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VCE Chemistry ½

Properties & Real Life Use of Organic Chemicals [0.20]

Workshop

Error Logbook:

New Ideas / Concepts	Didn't Read Question
Pg / Q #: _____ Notes:	Pg / Q #: _____ Notes:
Algebraic / Arithmetic / Calculator Input Mistake	**Working Out Not Detailed Enough**
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Section A: Recap

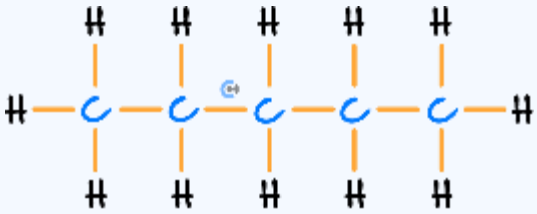
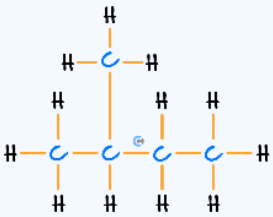
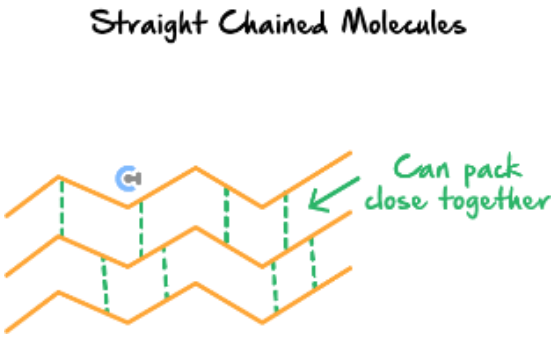
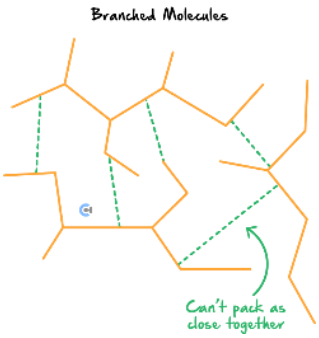
[2.8.1] - Identify & explain how the physical properties of branched / unbranched alkanes, haloalkanes, alkenes, alcohols, esters, & carboxylic acids compare

- Strength of Intermolecular Bonds:

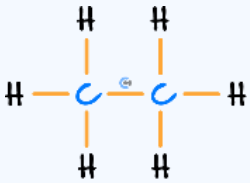
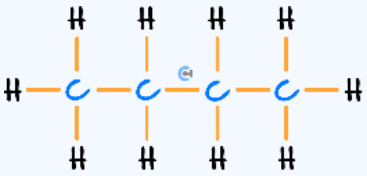
Weakest	Medium	Strongest

- Sample Response: Melting / Boiling Point
  - Explain why substance X has stronger intermolecular bonding.
  - More _____ is required to _____ intermolecular bonds.
  - Leads to [higher] / [lower] melting point.

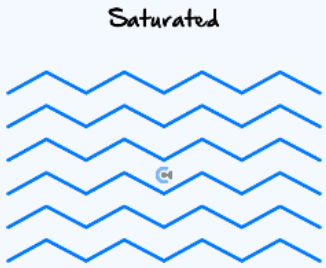
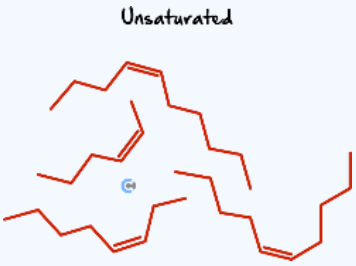
- Branching:

Pentane	Methylbutane
	
	
[Stronger] / [Weaker] intermolecular bonds.	[Stronger] / [Weaker] intermolecular bonds.

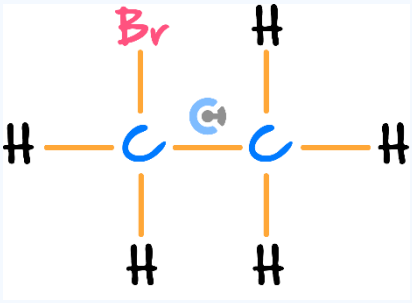
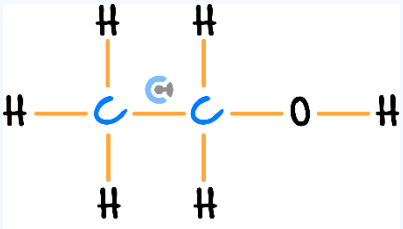
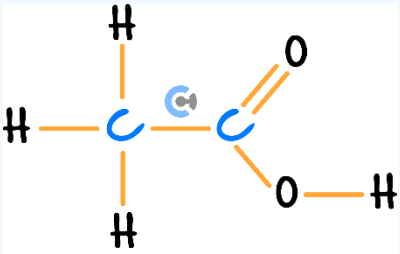
- Size of Molecule:

Ethane	Butane
	
[Stronger] / [Weaker] Dispersion Forces.	[Stronger] / [Weaker] Dispersion Forces.
[Higher] / [Lower] Melting Point.	[Higher] / [Lower] Melting Point.

