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VCE Chemistry ½

Properties & Real Life Use of Organic Chemicals [2.8]

Homework

Admin Info & Homework Outline:

Student Name	
Questions You Need Help For	
Compulsory Questions	Pg 2-Pg 13
Supplementary Questions	Pg 14-Pg 28

Section A: Compulsory Questions (51 Marks)

Sub-Section [2.8.1]: Identify & Explain How Physical Properties of Branched/Unbranched Alkanes, Haloalkanes, Alkenes, Alcohols, Esters, & Carboxylic Acids compare

Question 1 (1 mark)

Which of the following organic compounds is non-polar?

A. Ethyl ethanoate

B. Butanoic acid

C. Methylpropene

D. 2-methylpropan-2-ol

Question 2 (3 marks)

Explain why ethanol has a higher boiling point than ethane with reference to structure and relevant intermolecular forces.

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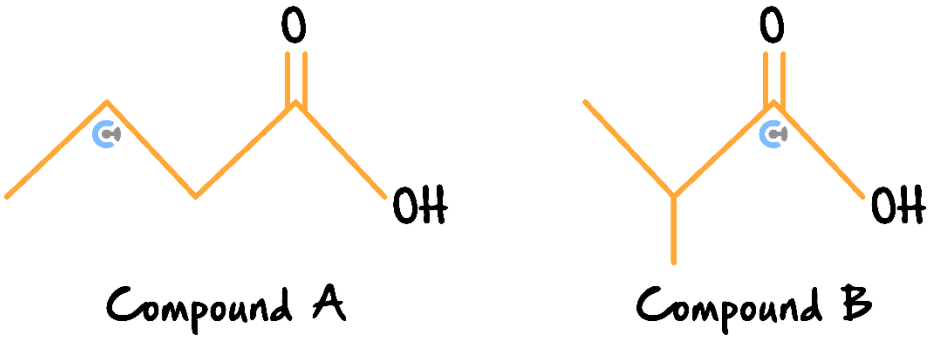
Question 3 (4 marks)

Two organic compounds are being studied by a chemist.



a. State the molecular formula for compound *A* and compound *B*. (1 mark)

b. Which of the compounds, compound *A* or compound *B*, has a lower boiling point? Justify your answer. (3 marks)

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Sub-Section [2.8.2]: Identify & Explain Non-Renewable Sources of Organic Matter & their Impacts on Society

Question 4 (1 mark)

Which of the following is **not** an example of a linear economy?

A. Cathode ray televisions.

B. Paper coffee cups.

C. Halogen light bulbs.

D. Plastic packaging.

Question 5 (3 marks)

A team of researchers at a university are studying some causes of climate change.

a. State the definition of a greenhouse gas. (1 mark)

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b. Explain how greenhouse gases contribute to climate change. (2 marks)

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Question 6 (8 marks)

A power plant in Lang Lang generates electricity by burning coal and converting liquid water into steam. The relevant equations for this process are shown below:

$$C(s) + O_2(g) \rightarrow CO_2(g)$$

$$H_2O(l) \rightarrow H_2O(g)$$

a. Explain why coal is considered non-renewable. (2 marks)

b. Identify **two** negative impacts this plant has on the environment. (2 marks)

c. State **two** greenhouse gases produced by this power plant. (2 marks)

d. Explain whether this power plant is an example of a linear or circular economy. (2 marks)

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Sub-Section [2.8.3]: Identify & Explain Renewable Sources of Organic Matter & their Benefits

Question 7 (1 mark)

Which of the following is a non-renewable resource?

A. Biomass.

B. Methane (produced by the mining of coal).

C. Methane (produced via anaerobic fermentation).

D. Drinking water.

Question 8 (2 marks)

A wastewater treatment plant is considering the use of biofuels to power their onsite treatment systems.

Explain why biofuels are considered renewable resources and how this affects their sustainability as a source of energy.

