University of Tikrit

College of Pharmacy

Dilution and Concentration of Pharmaceutical Preparations

By

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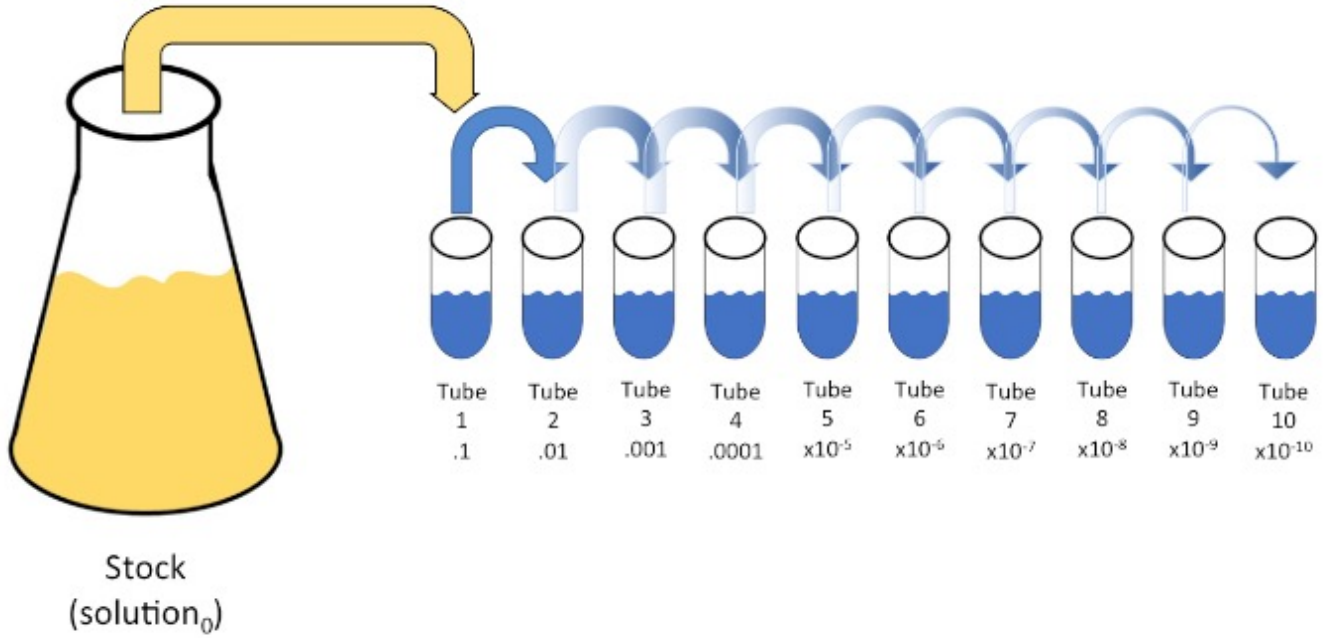
Stock Solutions

Stock Solutions

Stock solutions are **concentrated solutions** of active drug or inactive (e.g., colorant) substances and are used by pharmacists as a convenience to prepare solutions of lesser concentration.



Stock Solutions

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

4 liters = 4000 mL

1:400 = 0.25%

1:2000 = 0.05%

Q1 * C1 = Q2 * C2

4000 (mL) **x** 0.05 (%) = Q2(mL) **x** 0.25 (%)

Q2 = 800 mL, answer.

Stock Solutions

How many fluidounces of a 1:400 (w/v) stock solution should be used to make 1 gallon of a 1:2000 (w/v) solution ?

1 gallon = 128 fl oz

1 :400 = 0.25 % 1 :2000 = 0.05 %

Q1 (quantity) x C1 (concentration) = Q2 (quantity) x C2 (concentration)

128 (fl oz) * 0.05 (%) = Q2 (fl oz) * 0.25 (%)

Q2 = 25.6 (fl oz), answer.

Stock Solutions

How many milliliters of a 1:50 stock solution of phenylephrine hydrochloride should be used in compounding the following prescription?

℞

Phenylephrine HCl 0.25%
Rose Water ad 30 mL
Sig. For the nose.

