

# Pharmaceutical Calculations

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واحدة من أكثر هذه احتمالات  
الخطأ في تحضير الوصفات الطبية  
هو الخطأ بعجلات حسابات  
المهيبات..

صحيحين إننا الخطأ بغير  
والله أعلم بسبب الوفاة !!

- One of the greatest <sup>احتمالات..</sup> potentials for error in <sup>وصفات طبية..</sup> prescription compounding is in the area of pharmacy math or pharmacy calculations
- A misplaced <sup>عشر</sup> decimal or “estimated” value for a medication can have serious consequences including death
- There is no <sup>جمل</sup> excuse for <sup>فرد</sup> ignorance in this area and an <sup>غير مستعد..</sup> individual unprepared to do the necessary calculations should not be involved in pharmaceutical compounding

\* ما يجي أي تبرير الجمل بهاد الجال !!  
وأي شخص غير مستعد (تقفؤ) ما بصير يوفيل بهاد الجال ..

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## Numbers and Numerals

- **Number**: a total quantity or amount → digital
  - **N numeral**: a word, sign, or group of words and signs → word describing a number  
ex: four..
- Roman Numerals:
- A numeral system of ancient Rome based on letters of the Alphabet
  - I: one, V: five, X: ten, L:50, C:100, D: 500, M:1000
  - The first ten Roman numerals are: I, II, III, IV, V, VI, VII, VIII, IX, X
- |         |    |         |         |   |
|---------|----|---------|---------|---|
| ➤ XXX:? | 30 | IV = 4  | XC = 90 | كلمات: ما بصير أكثر<br>أكثر من ٣ أرقام درا بعضه .. ٧٧٧٧ |
| ➤ LX:?  | 60 | VI = 6  | XC = 80 |   |
|         |    | XL = 20 |         |   |
|         |    | IX = 9  |         |   |
|         |    | LX = 70 | XI = 11 |   |

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$$39 = \text{XXXIX}$$

$$\text{XL} = 40$$

$$\text{CD} = 400$$

$$\overline{\text{X}} = 10 \times 1000 = 10000$$

$$\overline{\text{V}} = 5 \times 1000 = 5000$$

## Numbers and Numerals

- **Arabic Numerals**:
- Most common symbols used to represent numbers <sup>يمثل</sup>
  - The **basic symbols** called digits are: 0,1,2,3,4,5,6,7,8,9
  - The position of a digit determines its value
  - 237 <sup>موقع الفاصلة هو الذي يحدد القيمة</sup>  
0.1   0.01   1.0
  - 0.237, 2.37, ...

0, 1, 2, 3 ← عربية  
٠, ١, ٢, ٣ ← هندية

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## Decimals \* كسور عشرية ..

- A decimal is a fraction whose denominator is 10 or a **multiple** of 10
- e.g.:
  - $0.7 = 7/10$
  - $0.06 = 6/100$
  - $0.006 = 6/1000$
- $0.3 = 0.30 = 0.300$
- $0.3 = 3/10$
- $0.03 = 3/100$
- $0.003 = 3/1000$

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## Using ratios, proportions, and percentages in dosage calculations:

- Example: <sup>تلاوة</sup> a vial of Rociphen contains **100 milligrams** per **milliliter**. How many milliliters should be given to a patient to obtain 650 milligrams?
- Amount      volume
- $100 \text{ mg} \rightarrow 1 \text{ ml}$
- $650 \text{ mg} \rightarrow X \text{ ml}$
- $X = 6.5 \text{ ml}$

$$* 100 \text{ mg} \rightarrow 1 \text{ ml}$$

$$* 650 \text{ mg} \rightarrow X \text{ ml}$$

$$\frac{100}{100} X = \frac{650}{100} \rightarrow \underline{\underline{6.5 \text{ mL}}}$$

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## Using ratios, proportions, and percentages in dosage calculations:

- Always look for what is being asked:
- ① - Number of doses
- ② - Total amount of drug
- ③ - Size of dose, size: volume or strength
- Given any two of the above, you can solve for the third
- General Formula: إذا هي (٢) من المعطيات بكل خطوات يعرف لا يس .

