BarCharts, Inc.®

WORLD'S #1 ACADEMIC OUTLINE

Quick Study® ACADEMIC

Nursing MATH

Complete essentials for the student or professional: math basics, measurement conversions, dosage calculations, vital signs, body-related calculations, health care operating indicators, condition specific calculations & calculating risk

BASICS

Positive & Negative Numbers

- **Positive numbers** are greater than 0 (to the right of 0 on a number line) and get larger as you move farther away from 0; they may be written with or without a **+** sign (**EX:** 5 or +5)
- **Negative numbers** are less than 0 (to the left of 0 on a number line) and get smaller as you move farther away from 0; they must be written with a **–** sign (**EX:** –5)

RULES FOR ADDITION

- The sum of two positive numbers is a positive number
  EX: 3 + 4 = 7
- The sum of two negative numbers is a negative number
  EX: –2 + –6 = –8
- The sum of one positive number and one negative number may be positive or negative, depending on which is larger; just remember that adding a negative number is the same as subtracting that number
  EX: 9 + (–2) = 9 – 2 = 7   –9 + 2 = 2 – 9 = –7

RULES FOR SUBTRACTION

- Think of subtraction as addition of the opposite; so, first change the subtraction sign to an addition sign, and write the opposite of the original number being subtracted and solve as usual
  EX: 3 – 8 = 3 + (–8) = –5   5 – (–2) = 5 + 2 = 7

RULES FOR MULTIPLICATION

- The product of two positive numbers is a positive number
  EX: 3 × 6 = 18
- The product of two negative numbers is a positive number
  EX: (–2) × (–5) = 10
- The product of one positive number and one negative number is a negative number
  EX: 4 × (–7) = –28

RULES FOR DIVISION

- The quotient of two positive numbers is a positive number
  EX: 9 ÷ 3 = 3
- The quotient of two negative numbers is a positive number
  EX: (–20) ÷ (–4) = 5
- The quotient of one positive number and one negative number is a negative number
  EX: 42 ÷ (–7) = –6   (–32) ÷ 4 = –8

DISTRIBUTIVE PROPERTY

- A rule used in multiplication states that $a(b + c) = ab + ac$, or that $a(b – c) = ab – ac$; in other words, the first term outside the parentheses must be distributed to, or multiplied by, each term inside the parentheses
  - Remember to use the rules for multiplying negative and positive numbers if negative numbers are included in the expression

  EX: $5(x – y + 3) = 5x – 5y + 15$ $–8(–x + 3y + 7) = 8x – 24y – 56$

Fractions

- Fractions represent parts of a whole; they are another way of showing division
- The top number is called the *numerator,* and the bottom number is called the *denominator*
- Three types of fractions:
  - Proper fractions: The numerator is less than the denominator: $\frac{3}{10}$
  - Improper fractions: The numerator is greater than or equal to the denominator: $\frac{7}{5}$
  - Mixed numbers: Contain a whole number and a fraction part: $1\frac{1}{3}$
- **Lowest terms:** Putting a fraction in a form so that the only common factor between the numerator and denominator is 1 (also called **reducing a fraction** or writing it in **reduced form**)
  EX: $\frac{6}{10}$; the numerator and denominator have a common factor of 2, so divide each by 2 to put it in lowest terms: $\frac{3}{5}$; now their only common factor is 1, so this is lowest terms

NOTE: *Fractions that have the same value (e.g., a fraction and that same fraction in lowest terms) are called* ***equivalent fractions***

FINDING THE LEAST COMMON DENOMINATOR (LCD)

- The **LCD** is the smallest number into which two or more denominators will divide evenly; this number is useful for performing operations (especially addition/subtraction) with fractions

  EX: Given the fractions $\frac{3}{5}$ and $\frac{1}{4}$, what is the LCD?

  Think about the smallest number that is divisible by both 5 and 4; in this case, it is 5 × 4, or 20; so multiply each of the numerators and denominators by whatever is needed to make each denominator equal to 20:

  $\frac{3}{5} \times \frac{4}{4} = \frac{12}{20}$ and $\frac{1}{4} \times \frac{5}{5} = \frac{5}{20}$ The LCD is **20**

ADDING FRACTIONS

- If the fractions have the **same denominator:**
  1. Add the numerators; the denominator stays the same
  2. Write the fraction in reduced form, if necessary

  EX: $\frac{1}{9} + \frac{5}{9} = \frac{1+5}{9} = \frac{6}{9}$; since the numerator and denominator are both divisible by 3, reduce the fraction: $\frac{6}{9} = \frac{2}{3}$
- If the fractions have **different denominators:**
  1. Find the LCD and write equivalent fractions for each fraction using the LCD
  2. Add the numerators; the denominator stays the same
  3. Write the fraction in reduced form, if necessary

  EX: $\frac{2}{3} + \frac{3}{4}$; the LCD is 12, so rewrite equivalent fractions with a denominator of 12: $\frac{2}{3} \times \frac{4}{4} = \frac{8}{12}$; $\frac{3}{4} \times \frac{3}{3} = \frac{9}{12}$; then add the numerators: $\frac{8+9}{12} = \frac{17}{12}$; then it can be reduced by writing as a mixed number: $\frac{17}{12} = 1\frac{5}{12}$

SUBTRACTING FRACTIONS

- If the fractions have the **same denominator:**
  1. Subtract the numerators; the denominator stays the same
  2. Write the fraction in reduced form, if necessary

  EX: $\frac{6}{17} - \frac{4}{17} = \frac{6-4}{17} = \frac{2}{17}$; since the greatest common factor of the numerator and denominator is 1, the fraction is already in reduced form
- If the fractions have **different denominators:**
  1. Find the LCD and write equivalent fractions for each fraction using the LCD
  2. Subtract the numerators; the denominator stays the same
  3. Write the fraction in reduced form, if necessary