1:50 = 2%

Q1 x C1 = Q2 x C2

30 x 0.25% = Q2 x 2%

Q2 = 3.75ml

Calculation of Stock Solution

Some interesting calculations are used in pharmacy practice in which a pharmacist need to prepare and **dispense a concentrated solution** of a drug and direct the patient to use a specific household measure of a solution (e.g., 1 teaspoonful) in a specified volume of water (e.g., a pint) to make of solution of the desired concentration.

In this case, the strength of a diluted portion of a solution is defined, but the strength of the concentrated stock solution used to prepare it must be determined.

Calculation of Stock Solution

This permits the **dispensing of a relatively small volume of liquid**, enabling a patient to prepare relatively large volumes as needed, rather than carrying home gallons of a diluted solution from a pharmacy.

Calculation of Stock Solution

How much drug should be used in preparing 50 mL of a solution such that 5 mL diluted to 500 mL will yield a 1:1000 solution?

1:1000 means 1 g of drug in 1000 mL of solution

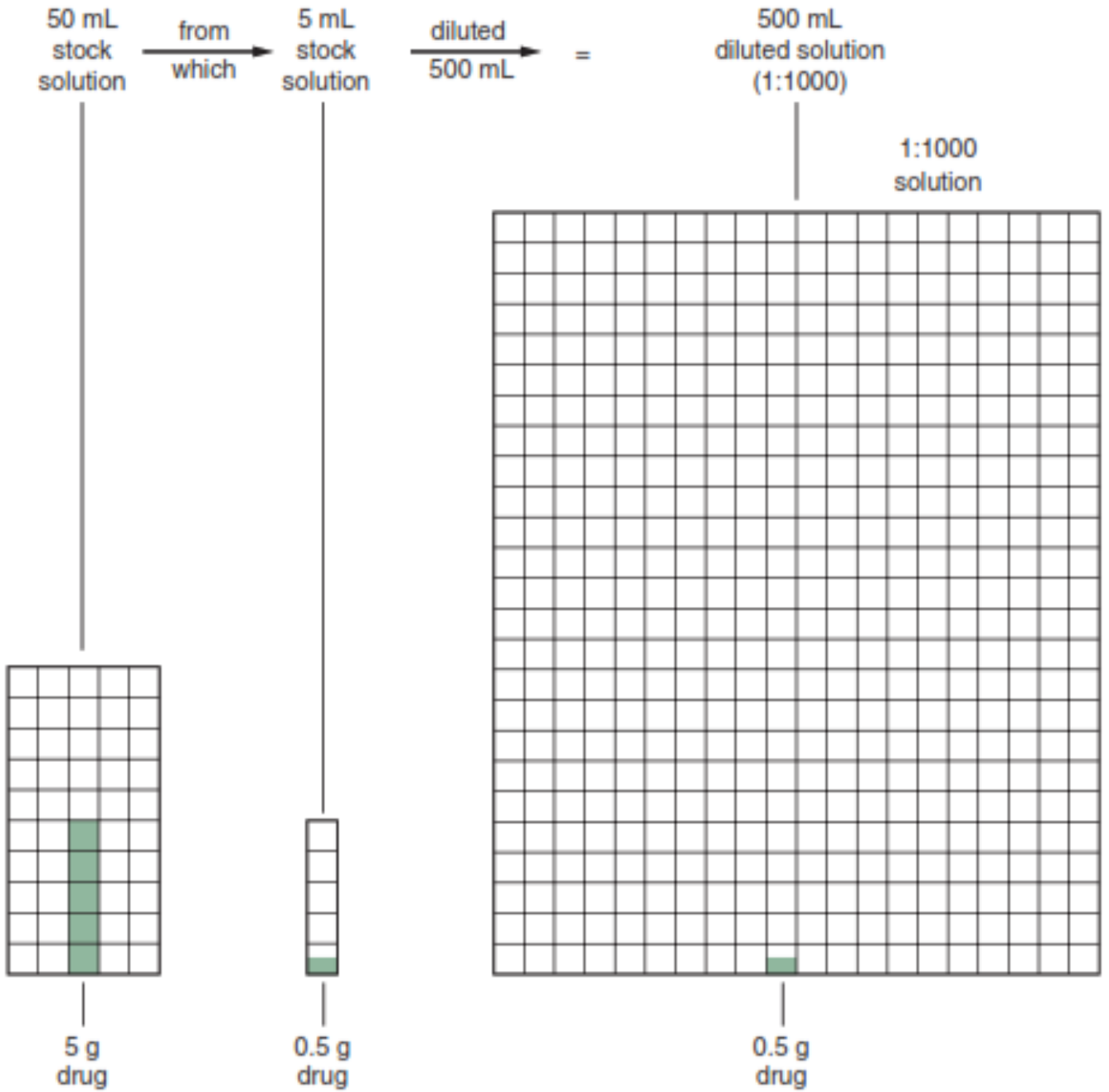
$$\frac{1000\ (\text{mL})}{500\ (\text{mL})} = \frac{1\ (\text{g})}{\text{x}\ (\text{g})}$$

