Physical properties

Fatty acid	Melting point (C^o)	Boiling point (C^o)
Palmitic ($C_{15}H_{31}COOH$)	62.9	351
Palmitoleic ($C_{15}H_{29}COOH$)	-0.1	363
Stearic ($C_{17}H_{35}COOH$)	69.3	359
Oleic($C_{17}H_{33}COOH$)	14	360
Linolenic ($C_{17}H_{29}COOH$)	-11	443

1. Consider the table shown above of the melting and boiling temperatures of chosen fatty acids.
   a. Palmitic acid and oleic acid have similar molar masses, however, their melting points differ significantly. Explain why.

   b. Using palmitic acid and linolenic acid explain what is more significant in determining the melting point of a straight chain, unsaturated, hydrocarbon. Is it carbon-chain length or the number of C=C bonds?

   c. Flash point is the lowest temperature at which vapours forming at the surface of the fuel can be ignited with a flame source. A fuel with a high flash point is safer to store than a fuel with a lower flash point. Using palmitoleic acid, flash point 239^{o}C and oleic acid, flash point 189 ^{o}C, explain which one of the two fatty acids can be used to manufacture a safe biodiesel fuel for northern hemisphere climates.

2. Four hydrocarbons are given below, three with the formula C_8H_{18} and one with the formula C_8H_{16} . Also given are the melting and boiling points of each compound.

Octane (MP -57 ^{o}C, BP 126 ^{o}C)

2,3-dimethylhexane (MP -110 ^{o}C, BP 115 ^{o}C)

2,3,3-trimethylpentane (MP -101 ^{o}C, BP 114 ^{o}C)

Cis-oct-3-ene (MP -94 ^{o}C, BP 121 ^{o}C)

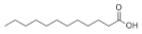
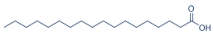
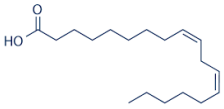
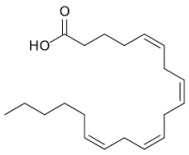
   a. Explain why octane, with the same molar as 2,3-dimethylhexane, has lower melting and boiling temperatures than 2,3-dimethylhexane.

   b. Explain the difference in melting and boiling temperatures between 2,3-dimethylhexane (MP -110 ^{o}C, BP 115 ^{o}C) and 2,3,3-trimethylpentane (MP -101 ^{o}C, BP 114 ^{o}C)

   c. Explain how octane and cis-oct-3-ene have such different melting temperatures.

Physical properties

3. Consider the table below of four fatty acids. Their melting temperatures(MP) and boiling temperatures(BP) at 760 mmHg are given.

Fatty acid	MP (°C)	BP(°C)
Lauric ($C_{12}H_{22}O_2$) 	44	296
Stearic ($C_{18}H_{36}O_2$) 	69	359
Linolenic ($C_{18}H_{30}O_2$) 	-5	443
Arachidonic($C_{20}H_{32}O_2$) 	-49	407

a. With reference to the information provided in the table above discuss the relative significance to the MP and BP of carbon chain length and degree of saturation.

b. At 760 mmHg the BPs of trans-2-pentene and cis-2-pentene are 36°C and 37°C ,respectively. Give a plausible explanation for this difference, albeit a small difference.