As easy as 1, 2, 3!
Dosage calculations

Dimensional analysis is a method of computation used in the physical sciences, but it also has practical applications for nursing. This approach to dosage calculation requires no memorization of formulas, can be applied to easy and complex computations, and shows a logical path to a correct solution. We help you add it up.

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Which is it? Desired over available? Available over desired? Confused by dosage calculation formulas? You might use ratio and proportions to figure out a dosage, but this can involve several different equations, and it's easy to get lost along the way.

Just try to follow the steps of ratio and proportion through this example:
- \( D \) = (desired dose)
- \( H \) = (dose on hand)
- \( V \) = (vehicle [tablet or liquid])
- \( X \) = (unknown)
- \( H \cdot V : D \cdot X \) and \( H \cdot X = D \cdot V \); therefore \( X = D \cdot V / H \).

Do you find yourself struggling to make sense of this? Try using the dimensional analysis method instead. This approach to dosage calculation requires no memorization of formulas. It uses a series of conversion factors, which are factors of equivalency from one system of measurement to another (such as 1 g = 1,000 mg and 1 kg = 2.2 lbs), but doesn’t require the user to commit to memory any specific formulas.

In this article, we’ll give you step-by-step examples to put dimensional analysis into operation to perform the common medication calculations you’ll face in the clinical setting.
**Start simple**

To start, try this simple problem.

**Example:** The healthcare provider prescribes furosemide 40 mg I.V. Furosemide is available in 20 mg/mL. How many mL should be administered?

**Step 1:** What label should the answer have? Write this down on the right side of the equation. This is what you want to work toward.

Like this:

\[= \text{mL (step 1)}\]

**Step 2:** On the left side of the equation, enter the desired dosage as a fraction.

Like this:

\[\frac{40 \text{ mg}}{1} = \text{mL (step 2)}\]

**Step 3:** Enter conversion factors as fractions to work toward the desired label, making sure that the numerator and denominator are equal (equals over equals). This is like multiplying the desired dosage by 1. Any time a number is multiplied by 1, the number doesn’t change. In this case, the dosage doesn’t change; only the form, in terms of label, changes.

Like this:

\[\frac{40 \text{ mg} \times \frac{1 \text{ mL}}{20 \text{ mg}}}{1} = \text{mL (step 3)}\]

**Step 4:** Cancel all labels that are in both the numerator and the denominator.

Like this:

\[\frac{40 \text{ mg} \times \frac{1 \text{ mL}}{20 \text{ mg}}}{1} = \text{mL (step 4)}\]

**Step 5:** Do the math by multiplying the numerators, then multiplying the denominators, then dividing the answer in the numerator by the answer in the denominator. This makes calculation errors less likely.

Like this:

\[\frac{40 \text{ mg} \times 1 \text{ mL}}{20 \text{ mg}} = \frac{40 \text{ mL} = 2 \text{ mL (step 5)}}{20}\]

**Step 6:** Finally, look at the derived answer and consider whether it makes logical sense.
**Get involved**

Next, we’ll show you how to perform a dosage calculation that’s a little more involved. This problem shows you how to calculate the number of drops per minute at which to run the I.V. You might think that infusion pumps would make such a calculation obsolete, but in the case of a power failure, the pump won’t function for long. It’s then up to you to manually regulate the infusion.

**Example:** The healthcare provider prescribes an I.V. of normal saline solution to run at 125 mL/hour. The drip factor (given on the I.V. tubing wrapper) is 10 drops/mL. At how many drops/minute will you run the infusion?

**Step 1:** What label should the answer have? Write this down on the right side of the equation. This is what you want to work toward.

Like this:

\[ \text{drops} \quad \text{(step 1)} \]
\[ \text{min} \]

**Step 2:** On the left side of the equation, enter the desired dosage as a fraction.

Like this:

\[ \frac{125 \text{ mL}}{1 \text{ hr}} = \text{drops} \quad \text{(step 2)} \]
\[ \frac{1 \text{ hr}}{60 \text{ min}} \]

**Step 3:** Enter conversion factors as fractions to work toward the desired label, making sure that the numerator and denominator are equal (equals over equals).

Like this:

\[ \frac{125 \text{ mL}}{1 \text{ hr}} \times \frac{1 \text{ hr}}{60 \text{ min}} = \text{drops} \quad \text{(step 3)} \]
\[ \frac{60 \text{ min}}{1 \text{ mL}} \]

The above step gets the minutes in the denominator.

Then:

\[ \frac{125 \text{ mL}}{1 \text{ hr}} \times \frac{1 \text{ hr}}{60 \text{ min}} \times \frac{10 \text{ drops}}{1 \text{ mL}} = \text{drops} \quad \text{(step 3)} \]
\[ \frac{60 \text{ min}}{1 \text{ mL}} \]

The above step gets the drops in the numerator.

**Step 4:** Cancel all labels that are in both the numerator and the denominator.

Like this:

\[ \frac{125 \text{ mL}}{1 \text{ hr}} \times \frac{1 \text{ hr}}{60 \text{ min}} \times \frac{10 \text{ drops}}{1 \text{ mL}} = \text{drops} \quad \text{(step 4)} \]
\[ \frac{60 \text{ min}}{1 \text{ mL}} \]

**Step 5:** Do the math by multiplying the numerators, then multiplying the denominators, then dividing the answer in the numerator by the answer in the denominator. This makes calculation errors less likely.
Multiply the numerators, then the denominators, then divide to prevent errors.

