Neap

Diagnostic Topic Test 2024

VCE Chemistry Units 3&4

Question and Answer Booklet

Test time: 45 minutes
Total marks: 35 marks

Test 5: How are organic compounds categorised and synthesised?

- Structure, nomenclature and properties of organic compounds
- Reactions of organic compounds

Student's Name: _____

Teacher's Name: _____

Instructions

Write your **name** and your **teacher's name** in the space provided above on this page.

A data booklet is provided.

Unless otherwise indicated, the diagrams in this booklet are **not** drawn to scale.

Answer **all** questions in the spaces provided.

SECTION A – MULTIPLE-CHOICE QUESTIONS

Instructions for Section A

Circle the response that is **correct** or that **best answers** the question.
A correct answer scores 1; an incorrect answer scores 0.
Marks will **not** be deducted for incorrect answers.
No marks will be given if more than one answer is completed for any question.
Unless otherwise indicated, the diagrams in this booklet are **not** drawn to scale.

Question 1
The numbers of structural isomers of propanol and butanol are, respectively,

A. 1 and 2.
B. 2 and 3.
C. 2 and 4.
D. 3 and 4.

Question 2
How many atoms of hydrogen are there in one molecule of 3-aminobutanoic acid?

A. 7
B. 8
C. 9
D. 11

Question 3
Which of the following does **not** contain six carbon atoms per molecule?

A. hexanoic acid
B. 2-methylpentan-1-ol
C. ethyl butanoate
D. 2,2-dimethylpropanoic acid

Question 4
Which of the following pairs of compounds can be used to prepare $CH_3CH_2CH_2COOCH_2CH_3$?

A. butanoic acid and ethanol
B. propanoic acid and ethanol
C. ethanoic acid and butanol
D. hexanoic acid and acidified potassium dichromate

Question 5

Which one of the following statements is **incorrect**?

A. The chemical reactivity of chloroalkanes is greater than the chemical reactivity of alkanes.

B. The number of double bonds in straight-chain or branched C_6H_{12} is less than the number of double bonds in straight-chain or branched C_5H_8, assuming no triple bonds occur in either molecule.

C. The acidity of CH_3COOH is less than the acidity of $CH_3CH_2NH_2$.

D. The boiling point of pentane is higher than the boiling point of propane.

Question 6

Dichloroethane may be produced using the following reaction.

$$CH_3CH_3(g) + 2Cl_2(g) \rightleftharpoons CH_2ClCH_2Cl(g) + 2HCl(g)$$

This reaction may be described as

A. a substitution reaction with an atom economy of close to 50%.

B. a substitution reaction with an atom economy of close to 60%.

C. an addition reaction with an atom economy of close to 50%.

D. an addition reaction with an atom economy of close to 60%.

Question 7

If separate samples of pent-1-ene and pent-2-ene are reacted with bromine, the products will be

A. the same.

B. unsaturated compounds.

C. of lower mass than the organic reactants.

D. structural isomers of each other.

Question 8

In which of the following reactions would you expect more than two products to form?

A. the chlorination of ethane in the presence of sunlight

B. the catalysed hydrolysis of but-2-ene

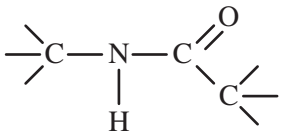
C. the condensation of methanol and ethanoic acid

D. the catalysed addition of hydrogen bromide to ethene

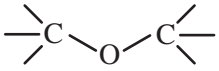
Question 9

Which one of the following shows the link that forms during transesterification of plant triglycerides to produce biodiesel?

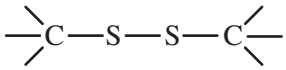
A.



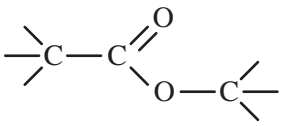
B.



C.



D.



Question 10

The use of catalysts in the sustainable production of organic chemicals is desirable because catalysts

A. increase the atom economy of reactions.

B. reduce the energy required to carry out reactions.

C. produce safer chemical products.

D. allow reactions to proceed in less harmful solvents.

END OF SECTION A

SECTION B

Instructions for Section B

Answer **all** questions in the spaces provided.

