MEDICAL MATH

FROM CLASSROOM MATH TO REAL PATIENT CARE

DOSE
Calculate accurately. Administer safely.

INFUSE
Set rates. Prevent errors. Save lives.

CONVERT
Units, concentrations, and more with confidence.

SOLVE
Real-world problems. Better outcomes.

$$\text{Dose} = \frac{\text{Desired Dose (mg)}}{\text{Have (mg/mL)}} \times \text{Volume (mL)}$$

$$\text{mL/hr} = \frac{\text{Total Volume (mL)}}{\text{Time (hr)}}$$

$$\text{gtt/min} = \frac{\text{mL/hr} \times \text{Drop Factor (gtt/mL)}}{60}$$

$$\%\ \text{Concentration} = \frac{\text{Amount of Solute (g)}}{\text{Total Solution (mL)}} \times 100$$

WEIGHT-BASED DOSING
DOSE (mg/kg) × WEIGHT (kg)

Weight (kg)	Dose (mg)
40	120
50	150
60	180
70	210
80	240

IV FLOW RATE REFERENCE

mL/hr	gtt/min (20 gtt/mL)
25	8
50	17
75	25
100	33
125	42
150	50

ACCURATE CALCULATIONS. SAFER CARE.

CONFIDENCE AT THE BEDSIDE.

BETTER DECISIONS. BETTER OUTCOMES.

ALFRED RICKS JR., MD

THE INCREDIBLE MEDICAL SCHOOL
BASIC MEDICAL MATH

Alfred Ricks Jr., M.D.

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NOTICE

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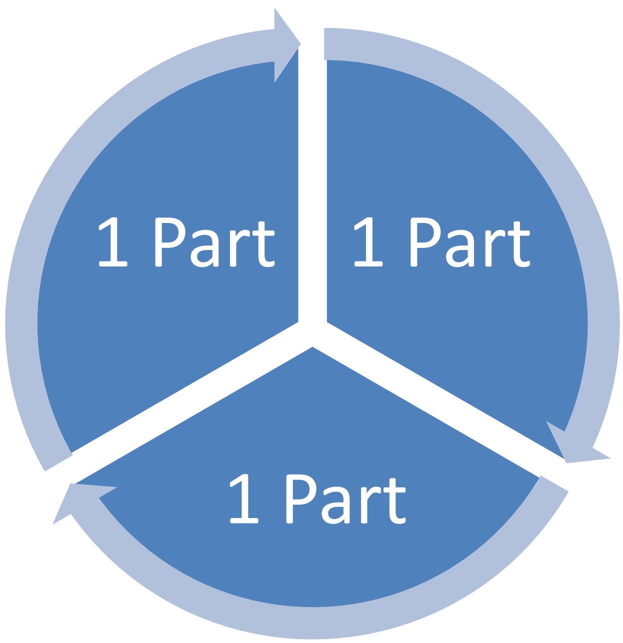
GENERAL MATH – FRACTIONS

A fraction is a part of a whole. It can be part of 1 as part of a circle, or part of a group as in part of a number of items. A fraction has a top number and a bottom number:

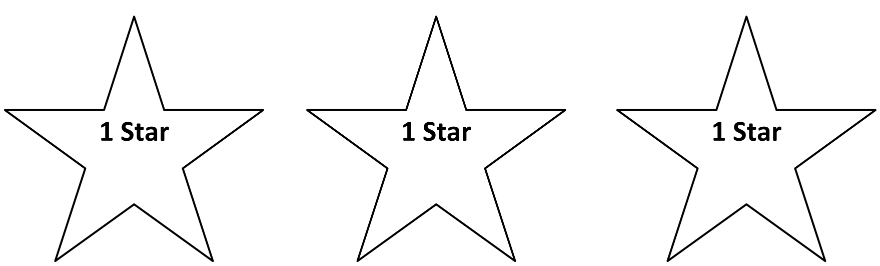
$$\frac{2}{3} \qquad \frac{\text{Numerator}}{\text{Denominator}}$$

The top number is the NUMERATOR. The bottom number is the DENOMINATOR

$\frac{2}{3}$ indicates that there are 3 total parts in the 1 item (such as a circle or space in a syringe) or in a group of items (such as number of stars on a page) AND we are referring to 2 parts of the item or group of items.