- Double Bonds:

Alkanes	Alkenes
	
[Stronger] / [Weaker] intermolecular bonds.	[Stronger] / [Weaker] intermolecular bonds.

- Functional Groups:

Haloalkanes	Hydroxyl	Carboxyl
		

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[2.8.2] - Identify & explain renewable & non-renewable sources of organic matter & their impacts on society, & the limitations of renewable feedstocks

- Renewable Definition: Can be replaced by _____ within a _____.
- Circular Economy: Resources are _____.
- Linear Economy: Resources are _____.

Example	Limitation
Biomass	Food shortages, deforestation, and habitat destruction.
Plant-based paracetamol	Expensive.
High-strength glue	Unable to source from biofuels.
Specific coloured dyes (e.g., Indigo)	Requires additives from petrochemicals (crude oil).
Harvesting of saffron	Worker exploitation.

[2.8.3] - Apply sources of organic matter to identify real-life compounds used in society

- Organic compounds are everywhere in modern life.
- Polar vs Non-Polar solvents help in _____ substances.
- Aspartame:
  - **Sweetness of Aspartame:** _____ sweeter than natural sugars.
  - **Energy Output of Aspartame:** [Higher] / [Lower] / [Same] as natural sugars.
  - **Amount of Aspartame Used:** Much _____ needed for the same sweetness.
  - **Effect on Energy Content:** [Higher] / [Lower] energy content as [more] / [less] aspartame is added.
- Polymers from organic compounds shape modern materials.

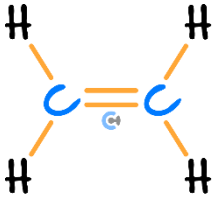
Section B: Warm Up (13.5 Marks)

INSTRUCTION: 13.5 Marks. 7 Minutes Writing.

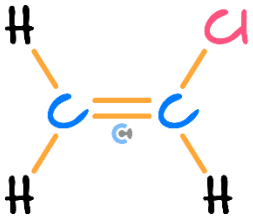
Question 1 (2.5 marks)

For each of the following molecules, state the strongest level of intermolecular bonding that they can have with themselves.

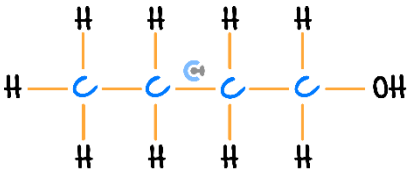
a. (0.5 marks)



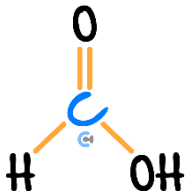
b. (0.5 marks)



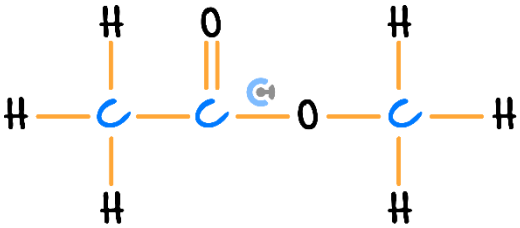
c. (0.5 marks)



d. (0.5 marks)



e. (0.5 marks)



Question 2 (6 marks)

Butanol and butanoic acid are two organic compounds that are readily found in the chemistry lab.

a. Draw the skeletal structure of both of these compounds. (2 marks)

b. Explain what the strongest type of intermolecular bonding is in both of these molecules. (1 mark)

c. Would butanol or butanoic acid be expected to have a higher boiling point? Explain with reference to specific intermolecular interactions. (3 marks)

_____

_____

_____

_____

Question 3 (5 marks)

Stearic acid is a fatty acid found in many foods. It is shown below.

a. Identify the strongest intermolecular bond in stearic acid. (1 mark)

_____

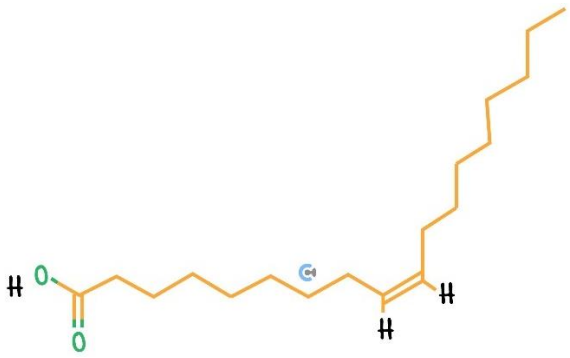
b. Explain whether stearic acid would have a higher or lower boiling point than decane. (2 marks)

_____

_____

_____

c. Another fatty acid also found in food is oleic acid. It is shown below.