  EX: $\frac{2}{3} - \frac{3}{5}$; the LCD is 15, so rewrite equivalent fractions with a denominator of 15: $\frac{2}{3} \times \frac{5}{5} = \frac{10}{15}$; $\frac{3}{5} \times \frac{3}{3} = \frac{9}{15}$; then subtract the numerators: $\frac{10-9}{15} = \frac{1}{15}$; since the greatest common factor of the numerator and denominator is 1, the fraction is already in reduced form

MULTIPLYING FRACTIONS

1. Write all numbers (even whole numbers or mixed numbers) in fraction form
2. Multiply the numerators, then multiply the denominators
3. Write the results in fraction form, then write the fraction in reduced form

EX: $\frac{1}{4} \times 2\frac{2}{5}$; first, write all numbers in fraction form: $\frac{1}{4} \times \frac{12}{5}$; then multiply the numerators: 1 × 12 = 12; then multiply the denominators: 4 × 5 = 20; then write the results in fraction form: $\frac{12}{20}$, and finally reduce: since each number is divisible by 4, divide each by 4: $\frac{12}{20} = \frac{3}{5}$

DIVIDING FRACTIONS

1. Write all numbers (even whole numbers or mixed numbers) in fraction form
2. Change the division sign to a multiplication sign
3. Write the **reciprocal** of the second fraction (reciprocals are found by inverting, or flipping, the fraction so that the numerator is on the bottom and the denominator is on the top)
4. Multiply the numerators, then multiply the denominators
5. Write the results in fraction form, then write the fraction in reduced form

EX: $\frac{3}{7} \div \frac{1}{4}$; the numbers are both already in fraction form, so change the division sign to a multiplication sign and write the reciprocal of the second fraction: $\frac{3}{7} \times \frac{4}{1}$; then multiply the numerators: 3 × 4 = 12; multiply the denominators: 7 × 1 = 7; then write the results in fraction form: $\frac{12}{7}$, or as a mixed number, $1\frac{5}{7}$

CONVERTING FRACTIONS TO DECIMALS

1. Write all numbers (even whole numbers or mixed numbers) in fraction form
2. Divide the numerator by the denominator, and add a zero in front of the decimal point, if necessary

EX: $1\frac{3}{10}$; since it is a mixed number, write it in fraction form: $\frac{13}{10}$; then divide 13 by 10 to get 1.3; since there is already a number to the left of the decimal point, there is no need to write the zero in front of it

CONVERTING FRACTIONS TO PERCENTAGES

1. Convert the fraction to a decimal (as explained above)
2. Round the decimal to the nearest hundredth
3. Multiply by 100 and add the percent sign (%)

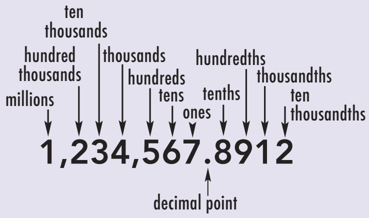
EX: $\frac{5}{8}$; it is already in fraction form, so just divide 5 by 8 to get 0.625; then round to the nearest hundredth: 0.63; then multiply by 100 and add the percent sign to get **63%**

Decimals

- Decimals, like fractions, represent parts of a whole; decimal numbers may contain a **whole number** part (to the left of the decimal point) and a **fractional** part (to the right of a decimal point)

NOTE: *Generally, decimals that are less than one should always have a zero to the left of the decimal point, but "trailing zeros" (zeros that come after digits on the right) should not be included (**EX:** 0.65, not .65; but 1.7, not 1.70)*

- **Place value:** Each spot to the right of the decimal point represents a different place value, similar to numbers to the left of the decimal point



ROUNDING DECIMALS

- Rounding is a way of estimating numbers, or describing their approximate value; numbers can be rounded to any decimal place

1. Determine the value of the place value to which you are rounding
2. Look to the right of that number; if the number is less than 5, the number to which you are rounding stays the same; if the number is greater than or equal to 5, add 1 to the number to which you are rounding

EX: Round 3.4762 to the nearest hundredth; the value in the hundredths place is 7, and the number to its right is 6; since 6 is greater than 5, that means you must add 1 to the number you are rounding: 7 + 1 = 8, so the answer is **3.48**

ADDING DECIMALS

1. Line up the decimal points in a column so the place values are aligned vertically
2. For any missing place value digits in either number, add zeros as placeholders
3. Add normally (like you would with whole numbers)

EX: 3.2 + 5.47; first, line up the numbers so that the decimal points are aligned vertically:

$$\begin{array}{r} 3.2 \\ \underline{+\ 5.47} \end{array}$$

Next, add a 0 in the hundredths place of the top number as a placeholder:

$$\begin{array}{r} 3.2\mathbf{0} \\ \underline{+\ 5.47} \end{array}$$

Now add:

$$\begin{array}{r} 3.20 \\ \underline{+\ 5.47} \\ \mathbf{8.67} \end{array}$$

SUBTRACTING DECIMALS

1. Line up the decimal points in a column so the place values are aligned vertically
2. For any missing place value digits in either number, add zeros as placeholders
3. Subtract normally (like you would with whole numbers)

EX: 16.371 – 9.24; first, line up the numbers so that the decimal points are aligned vertically:

$$\begin{array}{r} 16.371 \\ \underline{-\ 9.24} \end{array}$$

Next, add a 0 in the thousandths place of the bottom number as a placeholder:

$$\begin{array}{r} 16.371 \\ \underline{-\ 9.24\mathbf{0}} \end{array}$$

Now subtract:

$$\begin{array}{r} 16.371 \\ \underline{-\ 9.240} \\ \mathbf{7.131} \end{array}$$

