

MINISTRY OF EDUCATION
SECONDARY ENGAGEMENT PROGRAMME
GRADE 11
CHEMISTRY

WEEK 7

LESSON 1

Topic: Organic Compounds

Sub-topic: Reactions of Alcohols

Objective: Given equations for reactions, students will predict the products of reactions given the other members of the alcohol family.

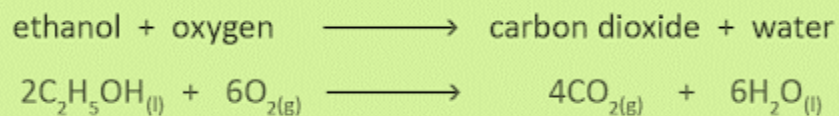
Content

In this lesson, the reactions of ethanol, alcohol with two Carbon atoms per molecule, will be studied.

Reactions of Ethanol

1. Ethanol burns easily in air or oxygen

The products of this reaction are Carbon Dioxide, and water in the form of steam. Ethanol burns with a clear blue, non-smoky flame. The equation for this reaction is:



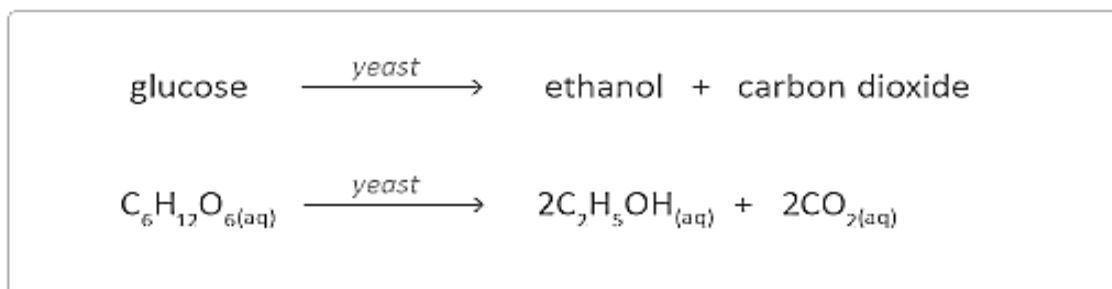
When the orange acidified potassium dichromate (VI) crystals are in the presence of ethanol vapour (from the breath of a driver who has consumed alcohol), the orange Cr_2O_7^- ion is reduced to the green chromium (III) ion (Cr^{3+}). This turns the crystals green. For this reason, the acidified potassium dichromate (VI) crystals are used in the breathalyzer test to determine the alcohol content of a driver's breath.

5. Ethanol reacts with alkanolic acids

Ethanol reacts with alkanolic acid to produce an ester and water. This reaction will be covered in further detail in the lesson with the reaction of alkanolic acids.

6. Production of Ethanol by fermentation of Carbohydrates

Yeast is used to ferment carbohydrates since the yeast produces enzymes that break down these complex carbohydrates into simple sugars, mainly glucose. The yeast then produces the enzyme zymase which changes the simple sugars into ethanol and carbon dioxide.



Fermentation of carbohydrates is used to produce a variety of alcoholic beverages, including wine and rum. However, in the production of wine, air should not come into contact with the wine, because aerobic bacteria oxidize the ethanol to ethanoic acid (vinegar), causing the wine to become sour.

Summary Table of Reactions

<p>1. Oxidation : Alcohol is oxidized with alkaline $K_2Cr_2O_7$ at room temperature.</p> $CH_3OH \xrightarrow{K_2Cr_2O_7, [O]} HCHO + H_2O \xrightarrow{K_2Cr_2O_7, [O]} HCOOH$	<p>2. Combustion of ethanol : Ethanol burns with a sooty flame.</p> $C_2H_5OH + 3O_2 \rightarrow 2CO_2 + 3H_2O + \text{Heat}$
<p>3. Reaction with acetic acid (esterification) : alcohol + carboxylic acid \rightarrow ester + water</p> $CH_3OH + CH_3COOH \rightarrow CH_3COOCH_3 + H_2O$ <p style="text-align: center;">Methyl Acetate</p>	<p>4. Dehydration with conc. Sulphuric acid :</p> <p>Alcohol + $H_2SO_4 \rightarrow$ alkene + H_2O</p> $C_2H_5OH \xrightarrow[\text{Heat}]{H_2SO_4} CH_2=CH_2 + H_2O$
<p>5. Halogenation (haloalkanes are produced):</p> $3CH_3OH + PCl_3 \rightarrow 3CH_3Cl + H_3PO_3$ <p style="text-align: center;">Chloromethane</p>	<p>6. Reaction with Halogen Acids (haloalkanes are produced):</p> <p>Alcohol + Haloacid \rightarrow Haloalkane + water</p> $CH_3OH + HCl \rightarrow 3CH_3Cl + H_2O$
<p>7. Reduction :</p> <p>Alcohol + $2HI \rightarrow$ Alkane + water + I_2</p> $CH_3OH + HI \rightarrow CH_4 + H_2O + I_2$	<p>8. Reaction with Sodium :</p> <p>Alcohol + Sodium \rightarrow Sodium alkoxide + H_2</p> $2CH_3OH + 2Na \rightarrow 2CH_3ONa + H_2$
<p>9. Reaction of Sodalime :</p> <p>Alcohol + Sodalime \rightarrow Sodium Ethanoate + Hydrogen</p> $C_2H_5OH + NaOH \rightarrow CH_3COONa + 2H_2$	<p>Dehydrogenation :Alcohol $\xrightarrow[-H_2]{Cu, 300^\circ C}$ Aldehyde</p> $C_2H_5OH \xrightarrow[-H_2]{Cu, 300^\circ C} CH_3CHO$

Bibliography

Tindale, A. (2016). Reactions of Ethanol. In A. Tindale, *Concise Revision Course CSEC Chemistry* (pp. 141-142). London: HarperCollins Publishers Ltd.