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Question 9 (4 marks)

Traditionally, car tyres are made of rubber, derived from petroleum sources. However, a tyre company is prototyping a new tyre design and is trying to use materials that are derived from biomass instead of crude oil.

a. Explain **one** advantage of using biomass to produce car tyres. (2 marks)

_____

_____

_____

Drift tyres are conventionally made of the same materials as regular tyres. During use, drift tyres are burned away, often releasing toxic chemicals into the atmosphere.

b. State **two** benefits, that drift tires made using compounds sourced from biomass have over regular drift tires. (2 marks)

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Sub-Section [2.8.4]: Identify & Explain the Limitations of Renewable Feedstocks

Question 10 (1 mark)

Which of the following is **not** a limitation of deriving organic compounds from biomass?

A. Land is required to grow plants for use as biomass.

B. Biomass is not a renewable resource.

C. Producing organic compounds from biomass can be expensive.

D. Some organic compounds cannot be sourced from biomass.

Question 11 (2 marks)

A study is considering the feasibility of a biofuel-powered generator used to produce electricity. The study has found that if half of Victoria's agricultural land was used to grow crops to be used as biomass, biofuel generators could be a sustainable replacement for some coal power plants.

Identify and explain **two** negative impacts of the biofuel generator plan.

Space for Personal Notes

Question 12 (5 marks)

Many dyes used in clothing and other applications are made using organic compounds derived from fossil fuels. Often, compounds used in these dyes can be derived from renewable sources like plant matter.

Evaluate the benefits and limitations of producing dyes using organic compounds from renewable sources like waste biomass. Refer to relevant green chemistry principles in your response. Use **Item 26. ii.** of the Data Book.

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Sub-Section [2.8.5]: Apply Sources of Organic Matter to Identify Real-Life Compounds Used in Society

Question 13 (1 mark)

The ratio of sweetness of aspartame to regular sugar is:

A. 50 : 1

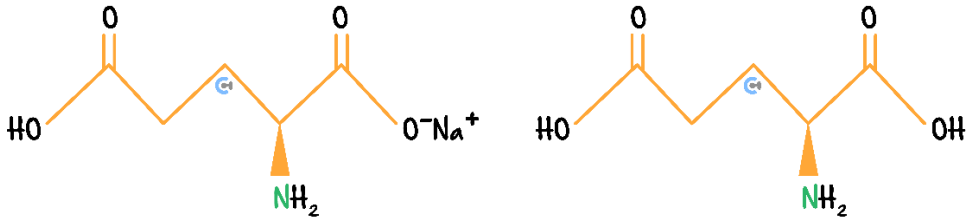
B. 200 : 1

C. 2000 : 1

D. 1200 : 1

Question 14 (3 marks)

Glutamic acid is a natural amino acid that contributes to the savoury taste of meats. Monosodium glutamate (MSG) is a flavour additive that is commonly used to intensify savoury flavours in food. The structure of glutamic acid and MSG are shown below:



a. Identify **one** functional group that is present in both MSG and glutamic acid. (1 mark)

_____

b. With reference to the structure of MSG, explain why glutamic acid and MSG contribute very similar flavours to foods. (2 marks)

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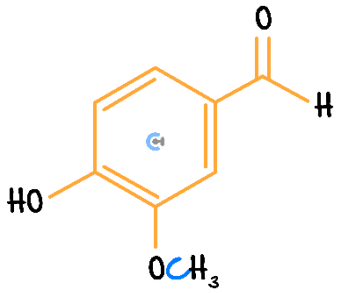
Question 15 (3 marks)

The vanilla flavour found in many baked goods often comes from an organic compound called vanillin, which has an identical structure to natural vanilla. The structure of vanillin is shown.



a. Identify **one** functional group present in the structure of vanillin. (1 mark)

Vanillin is a compound that can be both derived from fossil fuels and from chemicals found in wood pulp. Vanillin is used because natural vanilla extracts are expensive and are a limited resource.

b. Explain why vanillin derived from fossil fuels is the least desirable form of the flavour. (2 marks)