Explain whether stearic acid or oleic acid would have a higher melting point. (2 marks)

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Section C: Ramping Up (13 Marks)

INSTRUCTION: 13 Marks. 10 Minutes Writing.

Question 4 (1 mark)

Which one of the following molecules do you expect to have the highest boiling point?

A. C_3H_8

B. CH_3CH_2OH

C. CH_3COOH

D. CH_3CHO

Question 5 (9 marks)

The use of fossil fuels is a topic that has been frequently discussed by the United Nations conferences over the last four decades, with an increase in rates of climate change observed.

a. What is a fossil fuel? (1 mark)

_____

b. List two examples of fossil fuels. (1 mark)

_____

c. List two consequences of fossil fuel use. (1 mark)

_____

_____

d. List two benefits of fossil fuel use. (1 mark)

_____

e. Studies have shown that fossil fuels have high levels of greenhouse gas emissions. List four greenhouse gases. (2 marks)

_____

f. Explain what the implications of greenhouse gases are with reference to the greenhouse effect. (2 marks)

_____

_____

_____

g. Would fossil fuel usage be consistent with a linear economy or a circular economy? (1 mark)

_____

Question 6 (3 marks)

CFCs are a dangerous class of organic compounds.

a. Draw the structural formulae for tetrafluoromethane. (1 mark)

b. Ozone, or O_3, is a gas that comprises the Earth's ozone layer. What type of interactions would the compound above have with ozone? (2 marks)

_____

_____

_____

Section D: Getting Trickier I (14 Marks)

INSTRUCTION: 14 Marks. 11 Minutes Writing.

Question 7 (8 marks)

Suveer, an avid farmer, has recently been helping to government to procure biomass in order to create bio-based fuels as an alternative to fossil fuels.

a. What is biomass? (1 mark)

_____

_____

b. What are some downsides to sourcing biomass which Suveer would face? Explain at least 2. (2 marks).

_____

_____

c. Suveer knows that his biomass can be used to create plant-based paracetamol. However, studies show consumers are less likely to buy and use plant-based paracetamol. Why is this the case? (1 mark)

_____

_____

d. After breaking his tractor, Suveer wishes to glue it back together. However, he cannot find any plant-based adhesive. Why is this the case? (2 marks)

_____

_____

_____

e. Explain what feedstock refers to. (1 mark)

_____

_____

f. Would biomass be more consistent with a circular economy or linear economy? (1 mark)

_____

Question 8 (6 marks)

Consider the carboxylic acid of 2-fluoro-2-methylpropanoic acid.

a. Give the structural formula and label the primary functional group. (1 mark)

b. Define what a dimer is. (1 mark)

_____

_____

c. Would this molecule have a higher boiling point than 2-chloro-2-methylpropan-1-ol? Explain your answer. (2 marks)

_____

_____

_____

d. Explain whether this molecule is soluble in water. (2 marks)

_____

_____

_____

Section E: Getting Trickier II (19 Marks)

INSTRUCTION: 19 Marks. 17 Minutes Writing.

Question 9 (8 marks)

Kanta is investigating the properties of different organic compounds which she comes across at a petrol station. The first compound which she sees is butane.

a. Draw a molecule of butane. (1 mark)

b. Identify the type of intermolecular bonding in butane. (1 mark)

_____

c. Kanta then notices that while butane is a gas, octane is a liquid. Explain why this is with reference to intermolecular forces. (2 marks)

_____

_____

_____

d. Next, Kanta wants to compare octane, with 2-methyl-heptane. Which of these would she expect to have a higher boiling point and why? (2 marks)

_____

_____

_____

e. Kanta is also shown by the gas station attendant, a new organic fuel called but-2-ene. Kanta notices that this new fuel has a much lower boiling point than butane. Why is this the case? (2 marks)

