CONCENTRATION BASED ON DEGREE OF SATURATION

Saturation Degree

- Saturated solution
- is one where the concentration is at a maximum - no more solute is able to dissolve at a given temperature.
- ➢ A saturated solution represents an equilibrium.
- Unsaturated Solution
- less than the maximum amount of solute for that temperature is dissolved in the solvent.
- No solid remains in flask.
- Supersaturated
- Solvent holds more solute than is normally possible at that temperature.

Unsaturated, Saturated, & Supersaturated

Unsaturated

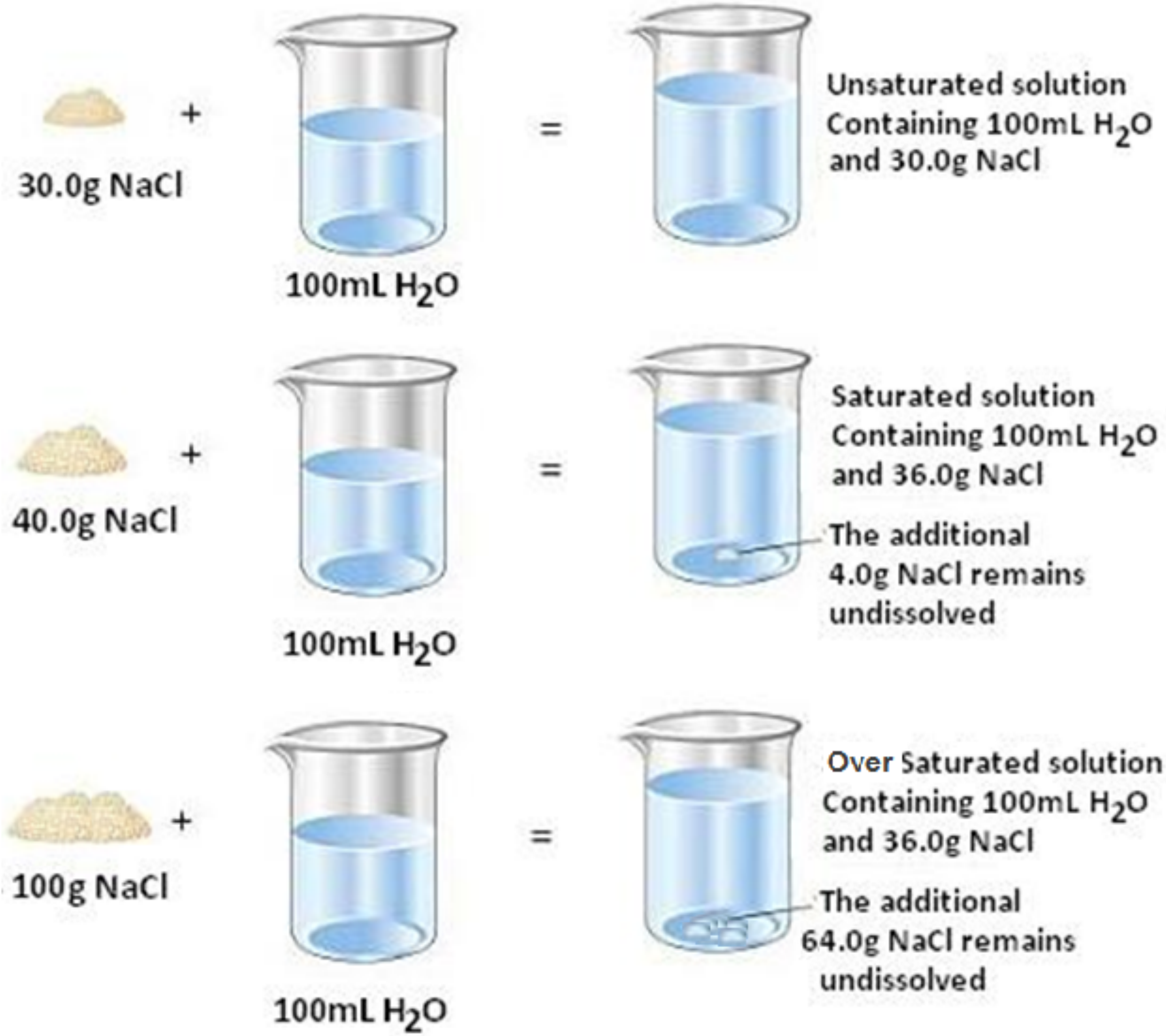
There is more available space for solute to dissolve in the solvent.

