

DILUTION PRINCIPLES WITH SAMPLE PROBLEMS page 37

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<http://biology.clc.uc.edu/fankhauser/Labs/Microbiology/Dilutions.htm>

Because solutions in science are often much more concentrated than are desired or can be managed for a given protocol, it is frequently necessary to dilute these solutions to a desired level. This requires a working knowledge of the principles of diluting, dilution factors, concentration factors and the calculations involved. High dilutions are usually expressed exponentially (*i.e.*: a solution which has been diluted a million fold is termed a 10^6 dilution, or is 10^{-6} concentration).

DEFINITIONS:

| | |
|-----------------------------------|--|
| Aliquot: | a measured sub-volume of a given sample. |
| Diluent: | material with which the sample is diluted |
| Final Volume: | the sum of the aliquot plus the diluent volumes |
| Dilution factor (DF): | ratio: final volume / aliquot volume |
| Concentration factor (CF): | ratio: aliquot volume / final volume |

Example: You make a dilution by adding 0.1 mL aliquot of a specimen to 9.9 mL of diluent which gives a final volume of 10 mL:

$$\text{Dilution Factor} = \text{final volume/aliquot volume} = (0.1 + 9.9)/0.1 = 1 \text{ to } 100, 1:100 \text{ or } 10^{-2}$$

$$\text{Concentration Factor} = \text{aliquot volume/final volume} = 0.1/(0.1 + 9.9) = 0.01 \text{ or } 10^{-2}$$

To prepare a desired volume of solution of a given dilution:

1. Calculate the volume of the aliquot: either = (final volume/dilution factor)
or = (concentration factor x final volume)
2. Calculate the volume of the diluent: = (final volume - aliquot volume)
3. Measure out the correct volume of diluent, add the correct volume of aliquot to it, mix.

SAMPLE PROBLEMS:

1. How much sample is required to prepare 10 mL of a 1 to 10 dilution, and how much diluent would you need?
2. What is the dilution factor when 0.2 mL is added to 3.8 mL diluent? What is the concentration factor?
3. What should the aliquot and diluent volumes be to prepare 5 mL of a 10^2 dilution?
4. You have 0.6 mL of sample, and want to dilute it all to a fiftieth of its present concentration. How much diluent will you add, and what will the final volume be?
5. How would you prepare 20 mL of a 1:400 dilution?
6. What is the dilution factor when you add 2 mL sample to 8 mL diluent?
7. You want 1 liter of 0.1 M NaCl, and you have 4 M stock solution. How much of the 4 M solution and how much dH_2O will you measure out for this dilution?
8. You add a pint of STP gas treatment to a 12 gallon fuel tank, and fill it up with gas. What is the dilution factor? (8 pints/gallon)
9. You diluted a bacterial culture 10^6 , and plated out 0.2 mL and got 45 colonies on the plate. How many bacteria/mL were in the original undiluted culture?

A harder one:

10. You have 100.00 mL of dH_2O . How much glycerine would you have to add in order to make a 2.000 % v/v dilution? (Hint: it takes a little algebra.)

ANSWERS) 1) 1 mL sample + 9.0 mL diluent, 2) DF = 20, CF = 0.05, 3) 0.05 mL aliquot, 4.95 mL diluent, 4) 29.4 mL diluent, 30 mL final volume, 5) 0.05 mL sample, 19.95 mL diluent, 6) DF = 5, 7) 25 mL stock solution + 975 mL dH_2O

0, 8) DF = 96, 9) 2.25×10