_____

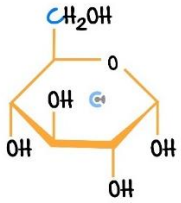
_____

_____

Question 10 (11 marks)

Figuring out alternative sweeteners to sugar is something that a lot of food companies research heavily.

a. Consider the following structure of the simplest sugar, glucose.



i. State what the strongest form of intermolecular bonding it would form with itself. (1 mark)

_____

ii. Explain whether you think this molecule would be soluble in water. (2 marks)

_____

_____

_____

iii. Calculate the molar mass of glucose and the percentage composition of oxygen in it. (2 marks)

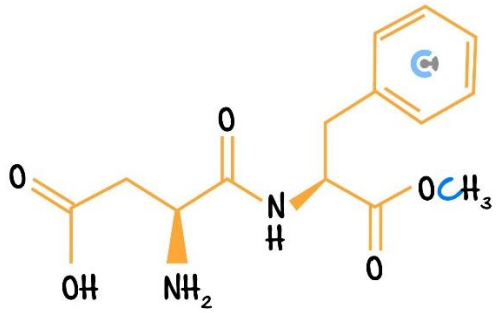
_____

_____

_____

_____

b. Now, consider the structure of the alternate sweetener, aspartame.



i. Explain whether you think this molecule would be soluble in an organic solvent of hexane. (2 marks)

_____

_____

_____

ii. Do you think it would be more or less soluble than glucose? Justify your answer. (2 marks)

_____

_____

_____

c. Aspartame is used in place of sugar a lot of times as a sweetener. Explain why it is a popular option for diabetics. (2 marks)

_____

_____

_____

Let's take a BREAK!

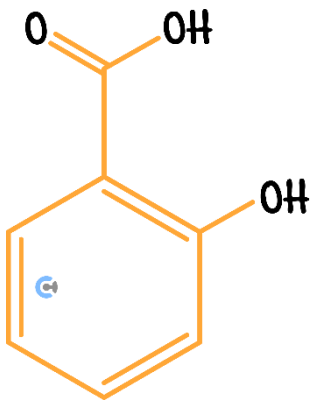
Section F: VCAA-Level Questions I (8 Marks)

INSTRUCTION: 8 Marks. 30 Seconds Reading. 8 Minutes Writing.

Question 11 (8 marks)

Salicylic acid is used in making aspirin and skin-care products. Traditionally, it's made using fossil fuel-derived phenol, which is carboxylated in the Kolbe–Schmitt reaction. However, salicylic acid can also be sourced renewably from willow bark or biosynthesised by microbes using plant sugars.

Its structure is shown below.



a. Circle and label three functional groups in salicylic acid above. (2 marks)

b. Describe **two** environmental advantages of producing salicylic acid from plant biomass rather than from fossil fuels. (2 marks)

_____

_____

_____

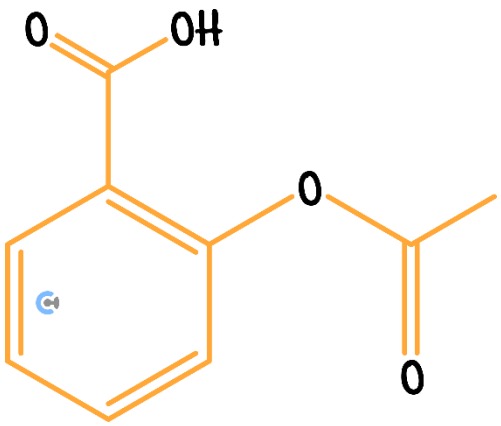
_____

c. State the reason why salicylic acid is used in the pharmaceutical industry. (1 mark)

_____

_____

Salicylic acid can be synthesised into aspirin, which is shown below.



d. State the new functional group present in aspirin which is not present in salicylic acid. (1 mark)

_____

e. It is found that aspirin has a lower melting point than salicylic acid. Explain this observation. (2 marks)

_____

_____

_____

_____

_____

Space for Personal Notes

Section G: Multiple Choice Questions (9 Marks)

INSTRUCTION: 9 Marks. 9 Minutes Writing.

Question 12 (1 mark)

Which one of the following statements regarding butane and pentane is correct regarding their relative boiling points?

A. Butane has a higher boiling point because it contains stronger dispersion forces than pentane due to its shorter chain.

B. Butane has a higher boiling point because it contains fewer atoms due to its shorter chain.

C. Pentane has a higher boiling point because it contains stronger dispersion forces than butane due to its longer chain.

D. Pentane has a higher boiling point because it contains more atoms due to its longer chain.

Question 13 (1 mark)

Which one of the following is an intermolecular bond?

