Volume-volume percentage:

- (v/v%) percentage expresses the number of milliliters of a drug or active ingredient in 100 milliliters of a mixture
- Most useful when a liquid-liquid solution is being prepared
- For example, a 40% v/v ethanol solution contains 40ml ethanol per 100ml total volume
- Example:

Prepare 500 ml of 5% solution of chloroform in 50% alcohol

5 ml chloroform ……… 100 ml of 50% alcohol

X ml ………… 500 ml of 50% alcohol

X= 25 ml of chloroform dissolved in sufficient quantity of 50% alcohol to make 500 ml of solution

$C_1V_1=C_2V_2$

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Ratio strength

- Ratio strength (1:N) is one part by weight or volume in N parts by weight or volume
- 1:200 ratio strength can be
  - 1gm solid to 200 gm solid ……..total: 201gm
  - 1 ml liquid to 200 ml liquid…….??
  - 1 gm solid to 200 ml liquid……..?? Check the density

* أحول ال ratio strength لـ percentage -

1:200 → $\frac{1}{200}$

$\frac{1}{200} = 0.5\%$

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- Example:

If 2000 gm of ointment contain 75 gm of hydrocortisone, what is the percentage strength (w/w) of the ointment?

2000 gm ointment ……….75 gm hydrocortisone

100 gm ointment …………. X

100 X 75 / 2000=

X=3.75%

$\frac{75}{2000} \times 100\% = 3.75\%$

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Ratio strength

- If 8 ml of phenol were used in 480 ml of lotion what is the percentage of phenol in the lotion?
- 8 ml……..480 ml
- ??? 100 ml
- X=1.6% of phenol
- 100 ml of lotion contain 1.6 ml of phenol

$\frac{8}{480} \times 100\% = 1.6\%$

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Ratio strength

- Solve:

1. If 1.2gm of menthol is added to 480 ml of lotion, what is the percentage of menthol in the lotion?

Answer= 0.25% of menthol

Methanol + lotion = Mixture

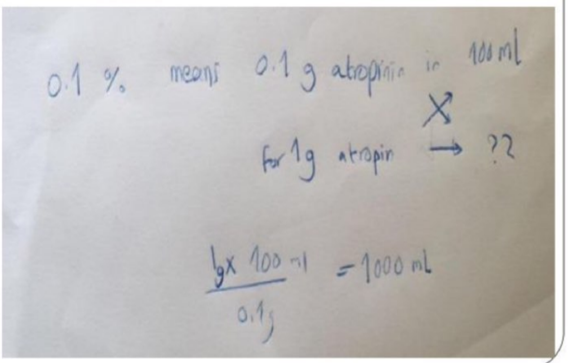
$(1.2) / (480 + 1.2) \times 100\% = 0.25\%$

2. How many milliliters of a 0.1% solution can be made from one gram of atropine sulfate?

Answer: 1000ml

0.1 g → 100 mL
1 g → x mL

$\frac{1}{10} x = 100$, x=1000 mL



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Concentration and Dilution

- **Stock solutions** are concentrated bulk solutions from which more dilute solutions can be quickly prepared
- These solutions can be used with a ratio strength or percentage strengths
- General formula for solving: **C1V1 = C2V2**
- V1= the quantity or the amount (volume??) of the original preparation
- C1= the % strength of the original preparation expressed as a decimal or percent
- V2= the quantity or amount of the wanted preparation
- C2= the % strength of the wanted preparation expressed as a decimal or percent
- C=S

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Concentration and Dilution

- Example: if 500 ml of a 15% solution are diluted to 1500 ml, what will be the percent strength ?

500 ml (V1) X 15% (C1)= 1500 ml (V2) X C2

C2=5%

(500) (15%) = (1500) (x)

x = 5%

- If 1000 ml of a 20% solution are diluted to 5000 ml what will be the percent strength?

1000 ml(V1)X 20% (C1) = 5000 ml (V2) X C2

C2= 4%

(1000) (20%) = (5000) (x)

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x = 4%

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Concentration and Dilution

- Solve:

1. **How many milliliters of a 25% solution can be prepared from 750ml of a 65% solution?** (750) (65%) = (25%) (x)

C1V1 = C2V2 ……. Answer:1950 ml

2. **If 30 gm of a 45% powder was diluted to make a 30% powder, how many grams will the new preparation weigh?**

C1V1 = C2V2 ………Answer: 45 gm (30)(45%)=(30%)(x)

3. **If 20 ml of a 1:200 solution of a chemical is diluted to 500 ml, what is the ratio strength?** (20) (1) / (200) = (500) (x)

C1V1 = C2V2 …….