Give simplified answers to all numerical questions, with an appropriate number of significant figures; unsimplified answers will not be given full marks.

Show all working in your answers to numerical questions; no marks will be given for an incorrect answer unless it is accompanied by details of the working.

Ensure chemical equations are balanced and that the formulas for individual substances include an indication of state, for example, $H_2(g)$, NaCl(s).

Unless otherwise indicated, the diagrams in this booklet are **not** drawn to scale.

Question 1 (6 marks)

a. Consider compounds with the molecular formula $C_3H_6O_2$.

Draw an isomer of this compound that

i. contains a ketone group. 1 mark

ii. is an ester. 1 mark

iii. Give the IUPAC name of the compound that you drew in **part a.i.** 1 mark

iv. Give the IUPAC name of the compound that you drew in **part a.ii.** 1 mark

b. Benzene and cyclohexane both contain six carbon atoms in their molecules.

i. State **one** other similarity between the structures of benzene and cyclohexane. 1 mark

ii. State **one** difference between the structures of benzene and cyclohexane. 1 mark

Question 2 (7 marks)

An experiment was conducted to synthesise ethanal, CH_3CHO. When 4.25 g of ethanol was treated with an excess of an acidified solution of potassium dichromate under appropriate conditions, 3.56 g of ethanal was obtained. The reaction is represented by the following balanced equation.

$$3CH_3CH_2OH(l) + Cr_2O_7^{2-}(aq) + 8H^+(aq) \rightarrow 3CH_3CHO(l) + 2Cr^{3+}(aq) + 7H_2O(l)$$

a. Write a balanced half-equation for the oxidation process occurring in the above reaction. 1 mark

b. Calculate the percentage yield for the synthesis experiment. 3 marks

c. Suggest **one** reason why the percentage yield is less than 100%. 1 mark

d. Which compound, ethanol or ethanal, would be expected to be more soluble in water? Explain your choice. 2 marks

Question 3 (12 marks)

a. The boiling points of the hydrocarbons increase with increasing molar mass.

Explain this trend in terms of structure and bonding. 2 marks

b. The use of renewable feedstocks is one principle of green chemistry.

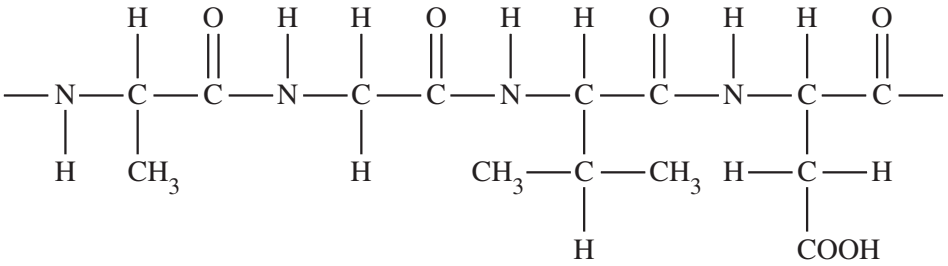
By considering the production of alternate fuels for use in vehicles, discuss **one** example that demonstrates this principle. 3 marks

c. Glucose molecules (M = 180 g mol^{-1}) are polymerised to form the carbohydrate starch.

i. Name the functional group that reacts during this polymerisation. 1 mark

ii. Calculate the molar mass of a starch molecule formed when 2000 glucose molecules are reacted. Show your working. 2 marks

d. The structure of a small section of a protein molecule is shown below.



This section of the protein polymer was produced by reaction of amino acid monomers.

i. How many amino acid monomers were used to produce the protein section shown? 1 mark

_____

ii. On the diagram above, circle and name one of the links formed when the amino acid monomers reacted. 1 mark

iii. Name the chemicals needed to produce the amino acid monomers by reaction with the protein segment. 2 marks

_____

_____

END OF TEST