MULTIPLYING DECIMALS

1. Line up the numbers in a column so the right sides of both numbers are aligned vertically; make sure the longest number (with the largest number of place values) is on top
2. Multiply normally (like you would with whole numbers)
3. Determine the correct number of decimal places by adding the number of decimals in each factor; then, starting from the right of the product, count to the left as many places as necessary, and add the decimal point

EX: 1.924 × 0.7; first, line up the numbers so that they're aligned on the right side and the longest number is on top:

$$\begin{array}{r} 1.924 \\ \underline{\times\ 0.7} \end{array}$$

Next, multiply:

$$\begin{array}{r} 1.924 \\ \underline{\times\ 0.7} \\ 13468 \\ \underline{+\ 00000} \\ 13468 \end{array}$$

Now, count the number of decimal places in each factor: 3 in 1.924, and 1 in 0.7; 3 + 1 = 4, so count, starting from the right, four decimal places: **1.3468**

DIVIDING DECIMALS

1. Change the divisor to a whole number by moving the decimal place to the right (which is actually multiplying by powers of ten)
2. Move the decimal in the dividend the same number of places as you moved the decimal in the divisor, and add zeros if necessary
3. Put the decimal point in the quotient space right above the decimal point in the dividend
4. Divide normally (like you would with whole numbers), adding zeros to the end of the dividend as needed
5. Fill in zeros in the quotient if necessary to get to the decimal point
6. Round to the desired place value, if necessary

EX: 16.731 ÷ 2.84, rounded to the nearest hundredth; first, rewrite in long-division form: $2.84\overline{)16.731}$

Now, change the divisor to a whole number: $284\overline{)16.731}$

Since the decimal was moved 2 places to the right in the divisor, do the same to the dividend, and put the decimal point in the same spot above the dividend: $284\overline{)1673.1}$

Next, divide normally, adding zeros to the end of the dividend as needed:

$$\begin{array}{r} 5.891 \\ 284\overline{)1673.100} \\ \underline{1420} \\ 2531 \\ \underline{2272} \\ 2590 \\ \underline{2556} \\ 340 \\ \underline{284} \\ 56 \end{array}$$

Since you only need to round to the hundredths place, you can stop here; since the digit to the right of the hundredths place is less than 5, the hundredths place will stay the same when rounding, making the answer **5.89**

CONVERTING DECIMALS TO FRACTIONS

1. Remove the decimal place from the number and make that the numerator
2. Make the denominator whatever power of ten is indicated by the last digit in the number
3. Reduce to its lowest terms; **EX:** $.275 = \frac{275}{1{,}000} = \frac{11}{40}$

CONVERTING DECIMALS TO PERCENTAGES

1. Round the decimal to the nearest hundredth
2. Multiply by 100 and add the percent sign (%)

EX: 0.2483; round to the nearest hundredth: 0.25; then multiply by 100 and add the percent sign: **25%**

Percentages

- Percentages are used to represent relationships between numbers; they are another way of expressing parts of a whole, like fractions and decimals
- Percentages represent how many parts out of the total (based on the total = to 100%)

CONVERTING PERCENTAGES TO FRACTIONS

1. Take away the percent sign and set that number as the numerator, then set 100 as the denominator
2. Reduce to its lowest terms

EX: Write 48% as a fraction; first, remove the "%" and set the number as the numerator, with 100 as the denominator: $\frac{48}{100}$; then reduce to lowest terms: $\frac{48}{100} = \frac{12}{25}$

CONVERTING PERCENTAGES TO DECIMALS

- Take away the percent sign and divide by 100; or, take away the percent sign and move the decimal point two places to the left

EX: Write 37% as a decimal, using the "divide by 100" method: 37 ÷ 100 = **0.37**; or, using the decimal-point method: 37.0, move the decimal two places to the left to get .37 and add the zero to the left of the decimal point: **0.37**

Ratios, Proportions & Rates

RATIOS

- Ratios are actually the same as fractions; they show the relationship between two numbers: parts and wholes

Hint: Like fractions, ratios should be reduced to their lowest terms

- Ratios are written using colons (:); when you read a ratio, you say "per" or "is to" when you see the colon

EX: 1:3 ("1 per 3," or "1 is to 3") is the same as $\frac{1}{3}$

PROPORTIONS

- Proportions are used to compare ratios or fractions that are equal; proportions may be written in several ways: as fractions with an equal sign (**EX:** $\frac{2}{4} = \frac{1}{2}$); as ratios with a colon and an equal sign in the middle (**EX:** 2:4 = 1:2); or as ratios with colons and a double colon in the middle, which means the same thing as an equal sign (**EX:** 2:4::1:2)
- **Means and extremes method:**
  - You can check that ratios are equal in a proportion by using the means and extremes; the two middle numbers of the ratio are the means, and the two outer numbers are the extremes; if you multiply the means and then multiply the extremes, the two results should be equal; if they are not equal, the ratios are not equal

EX: 1:6::3:18; multiply the means: 6 × 3 = 18; then multiply the extremes: 1 × 18 = 18; since the two products are equal, the two ratios are equal

- **Solving for x in proportions:** If there is an unknown in a proportion, the variable x is often used and can be solved for using the means and extremes method

EX: 4:12::x:9; first multiply the means: 12 × x = 12x; then multiply the extremes: 4 × 9 = 36; set the two equal to one another: 12x = 36; solve by dividing both sides by 12: x = **3**

RATES

- Rates are special kinds of ratios that compare two numbers using units; the words "per" and "for" often indicate a rate (**EX:** $1 for 3 limes; 24 miles per gallon); often used for costs, speeds, etc.
- To solve rate problems involving an unknown, it is often useful to use proportions; break the word problem into numbers, and set it up like an equation

EX: A store sells a 5-pound bag of potatoes for $7.99. How much do potatoes cost per pound?

