2010 educational expo

Calculations Review
Saturday - January 23, 2010
3:15pm - 4:45pm

Speakers: Anh Nguyen, PharmD, is a 2009 graduate of the Ernest Mario School of Pharmacy at Rutgers University in New Jersey. She is currently completing a PGY1 Community Pharmacy Practice Residency at Main at Locust Pharmacy Clinic and Medical Supplies in Davenport, Iowa. Her interests include talking to and building relationships with patients in order to manage their chronic disease states, conducting medication therapy management sessions, and providing immunizations. She also enjoys looking for new opportunities to increase the profitability of the pharmacy clinic. Her residency project is to implement a colorectal cancer screening service in her community pharmacy and measure the public health impact of the service. Upon completion of her training, she plans to bring her experiences back to New Jersey to start a pharmacy clinic of her own and work collaboratively with physicians to optimize the chronic management of mutual patients.

Catherine Pearce, PharmD, is a 2009 graduate of the University of Wisconsin. She is currently completing a PGY-1 Community Pharmacy Practice Residency through the University of Iowa at Osterhaus Pharmacy in Maquoketa, Iowa. Her interests include caring for patients through medication therapy management sessions and improving patient safety and pharmacy productivity with continuous quality improvement efforts. Her residency project is to evaluate the need for community pharmacist conducted medication reconciliation following discharge from an inpatient setting. Upon completion of her training, she plans to pursue independent pharmacy ownership in the Midwest.

Brittany Vander Pol, PharmD, is a 2009 graduate of South Dakota State University in Brookings, South Dakota. She is currently completing a PGY-1 at the Siouxland Medical Education Foundation in Sioux City, Iowa where she splits her time between a family practice clinic and St. Luke's Regional Medical Center. Her residency project is determining the impact of pharmacists on patient achievement of their goal LDL level. Upon completion of her training, she plans to continue gaining experience through working and hopes to someday pursue a clinical faculty position with patient care and teaching responsibilities.

NAPLEX: Calculations Review

Pre-Assessment Questions:

1. If 500 mL of ferric chloride solution weighs 650 g, what is its specific gravity?

2. Concentrations may be expressed in “parts”, or ratio strength, when the active ingredient is highly diluted. What weight of triamcinolone should be used in compounding 45 g of a cream containing triamcinolone at a concentration of 1:2500?

3. What is the molarity concentration of a 0.9% (w/v) sodium chloride solution (GMW=58.5)? Remember molarity expresses the number of moles per liter.

4. How many mL of 95% (v/v) alcohol and how much water should be used in compounding the following prescription?

Rx	Boric Acid	1.0 g
	Alcohol 70%	30.0 mL
	Sig. Ear drops	

5. What weight of a 10% (w/w) colchicine trituration is required to prepare 30 doses of 0.25mg each of colchicine?

6. What is the pH of a buffer solution prepared with 0.05 M sodium borate and 0.005 M boric acid? The pKa value of boric acid is 9.24 at 25°C.
(Hint: pH = pKa + log(salt/acid):This equation is not given on the NAPLEX)

Pre-Assessment Answers:

1. Specific gravity = Density of Substance (g/mL) / Density of H_2O (1g/mL)
   X = (650 g/500 mL) / (1g/mL) = **1.300**
   Good to remember: When density is measured as g/mL, it is equivalent to the Specific Gravity except specific gravity is reported without units.

2. Set up a proportion: X g/ 45 g = 1 g/ 2500 g
   X = **0.018 g triamcinolone**

3. 0.9% (w/v) is equal to 0.9 g NaCl /100 mL solution
   Covert grams to moles: 0.9 g x 1 mole / 58.5 g = 0.015 moles
   Molarity = moles/1000mL
   0.015 moles NaCl / 100mL solution = X moles NaCl / 1000 mL solution
   X = 0.15 moles NaCl in 1000 mL solution, thus the **molarity = 0.15**

4. You can set up an inverse proportion to solve this dilution:

   $\frac{95\%}{70\%} = \frac{30\text{ mL}}{X\text{ mL}}$ $\quad X = 22$ mL
   So, use **22 mL of 95% (v/v) alcohol and enough water to make 30 mL**.

5. 10 mg of mixture = 1mg drug (colchicine)

   $\frac{X\text{ mg of trituration}}{10\text{ mg of trituration}} = \frac{(30 \times 0.25\text{ mg}) \text{ colchicine}}{1\text{ mg colchicine}}$

   X = 10 x (30 x 0.25) = **75 mg of colchicine trituration**

6. pH = 9.24 + log(0.05/0.005)
   = 9.24 + log 10
   = 9.24 + 1
   = **10.24**

Calculations Review

Anh Nguyen, PharmD
Catherine Pearce, PharmD
Brittney Vander Pol, PhamD

Faculty Disclosure

- Anh Nguyen reports she has no actual or potential conflicts of interest associated with this presentation.
- Catherine Pearce reports she has no actual or potential conflicts of interest associated with this presentation.
- Brittney VanderPol reports she has no actual or potential conflicts of interest associated with this presentation.

NAPLEX Breakdown

- 185 questions
  - 150 are counted towards your score
  - 35 are being evaluated for future use
- Calculations fall under Area 2 of NAPLEX Competencies Statements (from the *NAPLEX Blueprint* at www.napb.net/)

  Area 2 - Assess Safe and Accurate Preparation and Dispensing of Medications (~35% of test)
  - 2.1.0 Demonstrate the ability to perform calculations required to compound, dispense, and administer medication.

Required Calculations

- 2.1.1:
  - Quantity of medication to be compounded or dispensed
  - Reduction and enlargement of formulation quantities
  - Quantity of ingredients needed to compound the proper amount of the preparation

Required Calculations

- 2.1.2 Nutritional needs and the caloric content of nutrient sources
- 2.1.3 Rate of drug administration
- 2.1.4 Drug concentrations, ratio strengths, and/or extent of ionization

From the Naplex Blueprint at www.nabp.net/

Tools Available

- Calculator
  - 5 Function Calculator on computer
    - + - * / Square root
  - You are not allowed to bring your own calculator so you do not have access to Log, Ln, e^x functions
  - Testing site may provide handheld calculator
- Whiteboard, marker
- Reference and/or equation sheets are NOT allowed

Overview

- Conversions
- Percentage Error
- Sensitivity Requirement
- Ratios/Proportions
- Specific Gravity/Density
- Concentrations
  - Percentage strength
  - Ratio strength
  - Milliequivalents
  - Millimoles
  - Milliosmoles
  - Miscellaneous
- Flow Rates
- Patient Dosing
  - IBW
  - BSA
  - Creatinine Clearance
- Dilutions
  - Alcohols
  - Acids
  - Triturations
  - Alligations
- Isotonicity
- Buffers
- TPN

Basics – Conversions

- Volume
  - 1 teaspoon = 5 mL
  - 1 tablespoon = 15 mL
  - 1 fl oz = 30 mL
  - 1 pint = 16 fl oz
  - 1 pint = 473 mL
  - 1 gallon = 3785 mL
- Length
  - 1 inch = 2.54 cm
  - 1 foot = 0.305 m
- Mass
  - 1 kilogram = 2.2 lbs
  - 1 ounce = 28.35 g
  - 1 pound = 454 g
  - 1 pound = 16 oz
  - 1 fluid ounce = 31.1 g
  - 1 grain = 64.9 mg
- Average adult
  - BSA = 1.73 m^2
  - Weight = 70 kg

Weights and Measures

- Common prefixes in the metric system
  - Kilo (k) = 10^3 = 1000
    - 1 Kg = 1000 gm
  - Deci (d) a 10^{th} or 10^{-1}
  - Centi (c) a hundredth or 10^{-2}
  - Milli (m) a thousandth or 10^{-3}
  - Micro (μ) a millionth or 10^{-6}

Temperature Conversion

- $^oC = (^oF-32) * 5/9$
- $^oF = (9/5*^oC) + 32$
- The ^oF temperature can estimated to be around twice $^oC + 20$
- ^oC temperature can be estimated to be about half $^oF - 10$
- Please remember that these are estimations and you should always estimate, compute, and check your conversion

Temperature Conversion

- Water boils at 100 ^oC and 212 ^oF
- Normal body temperature has been considered to be 37 ^oC and 98.6 ^oF
- Example: A child's temperature is reported to be 104 ^oF. Convert the temperature to Celsius.

