CHEMISTRY 2021

Unit 4

Key Topic Test 2 – Organic Chemistry - pathways

Recommended writing time*: 50 minutes

Total number of marks available: 50 marks

SOLUTIONS

SECTION A: Multiple-choice questions (1 mark each)

Question 1

Answer: C

Explanation:

The more branching in the molecule the further apart the molecules the molecules are. This results in weaker dispersion forces and a lower boiling point.

Question 2

Answer: D

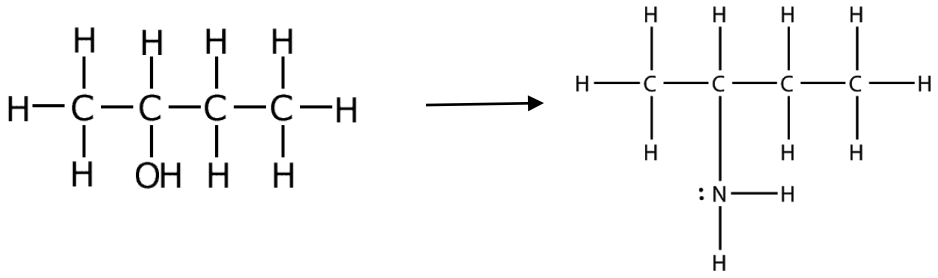
Explanation:

Molecules formed would be chloroethane, 1,2-dichloroethane, 1,1-dichloroethane, 1,1,2-trichloroethane, 1,1,1-trichloroethane, 1,1,1,2-tetrachloroethane, 1,1,2,2-tetrachloroethane, 1,1,1,2,2-pentachloroethane, hexachloroethane.

Question 3

Answer: D

Explanation:



Question 4

Answer: C

Explanation:

The reaction involves a primary alcohol and a carboxylic acid so an ester is formed. The empirical formula is C_3H_6O, and as there needs to be two oxygen atoms in an ester, the molecular formula is $C_6H_{12}O_2$. Methyl pentanoate has a total of 6 carbon atoms.

Question 5

Answer: A

Explanation:

An addition reaction occurs which results in the bromine reacting and being removed from the mixture. The resulting mixture is clear. An addition reaction results in just a single product.

Question 6

Answer: A

Explanation:

When propanol reacts with methanoic acid, propyl methanoate and water are formed.

Question 7

Answer: C

Explanation:

The polymer formed would be polar so there would be hydrogen bonds between the polymer chains.

Question 8

Answer: D

Explanation:

n(chloroethane) = 1.8/64.5 = 0.02791 mol
n(ethanol expected) = 0.02791mol
mass (ethanol expected) = 0.02791 x 46 = 1.28g
%yield = 1.20/1.28 x 100 = 93.8%

Question 9

Answer: A

Explanation:

M(product) / M(reactants) x 100 = 109/190 x 100 = 57%

Question 10

Answer: B

Explanation:

Increasing atom economy results in less wastage of chemical. An excess of a reactant may drive the equilibrium to the right but the extra chemical may be wasted. The shortest reaction pathway might have a lot of waste chemicals produced. Increasing temperature and pressure will increase rate but is unlikely to result in less waste.

SECTION B: Short-answer questions

Question 1

a. Ethanol is polar while ethane is non-polar.* Ethanol has Hydrogen Bonding between molecules which is stronger than the dispersion forces between ethane molecules.*

2 marks

b. Ethanoic acid forms two hydrogen bonds between adjacent molecules* (a dimer) while ethanol only forms one hydrogen bond between molecules.*

2 marks

c. Both octane and hexane are non-polar so have dispersion forces between molecules.* As octane is a larger molecule, its dispersion forces would be stronger.*

2 marks

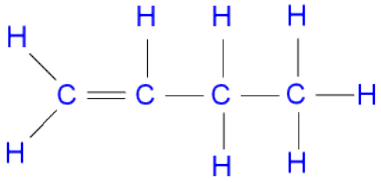
d. Both molecules are polar but octanol has a much larger non-polar section of the molecule.* The non-polar section reduces the solubility of the molecule, so octanol is less soluble than ethanol.*

2 marks

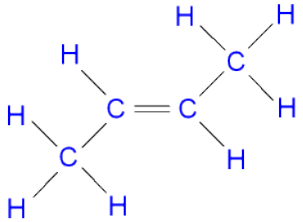
Total 8 marks

Question 2

a.



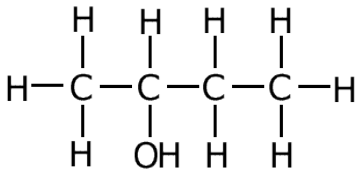
But-1-ene



but-2-ene

4 marks

b. **i.**

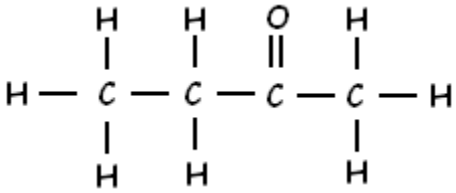


ii. substitution

c. **i.** MnO_4^- / H^+

ii. carbonyl

iii.



Question 3

a. 18

1 mark

b. i. hydroxyl
ii. carbonyl

2 marks

c. While both molecules have a polar hydroxyl group*, the majority of each molecule is non-polar.*

2 marks

d. The hydroxyl group would react and a carbonyl group would form.

2 marks

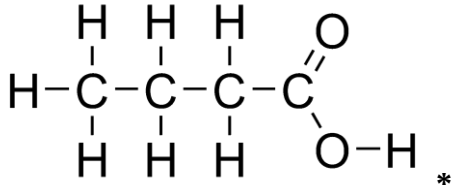
Total 7 marks

Question 4

a. **i.** ester
ii. they are sweet smelling

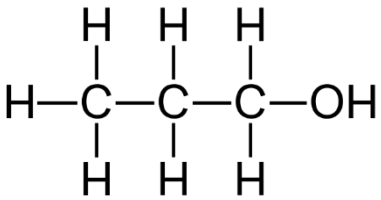
1 + 1 = 2 marks

b. **i.** butanoic acid *



*

ii. propan-1-ol *



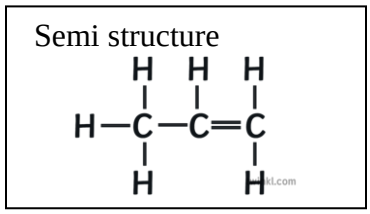
*

4 marks

Total 6 marks

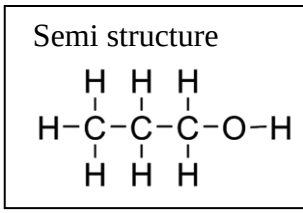
Question 5

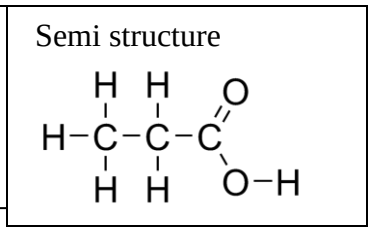
a.



H_2O
MnO_4^-
(H_3PO_4)

H^+

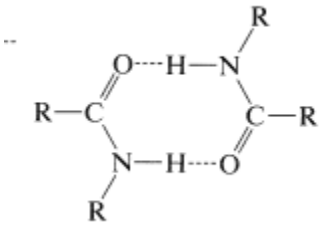




Name; propene **Name; propan-1-ol** **Name; propanoic acid**

6 marks

b. Promanamide molecules are polar*, so hydrogen bonds can form between the molecules (shown by dashed lines)*



(1 mark for a reasonable diagram showing the two hydrogen bonds that form)

3 marks
Total 9 marks