PHARMACEUTICAL CALCULATIONS

PRESCRIPTION AND MEDICATION ORDERS

Prescription

is a written order from a licensed physician, dentist, and veterinarian to a licensed pharmacist to prepare and dispense specific medication for a particular outpatient.

Parts of a prescription

- Patient information
  - → Name
  - → Age
  - → Gender
  - → Weight and height
- Date of prescribing
  - → The date when the prescription was written by the prescriber
  - → Basis for determining until when the prescription is valid
  - → Dangerous drug prescription is valid only for 30 days
- Superscription
  - → It is represented by the symbol rx which means
  - → "you take" or
  - → "take though" or
  - → "recipe"
- Inscription
  - → *Prepared or prefabricated drug*
    - Generic name of the drug
    - Brand name of the drug
    - Dosage form
    - Potency
    - Quantity
  - → *Compounding drug*
    - ❑ Name of the ingredients
      - Base quantity
        - Is the active ingredient responsible for the use of the drug
      - Adjuvant quantity
        - Is the substance added to enhance the action of the base
      - Corrective quantity
        - Is the substance added to mask the undesirable odor, color and taste
      - Vehicle quantity
        - Is the substance added to make the desire volume or quantity
    - ❑ Quantity
- Subscription
  - → Direction to the pharmacist on how to prepare the drug (found only in compounding drug)
  - → Instruction usually make use of Latin abbreviation
  - → Found only in compounding Rx
    - e.g. M. ft. sol.
    - M. ft. cap. Dtd #12
- Transcription (Sig. 1 tsp tid for cough for 5 days)
  - → Direction to the patient on how, when, how much to take, how long
  - → Size of the dose
    - One cap
    - One tablet
    - One teaspoon or 5 mL
    - One suppository
    - One tablet dissolve in a glass of water
    - One sachet
  - → Number of doses (frequency)
    - Once a day or od
    - Twice a day or bid
    - Three times a day or tid
    - Four times a day or qid
    - prn
  - → Number of days the drug must be taken
    - For 1 day
    - For 3 days
    - For 5 days
    - For 7 days
    - For 30 days
    - prn
  - → Use of the drug (optional)
  - → Mode of administration
    - Take
    - Instill
    - Apply
    - Insert
    - Apply with rubbing
    - Dissolve in a glass of water
    - Inhale
    - Place inside the mouth
    - Spray
    - Place under the tongue
    - Place in between the cheek
    - Inject
      - Intravenously
      - Intramuscularly
      - Subcutaneous

- Intradermal
- Intraperitoneal

- Prescriber information
  - → Name of the prescriber
  - → Signature of prescriber
  - → PTR no. And date issued
  - → PRC license no. And date issued
  - → S2 license no. And date issued (for yellow prescription)
- Refill information

Medication orders

are orders for medications by a licensed physician intended for the use of a particular inpatient in an institutional setting.

Information in the medication orders

- Patient information
- Room number
- Date and time the order was written
- Name of the drug, dosage form, potency, quantity and route of administration
- Prescriber's signature
- Directions for the pharmacist
- Instruction for administration, including quantity, schedule and duration of use
- Name or initials of person(s) who transcribed the order (nurse or pharmacist)

Dangerous Drug Prescription

- Can be obtained from the DOH
- It has serial number and comes in 3 copies. Orig-ph, 2nd copy-dr,3rd copy-pt
- Only one drug can be written per prescription
- Only Doctor with S2 license can used yellow prescription
- Only pharmacist with S3 license can dispense yellow prescription.

Prescription and Medication Order

Each medication must be:

- → therapeutically appropriate to the patient
- → prescribed at the correct dose
- → dispensed in the correct strength and the dosage form
- → correctly labeled with complete instructions for the patient or caregiver
- → for patient in the hospital, each medication must be administered to the correct patient, at the correct time and by the correct rate and route of administration

Pharmacist must check for correct reading and interpretation of prescription and MO

- → Prescriber information including address and telephone no. and S2 license no. and signature
- → Date of order and its currency to the request for filling
- → Patient information including dose-relevant information
- → Drug prescribed, including dose, preparation strength dosage form and quantity
- → Clarity of abbreviations, symbols and units of measure
- → Clarity and completeness of directions for use by the patient or caregiver
- → Refill or generic substitution authorization
- → Need for special labeling
- → A listing of the ingredients and quantity for orders to be compounded

Before dispensing, pharmacist must make certain of the following:

- → The filled prescription or medication order contains the correct drug, strength, dosage form and quantity. The bar coding of pharmaceutical products used in hospital is required in US.
- → The pharmacist imprinted serial number on the label matches that on the order.
- → The label has the correct information.

Information needed on the label:

- → Name of the drugstore and address
- → Correct patient and physician name
- → Correct drug name, quantity and strength
- → The name and initials of pharmacist who filled the order
- → The number of refills remaining
- → Expiration of the drug

Patient Compliance

- Patient compliance with prescribed and non-prescribed medications is defined as patient understanding and adherence to the directions for use. The compliant patient follows the label directions for taking the medication properly and adheres to any special instructions provided by the prescriber or pharmacist.
- Compliance includes
  - → taking medication at the desired strength
  - → in the proper dosage form
  - → at the appropriate time of the day and night

→ at the proper interval of the duration of the treatment and
→ with proper regard to food and drink and consideration of other concomitant medications and herbal remedies

Patient Noncompliance

- Patient noncompliance is the failure to comply with a practitioner's or labeled direction in the self-administration of any medication.
- Noncompliance may involve
  → underdosage or overdosage
  → inconsistent or sporadic dosing
  → incorrect duration of treatment and
  → drug abuse or misadventuring with medications