$$C^o = (104-32) * 5/9$$

  - Answer: 40 ^oC

Sensitivity Requirement

- By regulation, the maximum percentage error must be less than or equal to 5% when weighing pharmaceutical components
- This limits the smallest quantity that can be weighed, or the minimum weighable quantity (MWQ)
- To determine the MWQ, the sensitivity of the balance must be known
- For a class A prescription balance, SR= 6 mg

  MWQ = (SR/ % error) * 100%

  % Error = (SR/ MWQ) * 100%

Sensitivity Requirement

- Example: A balance in your pharmacy has a sensitivity of 2 mg. What is the least amount of drug you can weigh using this balance with an accuracy of 5%?
- MWQ = (2 mg/ 5%) * 100%
- Answer: 40 mg

Ratios

- A relationship between two quantities
- Normally expressed as the quotient of one divided by the other
  - *The ratio of 7 to 4 is written 7:4 or 7/4.*
- When represented in fractions
  - 1st term is the numerator
  - 2nd term is the denominator
- When 2 ratios have the same value they are equivalent
  - 1:4 = 5:20 that is each has a value of 0.25 (in this case the numerators are 1 and 5 and the denominators are 4 and 20)
- Arithmetic Rules for fractions apply to ratios
  - if both numerator and denominator are multiplied by the same number the value of the ratio remains the same

Proportions

- Relationship between two ratios
- a : b = c : d is the same as $\frac{a}{b} = \frac{c}{d}$
- A proportion can be manipulated to find whichever variable is needed
- Important: you need to set up the proportion correctly
- To use the proportion - ratios must be equal to each other and must *remain constant*
- Dimensions must remain the same on both sides of the proportion
  - You must convert to the same units (mg ≠ g)

Ratio and Proportions

- Example:
  - If 200 mL of solution contains 150 mg of active drug, how much active drug is in 500 mL?
  - $\frac{150 \text{ mg}}{200 \text{ mL}} = \frac{x \text{ mg}}{500 \text{ mL}}$
  - (150 mg * 500 mL)/200 mL = 375 mg

Specific Gravity and Density

- Density is defined as mass per unit volume of a substance
  - Commonly expressed as g/mL
- Specific Gravity is a ratio of the density of a substance relative to the density of water
- Specific Gravity = $\frac{\text{Density of Substance}}{\text{Density of } H_2O}$
- Density of water = 1 g/mL; SG of water = 1
- Specific Gravity is unit-less

Specific Gravity: Pre-test Review

1. If 500 mL of ferric chloride solution weighs 650 g, what is its specific gravity?

   A) 0.769 g/mL
   B) 0.769
   C) 1.300 g/mL
   D) 1.300

- Good to remember: When density is measured as g/mL, it is equivalent to the Specific Gravity except specific gravity is reported without units.

Specific Gravity

- Example:

Glycerin Suppository Formula (to prepare 50)

Glycerin	72.8 mL
Sodium Sterate	9 g
H_2O	5 mL

Glycerin has a specific gravity of 1.25. How many grams of glycerin will be required to prepare 36 suppositories?

A) 65.5 g
B) 91 g
C) 262 g
D) 3,276 g

Concentrations

- Concentration is the measure of how much of a given substance there is mixed with another substance
- Frequently expressed using:
  - Percent strength
  - Ratio strength
  - Parts per million or parts per billion
  - Milliequivalents per liter
  - Molarity or molality
  - Milliosmolarity

Concentrations: Percent Strength

- Percent weight-in-volume = % (w/v)
  - Grams of ingredient in 100 mL of product
    - Assumed for solutions of solids in liquids
- Percent volume-in-volume = % (v/v)
  - Milliliters of ingredient in 100 mL of product
    - Assumed for solutions or mixtures of liquids
- Percent weight-in-weight = % (w/w)
  - Grams of ingredient in 100 grams of product
    - Assumed for mixtures of solids and semisolids

Concentrations: Percent Strength

- mg%
  - Mg of ingredient in 100 mL of product
    - The units of ingredient are changing but not the 100 mL of product
  - Equal to mg/dL
    - Think about it: 100 mL = 1 dL
  - mg/dL used for blood glucose values
    - Example: Goal blood sugar 2 hours post meal for people with diabetes is <140 mg/dL (per ACE Guidelines)

Concentrations: Percent Strength

- Example - % (w/v)
  - How much hydrocortisone powder is needed to make a 2.5% solution in 8 fl oz of lotion?
    - 8 fl oz = 8 oz * 30 mL/oz = 240 mL
    - 2.5 g/100 mL = x g/240 mL
    - (2.5 * 240)/100 = 6 g
    - Answer = 6 g

Concentrations: Percent Strength

- Example - % (v/v)
  - How much propylene glycol is added to normal saline to make 30 mL of a 2.5% solution?
    - 2.5 mL/100 mL = x mL/30 mL
    - (2.5 * 30)/100 = 0.75 mL
- Example - % (w/w)
  - How much triamcinolone powder is needed in 480 g of Cetaphil to make a 0.025% cream?
    - 0.025 g/100 g = x g/480 g
    - (480 * 0.025)/100 = 0.12 g

Concentration: Ratio Strength or Parts

- Commonly used when the active ingredient is highly diluted
  - Written as a ratio (example 1:2500)
- Parts per million (ppm) and parts per billion (ppb) are special cases of ratio strength
  - ppm – number of parts of ingredient per million parts of mixture or solution
    - (equal to x:1,000,000)
  - ppb – number of parts of ingredient per billion parts of mixture or solution
    - (equal to x:1,000,000,000)

Concentration: Ratio Strength or Parts

- Example – ppm to % strength
  - Express 5 ppm of iron in water in percent strength and ratio strength
    - 5 ppm = 5 parts in 1,000,000 parts
    - Ratio strength: 5: 1,000,000
    - 5/1,000,000 = x/100
    - x = 0.0005
    - Percent strength = 0.0005%

Concentration: Ratio Strength or Parts

- Example – ratio strength to % strength
  - Express 1:4000 as a percentage strength
    - 1 part/4000 parts = x/100
    - (1 * 100)/4000 = x
    - x = 0.025
    - Answer = 0.025%

Concentration: Ratio Strength or Parts

- Example – % strength to ratio strength
  - Express 0.02% as a ratio strength
    - 0.02/100 = 1 part/x parts
    - (100 * 1)/0.02 = x
    - x = 5000
    - Answer = 1:5000

Concentrations: Pre-test Review

2. What weight of triamcinolone should be used in compounding 45 g of a cream containing triamcinolone at a concentration of 1:2500?

A) 0.018 g triamcinolone

B) 11250 g triamcinolone

C) 180 mg triamcinolone

D) 0.01125 g triamcinolone

Concentrations: Understanding Milliequivalents

- Refers to the chemical activity of an electrolyte
- Milliequivalents (mEq) are often seen in situations involving TPN and electrolyte solutions
- As a concentration you will typically see the expression mEq/L

Concentrations: Understanding Milliequivalents

- Equivalent weight – the atomic weight divided by the absolute value of its valence
  - Eq weight = atomic weight / l valence l
  - Typically expressed as g/Eq
- Milliequivalent weight – one thousandth of an equivalent weight
  - 1 equivalent weight = 1000 milliequivalent weights
  - Typically expressed as mg/mEq

Concentrations: Understanding Milliequivalents

- Molecules
  - Equivalent weight is equal to the gram molecular weight (formula weight) divided by the total cation OR total anion charge
  - Nondissociating molecule (dextrose, tobramycin) – the equivalent weight is equal to the formula weight

Concentrations: Understanding Milliequivalents

- Example
  - A 250 mL bottle contains 5.86 g of KCl. How many mEq of KCl are present? (molecular weight of KCl is 74.5 g)
    - Eqivalent weight = 74.5 g/1 = 75.4 g/Eq
    - 75.4 g / 1 Eq = 5.86 g / x Eq
    - x = 0.078 Eq
    - 0.078 Eq * 1000 mEq/ Eq = 78 mEq

Concentrations: Understanding Milliequivalents

- Example
  - What is the concentration, in g/mL, of a solution containing 4 mEq of $CaCl_2$ per mL? (molecular weight of Ca = 40 and Cl_2 = 71)
    - Equivalent weight = 111 g/2 = 55.5 g/Eq
    - 55.5 g/Eq = 0.0555 g/mEq
    - 0.0555 g / 1 mEq = x g / 4 mEq
    - x = 0.222 g
    - 0.222 g/mL

Concentrations: Molarity

- Molarity - moles per liter (mol/L)
  - Remember: A mole is the amount of a substance equal to its formula weight in grams
- Millimolarity - millimoles per liter (mMol/L)
  - Remember: A millimole is the amount of a substance equal to its formula weight in milligrams