x = 0.5 g of drug in 500 mL of *diluted* solution (1:1000), which is *also* the amount in 5 mL of the *stronger* (stock) solution

And,

$$\frac{5\ (\text{mL})}{50\ (\text{mL})} = \frac{0.5\ (\text{g})}{\text{y}\ (\text{g})}$$

y = 5 g, *answer*.


50 mL stock solution
from which
5 mL stock solution
diluted 500 mL
=
500 mL diluted solution (1:1000)
1:1000 solution
5 g drug
0.5 g drug
0.5 g drug

How many grams of sodium chloride should be used in preparing 500 mL of a stock solution such that 50 mL diluted to 1000 mL will yield a "⅓ normal saline" (0.3% w/v) for irrigation?

1000 (mL) × 0.003 = 3 g of sodium chloride in 1000 mL of "⅓ normal saline" (0.3% w/v), which is *also* the amount in 50 mL of the *stronger* (stock) solution to be prepared.

And,

$$\frac{50\ (\text{mL})}{500\ (\text{mL})} = \frac{3\ (\text{g})}{x\ (\text{g})}$$

$$x = 30\ \text{g},\ \textit{answer.}$$

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

1 liter = 1000 mL

1:5000 means 1 g of benzalkonium chloride in 5000 mL of solution

$$\frac{5000\ (\text{mL})}{1000\ (\text{mL})} = \frac{1\ (\text{g})}{\text{x}\ (\text{g})}$$

x = 0.2 g of benzalkonium chloride in 1000 mL of *diluted* solution (1:5000), which is *also* the amount in 15 mL of the *stronger* (stock) solution to be prepared, and:

$$\frac{15\ (\text{mL})}{300\ (\text{mL})} = \frac{0.2\ (\text{g})}{\text{y}\ (\text{g})}$$

y = 4 g of benzalkonium chloride needed,

because a 17% w/v concentrate contains 17 g per 100 mL, then:

$$\frac{17\ (\text{g})}{4\ (\text{g})} = \frac{100\ (\text{mL})}{z\ (\text{mL})}$$

z = 23.5 mL, *answer.*

A solution of known volume and strength may be diluted with water to prepare a solution of lesser strength. In such calculations, first, calculate the quantity of diluted solution that may be prepared from the concentrated solution. Then, subtract the volume of the concentrated solution from the total quantity that may be prepared to determine the volume of water needed.

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?

$$1{:}2500 = 0.04\%$$

$$1{:}750 = 0.133\%$$

$$\frac{0.04\ (\%)}{0.133\ (\%)} = \frac{300\ (\text{mL})}{x\ (\text{mL})}$$

Or, Q1 * C1 = Q2 * C2

$$x = 997.5 \text{ or } 1000 \text{ mL of } 0.04\% \text{ w/v solution to be prepared}$$

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.

1000 mL − 300 mL = 700 mL, *answer.*

If the quantity of a component is given rather than the strength of a solution, the solution may be diluted to a desired strength as shown by the following example:

How many milliliters of water should be added to 375 mL of a solution containing 0.5 g of benzalkonium chloride to make a 1:5000 solution?

1g 5000ml

0.5g X

X = 2500 ml of 1:5000 (w/v) solution containing 0.5 g of benzalkonium chloride.

