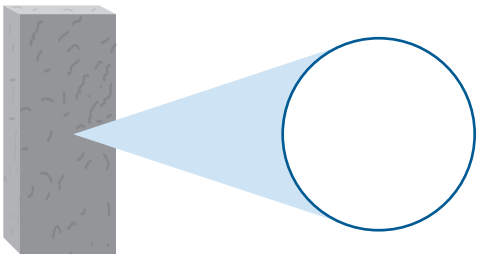
Determining Properties of an Unknown Substance

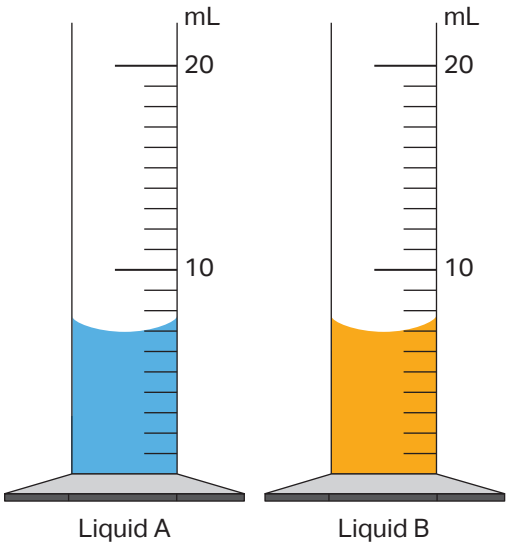
PRACTICE PERFORMANCE TASK

A student is given a solid block of an unknown pure substance. They are told the mass of the block is 42.13 g.

(a) The figure below is designed to show how the particles in the block are arranged. However, the figure is not complete. Complete the figure by drawing a particle diagram of the unknown substance in the empty circle.

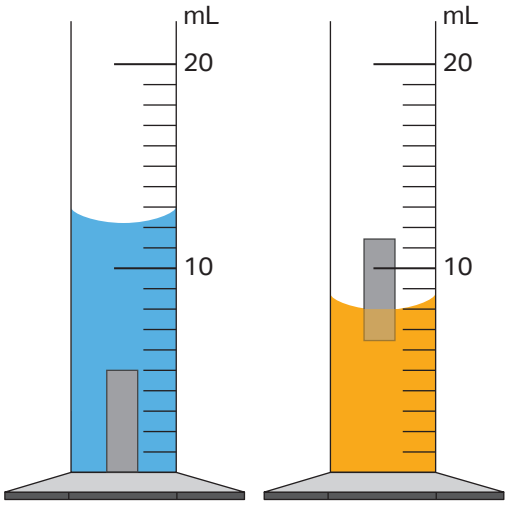


Next, the student is given two liquids and asked to rank the densities of the liquids and the solid block. The student measures out equal volumes of each liquid into two graduated cylinders as shown below.



PRACTICE PERFORMANCE TASK

The student then places the block into each cylinder and observes the following:



(b) Rank the liquids and the solid in order of **increasing** density. Justify your answer.

(c) The student records the volume of the liquid in each cylinder after the solid was placed in it. What volumes should the student record, to proper experimental precision?

Liquid A _____

Liquid B _____

(d) Recall from part (a) that the mass of the block is 42.13 g. Based on this information and the diagrams above, calculate the density of the block to proper experimental precision.

PRACTICE PERFORMANCE TASK

The student is then asked to determine the specific heat capacity of the block. To do so, the student heats the block to an initial temperature of 75.0°C. They then quickly move the block into a 62.00 g sample of water at 23.2°C and record the final temperature of the water as 26.0°C. The data collected are summarized in the table below.

Mass of block (g)	42.13
Initial temperature of the block (°C)	75.0
Mass of water (g)	62.00
Initial temperature of water (°C)	23.2
Final temperature of water (°C)	26.0

(e) Calculate how much heat energy was gained by the water during the experiment. The specific heat capacity of water is 4.18 J/(g • °C).

(f) Calculate the specific heat capacity of the block.