0.5% X 20ml = C2 X 500ml……C2= 0.02% 1/500 x 20/200 = 500/500 x

Ratio strength of the diluted solution??

1: 200 is 0.5%, x = 20/100000 2 : 10000 1 : 5000

Answer: 1:5000

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Concentration and Dilution

3. **If 20 ml of a 1:200 solution of a chemical is diluted to 500 ml, what is the ratio strength?**

C1V1 = C2V2 …….

0.5% X 20ml = C2 X 500ml……C2= 0.02%

Ratio strength of the diluted solution??

One part of solute in certain volume (weight)

$\frac{(20)(1)}{(200)} = (500)(x)$

the diluted solution= 0.02 %

0.02 gm ………100 ml

$\frac{1}{10} = (500)(x)$

1gm …………..???

$x = \frac{1}{5000} \times 100\% = 2\%$

Answer: 1:5000

$20 \times \frac{1}{200} = 500x$

$x = \frac{20}{200 \times 500}$

$x = \frac{1}{5000}$

$x = 1:5000$

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Reducing and Enlarging formulas

* enlarge or reduce

- Determine the total weight or volume of ingredients (مكونات) and convert to the required quantity. The quantity in the original and new formulas will have the same ratio
- Example: Calculate the amount needed for 50 ml strong sodium salicylate mixture (scaling down)

1000 ÷ 50 = 20

Sodium salicylate	10g	/20
Sodium metabisulfate	1 g	/20
D.S. chloroform water	525 ml	/20
Water q.s. up to	1000 ml	

or 10 → 1000

x → 50

$x = \frac{500}{1000}$

Answer:

Sodium salicylate	0.5g
Sodium metabisulfate	0.05g
D.S. chloroform water	26.25 ml
Water	qs 50 ml

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Reducing and Enlarging formulas

- Calculate the amounts needed for 100 ml peppermint water?

Peppermint water: scaling down   1000 ÷ 100 = 10 ml

Peppermint   2 ml ÷ 10

Talc   15gm ÷ 10

Purified water q.s.   1000 ml ÷ 10

Answer:

Peppermint   0.2 ml

Talc   1.5 gm

Purified water q.s.   100 ml

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A method of calculating quantities needed to produce a mixture with a certain percentage if a drug when you have stock products in two other percentages. Often referred to as the tic-tac-toe method.

Alligation method

- ***How many parts of an 20% w/v solution and 8% w/v solution are needed to produce 500 ml of 10% w/v solution?***
- **Solution of Highest Concentration**: 20% w/v
- **Solution of Lowest Concentration** : 8% w/v
- **Solution of Desired Concentration**: 10% w/v

Highest Concentration   **Desired Concentration**   **Lowest Concentration**

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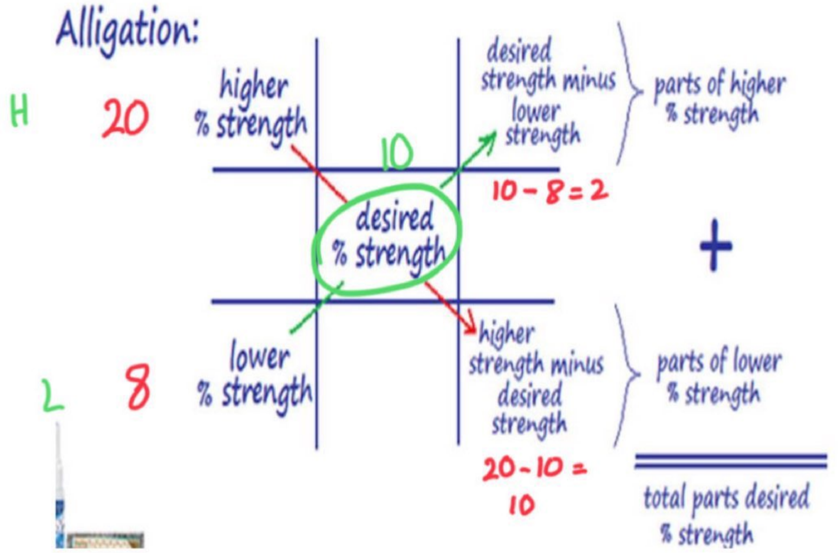

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Alligation method

- <u>Subtracting</u> the lower concentration (8 w/v) from the <u>desired</u> concentration (10% w/v) = **2** (*higher concentration ratio value*)
- **<u>Subtract</u>** the <u>desired</u> concentration (10 w/v) from the higher concentration (20% w/v) = **10** (*lower concentration ratio value*)

This gives us a ratio of **<u>2:10</u>** ***<u>(higher concentration : lower concentration</u>***)

In this case, we know the ratio – **2:10…….**

<u>Total parts= 12 parts</u>

In other words, **2 parts higher concentration** to **10 parts lower concentration**.