First, set up the "known" part of the equation: 5 pounds of potatoes cost $7.99, so write 5:7.99 (or $\frac{5}{7.99}$)

You want to know how much 1 pound costs, so you know the weight, or the first number, in the second part of the equation (1), and the second number is unknown, so use x to represent it: 1:x (or $\frac{1}{x}$)

Now set it up like a proportion: 5:7.99::1:x (or $\frac{5}{7.99} = \frac{1}{x}$)

Solve for x using the means and extremes method: 5 × x = 7.99 × 1; 5x = 7.99; x = 1.598; since it is money, round to the nearest hundredth: x = **$1.60 per pound**

Roman Numerals

I (i)	= 1
II (ii)	= 2
III (iii)	= 3
IV (iv)	= 4
V (v)	= 5
VI (vi)	= 6
VII (vii)	= 7
VIII (viii)	= 8
IX (ix)	= 9
X (x)	= 10
L (l)	= 50
C (c)	= 100
D (d)	= 500
M (m)	= 1,000

MEASUREMENT CONVERSIONS

Measurement Prefixes

mega-	1,000,000
kilo-	1,000
hecto-	100
deka-/deca-	10
deci-	1/10
(one-tenth	0.1)
centi-	1/100
(one-hundredth	0.01)
milli-	1/1,000
(one-thousandth	0.001)
micro-	1/1,000,000
(one-millionth	0.000001)

Mass & Weight Conversions

1 gr = 64.79 mg
20 gr = 1 scruple
60 gr = 2.19 dr
16 dr = 1 oz
1 g = 15.432 gr
1 g = 1,000 mg
1 g = 0.035 oz
1 g = 1 mL
10 g = 1 dekagram
1 dekagram = 0.35 oz
100 g = 1 hectogram
1 hectogram = 3.53 oz
1 mg = 1,000 mcg
1 mg = 0.001 g
1 centigram = 0.15 gr
1 centigram = 0.01 g
1 decigram = 0.1 g
1 decigram = 1.54 gr
1 kg = 1 L
1 kg = 2.2 lb
1 kg = 1,000 g
1 oz = 28.35 g/16 dr
1 Tbsp = 15 g
1 Tbsp = 4 dr
1 Tbsp = 3 tsp
1 lb = 16 oz
1 lb = 0.45 kg

Length, Height & Distance Conversions

1 mm = 0.1 cm
1 mm = 0.039 in
1 cm = 10 mm
1 cm = 0.39 in
10 mm = 1 cm
10 mm = 0.39 in
2.54 cm = 1 in
2.5 cm = 25.4 mm
1 ft = 12 in
1 yard = 3 ft
1 m = 1,000 mm
1 m = 100 cm
1 m = 1.09 yards
1 m = 3.28 ft
1 dm = 3.94 in
1 dam = 32.81 ft
1 km = 0.62 mile
1 km = 3,280.08 ft

Volume Conversions

15 gtts = 1 mL
1 mL = 0.001 L
1,000 mL = 1 L
1 cL = 0.01 L
1 dL = 0.1 L
1 dL = 100 mL
1 daL = 10 L
1 hectoliter = 100 L
1 kiloliter = 1,000 L
1 cup = 8 oz
1 cup = 236.5 mL
1 pt = 16 oz
1 pt = 473 mL
1 pt = 2 cups
1 pt = 16 floz
1 qt = 32 oz
1 qt = 2 pints
1 qt = 0.946 L
1 qt = 4 cups
4 qt = 1 gal
4 qt = 16 cups
1 gal = 3,785 mL
1 gal = 3.785 L
1 gal = 4 qt
1 glass = 8 oz
1 teacup = 6 oz
1 gtt = 1 minim
1 gtt = 0.06 mL
1 fldr = 3.96 mL
1 fldr = 60 minims
1 floz = 8 fldr
1 floz = 6 tsp
1 floz = 2 Tbsp
1 floz = 29.57 mL
1 dr = $27^{11}/_{32}$ gr
1 oz = 16 dr
1 oz = 2 Tbsp
1 oz = 6 tsp
1 tsp = 60 gtt
1 tsp = $1^1/_3$ fldr
1 tsp = 5 mL
1 Tbsp = 3 tsp
1 Tbsp = 4 fldr
1 Tbsp = ½ oz
1 Tbsp = 15 mL
1 mL = 0.27 fldr
1 mL = 16.23 minims

Temperature Conversions

0°C = 32°F
35°C = 95°F
37°C = 98.6°F
100°C = 212°F (boiling water)

°C = °F – 32/1.8
°F = °C × 1.8 + 32

Description	°F	°C
Very hot	105-115	41-46
Hot	98-105	37-41
Warm	93-98	34-37
Tepid	80-93	26-34
Cool	65-80	18-26
Cold	50-65	10-18

Measurement Systems

HOUSEHOLD SYSTEM

- A system based on measuring devices found in the home and commonly used for cooking; considered the least accurate of the systems because the size of the devices may vary greatly
- Popular unit measurements = drops, teaspoons, tablespoons, ounces, cups, pints, quarts, and gallons
- Household measurements and liquid volume equivalents:

60 drops = 1 tsp
3 tsp = 1 Tbsp
2 Tbsp = 1 oz
8 oz = 1 C
2 C = 1 pt
2 pt = 1 qt
4 qt = 1 gal

APOTHECARY SYSTEM

- An old system of pharmaceutical measure that is becoming less common because its measures are approximate
  - Basic unit of weight = grain (gr)
  - Basic units of volume = minim (m); dram (dr); ounce (oz)
  - Written using lowercase roman numerals, with the unit abbreviation before the number

EX: 7 drams = dr vii

METRIC SYSTEM

- Most common measurement system in the world and in medicine because it is based on the decimal system and is easy to use
  - Basic unit of length = meter (m)
  - Basic unit of weight = gram (g)
  - Basic unit of volume = liter (L)