Factors for noncompliance

- unclear or misunderstood directions,
- undesired side effects of the drug that discourage use,
- lack of patient confidence in the drug or to the prescriber
- discontinued use because the patient feels better or worse,
- economic reasons based on the cost of the medication
- absence of patient counselling and understanding of the need for and means of compliance,
- confusion over taking multiple medications,
- patient forgot taking the medications

Abbreviations Commonly Used in Prescriptions and Medication Orders

- must be interpreted correctly
- must be familiar with the abbreviations and the meaning

Acceptable Abbreviations

Abbreviation	*Acceptable*	*Abbreviation*	*Acceptable*
100 U	100 Units	Ug	Mcg
q.o.d	Every other day	T.I.W	Three times a week
D/C	Discontinue, discharge	IVP	IV push, intravenous pyelogram
Au, as, ad	Both ears, left ear, right ear	q.d	Every day
Ou, os, od	Both eyes, left eye, right eye	HS	At bedtime, half-strength
D	Day or dose	PB	Phenobarbital
Iv	Intravenous	10mg	10 mg

Classification of drug based on prescription requirement

- OTC drug
- Prescription drug
- Dangerous drug

DRUG	OTC	RX DRUG	Dangerous drug
Prescription required	none	Ordinary prescription	Yellow prescription
Number of copies	none	One	Three-ph, dr., & pt
Ways of identifying	No Rx sign	With Rx sign and add'l label requiring prescription	With Rx sign and add'l label requiring prescription and List A
Recording required	No	Prescription book	Dangerous drug book
Filing of prescription	No	2 years	1 year
Note: for poison drug – the prescription should be kept for 5 years and recorded in poison book. pharmacy 2 review 38			

SYSTEMS OF MEASURE

Metric systems

Fundamental unit for

- Weight – gram – g
- volume – liter – l
- length – meter – m

Prefixes

Exa-	E	10^{18}
Peta-	P	10^{15}
Tera-	T	10^{12}
Giga-	G	10^{9}
Mega-	M	10^{6}
Kilo-	k	1000 times the basic unit
Hekto-	h	100 times the basic unit
Deka-	da	10 times the unit basic
Deci-	d	0.1 times the basic unit
Centi-	c	0.01 times the basic unit
Milli-	m	0.001 times the basic unit
Micro-	u	One-millionth of the basic unit
Nano-	n	One-billionth of the basic unit
Pico-	p	One-trillionth of the basic unit
Femto-	f	10^{-15}
Atto-	a	10^{-18}

Particle size and nanotechnology

- Increase aqueous dissolution rates for poorly soluble substances
- Improved bioavailability with increased rates of absorption of orally administered drugs.
- Lower oral dosage possibilities with enhanced drug absorption

One nanometer

- one billionth of a meter
- 25,400,000 nm equal 1 inch
- helix of DNA has a diameter of 2nm

Commonly used equivalents

Metric measures of weight

1000 ug or mcg	= 1 mg
1000 mg	= 1 g
1000 g	= 1 kg

Metric measures of volume

1000 mL	= 1 L
1000 mm	= 1 m
1000 uL	= 1 mL

Metric measures of length

1000 um	= 1 mm
1000 mm	= 1 m
100 cm	= 1 m
1000 m	= 1 km
10 mm	= 1 cm

Apothecary systems

Volume

60 minims	= 1 fluidrachm
8 fluidrachms	= 1 fluidounce
16 fluidounces	= 1 pint (pt)
2 pints	= 1 quart (qt)
4 quarts	= 1 gallon (gal/C)

Mass

20 grains	= 1 scruple
3 scruples (60 gr)	= 1 drachm
8 drachm (480 gr)	= 1 ounce
12 ounces (5760 gr)	= 1 pound (tb)

Avoirdupois systems

Mass

437.5 grains (gr)	= 1 ounce (oz)
16 ounces (7000 gr)	= 1 pound (lb)

Length

1 m	= 39.37 in
1 in	= 2.54 cm or 25.4 mm
12 in	= 1 ft
3 ft	= 1 yd
1 yd	= 36 in

Mass

1 g	= 15.432 gr
1 gr	= 65 mg or 64.8 mg
1 kg	= 2.2 lb
1 oz	= 28.35 g
1 ounce	= 31.1 g
1 lb	= 424 g
1 tb	= 373.2 g

Volume

1 mL	= 16.23 mx
1 mx	= 0.06 mL
1 f3	= 3.69 mL
1 f ounce	= 29.57 mL
1 pt	= 473 mL
1 qt	= 946 mL
1 gal (US)	= 3785 mL
1 gal (UK)	= 4545 mL

Other Equivalents

1 tsp	= 5 mL
1 dsp	= 10 mL
1 tbsp	= 15 mL
20 gtts of H_2O	= 1 mL using std dropper
1 g of water	= 1 mL
1 fl ounce water	= 455 gr

REDUCING AND ENLARGING FORMULAS

Pharmacists may have to reduce or enlarge formulas for pharmaceutical preparations in the course of their professional practice or manufacturing activities. Formulas are based on the preparation of 1000 ml or 1000 g of product.

- Formulas can be provided in amounts or in parts.

