

Practice calculating Molar Concentrations, Percents and Fold Dilutions

Molar solutions start with the mass of a substance that contains 1 mole of atoms or molecules (Avaogadro's number is 6.023×10^{23} , one mole). This is always listed on the original container, as gm/mol. Molar is the mass per volume, and the abbreviation is a capital 'M'. 1M has one mole per liter of molecules.

Percent solutions are can be mass-volume or volume-volume.

If I start with a solid like agarose, then a 1% solution adds 1gm of agarose to 100ml of final volume (most are water-based and water comes close to weighing 1gm/ml at standard temperature and pressure – it is 0.998 at 20C if you want to be very precise). Note that you should put the solid in the measuring device first, and then add the solution up to the level finally desired.

If I start with a liquid like Tween (a detergent) then a 1% solution uses 1 part Tween and 99 parts buffer so the total is 100 parts.

Concentrated buffer stocks are often provided as fold-solutions, indicated with an 'X'. So a 20X TBE buffer stock is twenty times more concentrated than the usual working solution (1X is considered the standard working solution). To make a 1X working solution from a 20X Stock solution, I take one part of the 20X stock and 19 parts of the diluting solution (usually water) and mix them.

1. What mass of NaCl would you measure to make 100ml of a 1M solution?
 - a. What is the molecular weight of NaCl?
 - b. What mass of NaCl do you use?
 - c. What volume of water do you add?
 - d. What is the final volume of the solution?
2. What mass of KCl is needed to make 250 ml of a 5M stock solution?
 - a. What is the molecular weight of KCl?
 - b. What mass KCl do you use?
 - c. What volume of water do you add?
 - d. What is the final volume of the solution?
3. What mass of EDTA is needed to make 50ml of a 0.5M stock solution?
 - a. What is the molecular weight of EDTA?
 - b. What mass of EDTA do you use?
 - c. What volume of water do you add?

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- d. What is the final volume of the solution?
4. What mass of Tris-HCl is needed to make 500 ml of a 1M stock solution?
 - a. What is the molecular weight of Tris-HCl?
 - b. What mass of Tris-HCl do you use?
 - c. What volume of water do you add?
 - d. What is the final volume of the solution?
 - e. Note: with Tris solutions, you also have to adjust the acidity – this is done by adding concentrated HCl or NaOH. Usually you need to add 10 ml of 6M acid or base to change the acidity of Tris by 10-fold (called the pH which is a log scale). If the pH of the unadjusted Tris is 8.5 and you want to make a pH 8.3 solution you must leave some volume available for the acid or base. Describe the general process that you would use (you test the pH with a pH meter).
5. I want to make 100ml of a solution that has 1M Tris-HCl, pH 8.3 and 0.1M EDTA
 - a. What mass of Tris-HCl do you use?
 - b. What mass of EDTA do you use?
 - c. What volume of water do you add?
 - d. What is the final volume of the solution?
6. I want to make 10ml of a 10% solution of ammonium persulfate.
 - a. What mass of ammonium persulfate do you use?
 - b. How much water do you add?
 - c. What is the final volume of the solution?
 - d. Note: The ammonium persulfate is sensitive to temperature and slowly hydrolyzes. I should throw it out after one week. Since I only use 1ml in a week, but I have made 10ml, what should I do with the solution (note, it is stable at -20C).
7. I want to make 10 ml of a 20% solution of sodium dodecyl sulfate (SDS – a solid).
 - a. What mass of SDS do you use?
 - b. What volume of water do you use?
 - c. What is the final volume of the solution?

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8. I want to compare several PCR buffers. I want to make them at 10X (I will divide into 1ml aliquots and store them at -20C).
 - a. The first buffer contains 10mM Tris-HCl pH 8.3, 50mM KCl, 3.5mM MgCl₂. Describe how to make 5ml of this, at a 10-fold higher concentration, using stock solutions, and from solid reagents.
 - b. The second buffer contains 10mM Tris-HCl pH 7.8, 80mM (NH₄)₂SO₄, 2.5mM MgCl₂, 0.5% DMSO (a liquid). Describe how to make 5ml of a 10X concentration of this buffer, using stock solutions and from solid reagents.
9. I need to make a working solution of acrylamide/bisacrylamide for running gels. Describe how to make the following (note that acrylamide is a neurotoxin so you must wear gloves and should either wear a face mask or do the weighing in a hood):
 - a. 100 ml of a solution that is 30% acrylamide and 0.8% bis-acrylamide in water
 - b. 100ml of a solution that is 40% acrylamide and 1% bis-acrylamide and 8M urea in water
10. Describe how to make 50 ml of the following solutions:
 - a. 1M DTT (dithiothreitol, a solid)
 - b. 1% Tween (a liquid detergent that comes as a 20% stock)
 - c. 5M Sodium Acetate
 - d. 7.5M Ammonium Acetate
 - e. 1M KCl
 - f. 1M Ammonium Chloride
 - g. 8M urea
 - h. 1M MgCl₂
 - i. 5X CTAB buffer: {0.5M Tris-HCl pH 8.0, 7M NaCl, 0.1M EDTA, 1% beta-mercaptoethanol(a liquid), 10% polyvinyl pyrrolidone (PVP, a solid), 10% cetyl-triethyl ammonium bromide (CTAB, a solid)}.
 - j. 10X TBE buffer (0.9M Tris Base, 0.9M Boric Acid, 0.02M EDTA)