$\frac{2}{3}$ pronounced "two thirds" indicates 2 parts of the circle above or 2 stars from the group of 3 stars below



$4\frac{2}{3}$ is called a **mixed number** because it has a whole number and a fraction. Referring to our previous circle and group of stars, this mixed number indicates:
4 entire circles plus 2 of the 3 parts of the one circle. This would be a total of 14 parts.
4 group of stars (12 stars) plus 2 of the 3 stars that are in the group. This would be total of 14 stars.

We can determine the total number of parts in a mixed number by multiplying the whole number by the denominator and adding the results to the numerator. That would result in 4 X 3 which is 12. The 12 is added to 2 to produce the result of 14. Placing the 14 in the numerator and keeping the same denominator produces the following:

$\frac{14}{3}$ This fraction tells us that there are a total of 14 parts of the 3 part item.

$\frac{14}{3}$ is an **improper fraction**. An improper fraction has a numerator which is larger than the denominator. A proper fraction has a numerator which is smaller than the denominator. This fraction should be reduced by dividing the denominator into the numerator to produce the whole number, and the remainder is placed as the numerator while keeping the same original denominator. A fraction should also be reduced if the numerator and denominator can be divided by the same number.

$$\frac{2}{6} = \frac{1}{3}$$

The numerator and denominator can both be divided by 2 resulting in the reduction of the fraction.

$$7\frac{10}{15} = 7\frac{2}{3}$$

The numerator and denominator can both be divided by 5 resulting in the reduction of the fraction.

Occasionally, you will need to have fractions with the same denominator. You will need to multiply the numerator and denominator of the fraction by the same number to produce the desired denominator. This will not change the “value” of the fraction.

$\frac{2}{7}$ and $\frac{1}{3}$ Change both fractions to have the same denominator.

Multiply the numerator and denominator of the fraction on the left by 3, and the numerator and denominator of the fraction on the right by 7 to produce:

$\frac{2}{7} = \frac{6}{21}$ and $\frac{1}{3} = \frac{7}{21}$ Both fractions now have the same denominator of 21.

ADDING AND SUBTRACTING FRACTIONS

Like fractions (denominators are the same): Simply add or subtract the numerators:

$\frac{1}{3} + \frac{1}{3} = \frac{2}{3}$ $\frac{4}{5} - \frac{1}{5} = \frac{3}{5}$

$4 - \frac{1}{3} = 3\frac{3}{3} - \frac{1}{3} = 3\frac{2}{3}$

Unlike fractions (denominators are different): The denominators must first be changed to the same, then add or subtract the numerators:

$\frac{2}{3} + \frac{3}{5} = \frac{10}{15} + \frac{9}{15} = \frac{19}{15}$ which reduces to $1\frac{14}{15}$ (divide the 15 into the 19 to get the whole number and place the remainder as the numerator with the same denominator).

Sometimes, you will need to "borrow": $5\frac{2}{3} - 1\frac{11}{12} = 5\frac{8}{12} - 1\frac{11}{12}$

you cannot subtract $\frac{11}{12}$ from the smaller $\frac{8}{12}$, so borrow "1" from 5 which is $\frac{12}{12}$ and add it to the $\frac{8}{12}$ to get $\frac{20}{12}$ we now have: $4\frac{20}{12} - 1\frac{11}{12} = 3\frac{9}{12}$

The $3\frac{9}{12}$ reduces to $3\frac{3}{4}$ (by dividing the 9 and the 12 by 3).