Concentrations: Molarity

- Example
  - What is the millimolar concentration of a solution consisting of 0.9 g of NaCl (molecular weight = 58.5 g/mole) in 100 mL of water?
    - 0.9 g in 100 mL = 9 g in 1 L
    - 58.5 g / 1 mole = 9 g / x mole
    - x = 0.154 mole
    - 0.154 mole = 154 mmol
    - 154 mmol/L

Concentrations: Molarity

- Example
  - What weight (mg) of $MgCl_2$, formula weight = 95.3, is required to prepare 350 mL of a 6.0 millimolar solution?
    - 6 mmol / 1 L = x mmol / 0.350 L
    - x mmol = 2.1
    - 2.1 mmol = 0.0021 mole
    - x g / 0.0021 mole = 95.3 g / 1 mole
    - x = 0.2 g
    - Answer = 200 mg

Molarity: Pre-test Review

3. What is the molarity concentration of a 0.9% (w/v) sodium chloride solution (GMW=58.5)?

A) 0.15 mol/kg

B) 0.15 mmol/L

C) 0.15 mol/L

D) 0.015 mol/L

Concentrations: Osmotic Expressions

- Osmotic concentration – a measure of the total number of PARTICLES in solution and is expressed in milliosmoles
  - MilliosmolaRITY – milliosmoles per liter of solution (mOsm/L)
  - MilliosmolaLITY – millliosmoles per kilogram of solution (mOsm/kg)

Concentrations: Osmotic Expressions

- Milliosmoles – based on the total number of cations and total number of anions
- The osmolarity of a solution is the SUM of the osmolarities of the SOLUTE components of the solution
- In the absence of other information – assume salts dissociate completely ("ideal" osmolarity)

Concentrations: Osmotic Expressions

- Example
  - What is the milliosmolarity for normal saline, knowing Na weighs 23 g, and Cl weighs 35.5 g, and normal saline is 0.9% (w/v)?
    - 0.9 % = 0.9 g NaCl/ 100 mL = 9g / 1 L
    - 58.5 g / 1 mole NaCl = 9 g / x mol NaCl
    - x mol = 0.154 mol
    - 0.154 mol = 154 mmol
    - NaCl dissociates into 2 ions
    - 154 mmol * 2 = 308 mOsmol
    - Answer = 308 mOsmol/L

Concentrations: Osmotic Expressions

- Example
  - How many milliosomoles are represented by 500 mL of a 3% hypertonic NaCl solution? (molecular weight of NaCl = 58.5)
    - 3% solution = 3 g / 100 mL
    - 3 g / 100 mL = 15 g / 500 mL
    - 15 g * 1 mol / 58.5 g = 0.256 mol
    - NaCl dissociates to 2 particles, therefore 0.256 mol = 0.512 osmols
    - 0.512 osmoles = 512 mOsmols
    - Answer = 512 mOsmols

Flow Rates

- Infusion flow rates are expressed as an amount or volume per unit time
- Physicians can specify the rate of flow of IV fluids in: mg/hr, drops/min, ml/min

Flow Rates

- Example 1: A KCl solution of 20 mEq/ 250ml is run over 4 hours. What is the flow rate in mEq/hr? What is the approximate flow rate in ml/min?
- Solution:

20 mEq/4 hours = 5 mEq/hr

$$\frac{5\text{mEq}}{\text{hr}} * \frac{1\text{hour}}{60\text{min}} * \frac{250\text{mL}}{20\text{mEq}} = \mathbf{\sim 1mL/min}$$

Flow Rates

- Example 2: The infusion rate for IV insulin is 0.1 units/kg/hr. If the insulin is prepared in 250 ml normal saline at a concentration of 0.5 units/ml, what infusion rate (ml/hr) should be set for a 270 lb patient?
- Solution

$$270\text{ lb} * \frac{1\text{ kg}}{2.2\text{ lb}} * \frac{0.1\text{ units}}{\text{kg/hr}} * \frac{1\text{ mL}}{0.5\text{ units}} = \mathbf{24.5\ mL/hr}$$

Patient Dosing

- There are a variety of ways to dose
- Body weight
  - Actual body weight
  - Ideal body weight (in kg)
    - IBW men = 50 + (2.3 * inches above 60 in)
    - IBW women = 45.5 + (2.3 * inches above 60 in)

Patient Dosing

- Body Surface Area (BSA)
  - BSA units: square meters (m^2)
  - (Height = cm, Weight = kg)

$$\sqrt{(H * W)/3600}$$

(the square root of height * weight/3600)

  - The average BSA of an Adult = 1.73 m^2
  - Pediatric dose calculation based on body surface area:

Approximate Peds Dose = adult dose mg * (Child's BSA m^2)/ 1.73 m^2

Dosing Example: IBW

- The adult daily dosage for tobramcyin in adults with normal renal function is 3 mg/kg IBW given in 3 divided doses. What would each injection be for a male patient weighing 185 lb and 5 ft 9 in tall?
  - IBW = 50 + (9 * 2.3) = 70.7 kg
  - Dose = 3 mg/kg * 70.7 kg = 212 mg
  - Divided by 3 doses: **~70 mg/dose**

Dosing Example: BSA

- For the recovery of chemotherapy for acute myelocytic leukemia, sargramostim is prescribed. Its dose is 250 mcg/m^2/day IV infused over 4 hours. What is the dose in mcg/day for a patient who is 6'1" tall and weighs 178 lbs?
  - 178 lbs * 1 kg/2.2 lbs = 80.9 kg
  - 73 inches * 2.54 cm/1 inch = 185.4 cm
  - $\sqrt{(184.5 * 80.9)/3600}$ = 2.04 m^2
  - 250 mcg/m^2/day * 2.04 m^2 = **510 mcg/day**

Creatinine Clearance

- CrCl may be calculated for a patient using the Cockcroft Gault equation:
- For males: $\frac{[(140\text{-age}) * (\text{ideal body weight in kg})]}{(72 * \text{SrCr in mg/dL})}$
- For females: 0.85 * CrCl for males

Creatinine Clearance

- Example
  - What is the CrCl for a 76 y/o female patient who weighs 65 kg, and has a serum creatinine level of 1.3 mg/dl?
    - CrCl = $\frac{[(140\text{-age}) * (\text{ideal body weight in kg})]}{(72 * \text{SrCr in mg/dL})}$ * 0.85
    - CrCl= [(140-76)(65)/(72 * 1.3)] (0.85)
    - CrCl= 38 ml/min

Dilutions/Concentrations

- **To Dilute:** means to *diminish* the strength of a preparation by *adding* solvent
- **To Concentrate:** means to *increase* the strength of a preparation by *reducing* the solvent
- Inverse proportionality used:
  - Concentration1 * Quantity1 = C2 * Q2
  - C1/C2 = Q2/Q1 OR $\frac{C1}{C2} = \frac{Q2}{Q1}$

Simple Dilutions

- Example 1: How many grams of 5% hydrocortisone ointment is diluted with white petrolatum to prepare 2 lbs of 2% ointment?
- Convert lbs to grams
  - 2 lb * $\frac{454\ g}{lb}$ = 908 g of 2% ointment
- So before you set up your problem, think about it logically. Would you need MORE than 908 g of 5% ointment or LESS than 908 g of 5% ointment to make 908 g of 2% ointment?

Simple Dilutions

- Example 1, continued:
  - How many grams of 5% hydrocortisone ointment is diluted with white petrolatum to prepare 2 lbs (908 g) of 2% ointment?
- Set up the inverse proportionality:
  - C1 * Q1 = C2 * Q2
  (concentrated) → (dilute)
  - 5% * Q1 = 2% * 908 g
  - Q1 = $\frac{(2*908)}{5}$ = **363.2 g of 5% hydrocortisone**

Simple Dilutions

- Example 1, continued:
  - How many grams of 5% hydrocortisone ointment is diluted with white petrolatum to prepare 2 lbs (908 g) of 2% ointment?
  - **363.2 g of 5% hydrocortisone** is needed to compound this Rx
- How many grams of white petrolatum would you need?
  - Amount of Diluent needed = Q2-Q1
  - 908 g – 363.2 g = **544.8 g of white petrolatum**

Simple Dilutions

- Example 2: How much water should be added to 250 mL of a solution of 0.20% (w/v) benzalkonium chloride to make a 0.050% (w/v) solution?

  A) 1,000 mL
  B) 750 mL
  C) 500 mL
  D) 250 mL

Simple Dilutions

- The previous problems are examples of simple dilutions
- This is because you can assume that solute and solvent volumes are reasonably additive.