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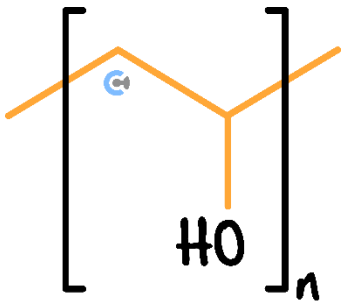
Sub-Section: The 'Final Boss'

Question 16 (9 marks)

PVA glue is a common adhesive used in craft projects and is a polymer. The structure of one monomer of PVA glue is shown. Strings of these monomers form the glue's structure.



a. Identify the functional group present in the monomer. (1 mark)

_____

b. Explain why PVA is a good adhesive. Refer to intermolecular bonds in your answer. (2 marks)

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PVA glue is biodegradable but is currently made using ethylene, a compound derived from fossil fuels.

c. Explain **one** impact that the production of PVA glue has on society. (2 marks)

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Recently, chemists have been trying to produce PVA glue from biomass like corn and sugarcane.

d. Discuss the benefits and limitations of producing PVA glue from biomass. (4 marks)

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Section B: Supplementary Questions (71 Marks)

Sub-Section [2.8.1]: Identify & Explain How Physical Properties of Branched/Unbranched Alkanes, Haloalkanes, Alkenes, Alcohols, Esters, & Carboxylic Acids compare

Question 17 (1 mark)

Which of the following compounds has the highest boiling point?

A. Butyl methanoate

B. Pentanoic acid

C. Pentanol

D. 2-methylbutanoic acid

Question 18 (3 marks)

Explain why methane has a lower boiling point than bromomethane with reference to polarity and intermolecular forces.

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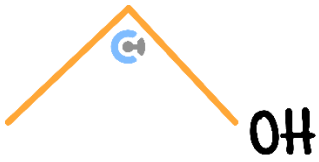
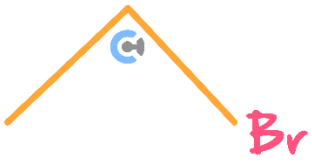
Question 19 (5 marks)

Two organic compounds are being studied by a chemist.



Compound A



Compound B

a. State the polarity of compound *A* and compound *B*. (1 mark)

b. Identify which compound, compound *A* or compound *B*, has a higher boiling point. Justify your answer. (4 marks)

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Question 20 (7 marks)

Three organic compounds are being studied by some chemistry students at Monash University. The semi-structural formulae for each compound are shown below.

Compound *A*: $CH_3CH_2CH_2CH_2OH$

Compound *B*: $CH_3CH_3CH_3COOH$

Compound *C*: $CH_3C(CH_3)OHCH_3$

a. State the systematic name for each of the three compounds. (2 marks)

Compound *A*: _____

Compound *B*: _____

Compound *C*: _____

b. List the compounds in order of highest boiling point to lowest boiling point. Justify your answer. (5 marks)

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Sub-Section [2.8.2]: Identify & Explain Non-Renewable Sources of Organic Matter & their Impacts on Society

Question 21 (1 mark)

Which of the following is a renewable resource?

A. Petroleum

B. Cellulose

C. Natural gas

D. Acrylic paint

Question 22 (3 marks)

A new solar farm near Lake Eyre in central Australia is being built as a part of a push for renewable resource use. Despite being renewable, the solar farm project still has a non-zero expected greenhouse gas emission value.

a. Explain why the solar farm project has an expected greenhouse gas emission value. (1 mark)

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b. Explain how the emission of greenhouse gases could affect aquatic life. Specific reactions are not required. (2 marks)

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Question 23 (6 marks)

Port Melbourne and many of the docks on the Yarra River see frequent ship traffic. Many of these ships use large diesel engines to make trips across oceans and transport goods.

a. Explain why diesel is a non-renewable resource. (1 mark)

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b. Explain **two** disadvantages of using diesel to power ships like these. (2 marks)

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c. Identify **one** greenhouse gas produced by these ships. (1 mark)

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d. Is the use of diesel to power ships of this nature, an example of a circular or linear economy? Justify your answer. (2 marks)

