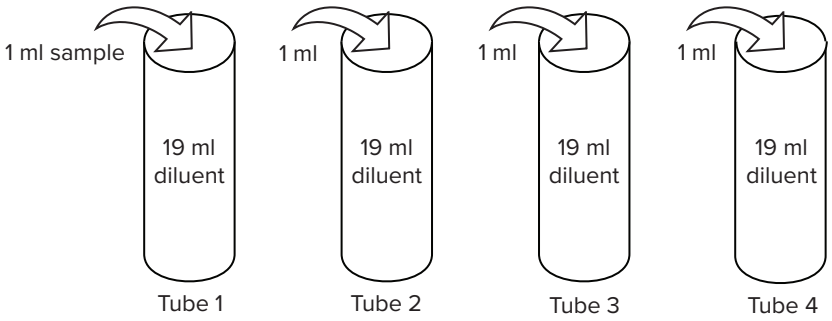
Activity 1.1.5 Student Resource Sheet Serial Dilutions

In the lab, scientists often need to make dilutions of the same solution. Producing samples with different concentrations in a series is more time efficient than trying to prepare each sample one by one. A serial dilution is a stepwise dilution of a substance in solution. Calculating serial dilutions involves expressing the amount of sample in each tube as a fraction (1/X). The value of that fraction is the amount of sample (numerator) over the total volume (sample + diluent) in the tube (denominator). The diluent is the liquid that is doing the diluting. See the example below:



1 ml sample
+19 ml diluent
20 ml total volume

The dilution in Tube 1 = 1/20. Reduce the fraction if necessary.

Each tube dilution needs to be calculated and expressed as a fraction in the same way. Then, to determine the final sample dilution, multiply the fractions from each tube. In the example, the final dilution in Tube 2 is the dilution in Tube 1 (1/20) ***times*** the dilution in Tube 2 (1/20).

$$\frac{1}{20} \times \frac{1}{20} = \frac{1}{400}$$

The final dilution in Tube 4 is the dilution in Tube 1 (1/20) ***times*** the dilution in Tube 2 (1/20) times the dilution in Tube 3 (1/20) ***times*** the dilution in Tube 4 (1/20).

$$\frac{1}{20} \times \frac{1}{20} \times \frac{1}{20} \times \frac{1}{20} = \frac{1}{160{,}000}$$

If the concentration of the first tube is known, the concentration of each subsequent tube can be calculated. For example, let us say that Tube 1, the first tube with a 1/20 dilution, has a concentration of 50 ng/ml. Therefore, the second tube has a concentration of:

$$50 \text{ ng ml} \times 1/20 = 2.5 \text{ ng/ml}$$

The third tube has a concentration of:

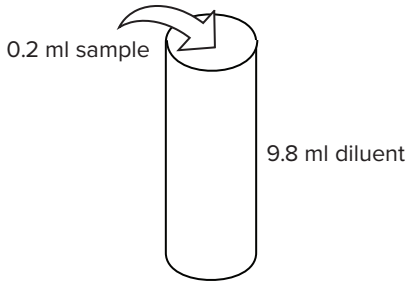
$$2.5 \text{ ng/ml} \times 1/20 = 0.125 \text{ ng/ml}$$

The final tube has a concentration of:

$$0.125 \text{ ng/ml } 1/20 = 0.00625 \text{ ng/ml}$$

If the ELISA test can still detect disease antigen or antibody at a dilution of 1/160,000 and a final concentration of 0.00625 ng/ml, the patient must have a very strong infection.

