Name:

Period:

LAB 5.3 – THE OVERFLOW CONTAINER AND THE GRADUATE

BACKGROUND

We know how to use formulae to calculate the volume of objects with straight sides. However, not all objects are so readily measured. For objects that are irregular in shape, it is nearly impossible to measure and calculate using a ruler. The best you could do would be to estimate (like we did for irregular shapes on a metric area grid).

However, there are a few tools that we can use to more easily measure the volume of an irregularly shaped object.

PROBLEM

What ways can we measure the volume of an irregularly shaped object?

MATERIALS

- metric area grid
- metric ruler
- calculator (optional)
- graduated cylinder (100mL) – this is also known as a "graduate"
- beaker (250mL)
- beaker (600mL)
- overflow container
- water
- apron and goggles
- various irregular objects

PROCEDURE

1. Determine which side is the base of your object. Use the metric area grid to measure the area of the base. Record your results in table 5.3-1.

2. Measure the height of your object. The height of the object is from the base upwards. Record your results in table 5.3-1.

3. Write down the formula for the volume of an object _____. Use that formula to determine the estimated volume of your object. Record your results in table 5.3-1.

4. Check your results with Mr. Koerger. Get his initials here _____.

5. Read the information at the back of this packet on how to use a graduated cylinder. Pay careful attention to the part about the ***meniscus*** as you will be required to know about that in the future.

6. Put between 25mL and 50mL of water in the 100mL graduated cylinder. Record the actual amount in table 5.3-1.

7. Place your object in the graduate. Notice that the water level increases as the object enters the water. Record the new water level in the graduated cylinder.

8. The difference in the water level is the volume of the object. Subtract the first reading from the second reading to determine the volume of the object. This value should hopefully be close to the estimated volume that you calculated earlier.

9. Show your results to Mr. Koerger and get his initials here _____

10. Read the information on using an overflow container at the back of this packet.

11. Fill and calibrate the overflow container using the following steps.
    a. Place the 250mL beaker under the nozzle.
    b. Fill the overflow container with water until water starts coming out the nozzle.
    c. Wait for the water to stop flowing out of the nozzle
    d. Empty the 250mL beaker into the sink, then put the 250mL beaker back under the nozzle.
    e. Your overflow container is now calibrated.

12. Using the metric area grid and a ruler, estimate a larger object's volume. Record your results in table 5.3-2.

13. Carefully place the object into the calibrated overflow container. Water will spill out through the nozzle into the 250mL beaker. *If water spills over the top of the overflow container, the results are invalid – you must recalibrate your overflow container and try again.*

14. Wait for the water to stop flowing out of the nozzle. If it is dripping slowly but won't stop, you may gently tap the end of the nozzle as demonstrated by Mr. Koerger.

15. Read the volume of liquid on the side of the beaker. Be careful to use the correct scale (the one that starts from the bottom). Record your results in table 5.3-2.

16. Pour the water from the beaker an **empty** 100mL graduate. If you accidentally forget to empty the graduate first, your results are invalid and you must start again.

17. Read the volume of the liquid in the graduate and record your results in table 5.3-2. This is the actual volume of the object. Note, depending on how accurate your measurements were, this should be close to the estimated volume from step 12.

18. If you have time, you may repeat steps 12 – 17 for another object. This would be a good idea so that both you and your lab partner get a chance to work with the equipment.

19. Clean up your lab station.

SUMMARY

Summary and Challenge Questions must be typed or written neatly on a separate piece of paper.

