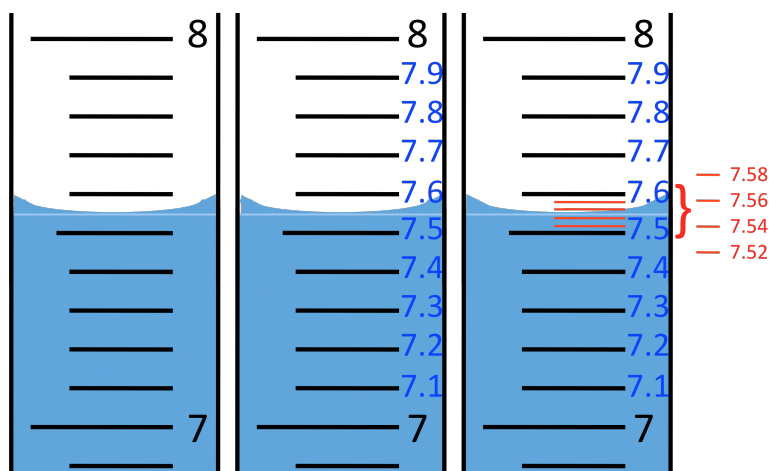


Reading Graduated Glassware

Reading graduated cylinders.

The figure at right shows a portion of a 10-mL graduated cylinder filled with a liquid. Each marked gradient is 0.1 mL. These tenths are not marked on the glassware, but you must imagine them as shown in blue on the second figure. When reading a graduated cylinder, start by determining the volume to the first number not printed on the glassware – the blue number in this example. Using the example at right, we would start by concluding that the volume is between 7.5 and 7.6 mL.



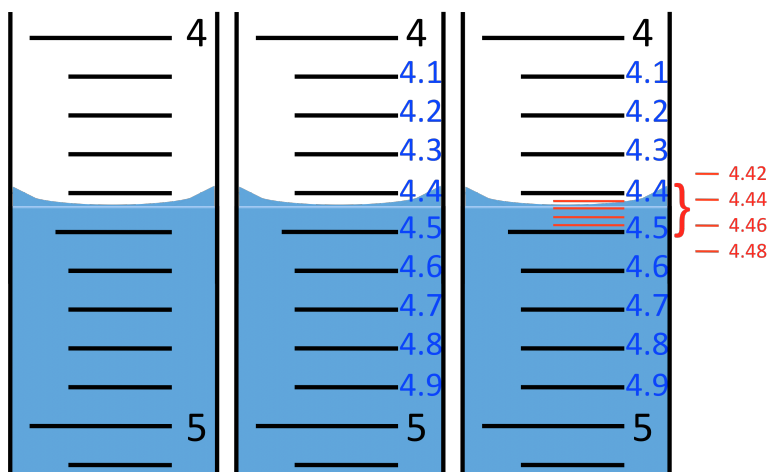
We can always estimate one place between any two printed lines. So our next step is to estimate the hundredths place in this example. This task is shown in the third figure, with red print. I have marked the even number of hundredths (7.52, 7.54, 7.56, and 7.58 mL) because it is a bit crowded to include all the numbers. Nevertheless, we can imagine the odd numbered hundredths, such as 7.51 or 7.57 mL, and so on. Read the volume of the liquid shown. What did you get? Answers such as 7.54, 7.55 or 7.56 mL are all equally correct. Reading this printed meniscus is clearly 7.55 mL, but reading a real meniscus is more difficult and uncertainty exists in the hundredths place.

Sometimes the meniscus rests exactly on a line marked with a number, such as 7 mL on the graduated cylinder, in which case we would read it as 7.00 mL. The meniscus can also rest on a marked tenths line (the ones numbered with blue). Suppose the meniscus rested exactly on the line marked 7.8 mL. One would correctly write the volume read as 7.80 mL. Other readers may report 7.79 mL or 7.81 mL. All are equally correct, assuming the actual volume was 7.80 mL. In general, you should be able to record two places past the numbers written on the glassware. With a 10 mL graduated cylinder, the printed numbers are 1, 2, 3, etc., so you can read x.xx mL. With larger graduated cylinders, such as a 100 mL graduated cylinder, the printed numbers are 10, 20, 30, etc., so you can read xx.x mL.

Reading burets and Mohr pipets.