2500 mL - 375 mL = 2125 mL

If 15 mL of a 0.06% ATROVENT (ipratropium bromide) nasal spray were diluted with 6 mL of normal saline solution, what would be the final drug concentration?

$$15\ \text{mL} \times 0.06\% = 0.009\ \text{g of ipratropium bromide}$$

$$15\ \text{mL} + 6\ \text{mL} = 21\ \text{mL, new total volume}$$

$$\frac{0.009\ \text{g}}{21\ \text{mL}} \times 100 = 0.043\ \%, \textit{answer.}$$

Or,

$$15\ (\text{mL}) \times 0.06\ (\%) = 21\ (\text{mL}) \times x\ (\%)$$

$$x = 0.043\ \%, \textit{answer.}$$

Dilution of Alcohol

When water and alcohol are mixed, there is a **physical contraction** such that the resultant volume is less than the total of the individual volumes of the two liquids. Thus, to prepare a volume-in-volume strength of an alcohol dilution, the alcohol "solute" may be determined and water used to "**q.s.**" to the appropriate volume. Because the contraction of the liquids **does not affect the weights of the components,** the weight of water (and from this, the volume) needed to dilute alcohol to a desired weight-in-weight strength may be calculated.

Dilution of Alcohol

How much water should be mixed with 5000 mL of 85% v/v alcohol to make 50% v/v alcohol?

$$\frac{50\ (\%)}{85\ (\%)} = \frac{5000\ (\text{mL})}{x\ (\text{mL})}$$

$$x = 8500\ \text{mL}$$

Or,

$$5000\ (\text{mL}) \times 85\ (\%) = x\ (\text{mL}) \times 50\ (\%)$$

$$x = 8500\ \text{mL}$$

Therefore, use 5000 mL of 85% v/v alcohol and enough water to make 8500 mL, *answer.*

Dilution of Alcohol

How many milliliters of 95% v/v alcohol and how much water should be used in compounding the following prescription?

℞	Xcaine	1 g
	Alcohol 70%	30 mL
	Sig. Ear drops.	

$$\frac{95\ (\%)}{70\ (\%)} = \frac{30\ (\text{mL})}{x\ (\text{mL})}$$

$$x = 22.1\ \text{mL}$$

Therefore, use 22.1 mL of 95% v/v alcohol and enough water to make 30 mL, *answer.*

Dilution of Alcohol

How much water should be added to 4000 g of 90% w/w alcohol to make 40% w/w alcohol?

$$\frac{40\ (\%)}{90\ (\%)} = \frac{4000\ (g)}{x\ (g)}$$

x = 9000 g, weight of 40% w/w alcohol equivalent to 4000 g of 90% w/w alcohol

9000 g − 4000 g = 5000 g or 5000 mL, *answer.*

Dilution of Acids

The strength of an official **undiluted (concentrated) acid** is expressed as percentage **weight-in-weight**. For example, Hydrochloric Acid, NF, contains not less than 36.5% and not more than 38.0%, by weight, of HCl. However, the strength of an official **diluted acid** is expressed as percentage **weight-in-volume.** For example, Diluted Hydrochloric Acid, NF, contains, in each 100 mL, not less than 9.5 g and not more than 10.5 g of HCl.

It is necessary, therefore, to consider the specific gravity of concentrated acids in calculating the volume to be used in preparing a desired quantity of a diluted acid.

Dilution of Acids

How many milliliters of 37% w/w hydrochloric acid having a specific gravity of 1.20 are required to make 1000 mL of diluted hydrochloric acid 10% w/v?

1000 g × 0.10 = 100 g of HCl (100%) in 1000 mL of 10% w/v acid

$$\frac{37\ (\%)}{100\ (\%)} = \frac{100\ (g)}{x\ (g)}$$

$$x = 270\ g \text{ of } 37\% \text{ acid}$$

270 g of water measure 270 mL

Or, Q1 * C1 = Q2 * C2

270 (mL) ÷ 1.20 = 225 mL, *answer.*

Dilution of Acids

How many milliliters of 85% w/w phosphoric acid having a specific gravity of 1.71 should be used in preparing 1 gallon of ¼% w/v phosphoric acid solution to be used for bladder irrigation?

1 gallon = 3785 mL

3785 (g) × 0.0025 = 9.46 g of H_3PO_4 (100%) in 3785 mL (1 gallon) of ¼% w/v solution

$$\frac{85\ (\%)}{100\ (\%)} = \frac{9.46\ (g)}{x\ (g)}$$

Or, Q1 * C1 = Q2 * C2

x = 11.13 g of 85% phosphoric acid

11.13 g of water measures 11.13 mL

11.13 (mL) ÷ 1.71 = 6.5 mL, *answer*.

THANK YOU

Dilution and Concentration