CONVERSION BETWEEN SYSTEMS

Metric	Apothecary	Household
64.79 mg	1 gr	
1 g	15 gr	
1 kg		2.2 lb
0.45 kg		1 lb
5 mL		1 tsp
15 mL	½ oz	1 Tbsp
29.57 mL		1 floz
30 mL	1 oz	2 Tbsp
473.176 mL		1 pt
946.35 mL		1 qt
1,000 mL		33.8 oz
1 cm		0.4 in
2.5 cm		1 in

COMMON EQUIVALENTS

- 1 kg = 2.2 lb
- 30 mL = 1 oz
- 240 mL = 8 oz = 1 cup
- 5 mL = 1 tsp
- 15 mL = 3 tsp = 1 Tbsp

PHARMACOLOGIC ABBREVIATIONS

Apothecary

b.i.d., BID	twice a day
dr ap	dram apothecary
h.s., HS	at bedtime (or hour of sleep)
lb ap	pound apothecary
o.d.	once a day
oz ap	ounce apothecary
p.c.	after meals
po	by mouth
q	every
q.a.m.	every morning
q.d.	every day
q.h.	every hour
q.2.h.	every 2 hours
q.h.s.	every night
q.i.d.	four times a day
q.o.d.	every other day
ss	one-half
tab	tablet
Tbsp	tablespoon
t.i.d.	three times a day
tsp	teaspoon

Laboratory

cm = centimeter
cm^3 = cubic centimeter
dL = deciliter
floz = fluid ounce
g = gram
L = liter
lb = pound
m = meter
mg = milligram
mL = milliliter
mm = millimeter
mm Hg = millimeters of mercury
oz = ounce
pt = pint
QNS = quantity not sufficient
qt = quart
U = unit
wt = weight

DOSAGE CALCULATIONS

FORMULAS

$\frac{\text{Dose ordered}}{\text{Dose on hand}}$ = Amount to administer

SOLUTION CONCENTRATION

$\frac{\text{Dosage in solution}}{\text{Volume of solution}}$ = Solution concentration

IV DOSE RATE CALCULATION

$\frac{\text{Dose ordered}}{\text{Solution concentration}}$ = Volume/hour

Oral Medication Dosage Calculations: Liquids

- Use **formula** method to find dosage for liquids: $\frac{desired}{have} \times quantity = x$

  EX: Order: Amoxicillin 500 mg PO daily; Available: Amoxicillin oral suspension 200 mg/5mL

  Use D/H × Q: $\frac{500}{200} \times 5 = x = 2.5 \times 5 = 12.5 =$ **12.5 mL**

Oral Medication Dosage Calculations: Tablets/Capsules

- Two types of **capsules:** hard two-piece gelatin shell that may, in some cases, be opened to release powder/pellets (to be combined with soft food), or a soft gelatin shell; capsules should never be split, crushed, or altered
- **Tablets:** Scored tablets may be split, but unscored tablets should never be split, crushed, or altered
- Use **formula** method to find dosage for tablets and capsules:

  $\frac{desired}{have} \times quantity = x$

  EX: Order: Ibuprofen 1,000 mg PO daily; Available: Ibuprofen 200 mg tablets

  Use D/H × Q: $\frac{1{,}000}{200} \times 1 = x = 5 \times 1 = 5 =$ **5 tablets**

Parenteral Medication Dosage Calculations

- **Parenteral medications:** Any medications not given through the gastrointestinal tract, including **intravenous, intramuscular,** and **subcutaneous**

  NOTE: *For amounts less than 1 mL, round to the nearest hundredth; for amounts greater than 1 mL, round to the nearest tenth*
- Use **formula** method to find dosage for liquids: $\frac{desired}{have} \times quantity = x$

  EX: Order: Bactocill 300 mg IM every 8 hours; Available: Bactocill 1 g/3 mL

  First, make any necessary conversions: 1 g = 1,000 mg

  Then use D/H × Q: $\frac{300}{1{,}000} \times 3 = x = 0.3 \times 3 = 0.9$ mL

  Since the answer is less than 1 mL, round to the nearest hundredth: **0.90 mL**

Intravenous (IV) Flow & Drip Rate Calculations

INTRAVENOUS DRIP RATES – FORMULA

Amt × Drip/Minutes = # of drops per min.

Amt (Amount to be infused) × Drip (drip set) / min. (time of infusion – in min.) = # of drops per min. (the # of drops per min. to be infused)

- **Drip rate** calculations are measured in different units depending on how they are administered: by electronic diffusion device = mL per hour; by gravity infusion = gtt per minute

  EX: Nicardipine 10 mg in 25 mL over 1 hour; drop factor = 15

  First, convert hours to minutes: 1 hour = 60 minutes

  Then calculate rate: $\frac{25\text{mL} \times 15}{60} = \frac{375}{60} = 6.25$

  Round to the nearest whole number: **6 gtt/min**

INTRAVENOUS FLOW RATE

Total mL/total hour = mL per hour

[Volume (mL)/Time (min.)] × C (gtt/mL) = R (gtt/min.)

