

#2 Density of Liquids

Purpose: The object of this experiment is to identify a liquid by measuring its density.

Introduction

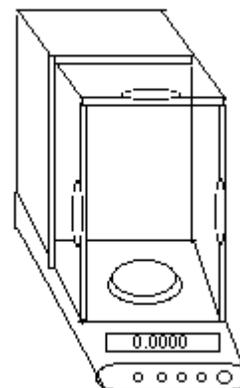
In this lab, the mass (m) and volume (V) of a liquid will be measured, and its density ($D = m/V$) calculated. The density of a liquid changes with temperature. Densities in the table provided are listed for two temperatures, 20 and 25°C. You will have to estimate the tabulated densities at the temperature of your sample.

Apparatus:

To weigh a liquid, a weighing bottle (with lid) is placed on the analytical balance, the ones with doors to avoid the effect of air currents. The balance is then zeroed by pressing the blue “ZERO” or “TARE” key on the front face, giving a digital display of 0.000 or 0.0000 g.

CAUTION: Do not overload balances. Capacity < 120 g.

The volume of liquid is measured using a transfer or volumetric pipette designed to deliver 10.00 mL. The volume indicated on the pipette is measured out by letting go all the liquid below the mark. You must not force out the last drops. Just touch the lower tip of the pipette to the wall of the container, so that no drop remains hanging on the tip. Your instructor will show you how to measure liquids using the pipette and a pump.



Analytical Balance

Procedure:

Identifying a Liquid from its Density

1. Measure ambient temperature and record on data sheet. Record the sample code letter on the data sheet.
2. Place a weighing bottle with lid on the balance and then press “Zero” or “Tare.” (Most of the liquid unknowns evaporate readily, so a weighing bottle is required.) Remove the weighing bottle from the balance.
3. Using the volumetric pipette (right) with a pump, pipette 10.00 mL of sample into the weighing bottle. Place the weighing bottle on the balance. Record the mass.

CAUTION: *Never* pipette by mouth.

4. Calculate the density and then use the table of liquid densities below to identify the unknown. Estimate the density at the temperature of your sample.



Liquid, formula	Density g/ml (20°C)	Density g/ml (25°C)
Cyclohexane, C ₆ H ₁₂	0.7785	0.7739
isopropyl alcohol C ₃ H ₈ OH	0.7854	0.7812
methyl ethyl ketone C ₄ H ₈ O	0.8049	0.7997
ethyl acetate, C ₄ H ₈ O ₂	0.9006	0.8945

Data and Results (Density of Liquids)

Name(s) _____

Identifying a Liquid from its Density

Record Code Letter of your unknown(s)

Temperature _____

Code Letter	Vol. liquid (mL)	Mass liquid (g)	Measured density (g/mL)	Identity of liquid & tabulated density*

* Estimate the tabulated density for the temperature of your sample. For example, suppose the temperature of your sample is 22.5°C. You can assume that the tabulated density is halfway between the recorded values.

Questions:

1. Why must the volume of the liquid be at least 10 mL? Explain.
2. What is the advantage of using a weighing bottle rather than an open vessel?

Instructor's Guide (#2 *Density of Liquids*)

(Data and Results)

Identifying a Liquid from its Density

Record Code Letter of your unknown(s)

Temperature 22.5 °C

Code Letter	Vol. liquid (mL)	Mass liquid (g)	Measured density (g/mL)	Identity of liquid, tabulated density*
<i>A</i>	<i>10.00</i>	<i>7.8294</i>	<i>0.7829</i>	<i>isopropyl alcohol 0.7850</i>
<i>B</i>	<i>10.00</i>	<i>7.7177</i>	<i>0.7718</i>	<i>cyclohexane 0.7762</i>
<i>C</i>	<i>10.00</i>	<i>8.9641</i>	<i>0.8964</i>	<i>ethyl acetate 0.8976</i>
<i>D</i>	<i>10.00</i>	<i>8.0193</i>	<i>0.8019</i>	<i>methyl ethyl ketone 0.8045</i>

* Estimate the tabulated density for the temperature of your sample. For example, suppose the temperature of your sample is 22.5°C. You can assume that the tabulated density is halfway between the recorded values.

Questions:

1. Why must the volume of the liquid sample be at least 10 mL?
2. What is the advantage of using a weighing bottle rather than an open vessel?

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1. *Enough liquid is needed to provide at least three significant figures in the density calculation.*
 2. *Liquids such as ethanol evaporate readily. Some liquid could be lost during the weighing process.*

Instructor's Guide
Density of Liquids (cont'd)

Time: 30 min

Equipment and Materials: 1 group:

Items	Number	Comment
analytical balance, power cord	1	
thermometer	1	
weighing bottle with lid	4	
Volumetric pipettes 10.00 mL	4 per class	one for each of the unknowns
pipette pumps	4 per class	
250 mL beakers	4 per class	these are for collecting the sample. Never dip pipettes into an unknown liquid.
unknown samples	4 per class	cyclohexane, isopropyl alcohol, methyl ethyl ketone, ethyl acetate
marker	1 per class	Used to label beakers
safety glasses	1 per student	

Ideas/ Information

Instructor's Notes: Before beginning the experiment pour each of the unknown samples into a 250 mL beaker labeled with a code letter, and designate a pipette for each.