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Question 24 (4 marks)

Catalytic converters are a common part of exhaust systems in many modern cars. Their purpose is to remove harmful pollutants like carbon monoxide, methane, nitrogen oxides, and other hydrocarbons from the exhaust stream by converting them into less harmful substances like carbon dioxide, water, and nitrogen.

a. List **three** greenhouse gases associated with this process. (2 marks)

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_____

_____

Carbon monoxide is very toxic and can cause death by asphyxiation quickly.

b. Evaluate the effectiveness of catalytic converters as a:

i. Method of reducing the release of toxic chemicals into the atmosphere. (1 mark)

_____

_____

ii. Method of reducing the release of greenhouse gases into the atmosphere. (1 mark)

_____

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Sub-Section [2.8.3]: Identify & Explain Renewable Sources of Organic Matter & their Benefits

Question 25 (1 mark)

Which of the following is **not** a renewable source of electricity?

A. Solar power.

B. Hydroelectricity.

C. Nuclear power.

D. Geothermal electricity.

Question 26 (1 mark)

Biofuels are being considered as an alternative to fossil fuels for electricity production and are being advocated for by sustainability and environmentalist groups.

Explain how the renewability of biofuels makes them a sustainable source of energy.

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Space for Personal Notes

Question 27 (6 marks)

Paracetamol is traditionally made with organic compounds derived from crude oil. One company is experimenting with paracetamol production techniques that use compounds derived from biomass like plant matter or algae to reduce dependence on fossil fuels. The company has found that renewable methods are often more costly than traditional methods.

a. Explain **one** advantage of using biomass to produce paracetamol with reference to **one** relevant green chemistry principle. Use **Item 26. ii.** of the Data Book. (2 marks)

_____

_____

_____

b. Identify and explain **one** reason the company may prefer traditional methods over methods that use biomass. (1 mark)

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The packaging used by the company is made from biodegradable, paper-like cardboard.

c. Explain how this fits into the concept of a circular economy. (3 marks)

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Question 28 (5 marks)

Compare the benefits of sourcing organic compounds from fossil fuels and biomass.

Space for Personal Notes

Sub-Section [2.8.4]: Identify & Explain the Limitations of Renewable Feedstocks

Question 29 (1 mark)

Which of the following is **not** a limitation of biodiesel, a fuel made from biomass, as a replacement fuel for diesel?

A. Biodiesel provides less energy when combusted compared to regular diesel.

B. A significant amount of agricultural land will need to be used to source the required biomass.

C. Producing a lot of biodiesel for a long time is unsustainable because biodiesel is a non-renewable resource.

D. Producing the quantities of biodiesel needed to fully replace diesel in society could result in food shortages due to the use of agricultural land.

Question 30 (3 marks)

The use of an organic compound derived from plant waste in a tyre factory is being trialled as part of a feasibility study. The structure of the compound has a few differences from the regular compound derived from fossil fuels.

Identify **two** limitations the study may discover and explain the impact of these limitations.

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Question 31 (5 marks)

Lisa, in an argument about the need for electric vehicles, makes the following statement:

"We don't need electric cars because we can just use biofuels like biodiesel to power our cars instead of petrol."

Evaluate Lisa's statement. In your response, refer to **two** benefits and **two** limitations of biofuels.

Space for Personal Notes

Question 32 (5 marks)

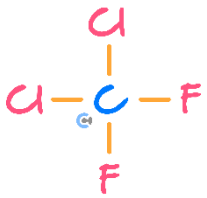
Compare the limitations of sourcing organic compounds from fossil fuels and biomass in terms of sustainability.

Space for Personal Notes

Sub-Section [2.8.5]: Apply Sources of Organic Matter to Identify Real-Life Compounds Used in Society

Question 33 (1 mark)

CFCs were a type of molecule used in refrigerators in the 1930s. The structure of one particular CFC is shown below.



