The Chemistry of Cooking and Oxidation of Food

1. Which of the following is an aldehyde?

2. Which is true of a compound with the following formula?

   \[ \text{CH}_3\text{CH(OH)CH}_3 \]

   A. It is a primary alcohol
   B. It can be oxidised to an aldehyde
   C. It is a tertiary alcohol
   D. It can be oxidised to a ketone.

3. Which process is used to convert methanol to methanal?

   A. oxidation
   B. condensation
   C. hydration
   D. hydrogenation
4. Which of the following alcohols can be oxidised to give a ketone?
   A  2-methylbutan-1-ol
   B  2,3-dimethylpentan-1-ol
   C  3-methylbutan-2-ol
   D  2-methylbutan-2-ol

5. Ethanol vapour is passed over hot aluminium oxide.
   What kind of reaction occurs?
   A  Hydrogenation
   B  Dehydration
   C  Hydrolysis
   D  Dehydrogenation

6. After heating for several minutes as shown in the diagram, the pH indicator
   solution turned red.
   Liquid Q could be,
   A  propanone
   B  paraffin
   C  propan-1-ol
   D  propan-2-ol
7. The dehydration on butan-2-ol can produce two isomeric alkenes, but-1-ene and but-2-ene. Which of the following alkanols can similarly produce, on dehydration, a pair of isomeric alkenes?

A  propan-2-ol
B  pentan-3-ol
C  hexan-3-ol
D  heptan-4-ol

8. What compound is formed by the oxidation of propan-2-ol?

A  CH₃CH₂CHO
B  CH₃CO CH₃
C  CH₃CH₂COOH
D  CH₃CH₂ CH₂OH

9. \[ \text{CH}_3 - \text{CH} = \text{CH}_2 \]

\[ \text{reaction X} \]

\[ \text{CH}_3-\text{CH}_2-\text{CH}_2-\text{OH} \]

\[ \text{Reaction Y} \]

\[ \text{CH}_3-\text{CH}_2-\text{COOH} \]

Which line in the table correctly describes reaction X and Y?

<table>
<thead>
<tr>
<th>Reaction X</th>
<th>Reaction Y</th>
</tr>
</thead>
<tbody>
<tr>
<td>A  hydration</td>
<td>oxidation</td>
</tr>
<tr>
<td>B  hydration</td>
<td>reduction</td>
</tr>
<tr>
<td>C  hydrolysis</td>
<td>oxidation</td>
</tr>
<tr>
<td>D  hydrolysis</td>
<td>reduction</td>
</tr>
</tbody>
</table>
10. Vanillin and zingerone are flavour molecules.

![Vanillin and Zingerone Structures]

Which line in the table correctly compares the properties of vanillin and zingerone?

<table>
<thead>
<tr>
<th></th>
<th>More soluble in water</th>
<th>More volatile</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>vanillin</td>
<td>vanillin</td>
</tr>
<tr>
<td>B</td>
<td>vanillin</td>
<td>zingerone</td>
</tr>
<tr>
<td>C</td>
<td>zingerone</td>
<td>vanillin</td>
</tr>
<tr>
<td>D</td>
<td>zingerone</td>
<td>zingerone</td>
</tr>
</tbody>
</table>

11. Propanone is a widely used solvent. It can be made from propene.

Using full structural formulae show the steps involved in this preparation and name the reagent used in each step. (2)
12. Butan-2-ol reacts in different ways

\[ \text{dehydration} \]

\[ \text{butan-2-ol} \]

\[ \text{oxidation} \quad \text{condensation with ethanoic acid} \]

\[ \text{butanone} \]

(a) Name the two products formed by the dehydration of butan-2-ol (1)
(b) Name a reagent which could be used to oxidise butan-2-ol to butanone. (1)

13. Although aldehydes and ketones have different structures, they both contain the carbonyl functional group.

(a) In what way is the structure of an aldehyde different from that of a ketone? (1)

(b) As result of this difference in structure, aldehydes will react with Fehling’s (or Benedict’s) solution and Tollens’ reagent but ketones do not. What colour change would be observed when propanal is heated with Fehling’s (or Benedict’s) solution? (1)

(c) In the reaction of propanal with Tollens’ reagent, silver ions are reduced to form silver metal.

Complete the following ion-electron equation for the oxidation.

\[ C_3H_6O \rightarrow C_2H_5COOH \] (1)

14. Cooking changes the appearance and composition of food.
Using your knowledge of chemistry, comment on the changes to food which may occur during cooking.

15. Alkenes can react with oxygen to produce unstable compounds called peroxides. These peroxides rapidly break down to produce compounds which have the same functional group.

For example alkene $X$ reacts to form compounds $Z$ and $Y$.

(In the following structural formulae $R'$ and $R''$ are used to represent different alkyl groups.)

(a) To which homologous series do both compounds $Y$ and $Z$ belong? (1)
(b) In one reaction alkene $X$ produces the two compounds shown below.

16. Peeled apples turn brown due to the reaction of compounds called phenols.

The first two steps in the reaction of one phenol, $A$ are:
17. Alcohols can be prepared by the reaction of carbonyl compounds with methyl magnesium bromide. The reaction takes place in two stages.

Stage 1: Methyl magnesium bromide reacts with methanal in an addition reaction across the carbonyl group.

\[
\text{H}_2\text{C}=\text{O} + \text{H} - \text{C} - \text{MgBr} \rightarrow \text{H} - \text{C} - \text{C} - \text{O} - \text{MgBr}
\]

methanal \hspace{1cm} \text{methyl magnesium bromide}

Stage 2: Reaction of the product with water produces ethanol

\[
\text{H} - \text{C} - \text{C} - \text{O} - \text{MgBr} + \text{H}_2\text{O} \rightarrow \text{H} - \text{C} - \text{C} - \text{OH} + \text{MgBrOH}
\]

ethanol

(a) Suggest a name for the type of reaction which takes place in stage 2. (1)
(b) Draw a structural formula for the product obtained if propanone had been used instead of methanal.  

18. The following compounds are found in foodstuffs.

(a) Explain why furaneol is soluble in water but capsaicin is not.  
(b) Capsaicin is found in chilli peppers and is responsible for the burning sensation you experience when you eat them. Milk is used to relieve the sensation as the milk dissolves the capsaicin.  
   What substances present in milk allow the capsaicin to be dissolved?