

## Problem 4: Alcohol detective

### Curriculum links;

alcohols – nomenclature and classification, oxidation, redox equations

### Practical skills;

distillation, chemical tests

The students use distillation to purify two samples of fake vodka seized by the local police and then identify the nature of the alcohol as ethanol or tert-butanol from its boiling point. The identity of the alcohol is then confirmed using standard test tube reactions (potassium dichromate and the iodoform test).

### Extension discussion points:

- What is the mechanism of the iodoform reaction?
- Why was it important that the samples had been freeze-dried and all water removed?

### Pre-Lab questions

(Remember to give full references for any information beyond A-level that you find out)

1. Two liquids which are miscible can be separated by distillation. Draw a fully labelled diagram of the equipment you would use to carry out a distillation. Mark with an X the most accurate place to record the boiling point of the distillate (the solution you are collecting)?

2. Find out the boiling points of the following alcohols and place them in order of increasing boiling point.

Explain the trend observed.

methanol; butan-1-ol; ethanol; glycerol (propane-1,2,3-triol); 2-methylpropan-2-ol

3. Short chain alcohols such as ethanol are completely miscible with water. Draw a diagram to explain why.

4. Describe a simple chemical test (or series of chemical tests) that can be used to distinguish between the following pairs of alcohols;

$\text{CH}_3\text{CH}_2\text{OH}$  and  $\text{CH}_3\text{CH}(\text{OH})\text{CH}_3$

$\text{CH}_3\text{CH}(\text{OH})\text{CH}_3$  and  $(\text{CH}_3)_3\text{COH}$

$\text{CH}_3\text{OH}$  and  $\text{CH}_3\text{CH}_2\text{OH}$

Scientific Support Unit  
Lincolnshire Constabulary  
Northampton Street  
Kings Heath  
Lincoln  
LN1 1DU



Dear scientist,

Bottles of counterfeit vodka have recently been seized from a shop in Scunthorpe by North Lincolnshire Council, Trading Standards officers. The seized bottles were labelled as Smirnoff vodka and Glen's vodka but tests have shown that they do not contain vodka as defined by the Spirit Drinks Regulations 2008. The alcohol in samples of the fake vodka was believed to be from non-agricultural tertiary butanol (2-methylpropan-2-ol) (North Lincolnshire Council, PR4887, Fake vodka seized in Scunthorpe, 17th August 2011). Production and distribution of such products is a serious offence.

We recently had a tip off as to the origin of the counterfeit vodka. Investigations, revealed an illegal distillery in a small shed located in the back garden of a private house in the city centre. The house owner claims to be producing only small quantities of vodka via the fermentation of potato starch for personal consumption.

We have supplied you with a sample of vodka from the back garden shed distillery (labelled Sample A) and a sample of the seized counterfeit vodka (labelled sample B). In both cases the water has been removed by freeze drying leaving only the residual alcohol and other contaminants. We would like you to extract the alcohol from both samples and carry out tests to confirm the identity of the type of alcohol present in each. Vodka produced via fermentation will contain only ethanol, whereas we believe the counterfeit vodka will contain tertiary butanol.

The results of your findings will be presented in court as evidence in the prosecution of the owner of the shed distillery. Please therefore provide a full report of your investigations including detailed results to support any conclusions that you reach.

Many thanks,

A handwritten signature in blue ink that reads 'R. Freeman'.

DC R. Freeman