Solution Concentrations

3:100 MEANS 3 parts of drug or mineral are in 100 parts of liquid

15 mg/mL MEANS that 15 mg of the drug are in each mL of liquid

- **Flow rate** calculations are two-part: First, determine dosage; then determine rate

  EX: Order: Atenolol 3 mg IVP STAT over 3 minutes; Available: Atenolol 5 mg/10 mL; find how much should be given every 15 seconds

  First, find out how much to give using D/H × Q: $\frac{3}{5} \times 10 = x = 0.6 \times 10 = 6.0$ mL

  Then determine the rate in minutes: 6 mL in 3 minutes = x mL in 1 minute; x = 2 mL/min

  Then determine the rate in seconds: 2 mL/min = 2 mL/60 seconds

  Then determine the amount to be given every 15 seconds:

  2 mL : 60 seconds :: x mL : 15 seconds = **0.5 mL every 15 seconds**

Solution Preparation Calculations

- Directions for reconstitution of solutions give volumes of fluids to be added; once that is added, those volumes do not matter: calculate dosages using same formula method as other parenteral or oral liquid medications: $\frac{desired}{have} \times quantity = x$

  EX: Order: Cefazolin sodium 0.75 g every 8 hours; Available: Add 2.5 mL sterile water for injection to make cefazolin sodium 330 mg/mL

  First, make any necessary conversions: 0.75 g = 750 mg

  Then use D/H × Q: $\frac{750}{330} \times 1 = x = 2.2727\ldots \times 1 = 2.2727\ldots$ mL

  Since the answer is greater than 1 mL, round to the nearest tenth: **2.3 mL**

Calculating Age- & Weight-Adjusted Dosages

- Often, dosages are adjusted based on weight, especially for pediatric and geriatric patients

  Geriatric EX: An 82-year-old man weighs 174 pounds and is ordered amikacin sulfate; ordered dose is 7.5 mg/kg IM bid; available dose is amikacin sulfate 250 mg/mL

  Convert weight to kilograms: 2.2 lbs = 1 kg, so 174 lbs = 79.0909… kg, or 79.1 kg

  To find the dose, multiply 7.5 mg/kg by 79.1 kg: 7.5 × 79.1= 593.3 mg

  Then use D/H × Q: $\frac{593.3}{250} \times 1 = x = 2.373 \times 1 = \mathbf{2.4}$ **mL**

  Pediatric EX: A 14-month-old child weighs 25 pounds and is ordered oxacillin sodium; ordered dose is 50 mg/kg every 6 hours; available dose is 250 mg/5 mL

  Convert weight to kilograms: 2.2 lbs = 1 kg, so 25 lbs = 11.3636 kg, or 11.4 kg

  To find the dose, multiply 50 mg/kg by 11.4 kg: 50 × 11.4 = 570 mg

  Then use D/H × Q: $\frac{570}{250} \times 5 = x = 2.28 \times 5 =$ **11.4 mL every 6 hours**

NOTE: *Other considerations must be taken into account for geriatric patients, especially any other medications that are being taken, frailty or disease of other organs, etc.*

OTHER METHODS FOR CALCULATING PEDIATRIC DOSAGES

- **Classifications of young patients**

< 38 weeks gestation	Premature or preterm infant
< 1 month	Neonate or newborn infant
1 month to < 1 year	Infant
1 year to < 12 years	Child

- **Formulas**
  - *Clark's Rule*

    [Weight of child/150 lbs] × adult dose = child's dose
  - *Fried's Rule*

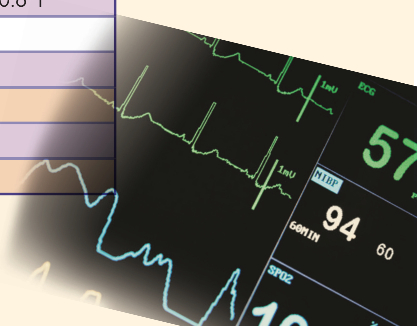
    [Age of child in months/150 lbs] × average adult dose = child's dose
  - *Young's Rule* – Children (up to 12)

    [Age of child (in years)/Age of child (in years) + 12] × average adult dose = child's dose
  - *West Nomogram*

    [BSA of child/BSA of adult] × adult dose = est. child's dose

    BSA of child (m^2) × [dose/m^2] = est. child's dose

Vital Signs					
	Age 0–1	Age 1–6	Age 6–11	Age 11–16	Adult
Temperature (F = Fahrenheit)					
Oral	96°–99.5°F	98.5°–99.5°F	97.5°–99.6°F	97.6°–99.6°F	97.6°–99.6°F
Rectal	99°–100°F	99°–100°F	98.5°–99.6°F	98.6°–100.6°F	98.6°–100.6°F
Blood Pressure					
Systolic	74–100	80–112	80–120	88–120	90–120
Diastolic	50–70	50–80	50–80	58–80	60–80
Pulse (bpm)	80–160	75–130	70–115	55–110	60–100
Respirations	26–40	20–30	18–24	16–24	12–20



BODY-RELATED CALCULATIONS

Body Surface Area (BSA) Calculation

BSA (m^2) = Square root of $\frac{[h (cm) \times wt (kg)]}{3,600}$

BSA (m^2) = Square root of $\frac{[h (in) \times wt (lb)]}{3,131}$

EX: If a woman is 65 inches tall and weighs 145 lbs, what is her BSA in m^2?

$$\frac{[h(in) \times wt(lbs)]}{3,131} = \frac{65\,in \times 145\,lbs}{3,131} = \frac{9,425}{3,131} \approx \mathbf{3.01\,m^2}$$

Ideal Body Weight Calculation

- The **Dr. Devine formula** (used to calculate dosage of certain medications):
  - **For men:** Ideal Body Weight = 50 kg + 2.3 kg × [Height (in) – 60]
  - **For women:** Ideal Body Weight = 45.5 kg + 2.3 kg × [Height (in) – 60]

EX: What is the ideal body weight of a man who is 5′9″ tall?
Convert height to inches: 5 ft × 12 in = 60 in + 9 in = 69 in
50 kg + 2.3 kg × (69 – 60) = 50 kg + (2.3 kg × 9) = 50 kg + 20.7 kg = **70.7 kg**
To convert to pounds (if needed): 1 kg = 2.2 lbs, so 70.7 kg = **155.5 lbs**

Adjusted Body Weight Calculation

- Adjusted Body Weight = Ideal Body Weight + 0.4 (Actual Body Weight – Ideal Body Weight)

