1. How would you prepare 400 ml of a 5% sodium chloride (a powder, MW = 58) solution in water?
\[
5g/100\ \text{ml} \times 400\ \text{ml} = 20g \ \text{NaCl} + \text{H}_2\text{O} \ \text{to 400ml}
\]

2. How would you prepare 200 ml of a 10 mM sodium chloride solution in water?
\[
58g/M \times 0.01\ \text{M/L} \times 0.2\ \text{L} = 0.116\ g \ \text{NaCl} + \text{H}_2\text{O} \ \text{to 200 ml}
\]

3. If you have 1 ml of a stock solution of 0.5 mg DNA /ml, how would you make up exactly 1 ml of a solution containing 10 ng DNA/µl?
\[
\frac{D}{C_f/C_i} = \frac{10\ \text{ng/µl}}{0.5\ \text{mg/ml}} = \frac{10\ \text{ng/µl}}{500\mu g/\mu l} = 1/50
\]
\[
\frac{1}{50} = \frac{X}{1000\ \mu l} = 20\ \mu l\ \text{stock} + 980\ \mu l\ \text{H}_2\text{O}
\]

4. If you have 1 ml of a stock solution of 0.1 mM primer, how would you make up 100 µl of a 10 µM solution?
\[
\frac{D}{C_f/C_i} = \frac{10\ \mu M}{0.1\ \text{mM}} = 100\ \mu M = 1/10...10\ \mu l\ \text{stock} + 90\ \mu l\ \text{diluent}
\]

5. You have a 20% glucose solution, a 10 mM vitamin solution, NaCl (a powder, MW = 58), and agar. How would you make up 500 ml of nutrient agar that contains 1% glucose, 1 µM vitamin solution, 0.1 M NaCl, and 15 g/L of agar?

For the glucose: \[
\frac{D}{C_f/C_i} = \frac{1\%}{20\%} = 1/20
\]
\[
\frac{1}{20} = \frac{X}{500\ ml} \Rightarrow\ \text{want to add 25 ml of the 20\% glucose}
\]

For the vitamins: \[
\frac{D}{C_f/C_i} = \frac{1\mu M}{10\text{mM}} = 1\mu M/10,000\mu M = 10^{-4}
\]
\[
10^{-4} = \frac{X}{500\ ml} \Rightarrow\ \text{want to add 50 µl vitamin solution}
\]

For the NaCl: \[
0.1\ M\ \text{NaCl/L} \times 58\ g/M \times 0.5\ L = 2.9\ g\ \text{NaCl}
\]

For the agar: \[
15\ g/L \times 0.5\ L = 7.5\ g
\]

Mix the above amounts of the components and add water to 500 ml

6. You decide that you need to dilute a particular sample 0.00067. How would you do this?
\[
6.7 \times 10^{-4} = 6.7/10 \times 1/100 \times 1/10
\]
\[
6.7/10 = 6.7\ \mu l\ \text{sample} + 3.3\ \mu l\ \text{diluent}
\]
7. You dilute a bacterial culture $10^{-5}$, plate 100 µl of your dilution, and in the morning find 50 colonies on the plate. What was the original concentration of the culture, in units of cells/ml?

$Ci = Cf/D = (500 \text{ cells/ml}) / 10^{-5} = 5 \times 10^{7} \text{ cells/ml}$

8. You dilute a bacterial culture $10^{-6}$, plate 50 µl of your dilution, and in the morning find 150 colonies on the plate. What was the original concentration of the culture, in units of cells/ml?

$Ci = Cf/D = (3000 \text{ cells/ml}) / 10^{-6} = 3 \times 10^{9} \text{ cells/ml}$

9. You have a bacterial culture that contains $6 \times 10^{10}$ cells/ml. How can you dilute and plate the culture such that you have 30-300 colonies on the plate?

want to plate 100 µl, that contains 60 cells...so pick $Cf = 600 \text{ cells/ml}$

$D = Cf/Ci = 600 \text{ cells/ml} / 6 \times 10^{10} \text{ cells/ml} = 10^{-8}$

$1/100 * 1/100 * 1/100 * 1/100$.

10. You dilute a stock of DNA $10^{-2}$, and then determine that the concentration of the diluted stock of DNA is 10 pg/µl (pg=pico gram). What was the concentration of the initial stock solution, in units of µg/ml?

$Ci = Cf/D = 10 \text{ pg/µl} / 10^{-2} \rightarrow 10^{3} \text{ pg/µl} = 1 \text{ ng/µl} = 1 \mu g/\mu l$

11. You have 100 µl of Yangtze river dolphin DNA. You need to prepare exactly 100 µl of a $4.7 \times 10^{-3}$ dilution. How would you do this, without wasting any of the DNA?

goal here is to not waste DNA...so first step should use the smallest amt of DNA that you can measure accurately. This is either 1 µl or, better, 2 µl, with the pipettes we have. So 1/10 is first dilution ...2 µl DNA + 18 µl diluent then take 4.7 µl of this and add 95.3 µl diluent

12. You have 1 L of 0.5 M Tris-HCl, and 1 L of 0.5 M EDTA. How could you use these stocks to prepare 500 ml of TE buffer (10 mM Tris-HCl, 1 mM EDTA)?

For the Tris: $D = Cf/Ci = 10 \text{ mM} / 500 \text{ mM} = 1/50$

$1/50 = X \text{ ml over 500ml} --> \text{ want to add 10 ml of the 0.5 M Tris}$

For the EDTA: $D = Cf/Ci = 1 \text{ mM} / 500 \text{ mM} = 1/500$

$1/500 = X \text{ ml over 500ml} --> \text{ want to add 1 ml of 0.5 M EDTA}$

Therefore, mix 10 ml of Tris with 1 ml EDTA and 98.8 ml of water