Saturated

When there is enough solute in the solvent, and you begin to see some crystals.

Supersaturated

When there is pretty much an excess of solute in the solvent, and you can see a big amount of solute at the bottom of the solvet.


30.0g NaCl
+
100mL H_2O
=
Unsaturated solution Containing 100mL H_2O and 30.0g NaCl
40.0g NaCl
+
100mL H_2O
=
Saturated solution Containing 100mL H_2O and 36.0g NaCl
The additional 4.0g NaCl remains undissolved
100g NaCl
+
100mL H_2O
=
Over Saturated solution Containing 100mL H_2O and 36.0g NaCl
The additional 64.0g NaCl remains undissolved

Percent saturation

- The concentration of salt in a solution as a percent of the maximum concentration possible at a given temperature.
- $$\textbf{Vol (ml)} = \frac{100\,(S_2 - S_1)}{1 - S_2}$$
- At the equation above:
- Volume is the volume of the saturated salt needed.
- S1 is the initial low saturation (used as a decimal).
- S2 is the final high saturation (used as a decimal).
- This is to the volume to be added to 100 ml at saturation S1.

Example

- How many ml of a saturated ammonium sulfate solution must be added to 40 ml of a 20% saturated solution to make the final solution 70% saturated?
- $S_1 = 0.2$
- $S_2 = 0.7$
- Answer: $\dfrac{100\,(0.70 - 0.20)}{1 - 0.70} = 166.6$ ml

100 ml → 166.6 ml

40 m → ?

- The volume needed $= \dfrac{40 \times 166.6}{100}$

$= 66.6$ ml

Units Conversion

Prefix	Symbol	10^n
Deci	d	10^{-1}
Centi	c	10^{-2}
Milli	m	10^{-3}
Micro	µ	10^{-6}
Nano	n	10^{-9}
Pico	p	10^{-12}
Femto	f	10^{-15}

PREPARATIONS OF SOLUTIONS

Preparation of stock solutions

- The concentrations of many acids are given in the terms of w/w%
- In order to prepare a stock solution for acids we need to know:

a) Density (ρ) : wt/ unit volume

b) Specific gravity : Density relative to water

- Since density of water is 1 gm/ml
- $SG = \dfrac{\textit{Density } (\rho) \textit{ of substance}}{\textit{Density of water}}$
- $SG = \dfrac{\textit{Density of substance } (\rho)}{1}$
- $SG = \textit{Density } (\rho)$

PREPARATION OF SOLUTIONS

It could be prepared either from:

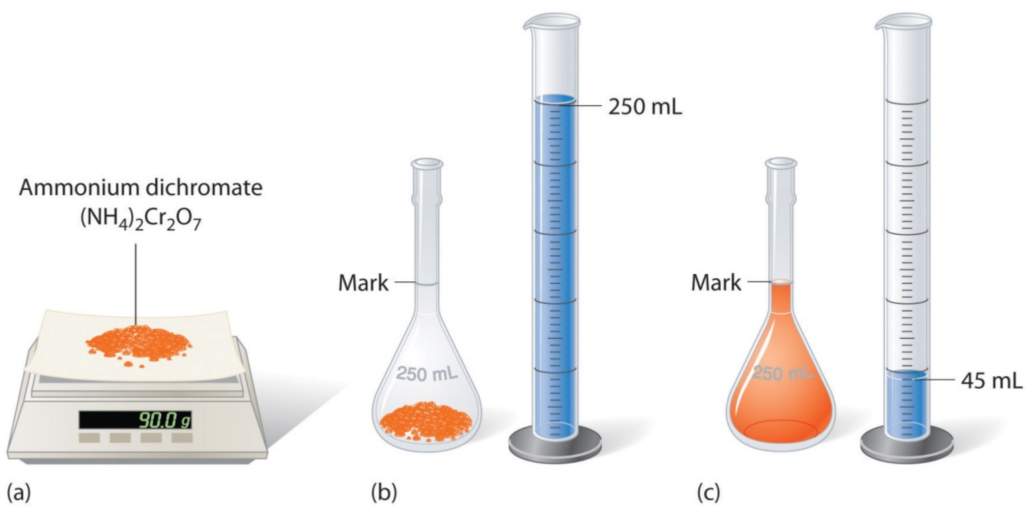
1- Solid material.

