Oxidation of Alcohols Past Papers

Question 1

A student devised an experiment to investigate the enthalpies of combustion of some alcohols. The student chose the following series of primary alcohols.

|  |  |
| --- | --- |
| **Name** | **Formula** |
| Methanol | CH3OH |
| Ethanol | CH3CH2OH |
| Propan-1-ol | CH3CH2CH2OH |
| Butan-1-ol | CH3CH2CH2CH2OH |
| Pentan-1-ol | CH3CH2CH2CH2CH2OH |
| Alcohol **X** | CH3CH2CH2CH2CH2CH2OH |
| Heptan-1-ol | CH3CH2CH2CH2CH2CH2CH2OH |

(a)     (i)      Name alcohol **X**.

.............................................................................................................

**(1)**

(ii)     State the general name of the type of series shown by these primary alcohols.

.............................................................................................................

**(1)**

(iii)     Draw the displayed formula of the position isomer of butan-1-ol.

**(1)**

(iv)    Using [O] to represent the oxidising agent, write an equation for the oxidation of butan-1-ol to form an aldehyde.

.............................................................................................................

**(1)**

(v)     Draw the displayed formula of a functional group isomer of this aldehyde.

**(1)**

Question 2

There are **seven** isomeric carbonyl compounds with the molecular formula C5H10O.  
The structures and names of some of these isomers are given below.

|  |  |
| --- | --- |
| **Structure** | **Name** |
| http://content.doublestruck.eu/getPicture.asp?sub=AA_CH&CT=Q&org=bc4e85edfb0090d5d4c4c7777cbe9359&folder=QS06305_files&file=image001.png | pentanal |
| http://content.doublestruck.eu/getPicture.asp?sub=AA_CH&CT=Q&org=bc4e85edfb0090d5d4c4c7777cbe9359&folder=QS06305_files&file=image002.png | 2-methybutanal |
| http://content.doublestruck.eu/getPicture.asp?sub=AA_CH&CT=Q&org=bc4e85edfb0090d5d4c4c7777cbe9359&folder=QS06305_files&file=image003.png | 2, 2-dimethypropanal |
| http://content.doublestruck.eu/getPicture.asp?sub=AA_CH&CT=Q&org=bc4e85edfb0090d5d4c4c7777cbe9359&folder=QS06305_files&file=image004.png |  |
|  | pentan-2-one |

(a)     (i)      Complete the table.

(ii)     **Two** other isomeric carbonyl compounds with the molecular formula C5H10O are not shown in the table. One is an aldehyde and one is a ketone. Draw the structure of each.

*isomeric aldehyde*                           *isomeric ketone*

**(4)**

(b)     Pentanal, CH3CH2CH2CH2CHO, can be oxidised to a carboxylic acid.

(i)      Write an equation for this reaction. Use [O] to represent the oxidising agent.

.............................................................................................................

(ii)     Name the carboxylic acid formed in this reaction.

.............................................................................................................

**(2)**

(c)     Pentanal can be formed by the oxidation of an alcohol.

(i)      Identify this alcohol.

.............................................................................................................

(ii)     State the class to which this alcohol belongs.

.............................................................................................................

**(2)**

**(Total 8 marks)**

Answers

Question 1

(a)     (i)      Hexan-1-ol1

ONLY

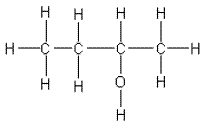
1

(ii)     Homologous (series)

ONLY

1

(iii)     Displayed formula for butan-2-ol



All bonds must be drawn out including the O–H bond

Ignore bond angles

1

(iv)    CH3CH2CH2CH2OH + [O] http://content.doublestruck.eu/getPicture.asp?sub=AA_CH&CT=M&org=bc4e85edfb0090d5d4c4c7777cbe9359&folder=MW11209_files&file=image002.png CH3CH2CH2CHO + H2O

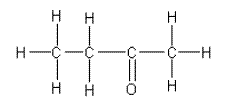
Require this whole equation as written or formulae drawn out

Penalise “sticks”

1

(v)     Displayed formula for butanone

(credit possible enols, ethers and cyclic structures for C4H8O)



All bonds must be drawn out Ignore bond angles. 1

Question 2

(a)     (i)      M1 pentan-3-one only

**1**

M2 CH3CH2CH2COCH3

*(insist on C=O being drawn out)*

*(penalise use of C3H7)*

**1**

(ii)     *aldehyde*         (CH3)2CHCH2CHO

**1**

*ketone*             (CH3)2CHCOCH3

**1**

*(insist on a clear structure for the C=O of the functional groups, but do not be too harsh on the vertical bonds between carbon atom son this occasion)*

*(If both structures correct, but wrong way around, award one mark)*

*(ignore names)*

(b)     (i)      CH3CH2CH2CH2CHO + [O] → CH3CH2CH2CH2COOH

*(accept C4H9CHO going to C4H9COOH)*

*(insist on a balanced equation – for example do not credit [O] over the arrow alone)*

**1**

(ii)     pentanoic acid

*(credit pentan–1–oic acid)*

**1**

(c)     (i)      CH3CH2CH2CH2CH2OH OR pentan–1–ol

*(If both a structure and a formula are given, credit either correct one of these provided the other is a good, if imperfect, attempt)*

**1**

(ii)     Primary

*(credit 1o or 1)*

**1**

**[8]**