In other words, there are 12 parts (*2 parts + 10 parts*):

- **(higher conc)** 2/12 x 500mL = **83.33 mL of 20%**

(lower conc) 10/12 x 500mL = **416.66 mL of 8%**

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$2 \to 100$
$x \to 5$
$10 = 100x$
$x = 0.1$

$4 \to 100$
$x \to 10$
$40 = 100x$
$x = 0.4$

$\frac{0.5}{15} = 0.33$

$x = 3.33\%$

- What is the percentage of alcohol in the following mixture ?

Alcohol 2% 5ml (will take 0.1 ml) (lowest concentration)

Alcohol 4% 10 ml (will take 0.4 ml) (highest concentration)

Total volume (parts)= 5 + 10= 15 ml

(can be solved by the alligation method)

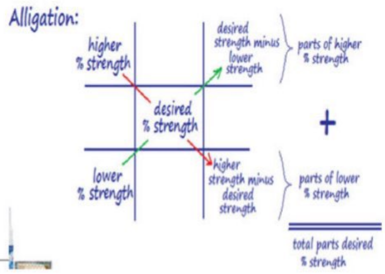
Answer:

0.1+0.4=0.5 = no. of parts of the desired concentration

Total volume (parts)= 5 + 10= 15 ml

0.5/(5+10)=0.0333….Multiply by 100 to get % desired concentration

X= 3.33%



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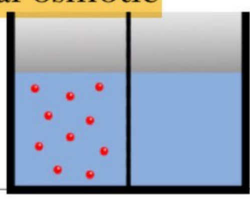
Iso-osmoticity and Isotonicity

- **Osmosis** is a phenomenon that occur when a semipermeable membrane (permeable only to solvent molecules) is used to separate solutions of different solute concentrations
- The solvent molecules cross the membrane from lower to higher concentration to establish a concentration equilibrium
- The pressure driving this movement called osmotic pressure
- Osmotic pressure is governed by the number of **particles** of solute in solution
- Iso-osmotic solutions: solutions containing the same concentration of particles and thus exert equal osmotic pressure



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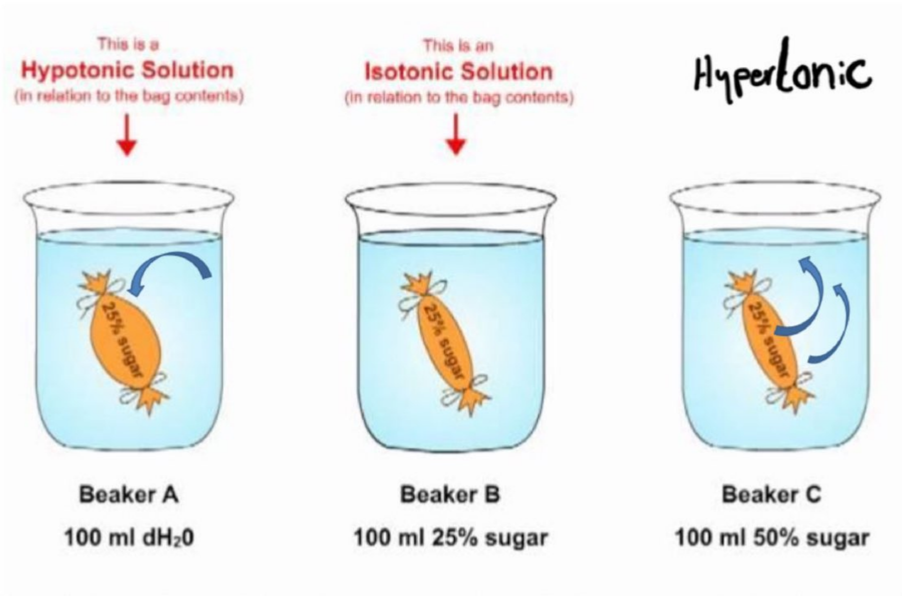

In the final experiment, watch what happens when a bag containing 25% sugar is placed in a beaker containing 50% sugar. In this case, the solute concentration of the beaker is higher than that of the bag.

