Dosage Calculation using Dimensional Analysis

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Methods in Dosage Calculation

› Formula method

$$\frac{D}{H} \times Q = X$$

› Ratio and Proportion

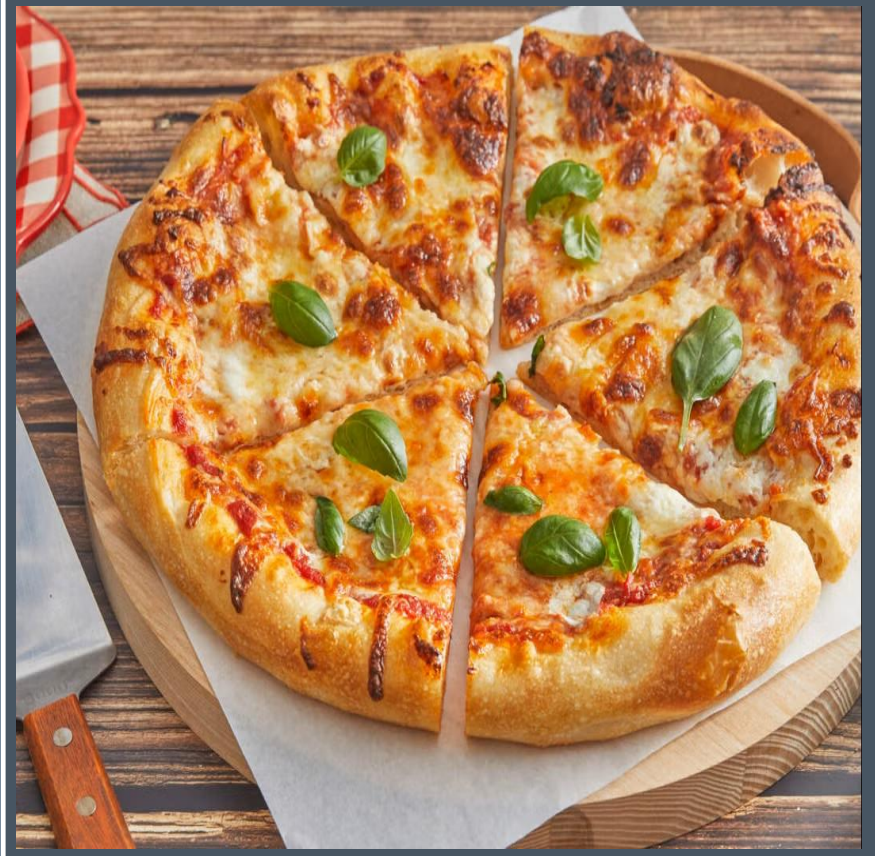
50 mg:1ml or $\frac{50mg}{1ml}$

› Dimensional Analysis (Units Conversion)

Why Dimensional Analysis?

- Decreases number of steps to calculate.
- Units of measure can be mixed, they will cancel each other out.
- May be a safer method of calculation.
- Can use as a second method to see if another method calculated correctly.

DECIMALS



- Think of decimals like money or pizza slices:

  Tenths place **(0.1)**: Like dimes in a dollar or cutting a pizza into 10 big slices.

- Example: 3.4 → 3 wholes and 4 tenths (4 dimes = $0.40).

  Hundredths place (0.01): Like pennies in a dollar or cutting each pizza slice into 10 smaller pieces.

- Example: 3.46 → 3 wholes, 4 tenths, and 6 hundredths (46 cents).

  Rule of thumb: Tenths = bigger chunks, Hundredths = finer detail.

MEDICATION AND IV ROUNDING RULES

- **Adults:**
  - Oral meds <1 mL → round to hundredths (0.01 mL)
  - Oral meds >1 mL → round to tenths (0.1 mL)
  - Tablets → whole or half if scored
  - IV fluids → whole mL/hr

Pediatrics (Children):
- Oral meds → round to hundredths (0.01 mL)
- Prefer liquids, avoid rounding tablets
- IV fluids → round to whole mL/hr

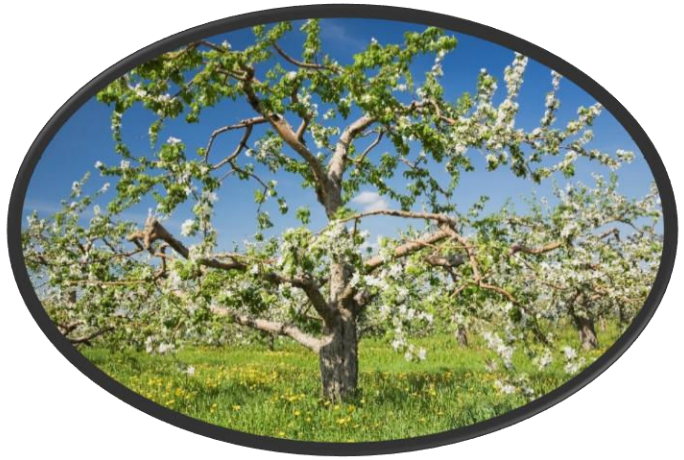
Neonates / NICU:
- Oral/IV meds → round to hundredths (0.01 mL)
- Critical meds (insulin, heparin, vasoactive) → never round
- IV fluids → round to tenths (0.1 mL/hr) if pump allows

Rounding 5-4 Rules

- **The Rule**
- If the digit **after your rounding place is 5 or more (5,6,7,8,9) → round up.**
- If the digit **after your rounding place is 4 or less (0,1,2,3,4) → round down** (keep the number the same).