Concentration

- Example: A 250 mL volume of sucrose syrup 65% (w/v) was evaporated to 200 mL. What is its concentration now?
  - C1 * Q1 = C2 * Q2
  (dilute) → (concentrated)
  - 65% * 250 mL = C2 * 200 mL
  - 16,250 mL% = 200 mL * C2
  - C2 = 81.25%

Dilutions: Pre-test Review

4. How many mL of 95% (v/v) alcohol and how much water should be used in compounding the following prescription?

   Rx: Boric Acid 1.0 g
   Alcohol 70% 30.0 mL
   Sig. Ear drops

- Set up your inverse proportionality

Dilutions: Pre-test Review

4. How many mL of 95% (v/v) alcohol and how much water should be used in compounding the following prescription?
   - C1 * Q1 = C2 * Q2
   (concentrated) → (dilute)
   - 95% * Q1= 70% * 30 mL
   - Q1 = $\frac{(70*30)}{95}$ = **22 mL of 95% alcohol**

- **QS with enough water to make 30 mL**
  - You do not use 8 mL of water. Why?

Dilutions: Alcohols

- For dilutions of concentrated ethyl alcohol (ethanol) in water, a noticeable contraction in volume occurs upon mixing.
- The precise volume of water to be added cannot be calculated as Q2-Q1.
- You have to calculate the final volume (Q2) and specify that sufficient water be added to reach the final volume of the diluted alcohol solution.

Dilutions: Alcohols

- Example: How much water should be added to 100 mL of 95% (v/v) ethanol to make 50% (v/v) ethanol?

  A) 190 mL
  B) QS to 190mL
  C) 100 mL
  D) 90 mL

Dilution: Acids

- Example 2: How many mL of 85% (w/w) phosphoric acid having a specific gravity of 1.71 should be used in preparing 1 gallon of 0.25% (w/v) phosphoric acid solution to be used for bladder irrigation?

  A) 6.5 mL of 85% phosphoric acid
  B) 4.7 mL of 85% phosphoric acid
  C) 0.016 mL of 85% phosphoric acid
  D) 8.2 mL of 85% phosphoric acid

Dilutions: Acids

- Concentrated acids are manufactured by bubbling the pure acid gas into water to make a saturated solution
- Concentration of acids is listed as % (w/w) and need to be converted to % (w/v) using the specific gravity when diluting
- Specific Gravity = $\frac{\text{Density of Substance (g/mL)}}{\text{Density of } H_2O \text{ (g/mL)}}$

Dilutions: Acids

- Example 1: What volume of 35% (w/w) concentrated HCl, specific gravity 1.20, is required to make 500 ml of 5% (w/v)?
- **Steps for Solving:**
  1. Determine the weight of HCl required for the dilute solution
     - 5 g/100 ml * 500 ml = 25 g of HCl needed
  2. Determine how many grams of the concentrated HCl is needed to get 25 g of HCl
     - C1 * Q1 = C2 * Q2
     - 35 g * Q1 = 25 g * 100 g
     - Q1 = 71.4 g of concentrated solution needed
  3. Use the specific gravity to find the volume of concentrated HCl solution needed
     - Specific gravity of 1.2 = Density of HCl (g/ml)/Density of water (g/ml)
     - 1.2 = density of HCl/ 1g/ml of water
     - Density of HCl = 1.2 g/ml
     - 71.4 g * (1 ml/1.4 g) = **59.5 ml of concentrated HCl needed**

Dilutions: Triturations

- Triturations (used as a noun) are dilutions of potent medicinal substances
  - NOTE: This is different from trituration (used as a verb), which is the process of reducing substances to fine particles through grinding in a mortar and pestle
- They are used when amounts needed are smaller than a reasonable measured quantity
- Often defined as a 10% (w/w) finely powdered mixture of a drug in an inert substance

Triturations: Pre-test Review

5. What weight of a 10% (w/w) colchicine trituration is required to prepare 30 doses of 0.25 mg each of colchicine?

A) 0.75 mg
B) 7.5 mg
C) 75 mg
D) 750 mg

Dilutions: Alligations

- **Alligation Medial Method:** used to find the final concentration of a solution obtained by mixing specified quantities of two or more stock solutions
- **Alligation Alternate Method**: used to find the strength of a mixture which lies between a weaker and a stronger concentration of that medication

Dilutions: Alligation Medial

- Example 1:
  - What is the final concentration obtained by mixing 200 ml of 20% dextrose with 100 ml of 5% dextrose
    - 20 g/100 ml * 200 ml = 40 g
      5 g/100 ml * 100 ml = 5 g
      Totals: 300 ml 45 g
    - 45 g/300 ml = 0.15 g/mL * 100% = **15% dextrose**

Dilutions: Alligation Medial

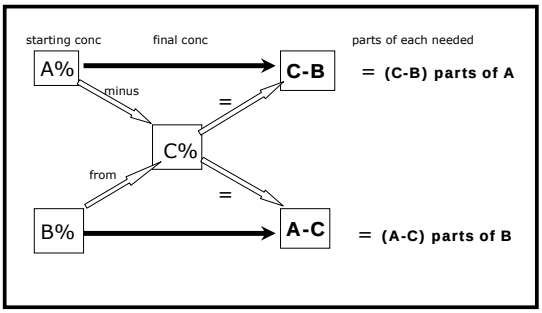
- Example 2: What is the concentration of a solution prepared by combining 100 mL of a 10% solution, 200 mL of a 20% solution, and 300 mL of a 30% solution?

A) 0.0233%
B) 0.233%
C) 2.33%
D) 23.3%

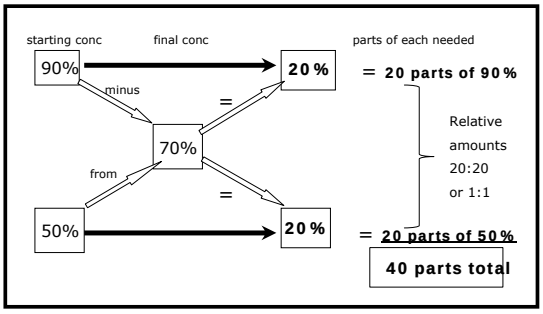
Dilutions: Alligation Alternate

- Example 1: What proportions of a 90% solution and a 50% solution should be mixed to make a 70% solution?
- The problem can be represented in the following fashion:

Alligation Alternate:



Alligation Alternate: What proportions of a 90% solution & a 50% solution should be mixed to make a 70% solution?



Dilutions: Alligation Alternate

- Example 2: What volume of water should be mixed with 70% dextrose solution to prepare 700 ml of a 25% dextrose solution?

  A) 45 mL of water
  B) 450 mL of water
  C) 70 mL of water
  D) 700 mL of water

Isotonicity

- Many solutions prepared in pharmacy require attention to osmotic pressure
- A solution that has the same osmotic pressure as bodily fluids is iso-osmotic and isotonic
- 0.9% NaCl is isotonic

Isotonicity: Sodium Chloride Equivalents

- **Sodium chloride equivalent** is the number of grams of sodium chloride that would produce the same tonicity effect as 1 gm of the drug
- Used when preparing isotonic solutions to account for the tonicity contribution of the drug
- Can be calculated using the molecular weights and dissociation factors of sodium chloride and the drug in question
  *Sodium chloride equivalents are usually given

Isotonicity: Sodium Chloride Equivalents

- Sodium chloride equivalent (E) =
  [(MW of NaCl) * (drug dissociation factor)]
  [(MW of drug) * (NaCl dissociation factor)]
  - **Simplified: [58.5(i)] / [(MW of drug)(1.8)]**
  - Example: What is the sodium chloride equivalent of demecarium bromide (MW=717, i=2.6)
    - Sodium chloride equivalent = (58.5 * 2.6)/(717 * 1.8)
    - Answer = 0.12
    - **Each gram of demecarium bromide is equivalent to 0.12 g of NaCl**

Isotonicity: Sodium Chloride Equivalents

- To make an isotonic drug solution :

1. Calculate the weight of NaCl (alone) required to make the total volume of isotonic solution ***(x)***
2. Using the weight of drug to be incorporated in the solution and its sodium chloride equivalent, calculate the weight of NaCl that would correspond to the weight of the drug ***(y)***
3. Subtract ***(x-y)*** to find the weight of additional NaCl needed to be added to make the solution isotonic.

Isotonicity: Sodium Chloride Equivalents

- Example1: A new drug, Utopical, MW 175 and dissociation factor i = 3.4, is to be provided as 325 mg in 60 mL of solution made isotonic with sodium chloride. What is the required weight of sodium chloride?