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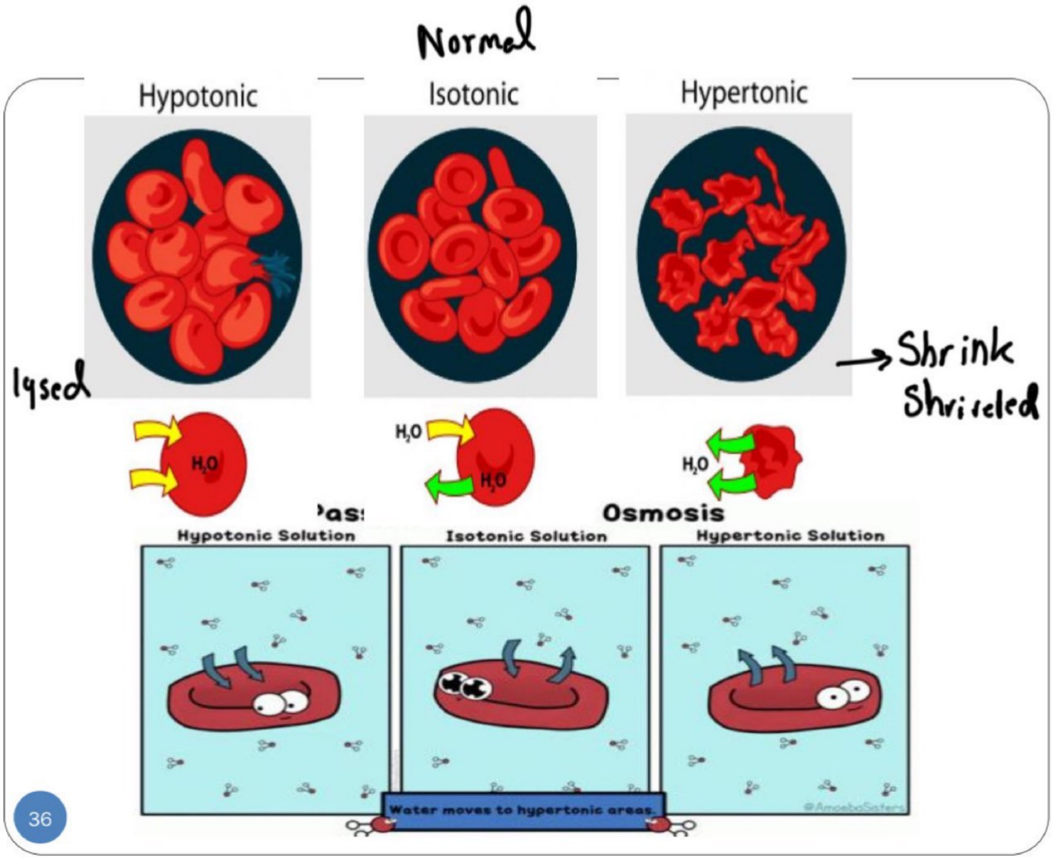

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Iso-osmoticity and Isotonicity

- A 0.9% solution of sodium chloride (normal saline) is iso-osmotic with blood
- Isotonic means equal tone and sometimes is used interchangeably with the term iso-osmotic
- The importance of using isotonic or iso-osmotic solutions is to assure that there is no tissue damage or pain when the formulation is administered ← - عند إعطاء التركيبة

  to prevent irritation
- **Hypotonic** solutions produce painful swelling of tissues
- **Hypertonic** solutions produce painful shrinking of tissues

Same Concentration of Solutes as blood plasma

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Methods used to adjust the isotonicity of compounded solutions:

normal Saline 0.9 %

1. Sodium chloride equivalent method:
- the most widely used
- The NaCl equivalent (E) is the amount of NaCl that has the same osmotic effect (based on the number of particles) as 1gm of drug
- Tables of (E) for various drugs are available in standard references