Rounding to the tenth place: Examples

- **Example:**
- **Example 1: 3.46 → round to tenths**
- Tenths place = **4**.
- Look at hundredths = **6** (≥5, strong wind).
- Tree gets pushed up → **4 → 5**.



- **"The Tree and the Wind"**
- Think of the **tenths digit** as a tree, and the **hundredths digit** as the wind:
- If the wind is **weak (0–4)**, the tree stays **still** → number doesn't change.
- If the wind is **strong (5–9)**, the tree gets pushed **up to the next branch** → number increases.
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FOUR STEPS IN DIMENSIONAL ANALYSIS

Example:

Order: KCL 30 meq PO x 1. The medication is supplied in a solution of 40 meq/15 ml. How may ml will you administer?

Xml=$\frac{30\ \cancel{meq}}{.}$x $\frac{15\ ml}{40\ \cancel{meq}}$ = $\frac{450}{40}$ = 11.25 ml

Label	Label what is needed
Line up	Line up the numbers
Place and cancel	Place and cancel like units
Do	Do the math

Order: Give 650 mg of Tylenol P.O. Q 8 hrs. Tylenol is supplied in 325 mg tablets. How many tabs will you give?

$$\text{X tabs} = \frac{650\ \cancel{mg}}{.} \times \frac{1\ tab}{325\ \cancel{mg}} = \frac{650}{325} = 2 \text{ tabs}$$

Parental Medications

A vial of Nafcillin is labeled 2 grams. The vial instructs to add 1.7 ml of sterile water for each 500 mg of the drug for reconstitution. The solution will equal 8 ml after reconstitution. How much of the solution should you draw up if the order is to administer 500 mg of Nafcillin per dose?

$$xml = \frac{500\cancel{mg}}{.} \text{X} \frac{8\ ml}{\cancel{2\ gram}} \text{X} \frac{\cancel{2\ grams}}{2ooomg} = 2\text{ml}$$

Infuse 1 Liter D5.2 NS over 10 hours.

Drop Factor 10

Calculate gtt/min

Intravenous Fluids

$$x\ \frac{gtts}{min} = \frac{1\ \cancel{L}}{10\ \cancel{hours}}\ x\ \frac{10\ gtts}{1\ \cancel{ml}}\ x\ \frac{1\ \cancel{hr}}{60\ min}\ x\ \frac{1000\ \cancel{ml}}{1\ L} =$$

$$\frac{10{,}000}{600} = 16.\overline{66}$$

Round to the nearest whole number
Ans=17 gtt/min

Note: gtt/min is always rounded to the whole number.

INTRAVENOUS DRIPS

The patient is receiving 10 mg/min through an IVPB. The solution has the strength of 400mg in 100 ml. Calculate the IV flow rate in ml/h

$$x\,\frac{ml}{hr} = \frac{100ml}{400\cancel{mg}}\,x\,\frac{10\,\cancel{mg}}{\cancel{min}}\,x\,\frac{60\,\cancel{min}}{1\,hr} = \frac{60{,}000}{400} =$$

150 ml/hr

A patient is to receive a loading dose of heparin which is ordered at 500 units and then a maintenance dose of 1300 units per hour.

The solution comes at 250 units/ml in a 250 ml bag.

1. How many ml will the patient receive as a loading dose?

2. Loading doses are typically given over 30 minutes. At what rate will you set the pump for the maintenance dose?

1. $x\text{ml} = \frac{500\ \cancel{units}}{.} x \frac{1\ ml}{250\ \cancel{units}} = \frac{500}{250} = 2\text{ ml}$

2. $x\ \frac{ml}{hr} = \frac{2\ ml}{30\ \cancel{min}} x \frac{60\ \cancel{min}}{1\ hr} = \frac{120}{30} = 4\text{ ml/hr}$

Drug Calculations by Body Weight

- Order Reads: Gentamycin 20 mg IV Q 8 hr
- Recommended safe dose range is 6-7.5 mg/kg/day
- Pt weighs 33 lbs
- Calculate the safe range

- Low Dose

$$xmg = \frac{6\ mg}{\cancel{kg}}\ x\ \frac{33\ \cancel{lbs}}{.}\ x\ \frac{1\ \cancel{kg}}{2.2\ \cancel{lbs}} = \frac{198}{2.2} = 90\text{mg}$$

- High Dose

$$xmg = \frac{7.5\ mg}{\cancel{kg}}\ x\ \frac{33\cancel{lbs}}{.}\ x\ \frac{1\ \cancel{kg}}{2.2\ \cancel{lbs}} = \frac{247.5}{2.2} = 112.5\ \text{mg}$$

References

Olsen, J., Giangrasso, A., Shrumpton, D. (2011). Medication Dosage Calculation: A dimensional Analysis Aproach. (10th ed). Prentice Hall. ISBN: 978-0-132-15-661-5.

"Education is not the learning of facts, but the training of the mind to think."
-Albert Einstein