- E = [58.5(i)] / [(MW of drug)(1.8)]
- E = (58.5 * 3.4) / (175 * 1.8) = 0.63
- 0.9 g/100 mL * 60 mL = 0.54 g (or 540 mg) total NaCl needed to make isotonic
- 325 mg x 0.63 = 204.75 mg of NaCl represented by Utopical
- 540 mg – 205 mg = 335 mg of NaCl needed to make isotonic

Isotonicity: Sodium Chloride Equivalents

- Example 2: What weight of sodium chloride should be used in compounding the following prescription for ephedrine sulfate (MW 429, i=2.6, sodium chloride equivalent = 0.23)?

  Rx: Ephedrine sulfate 0.25 g
  Sodium chloride qs
  Purified water ad 30 mL
  Make isotonic solution

  A) 1.22 g
  B) 784 mcg
  C) 213 mg
  D) 527 mcg

Buffers

- Solutions used to reduce pH fluctuations associated with the introduction of small amounts of strong acids or bases
- Maintain solution pH at a relatively constant level
- Composed of a weak acid or weak base plus a salt of the acid or base
- Henderson-Hasselbalch equation is used to calculate the solution pH when a buffer is used

Buffers

• Henderson-Hasselbalch Equation or the buffer equation:

$$pH = pK + \log\frac{[A^-]}{[HA]} = pK + \log\frac{[\text{conjugate base}]}{[\text{conjugate acid}]}$$

Remember this equation!

Buffers

- This buffer equation is useful for:
  - Calculating the pH of a buffer system if its composition is known
  - Calculating the molar ratio of the components of a buffer system required to give a solution of a desired pH
  - Calculate the change in pH of a buffered solution with the addition of a given amount of acid or base

Buffers

- Remember there is no log function on the calculator used for NAPLEX
- Helpful to memorize:
  - Log 1 = 0
  - Log 10 = 1
  - Log 100 = 2

  - Log 1/10 = -1
  - Log 1/100 = -2

Percent Ionization of weak acids

- Weak acid (different ways to write it)
  - pH = pKa + log [SALT] / [ACID]
  - pH = pKa + log [H+] + [A-] / [HA]
  - pH - pKa = log [B-] / [HB]
  - pH - pKa = log [ionized] / [unionized]
- As pH increases, ionization increases
- A weak acid is more ionized when its pH is above its pKa

Drugs that are Acids

Acid	Salt/Conjugate Base
Phenobarbital	Sodium Phenobarbital
Naproxyn	Sodium Naproxyn
Fenoprofen	Fenoprofen Calcium
Penicillin G	Penicillin G Potassium

Percent Ionization of weak bases

- Weak base (different ways to write it)
  - pH = pKa + log [B] / [HB+]
  - pH = pKa + log [unionized] / [ionized]
  - pH - pKa = log [B] / [HB+]
  - pH - pKa = log [unionized] / [ionized]
- As pH increases, ionization decreases
- A weak base will be more ionized when pH is below its pKa

Drugs that are Bases

Base	Salt/Conjugate Acid
Diphenhydramine	Diphenhydramine HCL
Glucosamine	Glucosamine sulfate
Epinephrine	Epinephrine sulfate
Ephedrine	Ephedrine HCl
Atropine	Atropine sulfate
Tetracycline	Tetracycline HCl

Buffers: Pre-test Review

6. What is the pH of a buffer solution prepared with 0.08 M sodium borate and 0.008 M boric acid ? Boric acid pKa is 9.24.
   A) 9.3
   B) 10.24
   C) 19.3
   D) 19.24

HINT: pH = pKa + log (salt/acid)

Buffers

- Example: Codeine Sulfate has a pKa=7. When the drug is present in the intestines (pH=5), what is the ratio of ionized to unionized molecules?
  - Weak base
  - pH - pKa = log [unionized] / [ionized]
  - 5-7 = log [unionized] / [ionized]
  - -2 = log [unionized] / [ionized]
  - Antilog (-2) = unionized/ionized
  - (Remember: Log 1/100 = -2)
  - Unionized/ionized=1/100; (unionized=1 ionized=100)
  - Answer - 100:1 (ratio of ionized to unionized)

TPN

- Caloric content of nutrients
  - Glucose = 3.4 kcal/g (hydrated in solution)
    - obtained from dextrose
  - Protein = 4 kcal/g
    - obtained from amino acid solution
  - Fat = 9 kcal/g
    - When fat is obtained from fat emulsions, some calories come from phospholipids and glycerol
    - Given as a 3:1 product or separately
    - 10% provides 1.1 kcal/mL
    - 20% provides 2 kcal/ml

TPN

- The following was ordered for an NPO patient. What is the total daily caloric intake?
  - D20W and amino acids 5% at 105 ml/hr (2520 ml/d) and IV fat emulsion 20% at 10 ml/hr for 24 hours
    - 20% * 2520 ml=504 g dextrose * 3.4 kcal/g= 1714 kcal
    - 5% * 2520 ml=126 g amino acids * 4 kcal/g= 504 kcal
    - 20% fat has 2 kcal/ml * 240 ml= 480 kcal fat
    - 1714 kcal + 504 kcal + 480 kcal= 2698 kcal

Other Calculations

- Tapering: how many tablets are needed for this prescription?
- Prednisone 10 mg
  - Sig: Take 40 mg daily x 4 days, then 30 mg daily for 4 days, then 20 mg daily for 4 days, then 10 mg daily for 4 days, then 5 mg daily for 4 days, then stop
  - (4*4) + (3*4) + (2*4) + (1*4) + (0.5*4) =
  - 16 + 12 + 8 + 4 + 2 = 42 tablets
  - (40*4) + (30*4) + (20*4) + (10*4) + (5*4) = 420 mg/10 mg tab = 42 tablets

Other Calculations

- Titration: how many capsules are needed for this prescription?
- Dilantin 100 mg Sig; take 100 mg Q HS x 5 days, increase by 100 mg every 5 days until taking 200 mg BID. #QS for 1 month
  - (1*5) + (2*5) + (3*5) + (4*15) =
  - 5 + 10 + 15 + 60 = 90 capsules
  - (100*5) + (200*5) + (300*5) + (400*15) =
  - 500 + 1000 + 1500 + 6000 = 9,000/100 = 90 capsules

Study Suggestions

- Start studying early enough to feel comfortable with the material:
  - Other than generic and trade names, pharmacy math is one of the most important areas to review, so give yourself enough time.
- Review your weakest areas, but remember the breakdown of the test's content
- Use your references:
  - Pharmacy Calculations book, APhA Review Book, calculations provided during review sessions

Testing Suggestions

- Take your time
- Read the question carefully and understand what they are asking
- Use your white board
- Remember when you've found your answer, plug it into the original problem: Double Check your answer!
  - You WILL have enough time for this
- Good Luck!

Study Tools

- APhA's Complete Review for Pharmacy, 7th edition now available
- Ansel HC, Stoklosa MJ. Phamaceutical Calculations, 11th ed. Lippincott Williams and Wilkens 2001: Philadelphia.
- Pre-Naplex – practice exam, available at www.napb.net/
- Kaplan NAPLEX Review: The Complete Guide to Licensing Exam Certification for Pharmacists

Post-Assessment Questions

1. If 50 glycerin suppositories are made from the following formula, how many milliliters of glycerin, having a specific gravity of 1.25, would be used in the preparation of 96 suppositories?

Glycerin	91 g
Sodium Stearate	9 g
Purified Water	5 g

A) 120 g
B) 140 g
C) 175 g
D) 218 g

Post-Assessment Questions

1. 91 g/50 supp = 1.82 g/supp * 96 supp = 174.72 g of glycerin needed.
   SG = 1.25 so Density = 1.25 g/mL
   Set up the proportion:
   174.72 g / x mL = 1.25 g/1 mL

Post-Assessment Questions

2. A solution has a ratio strength of 1:4300 (v/v). What is the concentration of the solution expressed as % (v/v)?

A) 0.023%(v/v)

B) 0.23% (v/v)

C) 2.3% (v/v)

D) 2.3 mL / 100mL

Post-Assessment Questions

2. A solution has a ratio strength of 1:4300 (v/v). What is the concentration of the solution expressed as % (v/v)?

- Remember % (v/v) represents the number of mL active ingredient in 100 mL of solution
- Set up a proportion:
  1 mL/4300mL = x mL/100 mL

Post-Assessment Questions

3. What weight of $MgSO^4$ (GMW = 120), is required to prepare 1 liter of a solution that is 25 mEq/L in Mg^{2+}?

A) 3000 mg MgSO4

B) 1500 mg MgSO4

C) 1000 mg MgSO4

D) 750 mg MgSO4

Post-Assessment Questions

3. What weight of $MgSO^4$ (GMW = 120), is required to prepare 1 liter of a solution that is 25 mEq/L in Mg^{2+}?

- You need 25mEq of $MgSO^4$ to obtain 25mEq Mg^{2+}
- Valence of Mg is 2^+ so the equivalent wt is 120/2
- Simply put: 1 Eq $MgSO^4$ = 60 g $MgSO^4$
  or 1 mEq $MgSO^4$ = 60 mg
- Set up a proportion: 60 mg/1 mEq = Xmg/25mEq

Post-Assessment Questions

4. How many grams of 1% hydrocortisone cream must be mixed with 0.5% hydrocortisone cream if the pharmacist wishes to prepare 60 g of a 0.8% (w/w) preparation?