Like this:

$$\frac{125\text{mL} \times \frac{1\text{hr}}{60\text{min}} \times \frac{10\text{ drops}}{1\text{mL}}}{\frac{1\text{hr}}{60\text{min}} \times \frac{1\text{mL}}{60\text{min}}} = \frac{1250}{21} = 21\text{ drops} \quad \text{(step 5)}$$

Step 6: Finally, look at the derived answer and consider whether it makes logical sense.

Tackle the complex

Now, let’s try a more complicated problem. Keep in mind that you can multiply as many conversion fractions as needed to arrive at the desired label that you identify in step one.

Example: The healthcare provider prescribes dopamine 5 mcg/kg/minute for a 140 lb (63 kg) patient. The medication comes in a premixed solution of 500 mL 0.9% NaCl with a concentration of 3.2 mg/mL. The infusion device should be programmed for how many mL/hour?

Step 1: What label should the answer have? Write this down on the right side of the equation. This is what you want to work toward.

Like this:

$$\frac{\text{mL}}{\text{hr}} \quad \text{(step 1)}$$

Step 2: On the left side of the equation, enter the desired dosage as a fraction.

Like this:

$$\frac{5\text{ mcg}}{\frac{\text{kg}}{\text{hr}}} \times \frac{\text{mL}}{\frac{\text{min}}{\text{hr}}} \quad \text{(step 2)}$$

Step 3: Enter conversion factors as fractions to work toward the desired label, making sure that the numerator and denominator are equal (equals over equals).

Like this:

$$\frac{5\text{ mcg}}{\frac{\text{kg}}{\text{min}}} \times \frac{60\text{ min}}{\frac{\text{hr}}{1\text{ hr}}} \times \frac{\text{mg}}{\frac{1,000\text{ mcg}}{\text{hr}}} \times \frac{1\text{ kg}}{2.2\text{ lb}} \times \frac{\text{mL}}{\frac{\text{hr}}{1\text{ hr}}} \quad \text{(step 3)}$$

This changes mg to mg.

Then:

$$\frac{5\text{ mcg}}{\frac{\text{kg}}{\min}} \times \frac{60\text{ min}}{\frac{\text{hr}}{1\text{ hr}}} \times \frac{1\text{ mg}}{\frac{1,000\text{ mcg}}{\text{hr}}} \times \frac{1\text{ kg}}{2.2\text{ lb}} \times \frac{\text{mL}}{\frac{\text{hr}}{1\text{ hr}}} \quad \text{(step 3)}$$

This changes mL to mL.

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This gets kg to lb.

Then:

\[
\frac{5 \text{ mcg}}{\text{kg}} \times \frac{60 \text{ min}}{1 \text{ hr}} \times \frac{1 \text{ mg}}{1,000 \text{ mcg}} \times \frac{1 \text{ kg}}{2.2 \text{ lb}} \times \frac{140 \text{ lb}}{1 \text{ hr}} = \text{mL} \quad \text{(step 3)}
\]

The above step allows the dosage to be specific to this patient and cancels the lb label.

Then:

\[
\frac{5 \text{ mcg}}{\text{kg}} \times \frac{60 \text{ min}}{1 \text{ hr}} \times \frac{1 \text{ mg}}{1,000 \text{ mcg}} \times \frac{1 \text{ kg}}{2.2 \text{ lb}} \times \frac{1 \text{ mL}}{3.2 \text{ mg}} = \text{mL} \quad \text{(step 3)}
\]

The above step allows the dosage to be reported in mL. Note that this information comes from the given concentration of the dopamine solution. Also note that the numerator and the denominator can be inverted to match the desired solution label, as long as it’s an expression of equals over equals. In this case, 1 mL = 3.2 mg or 3.2 mg = 1 mL.

Step 4: Cancel all labels that are in both the numerator and the denominator.

Like this:

\[
\frac{5 \text{ mcg}}{\text{kg}} \times \frac{60 \text{ min}}{1 \text{ hr}} \times \frac{1 \text{ mg}}{1,000 \text{ mcg}} \times \frac{1 \text{ kg}}{2.2 \text{ lb}} \times \frac{1 \text{ mL}}{3.2 \text{ mg}} = \text{mL} \quad \text{(step 4)}
\]

Step 5: Do the math by multiplying the numerators, then multiplying the denominators, then dividing the answer in the numerator by the answer in the denominator. This makes calculation errors less likely.

Like this:

\[
\frac{5 \text{ mcg}}{\text{kg}} \times \frac{60 \text{ min}}{1 \text{ hr}} \times \frac{1 \text{ mg}}{1,000 \text{ mcg}} \times \frac{1 \text{ kg}}{2.2 \text{ lb}} \times \frac{1 \text{ mL}}{3.2 \text{ mg}} = \frac{42,000}{7,040} = \frac{5.9 \text{ mL}}{\text{hr}} \quad \text{(step 5)}
\]

Step 6: Finally, look at the derived answer and consider whether it makes logical sense.

Made in the shade

What seems like a complex calculation is now easy! For the more complicated dosage calculations, remember that you aren’t alone. To confirm the accuracy of your calculations, you can always confer with a pharmacist.

Learn more about it


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