MULTIPLYING AND DIVIDING FRACTIONS

MULTIPLYING

To multiply fractions, multiply the numerators and multiply the denominators:

$\frac{2}{3}$ X $\frac{2}{5}$ = $\frac{4}{15}$ (read as "two thirds times two fifths" OR "two thirds of two fifths").

$2\frac{3}{4}$ X $2\frac{1}{8}$ (you first convert to improper fractions) = $\frac{11}{4}$ X $\frac{17}{8}$ = $\frac{187}{32}$ = $5\frac{27}{32}$

DIVIDING FRACTIONS

To divide fractions, we invert the divisor (the number we are dividing by; the second number) and then we multiply the fractions.

a ÷ b = c or b√a = c This is "a divided by b equals c".

b is the divisor, **a** is the dividend, **c** is the quotient, **√** is the dividing symbol.

$\frac{2}{3}$ ÷ $\frac{2}{5}$ = $\frac{2}{3}$ X $\frac{5}{2}$ = $\frac{10}{6}$ = $1\frac{4}{6}$ = $1\frac{2}{3}$

In the above $\frac{10}{6}$ fraction, 6 into 10 is 1 with a remainder of 4, the remainder is placed as the numerator with the original denominator which gives us $1\frac{4}{6}$ (dividing both numerator and denominator by 2 reduces the fraction to $1\frac{2}{3}$

$3\frac{3}{4}$ ÷ $2\frac{1}{8}$ = $\frac{15}{4}$ ÷ $\frac{17}{8}$ = $\frac{15}{4}$ X $\frac{8}{17}$ = $\frac{120}{68}$ = $1\frac{52}{68}$ = $1\frac{26}{34}$ = $1\frac{13}{17}$

The $3\frac{3}{4}$ is converted to $\frac{15}{4}$ as previously shown by multiplying the whole number by the denominator and adding the results to the numerator. That would result in 3 X 4 which is 12. The 12 is added to 3 to produce the result of 15. Placing the 15 in the numerator and keeping the same denominator produces the following $\frac{15}{4}$

The $2\frac{1}{8}$ is converted to $\frac{17}{8}$ in the same manner. It is then inverted prior to changing the sign from dividing to multiplying.

Again $\frac{120}{68}$ is an improper fraction which should be reduced. 68 into 120 is 1 with a remainder of 52, the remainder is placed as the numerator with the original denominator which gives us $1\frac{52}{68}$. Using a number that can divide evenly into both the numerator and denominator reduces the fraction further. That number is 4, which gives us $1\frac{13}{17}$ (notice that we used the number 2 both times to reduce the fraction to $1\frac{26}{34}$ and then to $1\frac{13}{17}$).

FACT: The numerator and denominator of a fraction can by multiplied or divided by the same number without changing the value of a fraction.

Looking at fractions differently (as ratios, divisions, and proportions)

Ratio: a package has 12 oranges and 8 apples in it. What is the ratio of oranges to apples? $\frac{12}{8}$ which reduces to $\frac{3}{2}$ The ratio is 3 to 2. (3 oranges for every 2 apples). Notice that fractions can be viewed as ratios. Also, $\frac{2}{3}$ indicates 2 apples for every 3 oranges.

Division: Reducing the $\frac{3}{2}$ fraction further would give you $1\frac{1}{2}$ This indicates that there are $1\frac{1}{2}$ oranges for every 1 apple. $1\frac{1}{2}$ is a mixed number.