A) 6 g
B) 12 g
C) 24 g
D) 36 g

Post-Assessment Questions

4. This question can be answered by the alligation alternate method:

1% 0.3 parts of 1% solution

0.8 %

0.5% 0.2 parts of 0.5% solution

0.3 parts / 0.5 parts total = x / 60 g

Post-Assessment Questions

5. What weight of sodium chloride would be required to prepare 50 mL of an isotonic solution containing 500 mg of pilocarpine nitrate (sodium chloride equivalent = 0.23)?

A) 44.89 mg
B) 44.89 g
C) 335 mg
D) 335 g

Post-Assessment Questions

5. Isotonic saline requires 0.9 g/100 mL, so 50 mL of isotonic saline will require 0.45 g (450 mg).

The 500 mg of pilocarpine nitrate will correspond to (500 mg * 0.23 = 115 mg of NaCl)

Subtract the two to find the sodium chloride needed to make the solution isotonic

Post-Assessment Questions

6. What molar ratio (ratio of ionized to unionized molecules) of salt/acid is required to prepare a sodium acetate-acetic acid buffer solution with a pH of 5.76? The pKa value of acetic acid is 4.76 at 25°C. HINT:pH – pKa = log (salt/acid)

A) 1:10
B) 1:100
C) 10:1
D) 100:1

Post-Assessment Questions

6. What molar ratio (ratio of ionized to unionized molecules) of salt/acid is required to prepare a sodium acetate-acetic acid buffer solution with a pH of 5.76? The pKa value of acetic acid is 4.76 at 25°C.

- pH – pKa = log (salt/acid)

Or pH - pKa = log [ionized] / [unionized]

- 5.76 – 4.76 = log (salt/acid)
- 1 = log (salt/acid)
- Antilog of 1 = salt/acid
- 10 = salt/acid or ionized/unionized
- The answer makes sense because a weak acid is more ionized when its pH is above its pKa.

More Problems

1. How many grams of 5% Hydrocortisone cream should be mixed with 100 g of 1% Hydrocortisone cream to make a 2.5 % cream?

2. How many milliosmoles of calcium chloride (mol. wt. 147) are represented in 147 ml of a 10% w/v calcium chloride solution?

More Problems

3. 90 ml of distilled water is usually added to constitute a Cefaclor powder of 150 ml size to yield 250 mg/ml. The normal dose for therapy in children with this antibiotic is 20 mg/kg/day. The Cefaclor was mistakenly prepared with 100 ml. What volume of solution will deliver 250 mg?

More Problems

4. What is the ratio strength of drug with a concentration of 4 mg/ml?

5.

Atropine Sulfate	1/200 gr
Codeine phosphate	¼ gr
Aspirin	5 gr
d.t.d.	#24 capsules
Sig:	1 capsule p.r.n.

The atropine sulfate is only available in the form of 1/150 gr tablets. How many atropine sulfate tablets would you use to compound the prescription above?

Problem Answers

1. 60 grams
2. 300 mOsmoles
3. 5.34 ml
4. 1:250
5. 18 tabs

Post- Assessment Questions:

1. If 50 glycerin suppositories are made from the following formula, how many milliliters of glycerin, having a specific gravity of 1.25, would be used in the preparation of 96 suppositories?

Glycerin	91 g
Sodium Stearate	9 g
Purified Water	5 g

2. A solution has a ratio strength of 1:4300 (v/v). What is the concentration of the solution expressed as % (v/v)?

3. What weight of $MgSO_4$ (GMW = 120), is required to prepare 1 liter of a solution that is 25 mEq/L in Mg^{2+}?

4. How many grams of 1% hydrocortisone cream must be mixed with 0.5% hydrocortisone cream if the pharmacist wishes to prepare 60 g of a 0.8% (w/w) preparation?
   a) 6 g
   b) 12 g
   c) 24 g
   d) 36 g
   e) 48 g

5. What weight of sodium chloride would be required to prepare 50 mL of an isotonic solution containing 500 mg of pilocarpine nitrate (sodium chloride equivalent = 0.23)?

6. What molar ratio (ratio of ionized to unionized molecules) of salt/acid is required to prepare a sodium acetate-acetic acid buffer solution with a pH of 5.76? The pK_a value of acetic acid is 4.76 at 25°C.

Post-Assessment Answers:

1. 91 g/50 supp = 1.82 g/supp x 96 supp = 174.72 g of glycerin needed.
   Specific Gravity = 1.25; so Density = 1.25 g/mL
   Set up the proportion 174.72 g / X mL = 1.25 g/1 mL
   X = 139.776 mL ~ **140 mL**

2. Remember % (v/v) represents the number of mL active ingredient in 100 mL of solution; set up a proportion: 1 mL /4300 mL = X mL / 100 mL
   X = 0.023 mL, thus the solution is **0.023% (v/v)**

3. You must use 25 mEq of $MgSO_4$ to obtain 25 mEq Mg^{2+}
   The valence of Mg is 2^+ making the equivalent weight 120/2
   Simply put: 1 Eq $MgSO_4$ = 60 g $MgSO_4$ or 1 mEq $MgSO_4$ = 60 mg
   Set up a proportion: 60 mg / 1 mEq = X mg / 25 mEq
   X = **1500 mg $MgSO_4$**

4. This question can be answered by setting up an alligation:

   1% 0.3 parts of 1% solution

   0.8 %

   0.5% 0.2 parts of 0.5% solution

   0.3 parts / 0.5 parts total = X / 60 g
   X = **36 g of 1% cream so the answer is D**

5. Isotonic saline requires 0.9 g/100 mL, so 50 mL of isotonic saline will require 0.45 g. The 500 mg of pilocarpine nitrate will correspond to (500 mg x 0.23 = 115 mg of NaCl) approximately 0.12 g of NaCl. Subtract the two to find the NaCl needed to make isotonic: 0.45 g – 0.12 g = **0.33 g sodium chloride**.

6. pH – pK_a = log (salt/acid)
   5.76 – 4.76 = log (salt/acid)
   1 = log (salt/acid)
   Antilog of 1 = salt/acid
   10 = salt/acid or a ratio of **10 ionized molecules to 1 unionized molecule**.
   This makes sense because a weak acid is more ionized when its pH is above its pK_a.

IPA Educational Expo 2010:

Calculations Review--Extra Problems

1. If 10 capsules contain 1500 mg of amoxicillin, what would be the weight of amoxicillin contained in 75 capsules?
   a) 10,500 mg
   b) 11,250 mg
   c) 13,750 mg
   d) 17,425 mg
   e) 22,500 mg

1. If 10 capsules contain 1500 mg of amoxicillin, what would be the weight of amoxicillin contained in 75 capsules?
   a) 10,500 mg
   b) 11,250 mg
   c) 13,750 mg
   d) 17,425 mg
   e) 22,500 mg

   10 capsules / 1500 mg = 75 capsules / x

2. Your patient has MRSA pneumonia and you recommend targeting a vancomycin trough concentration of 15 mcg/mL. Express this value in terms of mg/dL.
   2. 0.015 mg/dL
   3. 0.15 mg/dL
   4. 1.5 mg/dL
   5. 15 mg/dL
   6. 150 mg/dL

2. Your patient has MRSA pneumonia and you recommend targeting a vancomycin trough concentration of 15 mcg/mL. Express this value in terms of mg/dL.
   a) 0.015 mg/dL
   b) 0.15 mg/dL
   c) 1.5 mg/dL
   d) 15 mg/dL
   e) 150 mg/dL

   15 mcg/mL x 1 mg/1000 mcg x 100 mL/1 dL = 1.5 mg/dL

3. How many days will a 20 mL vial of hydromorphone (4 mg/mL) last if the hospice patient is ordered to receive 2 mg PO q4h ATC?
   a) 3
   b) 4
   c) 5
   d) 6
   e) 7