2-Liquid.

PREPARATION OF SOLUTIONS FROM SOLID MATERIAL

In general it follows a 4 steps:

1. Weigh the solute.
2. Dissolve the solute.
3. Make up the solution to a known volume.
4. Homogenise.

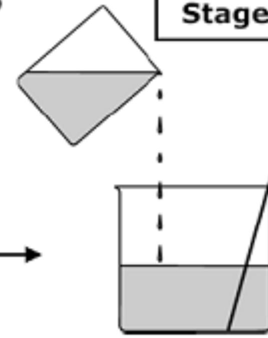


Stage 1

1. Weigh accurately the required amount of material (see section 3.2).

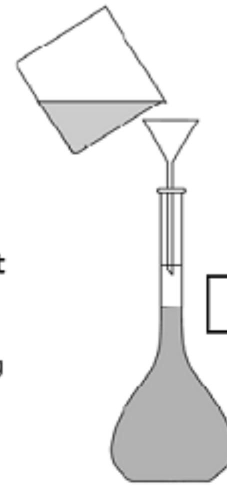
Stage 2

2. Transfer the material to a beaker and dissolve in a small amount of solvent (usually deionised water). Ensure all the solid has dissolved.



Stage 3

3. Using a clean glass funnel, transfer the solution quantitatively into a clean volumetric flask. Wash out the beaker with the solvent a number of times and transfer the washings to the flask. Hint: Pouring the liquid down a glass rod held in the spout of the beaker can help prevent liquid running down the side of the beaker.