NOTE: If the amount of sample is not 1, set up a ratio and cross multiply in order to make the amount of sample = 1. See example below:



$$\begin{array}{r} 0.2 \text{ ml sample} \\ +9.8 \text{ ml diluent} \\ \hline 10.0 \text{ ml total volume} \end{array}$$

$$\frac{0.2 \text{ ml sample}}{10.0 \text{ ml total volume}} = \frac{1}{X}$$

$$0.2\,X = 10$$

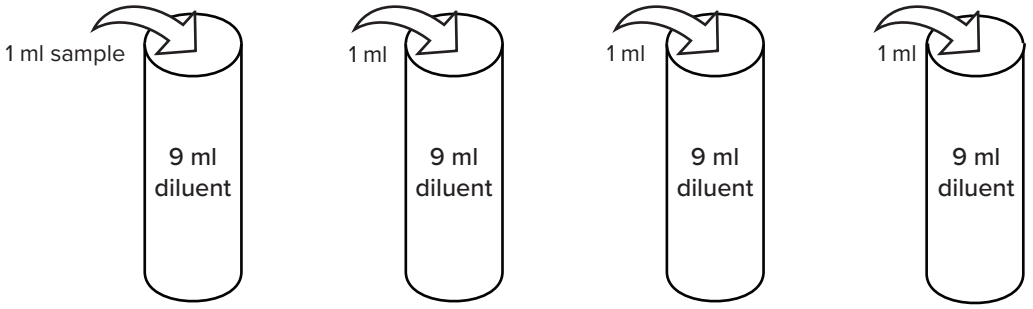
$$\frac{0.2}{0.2}X = \frac{10}{0.2}$$

$$X = 50$$

The dilution in the tube = 1/50.

SERIAL DILUTIONS PRACTICE PROBLEMS

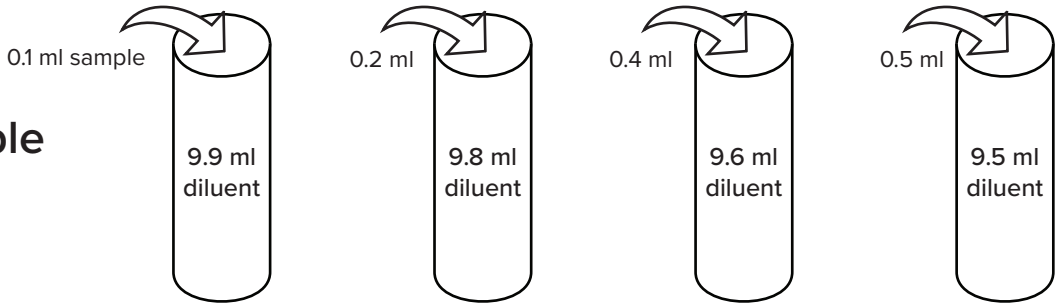
A
1 ml Sample



Tube dilution _____ _____ _____ _____

Final dilution _____ _____ _____ _____

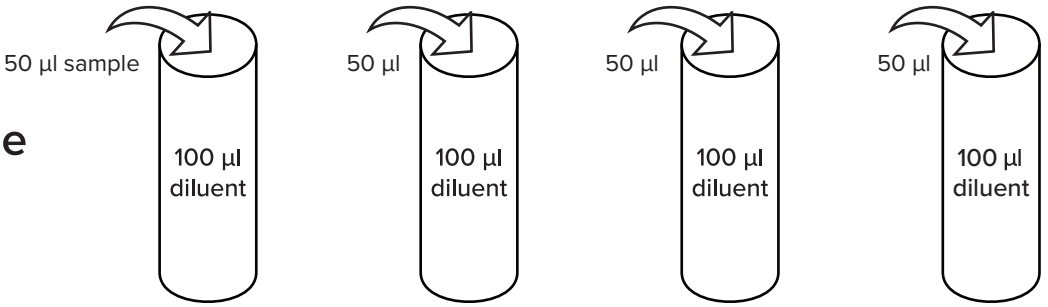
B
0.1 ml Sample



Tube dilution _____ _____ _____ _____

Final dilution _____ _____ _____ _____

C
50 µl Sample



Tube dilution _____ _____ _____ _____

Final dilution _____ _____ _____ _____

If the final concentration in the first tube in Problem C is 200 ng sample/ml, what is the concentration in the other three tubes? Show your work below.