3. How many days will a 20 mL vial of hydromorphone (4 mg/mL) last if the hospice patient is ordered to receive 2 mg PO q4h ATC?
   a) 3
   b) 4
   c) 5
   d) 6
   e) 7

   20 mL x 4 mg/mL = 80 mg
   Needed: 2 mg x 6 doses/day = 12 mg/day
   80 mg ÷ 12 mg/day = 6.67 days (6 days)

4. How many fluid ounces are contained in 5 quarts?
   a) 0.16 fluid ounces
   b) 1.6 fluid ounces
   c) 16 fluid ounces
   d) 160 fluid ounces
   e) 1600 fluid ounces

1 quart = 2 pints
1 pint = 473 mL
30 mL = 1 fluid ounce

   5 quarts x 946 mL/1 quart = 4730 mL
   1 fl. Oz/30 mL = x / 4730 mL = 157.7 fluid oz

5. If a prescription calls for 5 mg/kg and the patient weights 165 lbs., what is the dose to be delivered for this patient?
   a) 75 mg
   b) 185 mg
   c) 227 mg
   d) 375 mg
   e) 412 mg

1 Kg = 2.2 lbs

   165 lbs / x = 2.2 lbs / 1 kg
   X = 75 kg
   5 mg/kg x 75 kg = 375 mg

6. If a prescription calls for 2 tablespoons per day, how many milliliters are required for a 30-day supply?
   a) 50 mL
   b) 90 mL
   c) 500 mL
   d) 850 mL
   e) 900 mL

6. If a prescription calls for 2 tablespoons per day, how many milliliters are required for a 30-day supply?
   a) 50 mL
   b) 90 mL
   c) 500 mL
   d) 850 mL
   e) 900 mL

1 tablespoon = 15 mL

1 tblsp / 30 mL = 2 tblsp / x
X = 60 mL
60 mL/day x 30 days = 900 mL

7. An IV solution contains 250 mg of levofloxacin in 50 mL D5W. How many liters of D5W would contain 5 g of levofloxacin?
   a) 0.1
   b) 0.5
   c) 1
   d) 2
   e) 10

CLUE: The answer is in front of you! Set up ratios and see which ones match!

5 gm x 1000 mg / 1 gm x 50 mL / 250 mg x 1 L / 1000 mg

8. If a prescription calls for 5 g of sodium chloride, how many milliliters of a stock solution are needed if every 1000 mL contains 20 g?
   a) 25 mL
   b) 40 mL
   c) 250 mL
   d) 300 mL
   e) 400 mL

20 gm / 1000 mL = 5 gm / x

9. What is the minimum amount of a potent drug that may be weighed on a prescription balance with a sensitivity requirement of 6 mg if at least 95% accuracy is required?
   a) 6 mg
   b) 120 mg
   c) 180 mg
   d) 200 mg
   e) 300 mg

9. What is the minimum amount of a potent drug that may be weighed on a prescription balance with a sensitivity requirement of 6 mg if at least 95% accuracy is required?
   a) 6 mg
   b) 120 mg
   c) 180 mg
   d) 200 mg
   e) 300 mg

   Minimum weighable quantity = sensitivity requirement x 100 / %error
   6 mg x 100 / 5% = 120 mg

10. Calculate the dose of a drug to be administered to a patient if the dosing regimen is listed as 7 mg/kg/day. The patient weighs 140 lb.
   a) 65 mg
   b) 125 mg
   c) 315 mg
   d) 420 mg
   e) 450mg

10. Calculate the dose of a drug to be administered to a patient if the dosing regimen is listed as 7 mg/kg/day. The patient weighs 140 lb.
   a) 65 mg
   b) 125 mg
   c) 315 mg
   d) 420 mg
   e) 450 mg

   1 Kg / 2.2 lb = x / 140 lb
   X= 64 Kg
   7 x 64 = 448 mg

11. What is the ideal body weight for a female patient whose height is 5 ft 8 in?
   a) 53 kg
   b) 64 kg
   c) 68 kg
   d) 121 lb
   e) 150 lb

11. What is the ideal body weight for a female patient whose height is 5 ft 8 in?
   a) 53 kg
   b) 64 kg
   c) 68 kg
   d) 121 lb
   e) 150 lb

   Women – IBW = 45.5 + (2.3 x inches over 5 ft)
   Men – IBW = 50 + (2.3 x inches over 5 ft)
   IBW = 45.5 + (2.3 x 8) = 64 Kg

12. A patient weighing 175 lb is to receive an initial daily IM dosage of procainamide HCl (500 mg/mL vial) of 50 mg/kg based on actual body weight to be given in divided doses every 3 hours. How many milliliters should each injection contain?
   a) 0.49 mL
   b) 0.99 mL
   c) 1.87 mL
   d) 3.98 mL
   e) 8.23 mL

12. A patient weighing 175 lb is to receive an initial daily IM dosage of procainamide HCl (500 mg/mL vial) of 50 mg/kg based on actual body weight to be given in divided doses every 3 hours. How many milliliters should each injection contain?
    a) 0.49 mL
    b) 0.99 mL
    c) 1.87 mL
    d) 3.98 mL
    e) 8.23 mL

    175 lb / x = 2.2 lb / 1 kg
    X = 79.5 kg
    50 mg/kg x 79.5 kg = 3977 mg
    3977 mg / 8 doses per day = 497 mg / dose
    497 mg / x = 500 mg / 1 mL
    X = 0.99 mL

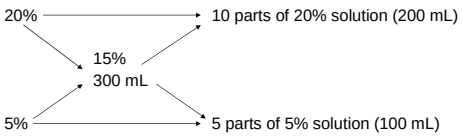
13. What is the creatinine clearance for a 65 year old female patient who weighs 110 lb and has a serum creatinine of 1.3 mg/dL?
    a) 26 mL/min
    b) 34 mL/min
    c) 40 mL/min
    d) 82 mL/min
    e) 100 mL/min

13. What is the creatinine clearance for a 65 year old female patient who weighs 110 lb and has a serum creatinine of 1.3 mg/dL?
    a) 26 mL/min
    b) 34 mL/min
    c) 40 mL/min
    d) 82 mL/min
    e) 100 mL/min

    CrCl = {[(140-65)x50kg] / (72 x 1.3)} x 0.85

14. What volume of a 5% dextrose solution should be mixed with 200 mL of a 20% dextrose solution to prepare 300 mL of a 15% dextrose solution?
    a) 50 mL
    b) 100 mL
    c) 150 mL
    d) 200 mL
    e) 250 mL

14. What volume of a 5% dextrose solution should be mixed with 200 mL of a 20% dextrose solution to prepare 300 mL of a 15% dextrose solution?
    a) 50 mL
    b) 100 mL
    c) 150 mL
    d) 200 mL
    e) 250 mL



15. What is the final concentration obtained by mixing 200 mL of 20% dextrose with 100 mL of 5% dextrose?
    a) 7.5%
    b) 10%
    c) 12.5%
    d) 15%
    e) 17.5%

15. What is the final concentration obtained by mixing 200 mL of 20% dextrose with 100 mL of 5% dextrose?
    a) 7.5%
    b) 10%
    c) 12.5%
    d) 15%
    e) 17.5%

    Two parts: solute and solvent – keep both totals in mind!
    Solvent = 200 mL + 100 mL = 300 mL
    Solute = x / 200 mL = 20 gm / 100 mL; x = 40 gm
    X / 100 mL = 5 gm / 100 mL; x = 5gm
    Solute = 45 gm
    Therefore 45gm / 300 mL = x / 100 mL
    X = 15%

16. You receive a prescription for prednisone 10 mg tablets with the instructions “Take 20 mg po once daily x 3 days, 10 mg po once daily x 3 days, 5 mg po once daily x 3 days”. Calculate the number of tablets to dispense to fulfill this prescription.
    a) 9
    b) 10
    c) 11
    d) 12
    e) 13

16. You receive a prescription for prednisone 10 mg tablets with the instructions “Take 20 mg po once daily x 3 days, 10 mg po once daily x 3 days, 5 mg po once daily x 3 days”. Calculate the number of tablets to dispense to fulfill this prescription.
    a) 9
    b) 10
    c) 11
    d) 12
    e) 13

    Step 1 = 2 tablets x 3 days = 6 tablets
    Step 2 = 1 tablet x 3 days = 3 tablets
    Step 3 = ½ tablet x 3 days = 2 tablets
    Total = 11 tablets