Formulas that indicate quantities

Benzyl benzoate	250 ml
Triethanolamine	5 ml
Oleic acid	20 ml
Purified water to make	1000 ml

Formula used in the computation:

$$\frac{Quantity\ desired}{total\ quantity} = Factor$$

$$quantity\ of\ each\ ing.needed\ to\ prepare\ the\ drug\ x\ factor = quantity$$

e.g., Prepare 500 mL of the formula
500 mL/1000 mL = 0.5

- 250 mL x 0.5 = 125 mL benzyl benzoate
- 5 mL x 0.5 = 2.5 mL
- 20mL x 0.5 = 10 mL
- 1000 mL x 0.5 = 500 mL

Formulas that indicate parts

Witch hazel	4 parts
Glycerin	1 part
Boric acid solution	15 parts
20 PARTS	250 mL

- 4/20 x 250 = 50 g
- 1/20 x 250 = 12.5 mL
- 15/20 x 250 = 187.5 mL

Formula Used:

$$Total\ parts : total\ qty\ desired :: parts\ of\ each\ ing : quantity\ of\ each\ ing.$$

e.g., Prepare 250 g of the formula

- 20:250::4:x
- 20x = 250 x 4
- x = 50 g of witch hazel

SPECIFIC GRAVITY, DENSITY AND SPECIFIC VOLUME

Specific Gravity

Specific gravity is the ratio of the weight of the substance to the weight of an equal volume of water.

$$Sp\ gr = \frac{w\ (substance)}{w\ (eq\ vol.of\ water)}$$

- std temp 25°C (alc 15.56°C)
- std liquid – water, H_2 for gases
- specific gravity bottle or pycnometer
  - → Sp gr less than 1 – liquid lighter than water
  - → Sp gr more than 1 – liquid heavier than water

Specific Gravity at 25°C

Agent	Sp gr	Agent	Sp gr
Ether	0.71	Clove oil	1.04
Acetone	0.79	Glycerin	1.25
Alcohol	0.81	Hydrochloric acid	1.37
Olive oil	0.91	Chloroform	1.47
Peppermint oil	0.90	Mercury	13.6

Clinical Applications of sp gr

- Normal adult has sp gr of 1.010 to 1.025
- Newborns has sp gr of 1.001 to 1.020
- A higher-than-normal sp gr denotes that the urine is concentrated
- A low sp gr denotes that the urine is diluted.

Density

Density is the mass per unit volume of the substance.

$$D = \frac{W}{V} = g/mL$$

Specific Volume

Specific volume is the ration of the volume of the substance to the volume of an equal weight of water.

$$Sp\ V = \frac{V\ (substance)}{V\ (eq\ wt\ of\ water)}$$

Specific gravity and specific volume are reciprocals

$$Sp\ Gr = \frac{1}{Sp\ Vol}$$

$$Sp\ Vol = \frac{1}{Sp\ Gr}$$

Use of Specific Gravity in the Calculation of weight and volume

$$Wt\ of\ liquid = volume\ x\ Sp.Gr$$

$$Volume\ of\ liquid = \frac{wt\ of\ liquid}{Sp.Gr}$$

CALCULATION OF DOSES

Dose of a drug is the quantitative amount administered or taken by a patient for the intended medicinal effect.

Doses are expressed using any of the following formats

- Quantity of drug
  - → ex. 25 mg
- Quantity of drug per kg of body weight
  - → ex. 5 mg per kg BW
- Quantity of drug per square meter of BSA
  - → ex. 10 mg drug/m^2

Dose may be expressed as

- According to the amount
  - → Single dose
  - → Daily dose
  - → Total dose

- According to its intended effect
  - → Priming dose
  - → Maintenance dose
  - → Therapeutic dose
  - → Prophylactic dose

Bases on Intensity of Effect of Drug

- The median effective dose of a drug – is the amount that produces the desired intensity of effect in 50% of the individuals tested
- The median toxic dose of a drug – is the amount that produces toxic effects in 50% of the individuals tested.

Based on Blood Serum Concentration

- Minimum effective concentration – is the minimum blood concentration of a drug that can be expected to produce the drug's desired effects in a patient.
- Minimum toxic concentration – the base level of blood serum concentration that produces dose-related toxic effects

Basis of giving the dose of a drug

- Age
- Weight and height or body surface area
- General physical health
- Liver and kidney function
- Severity of the illness being treated

Basis of Giving doses according to age

- Adult dose of a drug is the amount that ordinarily produces the medicinal effects intended in adults.
- Pediatric dose of a drug is the amount that ordinarily produces the medicinal effects intended in infants or child patients.

Dosing options

- Low dose and high dose therapies
- E.x. low dose therapy
  - → Aspirin 81 mg for lowering the risk of heart attack and clot related stroke
  - → Aspirin 325 mg –analgesic
- E.x. high dose therapy
  - → 1000 mg/day of vit E to prevent progression of hardening of the arteries
  - → 15 mg/day vit E- recommended daily allowance
- Fixed dose combination products – contain two or more drug taken as a single dose
- Splitting tablets – product is not available in the dose needed
- Special dosing regimens – oral contraceptives

Dosage regimen

- Name and quantity of drug with frequency of administration
  - → Diazepam 1 mg three times a day
- Name and concentration of drug with frequency of administration
  - → Hydrocortisone lotion 1% apply TID
- Name and quantity of drug per square meter of BSA with frequency of administration
  - → Diazepam 1.17/m2 BSA TID
- Name and quantity of drug per kg BW with frequency of administration
  - → Diazepam 40 ug/kg TID

Calibration of droppers

$$\frac{Total\ no.of\ drops}{volume} = no.of\ drops/mL$$

Standard dropper has an external diameter of 3mm and delivers 20 drops of water per mL