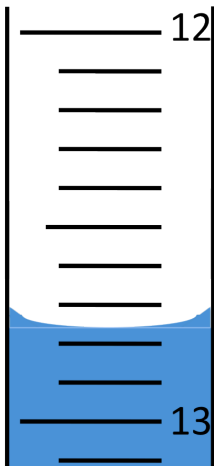
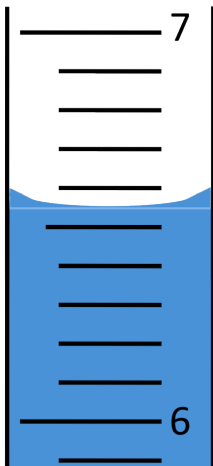
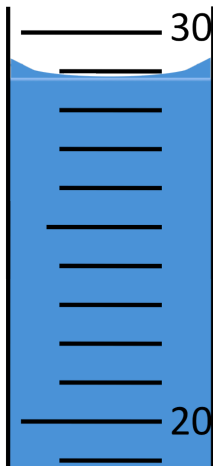
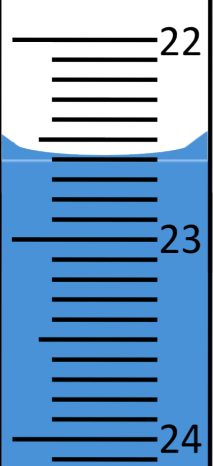
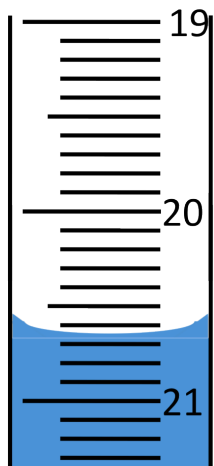
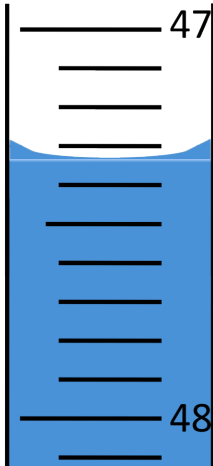
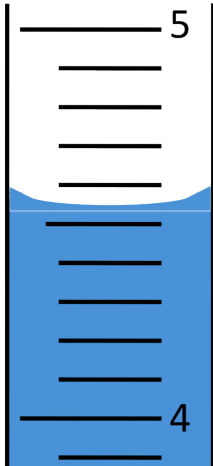
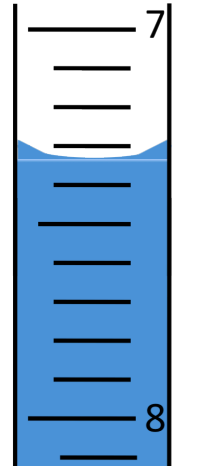
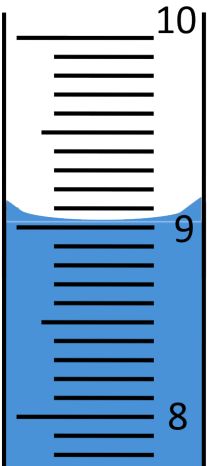
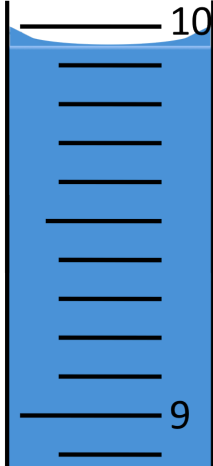
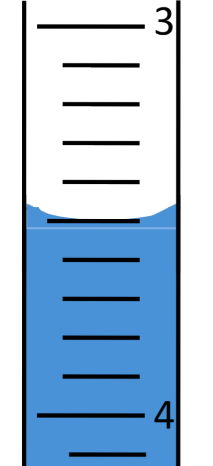
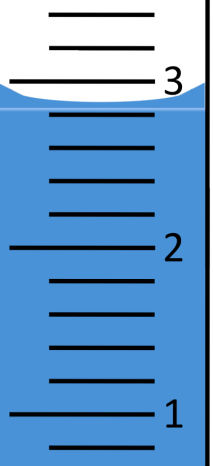
The figures shown at right are of a portion of a 10-mL buret or Mohr pipet. Notice that the numbers increase from top to bottom – just the opposite of the graduate cylinder. This is why one should read volumes in these three steps:

1. Note which direction the numbers increase,
2. Imagine the blue numbers – maybe say them out loud, “between 4.4 and 4.5, but closer to 4.4” and then
3. imagine the red numbers. You should get about 4.43 mL.



Reading glassware with the Buddy System. Reading volumes is always tricky – have your lab partner read the same measurement, and then compare readings.

Practice problems. Read these volumes and write your answer next to the figure. These volumes are mixed – some are of burets, some are of Mohr pipets and some are of graduated cylinders.

<p>Problem 1</p>  <p>Answer:</p>	<p>Problem 2</p>  <p>Answer:</p>	<p>Problem 3</p>  <p>Answer:</p>	<p>Problem 4</p>  <p>Answer:</p>
<p>Problem 5</p>  <p>Answer:</p>	<p>Problem 6</p>  <p>Answer:</p>	<p>Problem 7</p>  <p>Answer:</p>	<p>Problem 8</p>  <p>Answer:</p>
<p>Problem 9</p>  <p>Answer:</p>	<p>Problem 10</p>  <p>Answer:</p>	<p>Problem 11</p>  <p>Answer:</p>	<p>Problem 12</p>  <p>Answer:</p>

Check answers at lab website.