EX: What is the adjusted body weight of a woman who is 5′3″ and weighs 136 lbs?
Convert height to inches: 5 ft × 12 in = 60 in + 3 in = 63 in
Convert weight to kilograms: 136 lbs ÷ 2.2 lbs/kg = 61.8 kg
Calculate ideal body weight: 45.5 kg + 2.3 kg × (63 – 60) = 45.5 kg + (2.3 kg × 3) = 45.5 kg + 6.9 kg = 52.4 kg
Now calculate adjusted body weight: 52.4 + 0.4(61.8 – 52.4) = 52.4 + 0.4(9.4) = 52.4 + 3.8 = **56.2 kg**
To convert to pounds (if needed): 1 kg = 2.2 lbs, so 56.2 kg = **123.6 lbs**

Body Mass Index (BMI) Calculation

< 17.5	Anorexic
17.6–20	Underweight
20–25	Normal weight
25–30	Overweight
30–40	Obese
> 40	Severe obesity

Formula: Weight (in kg)/Height (in m) squared = BMI

EX: What is the BMI of a man who is 6′1″ and weighs 202 lbs?
Convert height to meters:
6 ft × 12 in = 72 in + 1 in = 73 in ÷ 39.37 = 1.85 m
Convert weight to kilograms:
202 lbs ÷ 2.2 lbs/kg = 91.8 kg
Calculate BMI:
kg/m^2 = 91.8 kg/$(1.85\text{ m})^2$ = 91.8 kg/3.42 m^2 = **26.8**

HEALTH CARE OPERATING INDICATORS

Formulas

Average Length of Stay (ALOS)
Total # of patient days/Total # of discharges

Inpatient Occupancy Rate
Total # of inpatient days/Total # of inpatient beds

Outpatient Revenue as a Percentage of Total Patient Revenue
Total outpatient revenue $/Total patient revenue $

Average Daily Inpatient Census
Total # of inpatient service days/Total # of days

Length of Stay (LOS)
Total length of stay/Total # of discharges (including deaths)

Death Rate (Gross Death Rate)
Total # of inpatient deaths/Total # of discharges

Net Death Rate
Total # of inpatient deaths minus deaths < 48 hours/Total # of discharges minus deaths < 48 hours

Newborn (NB) Death Rate
Total # of NB deaths/Total # of NB discharges (including deaths)

Maternal Death Rate (Hospital Inpatient)
Total # of direct maternal deaths/Total # of maternal discharges (including deaths)

Gross Autopsy Rate
Total inpatient autopsies/Total # of inpatient deaths

Hospital Infection Rate
Total # of nosocomial infections/Total # of discharges (including deaths)

Postoperative Infection Rate
[# of infections in clean surgical cases/Total # of surgical operations] × 100

Consultation Rate
Total # of patients receiving consultations/Total # of discharges and deaths

Community-Based Birth & Infant Death (Mortality) Rates
[# of live births for a given community/Estimated population of that community] × 100

Incidences Rate of Disease
[Total # of new cases of a specific disease/Total population at risk] × 10^n

Prevalence Rate of Disease
[All new & preexisting cases of a specific disease/Total population] × 10^n

Balance Sheet
Liabilities + Capital = Assets

CONDITION-SPECIFIC CALCULATIONS

Calculating Burn Percentages

FIRST DEGREE
Redness of the epidermis (skin)

SECOND DEGREE
Blisters on the skin; involvement of the epidermis and the dermis layers

THIRD DEGREE
Destruction of all layers of the skin, with possible involvement of the subcutaneous fat, muscle, and bone

NECROSIS
The death of the tissue

Glasgow Coma Scale		
Eyes Open	Spontaneously	4
	To speech	3
	To pain	2
	None	1
Verbal	Oriented	5
	Confused	4
	Inappropriate words	3
	Incomprehensible sounds	2
	None	1
Motor Skills	Obeys commands	6
	Localized pain	5
	Flexion withdrawal	4
	Abnormal flexion	3
	Abnormal extension	2
	Flaccid	1
Total		15

CALCULATING RISK

Attributable Risk: The part of the incidence of a disease in the exposed population that is due to the exposure
- Attributable Risk = (incidence in the exposed) – (incidence in the non-exposed)
- Attributable Risk Percentage = [Attributable Risk / (incidence in the exposed)] × 100%

Population Attributable Risk: The part of the incidence of a disease in a population (both exposed and non-exposed) that is due to exposure
- Population Attributable Risk = (incidence in the total population) – (incidence in the non-exposed)
- Population Attributable Risk Percentage = [Population Attributable Risk / (incidence in the total population)] × 100%

Relative Risk: The relationship between the incidence of a disease in the exposed population and that in the non-exposed population
- Relative Risk = (incidence in the exposed) / (incidence in the non-exposed)

Addition

- Addition is the process of adding, or uniting, two or more numbers, which are called *addends*; the result of adding two or more numbers is called the *sum*

Hint: When adding numbers, align them in a column so that the right sides line up; this will help make sure the place values are aligned starting with the ones column and moving to the tens, thousands, ten thousands, etc.

EX: 1,502 + 326 + 54

Align them:
```
 1,502
   326
 + 54
```

Start with the rightmost column (the ones) and add them: 2 + 6 + 4 = 12, which is more than 9, the maximum number for this column; write a "2" in the ones column and carry the 1 to the next column, the tens

Now add the numbers in the middle column: 0 + 2 + 5 + 1 = 8; write an "8" in the tens column and move to the next column, the hundreds

Add the numbers in the third column: 5 + 3 = 8; write an "8" in the hundreds column and move to the next column, the thousands

There is only one number in the thousands column: 1; write a "1" in the thousands column to show your complete answer: **1,882**

```
    1
 1,502
   326
  + 54
 1,882
```

Subtraction

- Subtraction is the process of subtracting, or taking away, one or more numbers from another number; the number from which other numbers are being taken away is called the *minuend*; the number being subtracted is called the *subtrahend*; the result of subtracting is called the *difference*

Hint: When subtracting numbers, make sure the larger number is on top and align them in a column so that the right sides line up; this will help make sure the place values are aligned starting with the ones column and moving to the tens, thousands, ten thousands, etc.

