Biology 324 **Dilutions and Solutions**

This worksheet will not be graded but similar questions may appear on your quiz.
Name:

For lab work, you have to be able to make up solutions. Somehow, this process is often perceived as ranging from difficult to impossible. This first lab will introduce you to the calculations that are employed to make solutions. Don't be too disheartened if it seems difficult. By the end of the quarter, you will be a walking abacus when it concerns making solutions.

Most working laboratory solutions are expressed in terms of molar concentrations.
Question 1) What is a mole?

Note that if a solution is a % solution, it refers to the number of grams per total of 100 ml. For example, a 15% SDS solution is made by adding 15 grams of SDS to a total volume of 100 ml.

Most chemicals give their gram/molecular weight on the bottle. From the gram/molecular weight you should be able to figure out how much mass of a given chemical you need to make up any given molar solution.
Example 1)
NaCl gram/molecular weight is 58.5 g.
To make 1 liter of a 1.0 molar NaCl solution, 58.5 g of NaCl is dissolved in a total of 1.0 liter of water.

Question 2) How much NaCl is needed to make a 100 ml of a 1.0 M solution?

Question 3) How much NaCl is needed to make 100 ml of a 5.0 M solution?

Stock Solutions

Most solutions used in lab work are made from dilutions of stock solutions. There are several ways to attack the problem of determining the right amount of stock solution to use. I will give you an example of a standard method, and an example of a simpler method that I use. (If you already are quite familiar with how to make solutions, and are happy with your method, you can keep on using it, but you still have to do the following worksheet.)

Example: Making 100 ml of 50 mM NaCl solution from a 1M NaCl stock solution.

Standard method:

A) Determine the number of moles of NaCl needed

50 mMoles/liter x 0.1 liter (100 ml) = 5 mMoles of NaCl required

B) Determine the volume of the stock solution that will yield the number of moles needed

First convert 1 M NaCl to mM NaCl

1M NaCl = 1000 mM NaCl = 1000 mMoles of NaCl/liter = 1000 mMoles of NaCl/1000 ml = 1mMole of NaCl/ml

Therefore 5 mls of 1M NaCl stock contains 5 mMoles of NaCl.

To make 100 ml of 50 mM stock, 5 mls of 1M NaCl is added to 95 ml of water.

A more elegant method is to determine the dilution of stock solution by understanding the relationship of the final concentration to the stock solution.

Stock Solution	Final Concentration	Stock soln/final conc = _____X
1 M or 1000 mM	5 mM	1000 mM/5 mM = 200 X

This means that the stock solution is 200 X more concentrated than the final concentration. Now that you know that the stock solution is 200X, how much volume of the stock solution do you need to add to make 1 liter of a 1X solution? You simply divide the volume of the final solution (1000 ml) by the relative concentration of the stock solution (200X).

Stock concentration	Final volume	volume of stock to make 1X
200 X	1000 ml	1000 ml/200 X= 5 ml

So: 5 ml of 1 M NaCl + 995 ml water= 1.0 liter of 5mM NaCl.
Using this approach, you don't have to worry about moles as the units cancel out. You just simply figure how many more times concentrated the stock solution is than the final concentration and dilute accordingly.

Make sure to work these practice problems (show your work):

(1) The gram/molecular weight of magnesium sulfate is 120 g/mole.
How much magnesium sulfate is needed to make 500 ml of a 5 M solution?

(2) You want to make 50 ml of 125 mM magnesium sulfate from the 5M magnesium sulfate stock.
a) Determine the relative concentration (X) of the stock solution

Stock solution	final concentration	stock/final = _____X

b) Determine how much volume of the stock you need

Stock concentration	Final volume	volume of stock to make 1X

c) Determine how much water you want to reach the final volume

d) ____ ml 5 M magnesium sulfate + _____ml water = 20 ml of 5mM magnesium sulfate.

(3) Solution wanted: 100 ml of 25 mM Tris-HCl
Stock solution: 1.5 M Tris-HCl (with pH = 8.0)

Stock solution	final concentration	stock/final = _____X

Stock concentration	final volume	volume of stock to make 1X

To make 100 ml of 25 mM Tris-HCl:

volume of 1.5 M Tris-HCl	volume of water

(4) Solution wanted: 250 ml of 25 mM NaCl, 75 mM Tris-HCl

Stock solutions: 1.5 M NaCl

0.5 M Tris-HCl (with pH = 8.0)

Stock solution	final concentration	stock/final = _____X

Stock concentration	final volume	volume of stock to make 1X

Stock solution	final concentration	stock/final = _____X

Stock concentration	Final volume	volume of stock to make 1X

To make 250 ml of 25 mM NaCl, 75 mM Tris-HCl:

volume of 1.5 M NaCl	volume of 0.5M Tris-HCl	volume of water

This same approach can be used for mg/ml or percentages, e.g.,

(5) Solution wanted: 5 ml of 250 μg/ml BSA

Stock solution: 5 mg/ml BSA

Stock solution	final concentration	stock/final = _____X

Stock concentration	final volume	volume of stock to make 1X

To make 5 ml of 250 μg/ml BSA:

volume of 5 mg/ml BSA	volume of water

(6) Solution wanted: 150 ml of 0.5% SDS

Stock solution: 10% SDS

Stock solution	final concentration	stock/final = _____X

To make 150 ml of 0.5% SDS:

volume of 10% SDS	volume of water