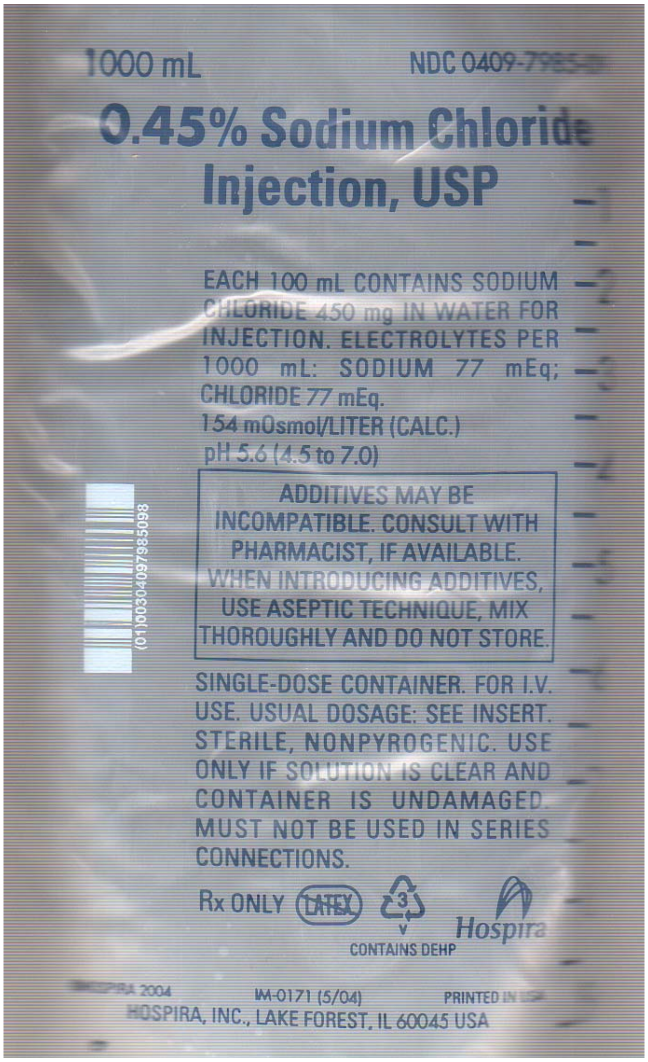
Proportion: To keep the same proportion in a larger package, how many apples would be in the package with 90 oranges?

$$\frac{\text{3 oranges}}{\text{2 apples}} = \frac{\text{90 oranges}}{\text{X apples}}$$

ANSWER: X apples = 60 apples.

$$\frac{3}{2} = \frac{90}{\text{x apples}} \qquad \text{X apples} = \frac{2 \text{ X } 90}{3} = \frac{180}{3} = \mathbf{60}$$

Below is 0.45% Sodium Chloride. It is also referred to as “half normal” saline. The osmolarity of 0.45% Sodium Chloride is approximately half the osmolarity of Sodium Chloride in blood, therefore the term “half normal”.



Determine the mg, mEq, and osmolarity of this solution:

0.45% = 0.45 Gm/100mL = 450 mg/ 100mL
450 mg/ 100mL = 4,500 mg/ 1,000mL
Molecular Weight: Na = **23**, Cl= **35.5**
23 (Na) + 35.5 (Cl) = **58.5**

$\frac{4500}{58.5}$ = **76.9 mEq/L**

Na (sodium) = 76.9 mEq/L = 76.9 mM (millimole)
Cl (chloride) = 76.9 mEq/L = 76.9 mM (millimole)

There is **450mg NaCl** in each 100mL
There is **4,500mg NaCl** in each 1,000mL
How many mg of Na and mg of Cl are in 1,000mL? We’ve determined that there are 76.9 mEq of sodium and 76.9 mEq of chloride in each liter. Multiplying the mEq times the molecular weight gives the total amount of mg in 1 liter.
Sodium 76.9 X 23 = 1, 768.7 mg/1,000mL.
Chloride 76.9 X 35.5 = 2,729.9 mg/1,000mL.
Adding these two numbers together gives the the total of **4,500mg** of NaCl in each liter. 1,768.7mg + 2,729.9mg = **4,498.6 mg**

Osmolarity is **76.9 mM** X 2 (because NaCl dissociates into 2 particles) = **153.8 mOsmol/Liter**.

153.8 mOsmol/Liter is about half human ECF. Therefore, the tem “half normal” saline.

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