Calculations in miscellaneous dosage problems

- $Total\ amount = size\ of\ the\ dose\ x\ no.of\ doses$
- $No.\ of\ doses = \frac{total\ amount}{size\ of\ the\ dose}$
- $Size\ of\ the\ dose = \frac{total\ amount}{no.of\ doses}$

Pediatric patients

- pediatrics is the branch of medicine that deals with disease in children from birth through adolescence
- Neonate –from birth to 1 month
- Infant – 1 month to 1 yr
- Early childhood – 1 yr to 5 yr
- Late childhood – 6 yr to 12 yr
- Adolescence – 13 yr to 17 yr
- Remember: infants and children are not little adults
- Neonate is considered premature if born less than 37 week's gestation

Proper Drug dosing of the Pediatric Patient depends on

- Patient's age
- Weight
- Overall health status
- Condition of such biological functions as respiration and circulation
- The stage of development of body systems for drug metabolism and drug elimination

Other groups of patients

- Adult – 18 yr to 59
- Geriatric patient – 60 and above

Geriatric Patients

- Geriatric medicines or geriatrics is the field that encompasses the management of illness in the elderly.

Special considerations in dose determination for elderly patients

- Therapy is often initiated with lower-than-usual adult dose
- Dose adjustment may be required based on the therapeutic response
- The patient's physical condition may determine the drug dose and the route of administration employed
- The dose may be determined based on patient's weight, BSA, health and disease status and pharmacokinetic factors.
- Concomitant drug therapy may affect drug/dose effectiveness
- A drug dose may produce undesired adverse effects and may affect patient compliance
- Complex dosage regimens of multiple drug therapy may affect patient compliance.

Calculation of the dose base on USP/DI

- Usual pediatric dose for diazepam children 6 mo. of age and over:
  - → oral 1 to 2.5 mg,
  - → 40 to 200 mcg per kg of BW, or
  - → 1.17 to 6 mg per sq m of BSA 3 to 4 times a day
- the dose being increased gradually as needed and tolerated.

Calculations of the child dose based on AGE

- Young's rule:

$$Child\ dose = \frac{Age}{Age + 12} x\ Adult\ dose$$

- Cowling's rule:

$$Child\ dose = \frac{Age\ at\ next\ birthday\ (yrs)}{24} x\ Adult\ dose$$

- Fried's Rule (for infants):

$$Child\ dose = \frac{Age\ (in\ months)}{150} x\ Adult\ dose$$

Calculations of the child dose based on BODY WEIGHT

- Clark's rule:

$$Child\ dose = \frac{Weight\ (lb)}{150} x\ Adult\ dose$$

Calculation of drug dosage based on mg/kg body wt.

Dose in mg: kg body wt :: dose in mg needed: wt. Of patient in kg

Calculations of the child dose based on body surface area BSA of child in m^2

- Adult Dose $= \frac{BSA\ of\ Adult\ (m^2)}{1.73\ m^2} x\ usual\ Adult\ dose$
- If Adult dose is given:

$$Child\ dose = \frac{BSA\ of\ Child\ (m^2)}{1.73\ m^2} x\ Usual\ Adult\ dose$$

- If Adult dose is given:

$$Child\ dose = BSA\ of\ Adult\ (m^2)\ x\ Dose\ per\ m^2$$

Calculation of the BSA using the formula

- $BSA\ m^2 = \sqrt{\frac{ht(cm)\ x\ wt(kg)}{3600}}$
- $BSA\ m^2 = \sqrt{\frac{ht(in)\ x\ wt(lb)}{3131}}$

PERCENTAGE, RATIO STRENGTH AND OTHER CONCENTRATION EXPRESSIONS

- Percent (%) means by the hundred or in a hundred while percentage means rate per hundred.
  - → 10%
  - → 85%
- Percents are usually changed to equivalent decimal, ratio or fraction form.
  - → 25%
  - → 0.25
  - → 25:100
  - → 25/100
- Percentage is used in expressing concentration of a solute in a solution, the amount of active material in a drug or preparation, or the quantity of an ingredient in a mixture.
  - → %W/W, %W/V, %V/V

Examples of Pharmaceutical Dosage forms Calculated on % Basis

Percentage concentration	Applicable dosage forms
Weight-in-volume	Solutions, lotions, sprays
Volume-in-volume	Aromatic waters, lotions
Weight-in-weight	Ointments, creams, suppositories

Percent Weight-in Volume

Percent weight-in-volume (w/v) expresses the number of g of a constituent in 100 ml of solution or liquid preparation.

- % W/V$= \frac{Weight\ (solute)}{Volume\ (solution)} x100$
- Weight (solute) $=$ $Volume\ (solution)\ x\ \%\ (expressed\ in\ decimal)$
- Volume (solution) $= \frac{Weight\ (solute)}{\%\ (expressed\ in\ decimal)}$
- Weight (gr) $=$ $V(fluid\ oz.)\ x\ 455\ x\ \%\ (expressed\ in\ decimal)$

Percent Volume-in Volume

Percent volume-in-volume (v/v) expressed the number of ml of constituents in 100 ml of solution or liquid preparation.

- % V/V $= \frac{Volume\ (solute)}{Volume\ (solution)}\ x\ 100$
- Volume (solute) $=$ $Volume\ (solution)\ x\ \%\ (expressed\ in\ decimal)$
- Volume (solution) $= \frac{Volume\ (solute)}{\%\ (expressed\ in\ decimal)}$

Percent Weight-in Weight

Percent weight-in-weight (w/w) expressed the number of g of constituents in 100 g of solution or preparation.