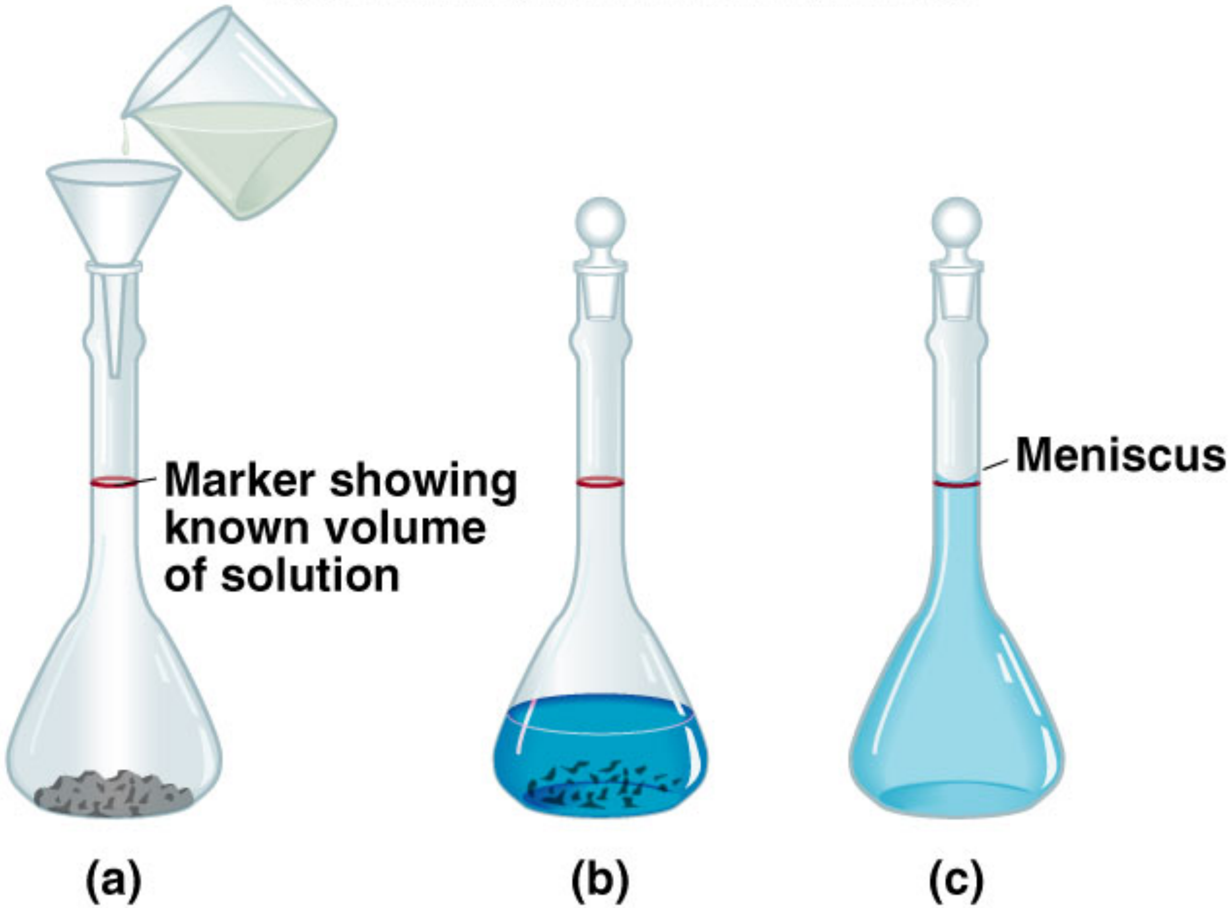
Stage 4

4. Make sure the flask and contents are at ambient temperature. Carefully add solvent to the flask. Use a pasteur pipette to slowly add solvent until the bottom of the meniscus touches the calibration mark on the neck of the volumetric flask (see section 3.1 for information on the correct use of volumetric flasks).

Stage 5

5. Stopper the volumetric flask and shake to ensure the solution is thoroughly mixed.

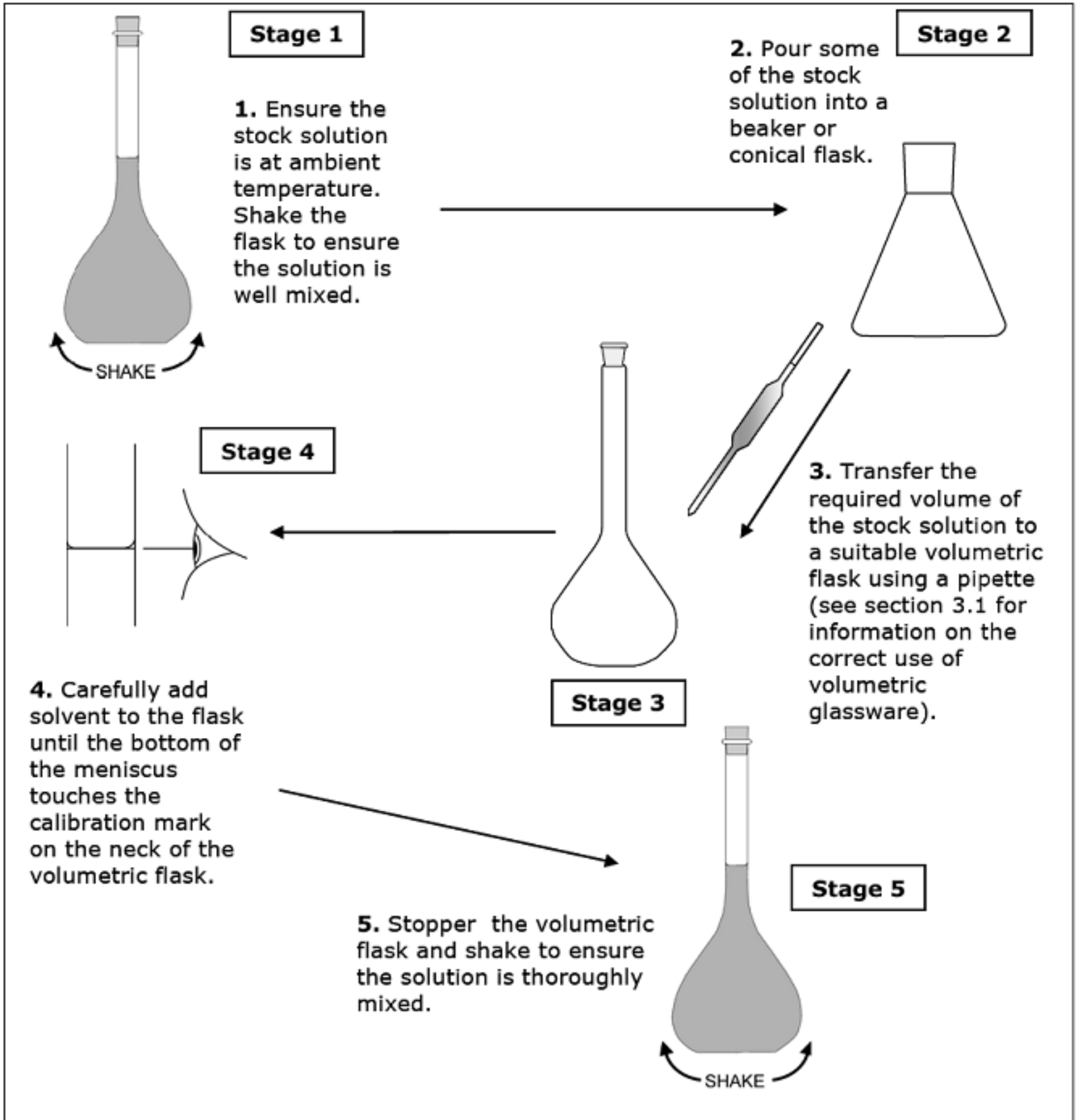
After calculating the weight required to prepare any given solution, you do the following:



PREPARATION OF SOLUTIONS FROM LIQUID

- Solutions are often prepared by diluting a more concentrated stock solution.

1. ~~A known volume of the stock solution is~~ transferred to a new container.
2. Make up the solution to a known volume.
3. Homogenize


Stage 1
1. Ensure the stock solution is at ambient temperature. Shake the flask to ensure the solution is well mixed.
SHAKE
Stage 2
2. Pour some of the stock solution into a beaker or conical flask.
Stage 3
3. Transfer the required volume of the stock solution to a suitable volumetric flask using a pipette (see section 3.1 for information on the correct use of volumetric glassware).
Stage 4
4. Carefully add solvent to the flask until the bottom of the meniscus touches the calibration mark on the neck of the volumetric flask.
Stage 5
5. Stopper the volumetric flask and shake to ensure the solution is thoroughly mixed.
SHAKE

Dilutions

- ***Dilution-*** the procedure for preparing a less concentrated solution from a more concentrated one.

- ***Serial Dilution-*** the process of diluting a solution by removing part of it, placing this in a new flask and adding water to a known volume in the *new* flask.

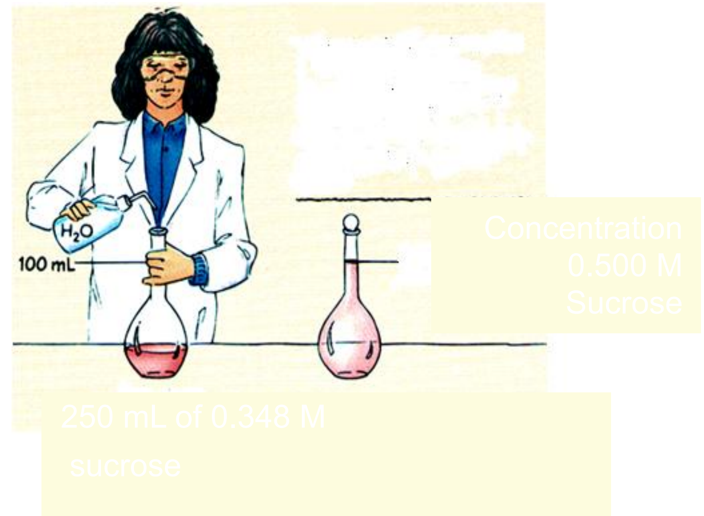
Dilutions

When a solution is diluted, solvent is added to lower its concentration.

The amount of solute remains constant before and after the dilution:

moles BEFORE = moles AFTER

$$C_1V_1 = C_2V_2$$



A bottle of 0.500 M standard sucrose stock solution is in the lab.

How can you use the stock solution to prepare 250 ml of a 0.348 M sucrose solution.