$$\text{Number of doses} = \text{Total amount} / \text{Size of dose} \quad N = T/S$$

$$\text{Total amount} = \text{number of doses} \times \text{size of dose} \quad T = N \times S$$

$$\text{Size of dose} = \text{Total amount} / \text{number of doses} \quad S = T/N$$

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## Using ratios, proportions, and percentages in dosage calculations:

- \* Example: how many milligrams of theophylline does a patient receive per day, if the prescription indicates 300mg tid?

$$X \text{ total amount} = 3 \times 300 \text{mg}$$

$$300 \times 3 = 900$$

$$X = 900 \text{ mg total}$$

- How much propranolol will a patient receive every 6 hours if he is to receive 160 mg per day?

$$X \text{ dose} = 160 \text{ mg} / 4 \text{ doses}$$

$$24/6 = 4$$

لث في اليوم

$$X = 40 \text{ mg}$$

**Note:** every 6 hours means 4 times daily  $24/6 = 4$   $160/4 = 40 \text{ mg}$

Every 8 hours means 3 times daily  $24/8 = 3$

Every 12 hrs means twice daily  $24/12 = 2$

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## Using ratios, proportions, and percentages in dosage calculations:

Solve by your self:

- How many doses are in 120ml of Benadryl Elixir, if one dose is 5ml? (Answer 24 doses)  $120/5 = 24$
- When erythromycin lactobionate is **reconstituted**, it yields a concentration of 50 mg/ml. How many milliliters are required to give a 0.9 gm dose? (Answer: 18 ml)... be careful for the unit



50mg..... 1ml  
0.9 gm(.....mg).....???

$$\begin{array}{l} 50 \text{ mg} \rightarrow 1 \text{ mL} \\ 0.9 \text{ gm} \rightarrow x \text{ mL} \end{array}$$

50 mg → 1 mL  
0.9 x 1000 → x mL

$$\frac{0.9 \times 1000}{50} = 18 \text{ mL}$$

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## Percentage

- $45\% = 45/100 = 0.45$
- It is not correct to divide by 100 and use the percent sign at the same time:

e.g.  $25\% = 25/100$  and not  $25\%/100$

- To calculate a percentage of a percentage:

50% of 40% is:

$$(50/100) \times (40/100) = 0.5 \times 0.4 = 0.2 = 20/100 = 20\%$$

$$\frac{50}{100} \times \frac{40}{100} = \frac{2000}{10000} = 0.2 \quad \frac{2}{10} \times 100\% = 20\%$$

$$\frac{2000}{10000} = 20\%$$

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## Mass percentage (fraction)

- **Wt%:** Percent weight-in-weight (w/w) expresses the number of grams of a drug or active ingredient in 100 grams of a mixture (g/g)
- If a bottle contains 40 gm of ethanol and 60 gm of water then it contains 40% ethanol by mass or 0.4 mass fraction ethanol

$$* 40 + 60 = 100$$

$$* 40 / 100 = 40\%$$

$$* 60 / 100 = 60\%$$

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## Mass percentage (fraction)

- **Examples:** Prepare 500 ml of (Phenol glycerin solution)

Phenol (solid): Glycerin(liquid)

150 gm : 850 gm

Weight per ml of glycerin: 1.25g .....(density= 1.25g/ml)

So for preparing 500 ml of phenol glycerin

Each 1ml glycerin.....1.25 gm glycerin

500 ml glycerin.....???

the quantity of glycerin required = 500ml X 1.25 = 625 gm

Phenol (solid): Glycerin(liquid)

150 gm ..... 850 gm

?????.....625 gm

- Quantity of phenol required =  $150 \times 625 / 850 = 110 \text{ gm}$
- So for preparing 500 ml of phenol glycerin the formula becomes:
  - Phenol 110 g
  - Glycerin 625 g

$$\begin{array}{r}
 1.25 \text{ g} \rightarrow 1 \text{ mL} \\
 \times \text{ g} \rightarrow 500 \text{ mL} \\
 \hline
 500 \times 1.25 = 625 \text{ g Glycerine} \\
 \hline
 \\
 150 \rightarrow 850 \\
 \times \rightarrow 625 \\
 \hline
 110 \text{ g}
 \end{array}$$