The correct systematic name for this molecule is:

A. Methane.

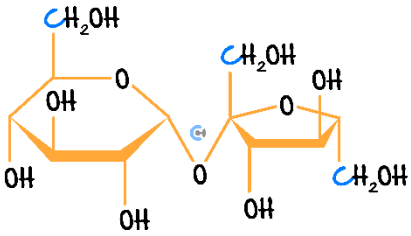
B. 1, 1-dichloro-1, 1-difluoromethane.

C. Tetrahalomethane.

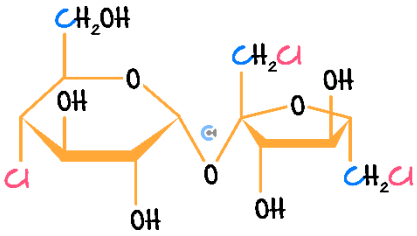
D. Dichlorodifluoromethane.

Question 34 (3 marks)

Similar to aspartame, sucralose is another artificial sweetener used as a zero-calorie sugar substitute. Sucralose does not get metabolised in the body and so does not contribute to blood sugar levels. Sucralose is 600 times sweeter than regular sugar. The structures of sucralose and sucrose (regular sugar) are shown.



Sucrose



Sucralose

a. State how the structure of sucrose differs from the structure of sucralose. (1 mark)

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_____

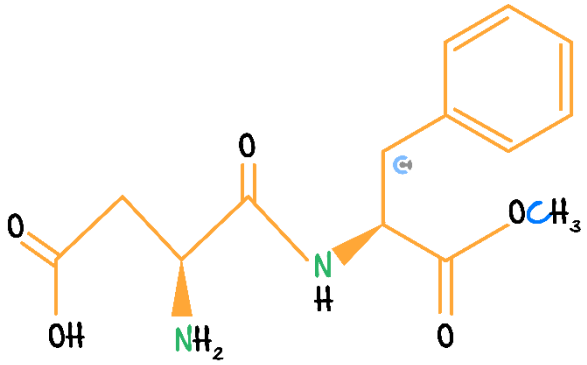
b. Circle the functional differences between sucrose and sucralose on the structure of sucralose in the diagram above. (1 mark)

c. State the amount of sucralose required to replace 30 mg of sugar in a drink. (1 mark)

_____

Question 35 (6 marks)

Aspartame is a common low-calorie sweetener used in many diet beverages. The structure of aspartame is shown below.



a. Identify **two** functional groups in the structure of aspartame. (2 marks)

_____

Aspartame is sweeter than regular sugar by orders of magnitude. Far less aspartame will have to be used for the same sweetness as an amount of regular sugar.

b. Explain why aspartame is a favourable replacement for sugar in diet beverages. (2 marks)

_____

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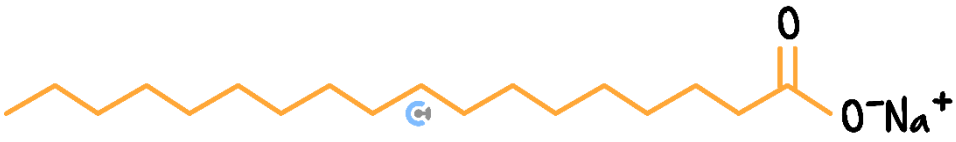
_____

Aspartame is hydrolysed in the body to produce methanol, aspartic acid, and phenylalanine, which are then absorbed into the bloodstream. Methanol is an extremely toxic alcohol but, despite this, aspartame is considered a safe sweetener.

c. Explain why, with reference to sweetness, aspartame is considered safe despite the toxicity of methanol. (2 marks)

Question 36 (4 marks)

Soaps are often used to allow oil and water to mix so that oily substances can be washed away with tap water. Soaps fall into a class of compounds known as emulsifiers. Emulsifiers allow a polar substance and a non-polar substance to interact. The structure of a soap molecule is shown.



a. Which end of the soap molecule is more likely to be polar? (1 mark)

b. Using your knowledge of intermolecular forces and polarity, explain how soaps act as emulsifiers. (3 marks)

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