1. What are the two metric units for measuring volume in this lab?

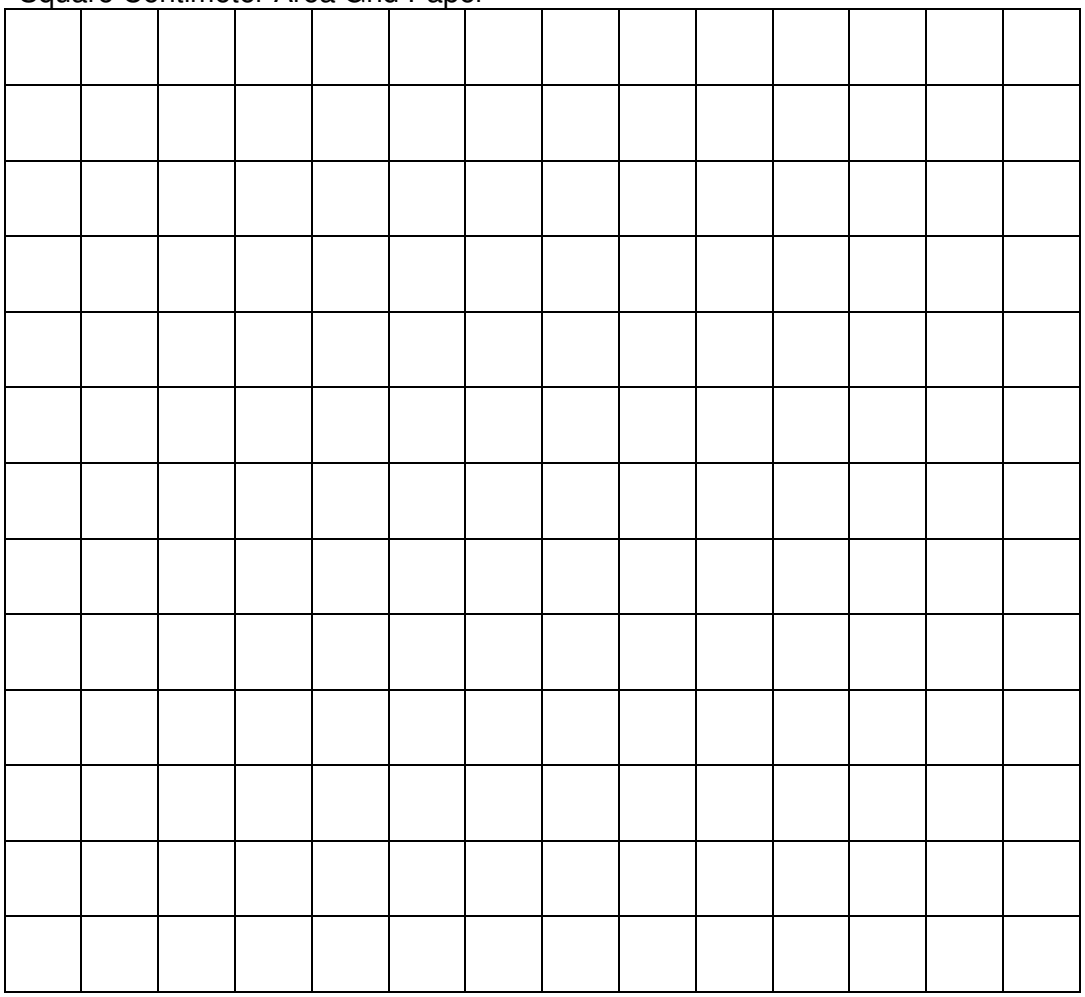
2. What is the difference between using a beaker to measure volume and using a graduated cylinder?

3. Step 6 says to put between 25mL and 50mL of water in the graduate. Why doesn't it matter exactly how much goes in?

4. Do you think it is possible to measure the volume of an absorbent material (like a sponge) in a graduated cylinder? Why or why not?

5. Why should you only read a graduate when it is on a level surface?

Square Centimeter Area Grid Paper



Using a Graduated Cylinder to Measure Volume

A *graduated cylinder* (also called a *graduate*) used to measure volume is marked in milliliters. A volume of 1 mL is equal to a volume of 1 cm^3.

To measure the volume of a liquid, follow these steps:

1. Set the graduate on a flat, level surface and pour the liquid to be measured into it.

2. Bring your eyes directly opposite the bottom of the *meniscus*, the thick curved band marking the surface of the liquid. See Figure 17.

3. Read the volume of the liquid.

   a. Read the mark at the bottom of the meniscus.

   b. Estimate the volume in tenths of the unit marked on the graduate.

4. Record the volume in the measured unit or its equivalent.

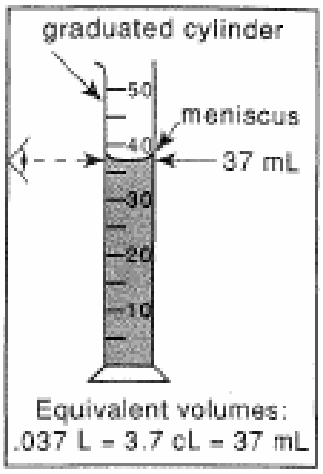


Figure 17 Reading a graduated cylinder

Equivalents of some units of volume:

1 L	=	100 cL	=	1,000 mL
.01 L	=	**1 cL**	=	10 mL
.001 L	=	.1 cL	=	**1 mL**

Using an Overflow Container to Measure Volume

An object put into an *overflow container* full of liquid pushes some of the liquid out of the container as the object sinks. The liquid that is pushed out is called *displaced liquid*. It flows through the spout of the overflow container into a *catch container*.

The volume of an object that sinks completely is equal to the volume of the displaced liquid. But if the object floats, the volume of the displaced liquid is equal to just the volume of the submerged part of the object.

To measure the volume of a solid object, follow these steps:

1. Fill the overflow container with water. Let the excess water flow through the spout into a catch container. Empty the excess water from the catch container.

2. Put the empty catch container under the spout of the overflow container.

3. Determine the volume of the object.

   a. Put the object into the overflow container.

   b. Let the displaced water flow into the catch container.

   c. Pour the displaced water into a graduated cylinder. See Figure 18.

4. Read the volume of displaced water in the graduated cylinder. See points 2 and 3 under "Using a Graduated Cylinder to Measure Volume" for information on reading marks on a graduated cylinder.

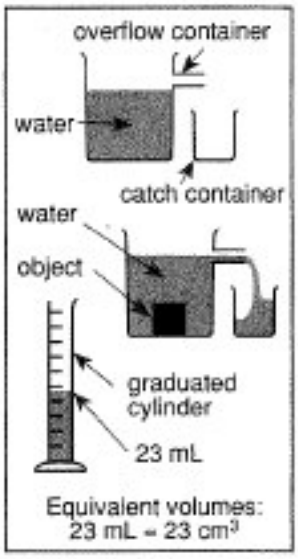


Figure 18 Using an overflow container to measure volume