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## Phenol Glycerin IP

- Method: Phenol and glycerin are mixed in a beaker. The beaker is warmed gently until it becomes a solution.
- Use: Local anesthetic and local antiseptic. Phenol glycerin is used to prepare Phenol Gargle and Phenol Glycerin Ear Drop.
- Cautions: Phenol Glycerin when diluted with water becomes caustic so it is diluted with glycerin.
- Label: FOR EXTERNAL USE ONLY should be displayed in the label.



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• Use: Local anesthetic and local antiseptic. Phenol glycerin is used to prepare Phenol Gargle and Phenol Glycerin Ear Drop.

• Cautions: Phenol Glycerin when diluted with water becomes caustic so it is diluted with glycerin.

• Label: FOR EXTERNAL USE ONLY should be displayed in the label.

• Method: Phenol and glycerin are mixed in a beaker. The beaker is warmed gently until it becomes a solution.

### • Examples:

Prepare 500 ml of sugar(solid) solution

Sugar 100 gm

\* Water 900 gm

Weight per ml of water = 1 gm.....(water density)

Sugar : water

100..... 900

???.....500

$100 \times 500 / 900 =$

The quantity of water required ? (500g)

The quantity of sugar required ? (55 g)

1g water → 1 ml

xg → 500 ml

$x = 500$  g water

100 → 900

x → 500

- 55 g Sugar

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## Mass-volume percentage:

- Weight-in-volume (w/v) percentage: expresses the number of grams of a drug or active ingredient in 100 milliliters of a mixture
- Often used for solutions made from a solid solute dissolved in a liquid
- For example a 40% w/v sugar solution contains 40 gm of sugar per 100 ml of resulting solution

$$\frac{40\text{g Sugar}}{100\text{ mL}}$$



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## Mass-volume percentage:

- Example:  
Calculate the quantity of sodium chloride required to prepare 400 ml of 2 (w/v)% solution

2g NaCl ..... 100 ml solution

X ..... 400 ml

X = 8 g of sodium chloride is dissolved in water to produce 400 ml makes 2% w/v solution



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## Mass-volume percentage:

- Example:  $\frac{1}{10000} = 0.01\%$        $\frac{1}{5000} = \frac{2}{2 \times 50 \times 100} = 0.02\%$

Prepare 500 ml of a 1 in 10000 solution from 1 in 5000 solution (stock solution)?

Strength of concentrate 1 in 5000 =  $100/5000 = 0.02\%$

Strength of dilute solution = 1 in 10000 =  $100/10000 = 0.01\%$

**Degree of dilution = strength of concentrate**  
**strength of dilute solution =**

$$0.02/0.01 = \underline{2} \text{ times}$$

Volume of solution to be prepared = 500 ml  $\rightarrow \frac{500}{2} = 250 \text{ ml}$

Therefore, dilute solution is obtained by diluting

$500/2 = 250$  ml of 1 in 5000 solution to 500 ml

$$C_1V_1 = C_2V_2$$

$$0.1\% \times V_1 = 0.02\% \times 500 \text{ ml}, \quad V_1 = 250 \text{ ml}$$

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## Mass-volume percentage:

- Solve by yourself:

$$\frac{2 \times 1}{2 \times 500} = \frac{2}{10 \times 100} = 0.2\%$$

How much of a 5% will be required to prepare 1000 ml of a 1 in 500 solution?

Strength of concentrate = 5%

Strength of dilute solution = 0.2% (1 in 500)

Degree of dilution =  $\frac{5}{0.2} = 25$  times

Volume to be prepared = 1000 ml

$1000/25 = 40$  ml of 5%

Therefore dilute solution is obtained by diluting 40 ml of 5% solution to 1000 ml

$$C_1V_1 = C_2V_2$$

$$5\% \times V_1 = 0.2\% \times 1000 \text{ ml} = \underline{40 \text{ ml}}$$

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