Practical physical pharmacy/Lab2: Alligation & Dilution and Concentration

- **Alligation** is an arithmetical method of solving problems that involve the mixing of solutions or mixtures of solids possessing different percentage strengths.

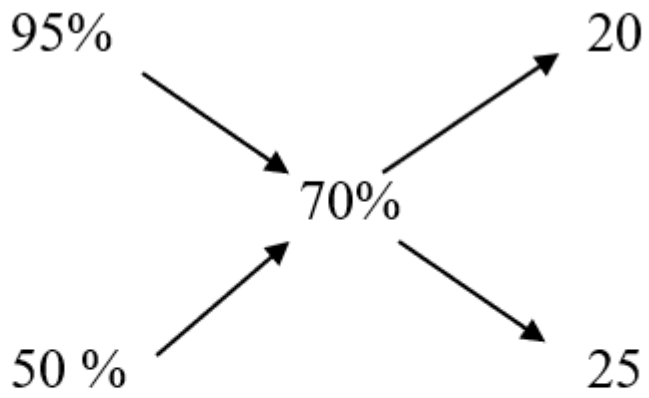
- **Alligation medial** is a method by which the "weighted average" percentage strength of mixture of two or more substances whose quantities and concentrations are known may be quickly calculated

Example

- **In what proportion should alcohols of 95% and 50% strengths be mixed to make 70% alcohol?**
- Which solution would I use more?

Example

- **In what proportion should alcohols of 95% and 50% strengths be mixed to make 70% alcohol?**
- Which solution would I use more?



Ratio 95 % alcohol : 50 % alcohol

20 : 25

4 : 5

Dilution and Concentration

- If a mixture of a given percentage or ratio strength is diluted to twice its original quantity, its active ingredient will be contained in twice as many parts of the whole, and its strength therefore will be reduced by one-half.
- Contrariwise, if a mixture is concentrated by evaporation to one-half its original quantity, the active ingredient (assuming that none was lost by evaporation) will be contained in one-half as many parts of the whole, and the strength will be doubled.
- Problems in this section generally may be solved by

(solution quantity) x (concentration) = (solution quantity) x (concentration)

$$Q_1 . C_1 = Q_2 . C_2$$

- Q/Is the quantity of solute before the dilution equal to its quantity after dilution?

- If 500 ml. of a 15% (v/v) solution of methyl salicylate in alcohol are diluted to 1500 ml., what will be the percentage ratio (v/v)?

Example

If 500 ml. of a 15% (v/v) solution of methyl salicylate in alcohol are diluted to 1500 ml., what will be the percentage ratio (v/v)?

$$Q_1 \cdot C_l = Q_2 \cdot C_2$$

$$500 \times 15 = 1500 \times C_2$$

$$C_2 = 500 \times 15/1500 = 5\%, \text{ answer.}$$

Example:

If a syrup containing 65% (w/v) of sugar is evaporated to 85% of its volume, what percent (w/v) of sugar will it contain?

Note: (evaporating the solvent to 85% of its original volume).

- **If a syrup containing 65% (w/v) of sugar is evaporated to 85% of its volume, what percent (w/v) of sugar will it contain?**

$$Q1.\ C1 = Q2.\ C2$$

$$100 \times 65 = 85 \times C2$$

$$C2 = 100 \times 65/85 = 76.4\ \%,\ \text{answer.}$$

STOCK SOLUTIONS

- Stock solutions are solutions of known concentration that are frequently prepared by the pharmacist for convenience in dispensing.
- They are usually strong solutions from which weaker ones may be conveniently made; and, when correctly prepared, they enable the pharmacist to obtain small quantities of medicinal substances that are to be dispensed in solution.
- Stock solutions are invariably prepared on a weight-in-volume basis, and their concentration is expressed as ratio strength or, less frequently, as percentage strength

- Q/How many milliliters of a 1 : 400 (w/v) stock solution should be used to make 4 liters of a1 : 2000 (w/v) solution?
- Note: Is the ratio one of the concentration expressions?(Y,N)
- So can we divide 1 over 400 or 1 over 2000 for example? (Y,N)

Example

How many milliliters of a 1 : 400 (w/v) stock solution should be used to make 4 liters of a1 : 2000 (w/v) solution?.

4 liters = 4000 ml.

1 :2000 = 0.05 %

1:400 = 0.25 %

$Q_1 . C_l = Q_2 . C_2$

$4000 \times 0.05 = Q_2 \times 0.25$

$Q_2 = 4000 \times 0.05/0.25 = 800$ ml., answer.

Example

- Q/How many milliliters of 17 % (w/v) concentrate of benzalkonium chloride should be used in preparing 300 ml. of stock solution such that 15 ml. diluted to a liter will yield a 1:5000 solution?
- Note: first determining the concentration of the second solution depending on its specifications. Then solving the problem

Example

How many milliliters of 17% (w/v) concentrate of benzalkonium chloride should be used in preparing 300 ml. of stock solution such that 15 ml. diluted to a liter will yield a 1 :5000 solution?

1 liter = 1000 ml.

1: 5000 = 0.02%

$Q_1 . C_I = Q_2 . C_2$

1000 x 0.02 = Q2 x 15

C_2 = 1000 X 0.02 /15 = 1.333 %

$Q_1 . C_I = Q_2 . C_2$

300 x 1.333 = Q_2x 17

Q_2 = 300 x 1,333/17 = 23.52 ml, answer.

- How many milliliters of water should be added to 300 ml. of a 1:750 (w/v) solution of benzalkonium chloride to make a 1 : 2500 (w/v)

Note: (Calculating the volume after dilution then finding the added water by subtraction)

Example

How many milliliters of water should be added to 300 ml. of a 1:750 (w/v) solution of benzalkonium chloride to make a 1 : 2500 (w/v) solution?

1:750 = 0.133%

1 :2500 = 0.04%

$Q_1 . C_1 = Q_2 . C_2$

$300 \times 0.133 = Q_2 \times 0.04$

$Q_2 = 300 \times 0.133/0.04 = 997.5$ ml. of 0.04% (w/v) solution to be prepared.

The difference between the volume of diluted (weaker) solution prepared and the volume of stronger solution used represents the volume of water (diluent) to be used.

997.5 ml. - 300 ml. = 697.5 ml., answer

DILUTION OF ALCOHOL

- Since there is a noticeable contraction in volume when alcohol and water are mixed, we cannot calculate the volume of water needed to dilute alcohol to a desired volume-in-volume strength.
- Q/Why contraction occur?
- But his contraction does not affect the weights of the components, and hence the weight of water (and from this, the volume) needed to dilute alcohol to a desired weight-in-weight strength may be calculated.

Example

- **How much water should be mixed with 5000 ml. of 85% (v/v) alcohol to make 50% (v/v) alcohol?**
- Note: (Calculating the volume after dilution then finding the added water by subtraction)

How much water should be mixed with 5000 ml. of 85% (v/v) alcohol to make 50% (v/v) alcohol?

$Q_1 . C_1 = Q_2 . C_2$

$5000 \times 85 = Q_2 \times 50$

$Q_2 = 5000 \times 85/50$ 8500 ml.

Therefore, use 5000 ml. of 85% (v/v) alcohol and enough water (3500 ml) to make 8500 ml., answer.