- % W/W $\frac{Weight\ (solute)}{Weight\ (mixture)}\ x\ 100$
- Weight (solute) $=$ $weight\ (mixture)\ x\ \%\ (expressed\ in\ decimal)$
- Weight (mixture) $= \frac{Weight\ (solute)}{\%\ (expressed\ in\ decimal)}$

Ratio Strength

Ratio strength is used to express the concentration of weak solutions or liquid preparations. It is another way of expressing the percentage strength of solutions or liquid preparations in ratio form.

→ 0.02% = 1: 5000

Parts per Million or Parts per Billion

Parts per million or parts per billion are used to express very dilute solutions. It is the number of parts of the agent per 1 million parts or per 1 billion of the whole.

→ 1:1,000,000 1:1,000,000,000

Conversion of concentration to mg/ml

Pharmacists in patient care setting need to convert rapidly product concentration expressed as % strength, ratio strength or g/l to mg/ml.

1. To convert product percentage strength to mg/ml, multiply the % strength by 10.
   → 4% = 4 x 10 = 40 mg/ml
   → 4g is 4000mg/100mL = 40mg/mL
2. To convert product ratio strengths to mg/ml, divide the ratio strength by 1000.
   → 1:10000 = (1000/1000) / (10000/1000) = 1 mg/10 ml
3. To convert product strengths expressed as grams per liter to mg/ml, convert the numerator to mg and divide by the number of ml in the denominator.
   → 1 g/ 250 ml
   → 1000 /250 = 4 mg/ml

Concentration Expressed in mg % and mg/dL

A. Milligram percent (mg %) expresses the number of milligrams of substance in 100 ml of liquid.
→ 80 mg%

B. Milligram per dl (mg/dl) expresses the number of milligrams of substances in biological fluids in clinical laboratory test values.
→ Glucose in serum is 60 to 110 mg/dl

Other Concentration Expression

- Molarity (M) is the expression of the number of moles of solute dissolved per liter of solution.
- Normality (N) of a solution is the number of gram-equivalent weights of solute per liter of solution.
- Molality (m) is the moles of solute dissolved per kilogram of solvent.
- Formality (F)

DILUTION AND CONCENTRATION

If the amount of drug remains constant in a dilution or concentration, then any change in the mass or volume of a mixture is inversely proportional to the concentration.

- dilution of liquids and alcohol
- stock solution
- dilution of solids

Dilution and concentration of liquids

Quantity x concentration = quantity x concentration
(concentrated) (diluted)

- Quantity – must be in ml
- concentration - must be in %

Stocks solutions are solutions of known concentrations that are prepared by the pharmacist for convenience in dispensing. They are usually strong solutions from which weaker ones may be made conveniently. Their concentration is expressed as ratio strength.

The same formula may be used. However, the ratio strength must be changed to % strength.

Dilution of acids.

$$Wt\ of\ acid = volume\ x\ \%\ (in\ decimal)$$

Q X C = Q X C
(conc.) (diluted)

$$Volume\ of\ acid = \frac{wt\ of\ acid}{Sp\ Gr\ of\ the\ acid}$$

The % strength of concentrated acid is expressed as % w/w while the concentration of dilute acid is expressed as % w/v. To determine the volume of concentrated acid to be used in preparing a diluted acid requires the specific gravity of the concentrated acid.

- Glacial acetic acid 100%w/w,
- HCL = 37%w/w,
- H_2SO_4 = 96%w/w,
- HNO_3 = 65%w/w,
- H_3PO_4 = 85%w/w
- Dilute HCL = 10%w/v,
- Dilute glacial acetic acid = 6% w/v

Dilution and concentration of solids

Q x C = Q x C

- Quantity is expressed in g concentration is expressed in %

Triturations

Triturations are dilutions of potent medicinal substances. (1:10 w/v or 10% w/v mixtures) they are prepared by diluting 1 part of the drug with nine parts of finely powdered lactose. Problems on triturations are solved by ratio and proportion.

→ 1: 10: wt of drug: wt of mixture

Alligation Medial

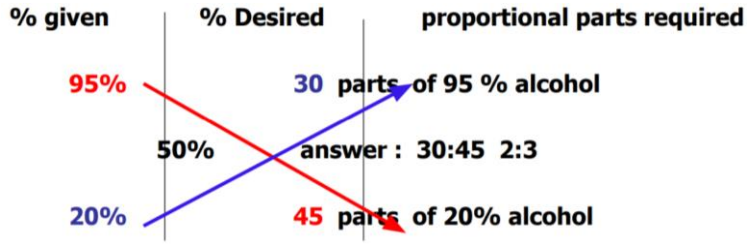
Alligation medial a method for calculating the average concentration of a mixture of two or more substances possessing different % strength.

$$Quantity\ x\ \% = Product$$

$$\frac{Total\ Product}{Total\ Quantity} = average\ \%$$

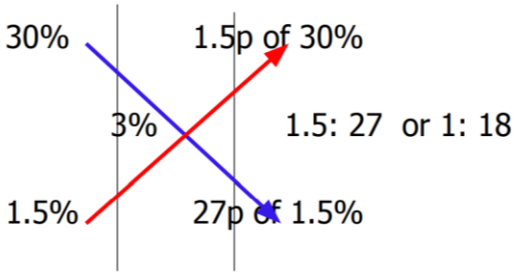
Alligation Alternate

Alligation alternate a method for calculation of the number of parts of two or more components of known concentration to be mixed when the final desired concentration is known.