A. Covalent bonding

B. Ionic bonding

C. Metallic bonding

D. Hydrogen bonding

Space for Personal Notes

Question 14 (1 mark)

Which one of the following statements is true regarding organic molecules with branching?

A. The branching causes the molecule to have stronger intermolecular bonds due to its wider surface area.

B. The branching causes the molecule to have weaker intermolecular bonding due to its inability to pack together tightly.

C. Branched organic molecules would have similar intermolecular bonding strength to their straight-chained equivalents; it's just distributed differently.

D. Branched organic molecules contain an imbalanced electron distribution across the whole molecule, causing dipole-dipole attractions to form.

Question 15 (1 mark)

Which one of the following molecules do you expect to be the most soluble in water?

A. $HCOOH$

B. CH_4

C. CH_3CH_2COOH

D. CH_3OH

Question 16 (1 mark)

Which one of the following is not a direct consequence of obtaining fossil fuels?

A. Contamination of water.

B. Deforestation.

C. Global warming via combustion of fuel.

D. Destruction of Indigenous / Culturally significant areas.

Space for Personal Notes

Question 17 (1 mark)

Select the molecule that would have the highest solubility in an organic solvent.

A. CH_3COCH_3

B. $CH_3CH_2CH_2CH_3$

C. CH_3CH_2COOH

D. $CH_3CH_2CH_3$

Question 18 (1 mark)

Which of the following is NOT a suitable material for the production of biomass fuel?

A. Corn starch

B. Sugarcane

C. Coal

D. Food Waste

Question 19 (1 mark)

Which of the following lists organic molecules from lowest to highest boiling point?

A. $CH_3CHO, CH_3COOH, CH_3CH_2OH$

B. $C_8H_{18}, CH_3CH_2OH, CH_4$

C. $CH_4, CH_3CH_2OH, C_8H_{18}$

D. $CH_3CH_2OH, CH_3COOH, CH_3CHO$

Space for Personal Notes

Question 20 (1 mark)

Which of the following statements is true about intermolecular bonding and its relation to solubility in water?

A. The intermolecular bonding should be comprised mainly of dispersion forces to be soluble in water.

B. Generally, the larger the molecule, the less soluble it should be in water.

C. The density of a molecule is determined by its intermolecular bonding strength, which then determines its solubility.

D. The intermolecular bonding between the molecules themselves can be different to the bonding that exists between the molecule and water.

Space for Personal Notes

Section H: VCAA-Level Questions II (10 Marks)

INSTRUCTION: 10 Marks. 30 Seconds Reading. 10 Minutes Writing.

Question 21 (10 marks)

Methane gas (CH_4) is commonly used in household kitchens. The way that methane gas is obtained can vary.

a. Explain the main difference between methane gas obtained from natural gas deposits underground and obtaining it from breaking down food waste. (2 marks)

_____

_____

_____

b. State and explain an advantage and a disadvantage of using natural gas deposits as a source of fuel. (2 marks)

_____

_____

_____

c. Write out the complete combustion reaction of methane in a limited supply of oxygen, assuming the only product produced is carbon monoxide and the reaction occurs at 25°C. (2 marks)

_____

d. Would using methane obtained from breaking down food waste be a completely greenhouse gas-free process? Justify your answer. (2 marks)

_____

_____

_____

e. If a sample had 4.67×10^3 g of methane, according to the reaction in **part c.**, what is the total mass of gases formed? (2 marks)

_____

_____

_____

_____

Space for Personal Notes

Section I: Extension Questions (11 Marks)

Question 22 (11 marks)

Fossil fuels are essential to the transportation industry but have many implications for their usage.

a. Where are fossil fuels obtained from? (1 mark)

_____

_____

b. Consider the straight-chained alkane octane, which is often used in petrol.

i. How would this octane be extracted from crude oil? (1 mark)

_____

ii. Write the combustion reaction for octane in excess oxygen, assuming the reaction occurs at 25°C. (2 marks)

_____

iii. If we burned 5.82 g of octane, then calculate the amount in grams of carbon dioxide produced. (2 marks)

_____

_____

_____

_____

iv. What is the effect of CO_2 on the environment? (1 mark)

_____

c. Between ethanol and octane, which one do you expect to have a higher boiling point? Justify your answer. (2 marks)

_____

_____

_____

d. Petrol is actually a mix of various hydrocarbons, with octane being the main component. Would it be more likely for octane to be mixed with hexane or butanol? Justify your answer. (2 marks)

_____

_____

_____

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