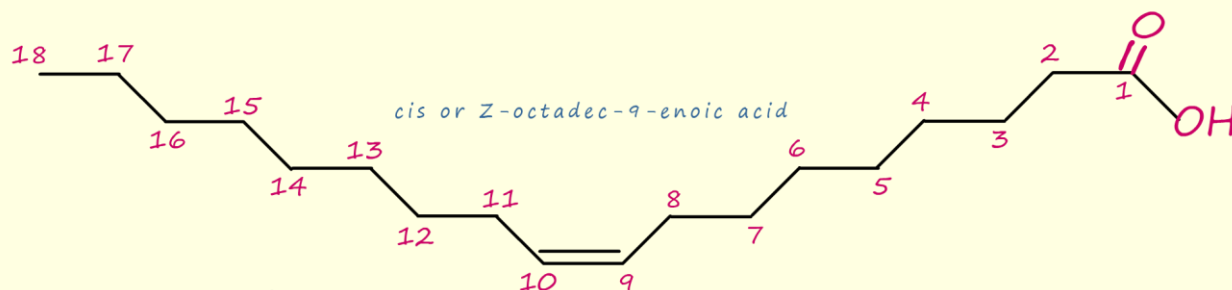
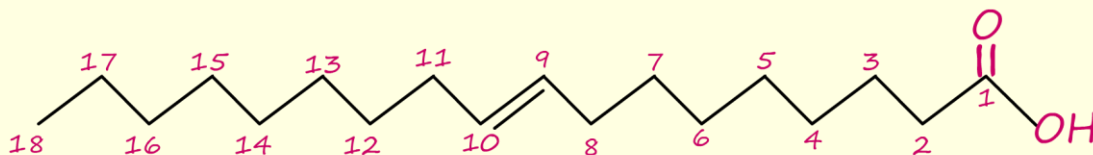


5. octadec-9-enoic and octadeca-9-12-dienoic acids are two long unsaturated acids found in fats and oils. Draw the skeletal formula for these two unsaturated acids.

See diagram below

- 5b. Octadec-9-enoic exists as a pair of geometric isomers. Draw and name these two geometric isomers.

the trans or E-isomer of octadec-9-enoic acid has a more linear shape which will allow the molecules to pack closely together, so it exists as a solid at room temperature.



the cis or Z-isomer of octadec-9-enoic acid has a branch like shape which prevents the molecules from packing as closely together as the trans or E-isomer, so this isomer is a liquid at room temperature.

- 5c. Which of the isomers is likely to be found in fats and which in an oil? Give a reason for your answer.

The E or trans isomer is likely to be found in fats. Fats are solids with higher melting points than oils. The cis or Z-isomer will not allow close packing of the the fatty acids in a triglyceride molecule and reduce intermolecular bonding between molecules, this will lower the melting point and result in a liquid oil.

6. What is the physical difference between a fat and an oil?

Fats are solids at room temperature, oils are liquids.

7. Why are some triglycerides fats and some oils?

The presence of unsaturated fatty acid in the triglyceride molecules will result the lowering of the melting point of the triglyceride molecule, due to the fact that only the cis or Z-isomers of the fatty acids occur naturally. These z-isomers have a branched shape which does not allow for close packing of triglyceride molecules, which results in a reduction in the amount of intermolecular bonding and hence a reduction in the melting point.

Triglyceride molecules where the fatty acids are saturated are likely to be solid fats, since saturated fatty acids have a more linear shape than the unsaturated fatty acids, this allows for more intermolecular bonding and hence a raising of the melting point.

8. What is a partially unsaturated vegetable oil?

Many vegetable oils contain polyunsaturated fatty acids. If during the hardening or hydrogenation of the vegetable oil only some of the C=C are hydrogenated then this results in a partially unsaturated vegetable oil.

9. What do you understand by the term trans fats and explain how trans forms are formed.

Natural unsaturated fatty acids have the cis or Z geometric arrangement. When polyunsaturated fats and oils are hydrogenated some of the sites of unsaturation, that is the carbon carbon double bonds (C=C) are hydrogenated but some of the carbon carbon double bonds (C=C) are left intact. However these C=C which are left intact are altered from the cis or Z isomer to the trans or E-isomer. This the results in fats which are called trans fats.