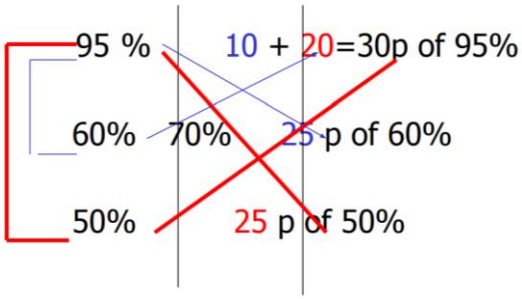
2 concentrations

In what proportion of 30% and 1.5% hydrogen peroxide solutions be mixed to prepare a 3 % hydrogen peroxide solution?



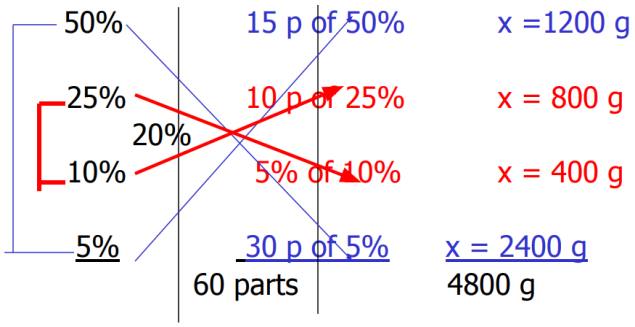
3 concentrations

The solvent for the extraction of vegetable drug is 70%. In what proportion of 95%, 60% and 50% be mixed to prepare the solvent of desired %.



4 concentrations

A manufacturing pharmacist has 4 lots of ichthammol ointment containing 50%, 25%, 10% and 5% of ichthammol. How many grams of each may be used to prepare 4800 g of 20% ichthammol ointment?

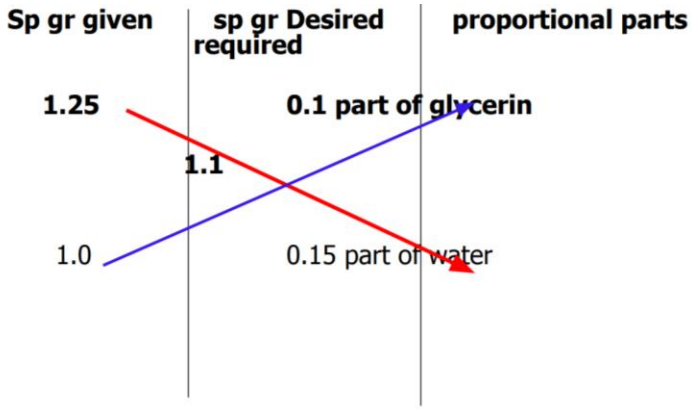


Specific Gravity of Liquid

Specific gravity of mixtures the methods of alligation medial and alternate can also be used to solve problems that involved specific gravity.

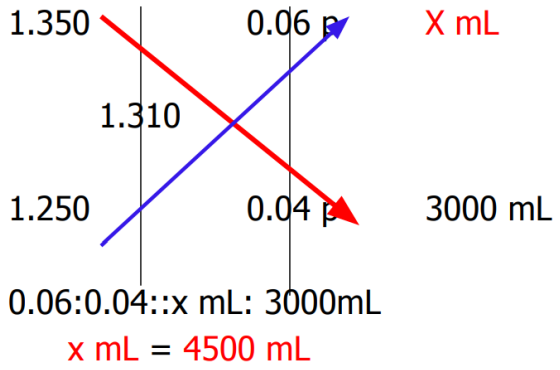
$$Sp\ gr.x\ volume = product$$

$$\frac{Total\ product}{Total\ volume}\ x\ average\ specific\ gravity$$



Sp. gr of liquid – Alligation alternate

How many mL of a syrup having a sp gr of 1.350 should be mixed with 3000 mL of a syrup having a sp gr of 1.250 to obtain a product having a sp gr of 1.310?



ELECTROLYTE SOLUTIONS

- Electrolytes solutions contain electrolytes that dissociate into ions. Nacl dissociates into na (cation) and cl (anion)
- Electrolyte ions in the blood plasma includes Na^+, K+, Ca^{++}, and Mg^{++} and the anions Cl^-, HCO_3^-, HPO_4^{--}, SO_4^{--}, organic acids, and proteins
- Uses of electrolyte preparations. They play important role in maintaining the acid-base balance in the body, controlling body water volumes and help to regulate body metabolism.
- Concentration of electrolyte preparation was once expressed in mg%. It is now expressed in milliequivalent (meq). A milliequivalent represents the amount in mg of a solute equal to 1/1000 of its gram equivalent weight taking into accounts the valence of the ions.

Ions	At wt.	Valence
Na	23	1
Al	27	3
Ca	40	2
Mg	24	2
K	39	1
Cl	35.5	1
SO_4	96	2
PO_4	96	3
HCO_3	61	1

Converting milliequivalents per unit volume to weight per unit volume

1. At. Wt of ion or mwt of compound
2. Eq wt = at wt/ valence of ion or mwt/ valence of cations or anions
3. Meq = eq wt /1000 = meq in g or mg
4. Conversion of meq to wt per unit volume or mg%

Converting milligrams percent to milliequivalents per liter

1. At. Wt of ion or mwt of compound
2. Eq wt = at wt/ valence of ion or mwt/ valence of cations or anions
3. Meq = eq wt /1000 = meq in g or mg
4. Conversion of mg% to meq per liter

Converting weight to milliequivalents

1. At. Wt of ion or mwt of compound
2. Eq wt = at wt/ valence of ion or mwt/ valence of cations or anions
3. Meq = eq wt /1000 = meq in g or mg
4. Conversion of weight to meq

Millimole

Millimole is 1/1000 of the molecular weight in grams.

