Concentration Questions & Answers

- How many grams of glucose would be dissolved to make 1 liter of a 0.5M glucose solution?
  0.5 mole/liter x 180 grams/mole x 1 liter = 90 g

- How many molecules of glucose are in that 1 liter of 0.5M glucose solution?
  0.5 mole/liter x 1 liter x 6.023x10^{23} molecules/mole = 3.012x10^{23} molecules

- What is the concentration of the 0.5M glucose solution expressed in mM?
  0.5 mole/liter x 1000 mmoles/mole = 500 mM

- What is the concentration of the 0.5M glucose solution expressed in %?
  0.5 mole/liter x 180 grams/mole x 1 liter/1000ml = 0.09 g/ml = 9 g/100ml = 9%

- How many grams of sucrose would be dissolved in 1 liter of a 0.5M sucrose solution? How does that compare to the grams of solute in the 0.5M glucose solution?
  0.5 mole/liter x 342 grams/mole x 1 liter = 171 g = almost twice as many grams

- How many molecules of sucrose in that 1 liter of 0.5M sucrose solution? How does that compare to the amount of solute in the 0.5M glucose solution?
  0.5 mole/liter x 1 liter x 6.023x10^{23} molecules/mole = 3.012x10^{23} molecules = same number of molecules

- How much of the 0.5M glucose solution is needed to provide 100 mg of glucose?
  100 mg x 1 mole/180 grams x 1 gram/1000 mg x 1 liter/0.5 moles x 1000 ml/liter = 1.11 ml

- If you were to dilute 100 ml of the 0.5M glucose solution with 400 ml water, what would be the concentration of the diluted solution?
  C_2=(V_1 x C_1)/(V_2) = (100 ml x 0.5 M)/(500 ml) = 0.1 M

- If you were to dilute 10 µl of the 0.5M glucose solution with 1.99 ml water, what would be the concentration of the diluted solution?
  C_2=(V_1 x C_1)/(V_2) = [(10 µl x 0.5 M)/(2 ml)] x 1 ml/1000 µl = 0.0025 M = 2.5 mM

- How would you prepare 10 ml of 0.1M glucose from the 0.5M glucose solution?
  V_1=(V_2 x C_2)/(C_1) = (10 ml x 0.1 M)/(0.5 M) = 2 ml 0.5 M glucose + 8 ml H_2O

- How would you prepare 100 ml of 1% glucose from the 0.5M glucose solution?
  C_1 = 0.5 M = 9% glucose [from fourth question above]
  V_1=(V_2 x C_2)/(C_1) = (100 ml x 1%)/(9%) = 11 ml 9% glucose + 89 ml H_2O

- How would you prepare 20 µl of 25 mM glucose from the 0.5M glucose solution?
  C_1 = 0.5 M = 500 mM glucose [from third question above]
  V_1=(V_2 x C_2)/(C_1) = (20 µl x 25 mM)/(500 mM) = 1 µl 500 mM glucose + 19 µl H_2O

- How would you prepare 100 µl of 40 mM glucose/40 mM sucrose from the 0.5M glucose **and** 0.5M sucrose solutions?
  V_1=(V_2 x C_2)/(C_1) = (100 µl x 40 mM)/(500 mM) = 8 µl 500 mM glucose per 100µl final vol.
  V_1=(V_2 x C_2)/(C_1) = (100 µl x 40 mM)/(500 mM) = 8 µl 500 mM sucrose per 100µl final vol.
  Total final volume = 100µl = 8 µl 0.5 M glucose + 8 µl 0.5 M sucrose + 84 µl H_2O

Activity

1. Prepare 2 ml of 10% solution of blue food-color dye in a test tube. **(tube S [stock] = 10% dye)**
10% x 2 ml = 0.2 ml dye (= 200 µl dye) + 1.8 ml H_2O

2. Put 0.9 ml H_2O into each of ten new test tubes. Label five of the tubes 1 through 5 and the other five A through E.

3. In tubes 1–5, prepare a **two-fold serial dilution** of your 10% dye solution.
What is the dye concentration in each tube?
#1:(0.9 ml #**S** + 0.9 ml H_2O) **= 5%; #2**:(0.9 ml #1 + 0.9 ml H_2O) **= 2.5%; #3**:(0.9 ml #2 + 0.9 ml H_2O) **= 1.3%; #4**:(0.9 ml #3 + 0.9 ml H_2O) **= 0.6%; #5**:(0.9 ml #4 + 0.9 ml H_2O) **= 0.3%**

4. In tubes A–E, prepare a **ten-fold serial dilution** of your 10% dye solution.
What is the dye concentration in each of these tubes?
#A:(0.1 ml #**S** + 0.9 ml H_2O) **= 1%; #B**:(0.1 ml #A + 0.9 ml H_2O) **= 0.1%; #C**:(0.1 ml #B + 0.9 ml H_2O) **= 0.01%; #D**:(0.1 ml #C + 0.9 ml H_2O) **= 0.001%; #E**:(0.1 ml #D + 0.9 ml H_2O) **= 0.0001%**

5. Prepare a twelfth tube containing 1 ml of 0.5% dye diluted directly from the 10% stock. **(tube X)**
(Describe how.)
$V_1=(V_2 \times C_2)/(C_1)$ = (1 ml x 0.5%)/(10%) = 0.05 ml x 1000µl/ml = 50 µl 10% dye + 0.95 ml H_2O

6. Arrange the twelve tubes in order of **decreasing** dye concentration. Does the pattern of decreasing color match your predicted calculations?
#**S**(10%) ⇒ #**1**(5%) ⇒ #**2**(2.5%) ⇒ #**3**(1.3%) ⇒ #**A**(1%) ⇒ #**4**(0.6%) ⇒ #**X**(0.5%)⇒ #**5**(0.3%) ⇒ #**B**(0.1%) ⇒ #**C**(0.01%)%) ⇒ #**D**(0.001%)%) ⇒ #**E**(0.0001%)

7. Would it be more accurate to prepare a 0.1% solution by direct or serial dilution?
By direct dilution, $V_1=(V_2 \times C_2)/(C_1)$ = (1 ml x 0.1%)/(10%) = 0.01 ml x 1000µl/ml
= 10 µl 10% dye + 0.99 ml H_2O
Can more accurately measure the 100µl for serial dilutions, than 10µl for direct dilution.