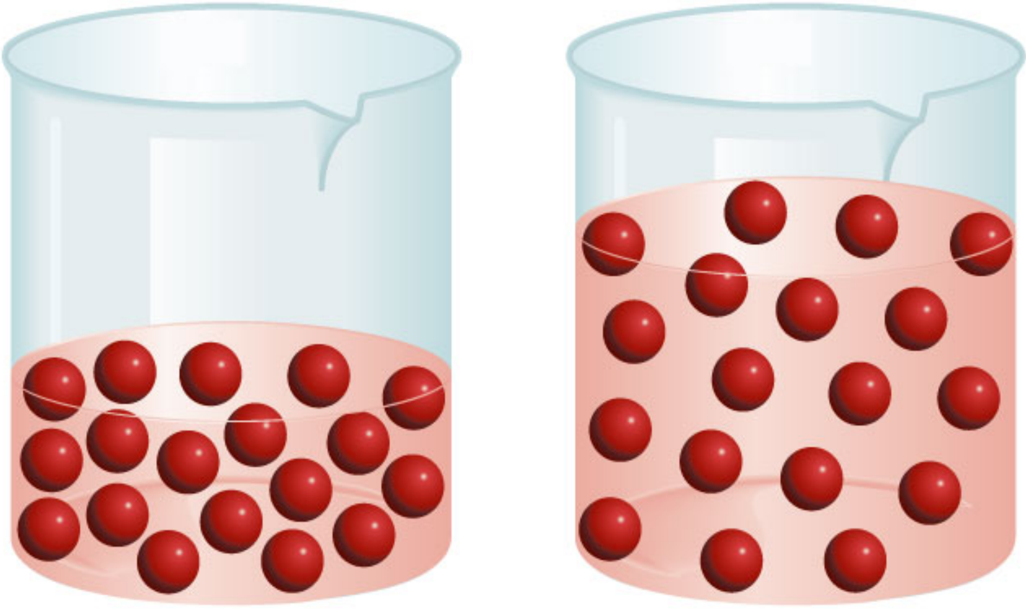
$C_1 X\ V_1 = C_2 X\ V_2$

$0.5\ M X\ V_1 = 0.348\ M\ X\ 0.25\ L$

$0.348\ X\ 0.25\ /\ 0.5 = 0.174\ L$

i.e: 174 ml of the stock solution will be diluted with water to reach the volume of 250 ml

Dilution of Solutions



(a)

(b)

Always remember that the number of moles **DOES NOT CHANGE**

Another example

- Describe how you would prepare 800mL of a 2.0M H_2SO_4 solution, starting with a 6.0M stock solution of H_2SO_4 .

800mL x 1L/ 1000mL
= 0.800L

$M_1V_1 = M_2V_2$
$6.0M \times V_1 = 2.0M \times 0.800L$
$6.0M \times V_1 = 1.6M \times L$
$V_1 = 1.6M \times L / 6.0M$
$V_1 = 0.26L$

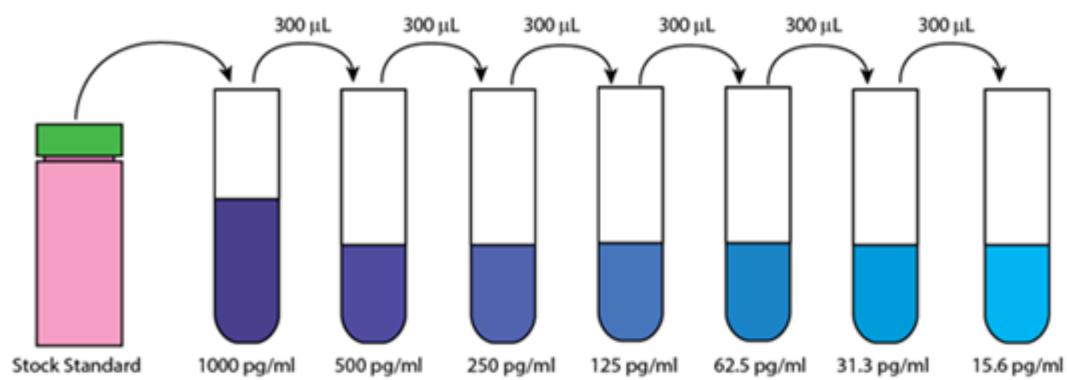
0.26L of the 6.0M H_2SO_4 solution should be diluted to give a final volume of 800mL.