- Mwt of NaCl 58
- 1 mole of NaCl = 58 g
- 1 millimole NaCl = 58/1000= .058g or 58 mg.

Milliosmoles (mOsmol)

- Milliosmol is the unit used to expressed the osmotic concentration of parenteral fluids.
- 1 mmol is = to 1 mOsmol
  - → Fwt of dextrose = 180g
  - → 1 mmol (180mg) = 1 mOsmol
  - → 5% dextrose=5 g per 100 mL or 5000 mg per 100 mL or 50,000mg/L
  - → 50,000mg /180mg = 278 mOsmol/L

ISOTONIC SOLUTIONS

Isotonic solutions are solutions having the same osmotic pressure as a specific body fluid such as the blood and the body fluids of the eye, nose and bowel. The preparations which must be isotonic with body fluids are ophthalmic, nasal, parenteral and some enemas.

Calculating the tonicic agent required using the NaCl method

1. NaCl represented by the solute = wt of solute x NaCl eq.
2. NaCl represented by the solution = volume of solution x 0.009
3. Wt of NaCl = NaCl represented by the solution – solute
4. Wt of alternative tonicic agt = wt of NaCl/ NaCl eq. Of alternative tonicic agt.

CALCULATION OF DOSES IN UNITS AND UG/MG

Preparations with different potency

Antibiotics – the activity or potency of antibiotics is determined by their inhibitory effect on microorganisms.

- E.g. 1590 USP units of penicillin g sodium per mg of the USP reference standard of the antibiotic.
- The potency of antibiotics may also be designated in terms of ug/mg.
- E.g. Ampicillin sodium has a potency equivalent to between 845 and 988 ug/mg of its parent compound ampicillin

Insulin- the potency of insulin is also expressed in units. These strengths are expressed as u-40, u-100 and u-500, and their potencies refer to 40, 100 and 500 USP insulin units per ml of solution.

Biologics are preparations produced from living source. They include vaccines, toxoids and immune sera used for the development of immunity or resistance to disease; certain antitoxins and antivenins, used as treatment against specific antigens; and toxins and skin antigens, used as diagnostic aids.

- Biologics are prepared from human serum (immune globulin), horse serum (tetanus antitoxin), chick cell culture (measles virus vaccine) and such other animate media.
- The strengths of the various biologic products are generally expressed in terms of ug or units of antigen per ml.
- The strength of a viral vaccine is expressed in terms of tissue culture infectious dose (tcid 50).
- The strength of toxoid is expressed in terms of flocculating units (lf)

Calculation involving ug/mg and other measures of potency.

Unit : volume in ml :: units needed : given volume

THERMOMETRY

- Thermometer is an instrument for measuring temperature or intensity of heat.
- Scale used in thermometry- Fahrenheit, centigrade and kelvin scales.
- Formula used to convert the different scales
  - → $(9/5\ x\ C) + 32$
  - → $5/9\ (F - 32)$
  - → $K = C + 273$
- 100 DEGREES----------212 DEGREES
- CENTIGRADE 100 FAHRENHEIT180
- O DEGREE----------32 DEGREES
- 100/180 = 5/9 C/F
- 180/100= 9/5 F/C

Every 5 degree increase in C scale there is 9 degrees rise in F scale

- 0 32
- 5 41
- 10 50
- 15 59

Storage of Pharmaceuticals

Freezer	Between -25oC and -10oC
Cold	Not exceeding 8°C
Refrigerator	Between 2°C and 8°C
Cool	Between 8°C and 15°C
Warm	Between 30°C and 40°C
Excessive heat	Above 40°C
Controlled room temperature	Between 20°C and 25°C

Normal body temperature is 37°C or 98.6°F

Types of thermometers

1. Laboratory thermometer
2. Clinical thermometer
   - → Oral thermometer
   - → Rectal thermometer
   - → Infrared emission detection (ired) ear thermometer measures heat radiated from the tympanic membrane without actually touching the membrane.
   - → Basal thermometer used to measure slight changes in body temperature because of hormonal changes which is useful in assessing optimal times for conception.
   - → Low reading thermometer used in measuring hypothermia which may involved body temperature of 35^{O}C or below. It registers temperature between 28.9^{O}C to 42.2^{O}C

PROOF STRENGTH

- Proof spirit – is an aqueous solution containing 50% of absolute alcohol
- Proof strength of alcohol is expressed by taking 50% alcohol or proof spirit as 100 proofs. Hence

  % strength x 2 = proof strength proof strength

$$\frac{Proof\ strength}{2} = \%\ strength$$

- Proof gallon is 1 wine gallon of proof spirit.

Calculation of the proof gallon

$$proof\ gallon = \frac{wine\ gallon\ x\ \%\ strength}{50\%}$$

$$proof\ gallon = \frac{wine\ gallon\ x\ proof\ strength}{100\ proof}$$

Calculation of the wine gallon

$$Wine\ gallon = \frac{proof\ gallon\ x\ 50\%\ strength}{\%\ strength}$$

$$Wine\ gallon = \frac{proof\ gallon\ x\ 100\ proof}{proof\ strength}$$

ENTERAL NUTRITION

- It is a method of providing nutritional support via nasogastric tubes or tubes may be inserted through surgical openings into the stomach, duodenum or jejunum.
- It finds its application in patients who have an inability or decreased ability to ingest nutrients by mouth.
- takes into account a patient's caloric requirements and
  - his needs for
    - → protein,
    - → carbohydrates,
    - → fat,
    - → vitamins and minerals,
    - → dietary fiber,
    - → electrolytes and
    - → fluids.