temp عن طريق ال ← 2. Cryscopic method

3. Isotonic solution **V** values

Table of Sodium Chloride Equivalents, Molecular Weights, Factors and Ions

Substance	Molecular weight	Ions	i	Sodium Chloride Equivalent
Antazoline phosphate	363	2	1.8	0.16
Antipyrine	188	1	1.0	0.17
Atropine sulfate.H_2O	695	3	2.6	0.12
Benoxinate hydrochloride	345	2	1.8	0.17
Benzalkonium chloride	360	2	1.8	0.16
Benzyl alcohol	108	1	1.0	0.30
Boric acid	61.8	1	1.0	0.52
Chloramphenicol	323	1	1.0	0.10
Chlorambutol	177	1	1.0	0.18
Chlortetracycline hydrochloride	515	2	1.8	0.11
Cocaine hydrochloride	340	2	1.8	0.17
Cromolyn sodium	512	2	1.8	0.11
Cyclopentolate hydrochloride	328	2	1.8	0.18
Demecarium bromide	717	3	2.6	0.12
Dextrose (anhydrous)	180	1	1.0	0.18
Dextrose.H_2O	198	1	1.0	0.16
Dipivefrin hydrochloride	388	2	1.8	0.15
Ephedrine hydrochloride	202	2	1.8	0.29
Ephedrine sulfate	429	3	2.6	0.20
Epinephrine bitartrate	333	2	1.8	0.18
Epinephryl borate	209	1	1.0	0.16
Eucatropine hydrochloride	328	2	1.8	0.22
Fluorescein sodium	376	3	2.6	0.22
Glycerin	92	1	1.0	0.36
Homatropine hydrobromide	356	2	1.8	0.16
Hydroxyamphetamine hydrobromide	232	2	1.8	0.25
Idoxurine	354	1	1.0	0.09
Lidocaine hydrochloride	289	2	1.8	0.22
Mannitol	182	1	1.0	0.18
Morphine sulfate.5H_2O	759	3	2.6	0.11
Naphazoline hydrochloride	247	2	1.8	0.27
Oxymetazoline hydrochloride	297	2	1.8	0.20
Oxytetracycline hydrochloride	497	2	1.8	0.12
Phenacaine hydrochloride	353	2	1.8	0.17
Phenobarbital sodium	254	2	1.8	0.23

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Sodium Chloride Equivalent Method:

يعني تركيز NaCl = 0.9%

- Example: Calculate the amount of NaCl required to make the following ophthalmic solution isotonic:

Atropine Sulfate 2%

NaCl q.s.

Aqua. Dist. q.s. ad. 30 ml

* each gram of **atropine sulfate** can be replaced by **0.13** g of **NaCl**

2 → 100
x → 30

$\frac{60}{100} = 0.6$

$0.6 \times 0.13 = 0.078$

0.9 → 100
x → 30

0.27 → 0.192 NaCl

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Sodium Chloride Equivalent Method:

Step 1:

Determine the amount of NaCl to make 30 ml of an isotonic solution:

- 0.9g of sodium chloride in 100 ml of water will make an isotonic solution
- 0.9gm → 100 ml
- X → 30 ml
- X= 0.27 gm

Rx

Atropine Sulfate	2%
NaCl	q.s.
Aqua. Dist. q.s. ad.	30 ml

- Atropine % convert to gm
- 2gm……..100ml
- ?? ………..30 ml
- 0.6gm

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Sodium Chloride Equivalent Method:

Step 2:

Calculate the contribution of atropine sulfate to the osmotic pressure of the solution (the sodium chloride equivalent for atropine 30 ml X 2g/100 ml= 0.6 g atropine sulfate will be present in the formulation

- sulfate **(E)= 0.13): from the table**
- 1 gram drug...........E 0.13 gm NaCl
- 0.6gm.....................????
- 0.6g X 0.13= 0.078 gm will be the sodium chloride equivalent contribution of atropine sulfate **in this preparation**

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Sodium Chloride Equivalent Method:

Step 3 Determine the amount of NaCl to add to the formulation:

For 30 ml 0.27 NaCl is needed if no drug, but...

- The sodium chloride needed to make the final solution isotonic is calculated by:

0.27 gm- 0.078g= 0.192 gm #

What if???

boric acid is used to adjust isotonicity in ophthalmic solution because of its buffering and anti-infective properties:

إذا كان عندي بدال ال NaCl بحل السؤال كأنه NaCl بعوض بحل هي الخطوة..

الجواب 0.5

- **E for boric acid= 0.5 from the table**
- 1 g boric acid........ 0.5 g NaCl
- X g boric acid........ 0.192g NaCl
- X= 0.38 g

Atropine Sulfate	0.6gm
NaCl	0.192gm
Aqua. Dist. q.s. ad.	30 ml

Atropine Sulfate	0.6gm
Boric acid	0.38gm
Aqua. Dist. q.s. ad.	30 ml

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