Serial Dilution

- The progressive dilution of a substance or infectious agent in a series of tubes or wells in a tray in predetermined ratios.
- Dilution starts first with stock solution and each diluted solution produced is used to prepare the next.
- A *serial dilution* is any dilution where the concentration decreases by the same quantity in each successive step.
- To calculate the concentration

use the equation:

$$C_1 V_1 = C_2 V_2$$



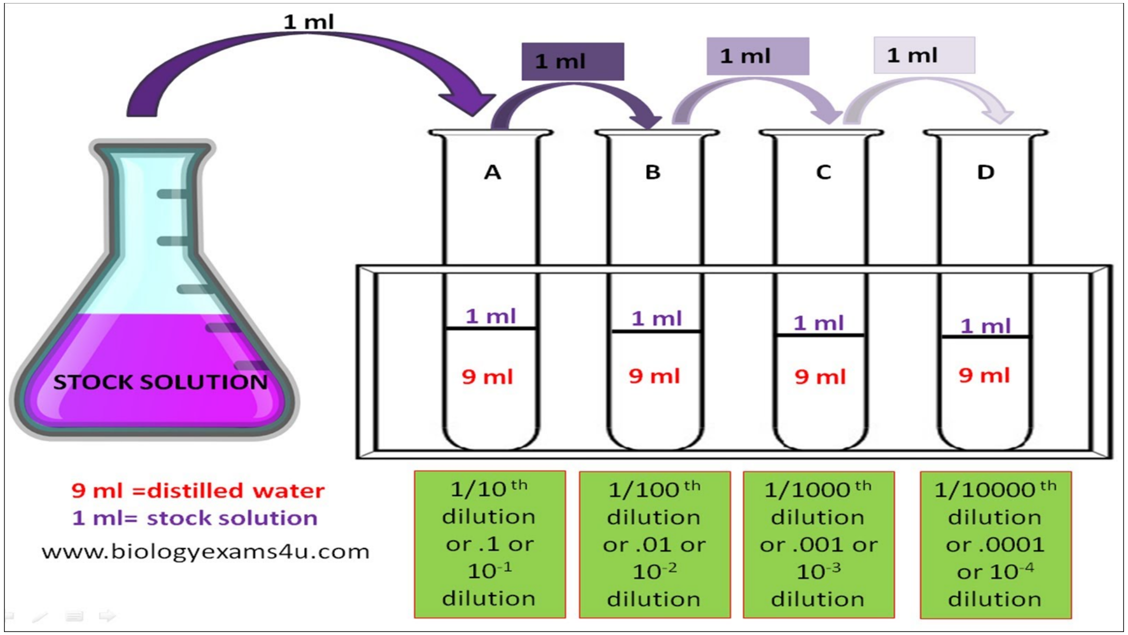
600µ l

Linear Dilution

- Same stock solution is used to produce samples of different

concentrations.

To calculate the concentration: $C_1 V_1 = C_2 V_2$



Dilution Factor

- Dilution factor refers to the ratio of the volume of the initial (concentrated) solution to the volume of the final (dilute) solution.
- To make a dilute solution without calculating concentrations use a dilution factor.
- Divide the final volume by the initial volume.
- $DF = Vf / Vi$
- Vi = initial volume
- Vf = final volume (aliquot volume + diluent volume)
- DF of 100 = ratio 1:100

Dilution Factor Continue

- Example: What is the dilution factor if you add 0.1 ml aliquot of a specimen to 9.9 ml of diluent?

- The final volume is equal to the aliquot volume PLUS the diluent volume:

  0.1 mL + 9.9 mL = 10 mL

- The dilution factor is equal to the final volume divided by the aliquot volume: 10 mL/0.1 mL = 1:100 dilution.

Dilution Factor Continue

- Example: What is the dilution factor when 0.2 ml is added to 3.8 ml diluent?

Dilution factor = final volume/aliquot volume

Final volume = 0.2 +3.8 = 4.0 ml

Aliquot volume = 0.2 ml

4.0/0.2 = 1:20 dilution.

Dilution Factor Continue

- Example: From the previous example if you had 4 tubes what would be the final dilution of tube 4?
- Since each dilution is 1:20 and we want to know the dilution of the FORTH tube so in this case it would be 1:20 multiplied FOUR times.

= 1:20 * 1:20 * 1:20 *1:20

= 1:160,000

Importance of Dilution

- Example: A blood glucose of 800 mg/dl was obtained. According to the manufacturer the highest glucose result which can be obtained on this particular instrument is 500 mg/dl.

The sample must be diluted.

The serum was diluted 1:10 and retested.

The result is 80 mg/dL.

THIS IS NOT THE REPORTALBE RESULT!

You must multiply by the dilution factor of 10.

10 x 80 = 800 mg/dl.