PARENTERAL NUTRITION

- Parenteral nutrition (PN) or intravenous hyperalimentation IVH is the feeding of a patient by the intravenous infusion of fluids and basic nutrients.
- Partial parenteral nutrition PPN is nutritional support that supplements oral intake and provides only part of the daily nutritional requirements
- Total parenteral nutrition TPN provides all the patient's daily nutritional requirements.
- Parenteral nutrition formulas contain the following:
  - → macronutrients
    - ▪ carbohydrates
    - ▪ protein
    - ▪ fat
  - → micronutrients
    - ▪ electrolytes
    - ▪ vitamins
    - ▪ trace elements
  - → sterile water for injection

Nutrition requirements

- Fluid requirements
  - → 30 ml/kg of body weight
  - → 1500per square meter of body surface area 1 ml/kcal of nutrition required
  - → Are among the methods used to estimate a patient's daily fluid or water
- Carbohydrates requirements – primary source of cellular energy
  - → For parenteral nutrition, dextrose provides 3.4 kcal per g,
  - → For enteral nutrition, the factor used is 4 kcal per g.
- Protein requirements – build tissues and body strength
  - → Infants – 2 to 3 g/kg/day,
  - → Children – 1.5 to 2 g/kg/day
  - → Teenagers- 1 to 1.5 g/kg/day
  - → Adults – 0.8 g/kg/day

- Lipid requirements – used to provide energy when the body cannot obtain all the necessary energy requirement from carbohydrates.
- 9 kcal of energy per g

BODY MASS INDEX

BMI is accepted as the clinical standard for judging excessive weight and obesity. It is defined as the body weight in kilograms divided by the square of height measured in meters.

$$BMI = \frac{Wt\ (Kg)}{Ht\ (m^2)}$$

Alternative formula:

$$BMI = \frac{weight\ (lb)}{height\ (in)^2}\ x\ 704.5$$

704.5 factor is derived by dividing the square of 39.37 (in/m) by 2.2 (lb/kg)

BMI Interpretation

- Individuals with a BMI
  - → Less than 18.5 may be considered underweight
  - → Between 18.5 and 24.9 may be considered weight – normal
  - → Between 25 and 29.9 are considered overweight
  - → 30 and above are considered obese
  - → Over 40 are considered extremely obese
- Waist circumference of more than 40 inches in men and more than 35 inches in women indicates an increased risk of obesity related diseases in persons who have a BMI of 25 to 35.

Strategies for treating overweight and obese patients

- → dietary therapy
- → physical activity
- → behavioral therapy
- → pharmacotherapy
- → weight loss surgery

IDEAL BODY WEIGHT

- For males
  - → IBW = 50 kg + 2.3 kg for each of patient's height over 5 ft
  - → IBW = 110 lb + 5 lb for each inch over 5 ft
- For females
  - → IBW = 45.5 kg +2.3 for each inch of patient's height over 5 ft
  - → IBW = 100 lb + 5 lb for each inch over 5 ft

NUTRITION LABELS

Daily reference values DRVS for the energy producing nutrients

- total fat based on 20-35 % of calories
- saturated fat based on less than 10% of calories
- carbohydrate based on 45-65 % of calories
- protein based on 10-35 % of calories
- fiber based on 11.5 g of fiber per 1000 calories

Upper limit for the maintenance of good health

- total fat – less than 65 g
- saturated fat – less than 20 g
- cholesterol – less than 300 mg
- sodium less than 2300 mg (person with HPN, less than 1500 mg)

Free foods

- calorie free – fewer than 5 calories per serving
- sugar free – less than 0.5 g of sugar per serving
- fat free – less than 0.5 g of fat per serving
- sodium free – less than 5 mg of sodium per serving
- cholesterol free – less than 2 mg of cholesterol per serving and 2 g or less of saturated fat per serving

Low foods

- low calorie – 40 calories or less per serving
- low sodium -140 mg or less per serving
- very low sodium – 35 mg or less per serving
- low fat – 3 g of fat or less per serving
- low saturated fat- 1 g of fat or less per serving
- low cholesterol – 20 mg of cholesterol or less and 2 g or less of saturated fat per serving.

DRUG ACQUISITION COSTS

- Pharmacists purchase prescription and non-prescription drugs and other merchandise from:
  - → Wholesalers
  - → Distributors and
  - → manufacturers
- A pharmacy's actual acquisition cost for a given product is the trade price OR the basic list price to the pharmacy, less all discounts that are applied.
- Discounts provided by suppliers may be based on quantity buying and or payment of invoices within a specified period.
- In addition, discounts may be available for certain seasonal or other promotional products, bonuses in terms of free merchandise, and advertising and display allowances.

- These discounts provide the pharmacy with a means of increasing the gross profit on selected merchandise.

Mark up

- The term markup is used interchangeably with the term margin of profit or gross profit. It refers to the difference between the cost of merchandise and its selling price.

Calculation of prescription pricing methods

- markup percentage
- markup percentage plus a minimum professional fee
- professional fee

COMPUTATION OF THE MARK UP, SELLING PRICE, DISCOUNTS AND GROSS PRICE

For prepared drug

→ List price x % discount = discount
→ list price – discount = net cost
→ List price x % mark up = mark up
→ list price + mark up = selling price

For compounding drug

→ List price + markup + professional fee = selling price