

5 Determination of Boiling Points

Purpose: The object of this experiment is to identify a liquid from its boiling point.

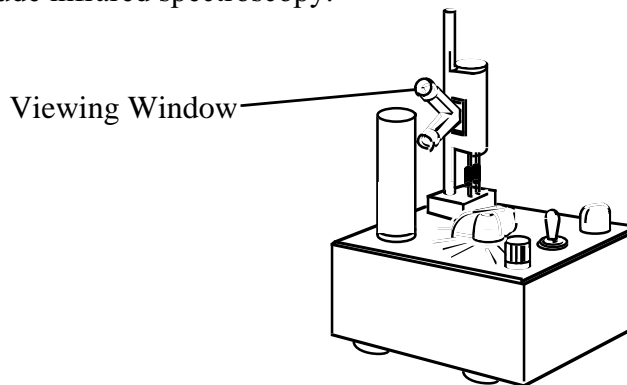
Introduction

The boiling point of a compound is the temperature at which it changes from a liquid to a gas. Like melting points, boiling points are characteristic properties of pure materials. Boiling points are approximately related to their molecular weight. The higher the molecular weight, the higher the boiling point.

Boiling points are difficult to measure accurately. The range is often several degrees. A crude estimate is sufficient for identifying the unknowns used in this experiment. Chemists use melting points for solids much more than they use boiling points to identify liquids. Other methods for identifying liquids include infrared spectroscopy.

Apparatus

The MelTemp apparatus can also be used to measure boiling points, which are more difficult to measure than melting points.



Procedure

Measuring Boiling Points

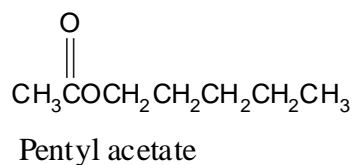
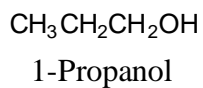
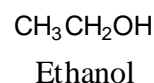
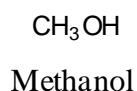
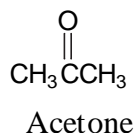
1. For this you will need a capillary tube closed on one end and a tiny "minipipet" (a narrower capillary tube open on both ends). The closed tube should be shorter by about 1 cm than the pipette. Break the closed tube if necessary. Dip the pipette into the liquid sample to fill it by capillary action. Place its contents inside the closed tube using the following procedure. Slide the pipette gently all the way down into the closed tube. The narrow space between the two capillaries works as an even narrower capillary and therefore the liquid will pull out from the pipette into the closed tube. By moving the pipette up and down (and adding some more liquid to the contents of the closed tube if necessary) you should try to force some liquid and a tiny air bubble into the pipette. Push the pipette back into the closed tube and you are ready for boiling point measurement. Since the size of the bubble that you placed into the pipette will dramatically increase when you reach the boiling point, it can be used as an indicator of boiling.



Determination of Boiling Points (cont'd)

- Place the closed tube and pipette assembly into the sample compartment as your instructor has shown you. Set the power level control between 3 to 5. As the temperature gradually increases so does the size of the bubble. Close to the boiling point the bubble starts to swell really fast, pushing up the liquid column above it. Now turn the power level control back to zero, and watch for the liquid to start drawing back into the inner tube. The temperature at which this happens is the boiling point. Record this temperature on the data sheet
- Repeat with unknowns. In this experiment the samples will be one of those listed in the table below.

Compound	b.pt. °C
acetone	56-57
methanol	65
ethanol	78-79
1-propanol	97
water	100
pentyl acetate	149



Data and Results (Boiling Points)

Name(s) _____

Sample	b.p. measured °C	b.p. from table °C *	Compound
Known			

* Choose the one that is closest to your measured value.

Question:

Which of the compounds, ethanol (C₂H₆O) or methanol (CH₄O) should have the higher b.p.? Explain.

Instructor's Guide

Determination of Boiling Points

Instructor's notes: Pour the samples into 250 mL beakers and mark the beakers with a code number. The beakers should be kept at a central location and the students should get their samples from that location.

(Data and Results)

Sample	b.p. measured °C	b.p. from table °C *	Compound
Known	100-102	100	<i>water</i>
1	97-99	97	<i>1-propanol</i>
2	56-58	56-57	<i>acetone</i>
3	149-152	149	<i>pentyl acetate</i>
4	78-81	78-79	<i>ethanol</i>
5	65-68	65	<i>methanol</i>

* Choose the one that is closest to your measured value.

Question:

Which of the compounds, ethanol (C₂H₆O) or methanol (CH₄O) should have the higher b.p.? Explain.

Ethanol. It has a higher molecular weight than methanol. Otherwise, the structures are similar.

Instructor's Guide
Determination of Boiling Points (cont'd)

Time: 40 min

Equipment and Materials: 1 group

Items	Number	Comment
MelTemp & power cord	1	
thermometers	1	
closed capillary tubes	3 packs	closed on one end
open capillary tubes	1 pack	open on both ends
known sample	1 per class	Distilled water
unknown samples	1 each per class	acetone, methanol, ethanol, 1-propanol, pentyl acetate
250-mL beakers	6 per class	
Waste glass container	1 per class	
gloves	1 box per class	
Safety glasses	1 per student	
marker	1 per class	

Ideas/ Information

Another method for determining boiling points is distillation.