EX: 842 – 96

Start with the rightmost column (the ones) and subtract: 2 – 6; since 6 is larger than 2, you must borrow from the next column (the tens); once you borrow a 10, the number becomes 12; now subtract: 12 – 6 = 6; write a "6" in the ones column and subtract the borrowed 1 from the next column, the tens

```
   3
  842
 – 96
  746
```

Now subtract the numbers in the middle column: 3 – 9; again, since 9 is larger than 3, you must borrow from the next column (the hundreds); once you borrow a 10, the number becomes 13; now subtract: 13 – 9 = 4; write a "4" in the tens column and subtract the borrowed 1 from the next column, the hundreds

There is only one number in the hundreds column: 7; write a "7" in the hundreds column to show your complete answer: **746**

```
  73
  842
 – 96
  746
```

Multiplication

- Multiplication is the process of multiplying two or more numbers together; the numbers being multiplied are each called *factors*; the result of multiplying is called the *product*
- Multiplication is the same as repeated addition; so 3 × 4 is like adding four groups of three (3 + 3 + 3 + 3)

x	0	1	2	3	4	5	6	7	8	9	10	11	12
0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	0	1	2	3	4	5	6	7	8	9	10	11	12
2	0	2	4	6	8	10	12	14	16	18	20	22	24
3	0	3	6	9	12	15	18	21	24	27	30	33	36
4	0	4	8	12	16	20	24	28	32	36	40	44	48
5	0	5	10	15	20	25	30	35	40	45	50	55	60
6	0	6	12	18	24	30	36	42	48	54	60	66	72
7	0	7	14	21	28	35	42	49	56	63	70	77	84
8	0	8	16	24	32	40	48	56	64	72	80	88	96
9	0	9	18	27	36	45	54	63	72	81	90	99	108
10	0	10	20	30	40	50	60	70	80	90	100	110	120
11	0	11	22	33	44	55	66	77	88	99	110	121	132
12	0	12	24	36	48	60	72	84	96	108	120	132	144

Hint: It helps to memorize the multiplication table (at right), or all multiplication facts from 0 to 12; for three-digit numbers, always align the numbers in a column so that the right sides line up and then multiply each digit in the top number by each digit in the bottom number

EX: 247 × 36

Start with the rightmost column (the ones) and multiply them: 6 × 7 = 42, which is more than 9, the maximum number for this column; write a "2" in the answer's ones column and carry the 4 to the next column, the tens

Next, multiply 6 by the digit in the first number's tens place (4): 6 × 4 = 24, then add the carried 4: 24 + 4 = 28,which is more than 9, the maximum number for this column; write an "8" in the answer's tens column and carry the 2 to the next column, the hundreds

Now multiply 6 by the digit in the first number's hundreds place (2): 6 × 2 = 12, then add the carried 2: 12 + 2 = 14; since there are no more numbers in a higher place value, write 14 in the answer

```
   24
  247
 × 36
1,482
```

1,482 is the first *partial product*

To start the next digit, 3, write a "0" in the ones column of the next line of the answer

Then multiply 3 by the digit in the first number's ones place (7): 3 × 7 = 21, which is more than 9, the maximum number for this column; write a "1" in the answer's tens column and carry the 2 to the next column, the tens

```
    12
   247
  × 36
  1482
+ 7410
```

Next, multiply 3 by the digit in the first number's tens place (4): 3 × 4 = 12, then add the carried 2: 12 + 2 = 14, which is more than 9, the maximum number for this column; write a "4" in the answer's hundreds column and carry the 1 to the next column, the hundreds

Now multiply 3 by the digit in the first number's hundreds place (2): 3 × 2 = 6, then add the carried 1: 6 + 1 = 7; since there are no more numbers in a higher place value, write a "7" in the answer

7,410 is the second *partial product;* to find the overall product, add the two partial products to get **8,892**

```
  1482
+ 7410
 8,892
```

Division

- Division is the process of finding how many times one number goes into another number; the number being divided is called the *dividend*; the number by which it is divided is called the *divisor*; the result of division is called the *quotient*

Hint: Division problems are often written with the division symbol (÷), but to solve them, it's best to write them in the long-division format, with a $\overline{)\ \ }$; also, remember that division problems may not result in whole-number answers

EX: 682 ÷ 14

Write it in long-division format: $14\overline{)682}$

(A) The first number of the dividend, 6, cannot be divided by 14, since 14 is larger than 6; write a 0 on top in the hundreds place, write a 0 under the 6, find the difference between 6 and 0, and bring the next place value down

(B) Since 14 does not go into 68 a whole number of times, you must use the number of whole times it *does* go in (4); write that number above the 8, write the product of 4 and 14 (56) beneath the 68, find the difference between those two, and bring the next place value down

(C) Since 14 does not go into 122 a whole number of times, you must use the number of whole times it *does* go in (8); write that number above the 2, write the product of 8 and 14 (112) beneath the 122, and find the difference between those two

```
A.    0         B.    04        C.    048
   14)682          14)682          14)682
      0               0               0
      68              68              68
                      56              56
                      122             122
                                      112
                                       10
```

Since 14, the divisor, is greater than 10, this is as far as you can go; this means that 682 ÷ 14 = **48 with a remainder of 10**

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Note to Student: This guide is intended for informational purposes only. Due to its condensed format, this guide cannot cover every aspect of the subject; it should be used in conjunction with course work and texts. This guide is not intended for the diagnosis, treatment, or cure of any medical condition or illness and should not be used as a substitute for professional medical care.

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