17. How many mL of a 3% solution can be made from 27 g of drug?
    a) 600 mL
    b) 700 mL
    c) 800 mL
    d) 900 mL
    e) 1000 mL

17. How many mL of a 3% solution can be made from 27 g of drug?
    a) 600 mL
    b) 700 mL
    c) 800 mL
    d) 900 mL
    e) 1000 mL

    27 gm / x = 3 gm / 100 mL

18. A nurse calls the pharmacy and asks for help determining how much heparin a patient is receiving. The patient weighs 78 kg and the heparin solution (25,000 units/500 mL D5W) is running at a rate of 22.4 mL/hr. How many units/kg/hr is the patient currently receiving?
    a) 13.2
    b) 14.3
    c) 15.4
    d) 16.7
    e) 17.1

18. A nurse calls the pharmacy and asks for help determining how much heparin a patient is receiving. The patient weighs 78 kg and the heparin solution (25,000 units/500 mL D5W) is running at a rate of 22.4 mL/hr. How many units/kg/hr is the patient currently receiving?
    a) 13.2
    b) 14.3
    c) 15.4
    d) 16.7
    e) 17.1

    25,000 units / 500 mL = 50 units / mL
    50 units / mL x 22.4 mL / hr = 1120 units / hr
    1120 units / 78 kg = 14.3 units/kg/hr

19. An ICU medical order reads "KCl 40 mEq in 1 L NS. Infuse at 0.5 mEq/min." How many minutes will this bottle last on the patient?
    a) 20
    b) 80
    c) 500
    d) 1000
    e) 2000

19. An ICU medical order reads "KCl 40 mEq in 1 L NS. Infuse at 0.5 mEq/min." How many minutes will this bottle last on the patient?
    a) 20
    b) 80
    c) 500
    d) 1000
    e) 2000

    1000 mL / 40 mEq x 0.5 mEq / min = 12.5 ml/min
    1000 mL / 12.5 mL = 80 minutes

20. Using the formula below, how much zinc oxide would be required to make 750 g of the mixture?
    - Zinc oxide 150 g
    - Starch 250 g
    - Petrolatum 550 g
    - Coal tar 50 g

    a) 38 g
    b) 113 g
    c) 188 g
    d) 200 g
    e) 413 g

20. Using the formula below, how much zinc oxide would be required to make 750 g of the mixture?
    - Zinc oxide 150 g
    - Starch 250 g
    - Petrolatum 550 g
    - Coal tar 50 g

    a) 38 g
    b) 113 g
    c) 188 g
    d) 200 g
    e) 413 g

    Total weight = 150 + 250 + 550 + 50 = 1000 gm
    150 gm zinc / 1000 gm total = x / 750 gm total

21. What is the weight of 500 mL of a liquid whose specific gravity is 1.13?
    a) 442 mg
    b) 885 mg
    c) 221 g
    d) 442 g
    e) 565 g

Specific Gravity

- Ratio
  - Weight of substance : Weight of standard substance
  - Weight of 10 mL of sulfuric acid
    Weight of 10 mL of water
    - 18 gm / 10 gm = 1.8

21. What is the weight of 500 mL of a liquid whose specific gravity is 1.13?
    a) 442 mg
    b) 885 mg
    c) 221 g
    d) 442 g
    e) 565 g

    Weight of 500 mL of liquid
    Weight of 500 mL of water
    = X / 500 g = 1.13
    X = 565 g

22. What weight of hydrocortisone should be used to prepare 20 g of an ointment containing hydrocortisone at a concentration of 1:400?
    a) 5 mg
    b) 25 mg
    c) 50 mg
    d) 75 mg
    e) 80 mg

22. What weight of hydrocortisone should be used to prepare 20 g of an ointment containing hydrocortisone at a concentration of 1:400?
    a) 5 mg
    b) 25 mg
    c) 50 mg
    d) 75 mg
    e) 80 mg

    1 / 400 = x / 20 g
    X = 0.05 g = 50 mg

23. Convert 104ºF to centigrade.
    a) 22ºC
    b) 34ºC
    c) 40ºC
    d) 46ºC
    e) 50ºC

23. Convert 104ºF to centigrade.
    a) 22ºC
    b) 34ºC
    c) 40ºC
    d) 46ºC
    e) 50ºC

    C = [(104-32)/9] x 5

24. A patient is to receive an infusion of 2 g of lidocaine in 500 mL D5W at a rate of 2 mg/min. What is the flow rate in milliliters per hour?
    a) 2
    b) 6.5
    c) 15
    d) 30
    e) 150

24. A patient is to receive an infusion of 2 g of lidocaine in 500 mL D5W at a rate of 2 mg/min. What is the flow rate in milliliters per hour?
    a) 2
    b) 6.5
    c) 15
    d) 30
    e) 150

$$\frac{500\ mL}{2\ gm} \times \frac{1\ gm}{1000 mg} \times \frac{2\ mg}{1\ min} \times \frac{60\ min}{1\ hr}$$

25. A prescription calls for tobramycin 0.3% with the directions "1 gtt OU TID". How many mg of tobramycin will be used per day? Assume that the dropper is calibrated to deliver 20 drops per mL.
    a) 9 mg
    b) 0.9 mg
    c) 0.009 mg
    d) 0.0009 mg
    e) 0.00009 mg

25. A prescription calls for tobramycin 0.3% with the directions "1 gtt OU TID". How many mg of tobramycin will be used per day? Assume that the dropper is calibrated to deliver 20 drops per mL.
    a) 9 mg
    b) 0.9 mg
    c) 0.009 mg
    d) 0.0009 mg
    e) 0.00009 mg

1 gtt OU TID = 6 gtt's per day
20 gtt / 1 mL = 6 gtt / x; x = 0.3 mL used per day
0.3 gm / 100 mL = x / 0.3 mL
X = 0.0009 gm = 0.9 mg

26. The infusion rate of theophylline established for an infant is 0.08 mg/kg/h. How many mg of theophylline are needed for a 12-hour infusion bottle if the infant weighs 16 lbs?
    a) 0.58 mg
    b) 7 mg
    c) 14 mg
    d) 30 mg
    e) 150 mg

26. The infusion rate of theophylline established for an infant is 0.08 mg/kg/h. How many mg of theophylline are needed for a 12-hour infusion bottle if the infant weighs 16 lbs?
    a) 0.58 mg
    b) 7 mg
    c) 14 mg
    d) 30 mg
    e) 150 mg

16 lb = 7.3 kg
0.08 x 7.3 = 0.584 mg/hr
0.584 mg x 12 hours = 7 mg

27. There are 5.86 g of potassium chloride (KCl) in a 250 mL infusion bag. How many milliequivalents (mEq) of KCl are present (molecular weight KCl = 74.6)?
    a) 12.7
    b) 20
    c) 78.5
    d) 150
    e) 157

Millequivalents

- The "combining power" of a substance relative to 1mg of hydrogen
- 1 mEq =
  - 1mg hydrogen
  - 20 mg calcium
  - 23 mg sodium
- mEq = $\frac{\text{(mg x valence)}}{\text{atomic, molecular, or formula weight}}$

Stoklosa MJ, Ansel HC. *Pharmaceutical Calculations*. 10th Ed. Media, PA: Williams & Wilkins; 1996.

27. There are 5.86 g of potassium chloride (KCl) in a 250 mL infusion bag. How many milliequivalents (mEq) of KCl are present (molecular weight KCl = 74.6)?
    a) 12.7
    b) 20
    c) 78.5
    d) 150
    e) 157

    Molecular weight of KCl = 74.5
    Equivalent weight of KCl = 74.5
    1 mEq of KCl = 1/1000 x 74.5 gm = 0.0745 gm = 74.5 mg
    5860 mg / 74.5 mg = 78.5 mEq

28. Propylene glycol was purchased at a cost of $24.00 per pound. What is the cost of 100 mL of the liquid (specific gravity = 1.04)?
    a) $2.60
    b) $2.64
    c) $2.75
    d) $5.50
    e) $13.00

28. Propylene glycol was purchased at a cost of $24.00 per pound. What is the cost of 100 mL of the liquid (specific gravity = 1.04)?
    a) $2.60
    b) $2.64
    c) $2.75
    d) $5.50
    e) $13.00

    $\frac{\text{Weight of 100 mL liquid}}{\text{Weight of 100 mL water (100 gm)}} = 1.04$
    Weight of 100 mL liquid = 104 gm

$$104\ \text{gm} \times \frac{2.2\ \text{lb}}{1\ \text{kg}} \times \frac{1\ \text{kg}}{1000\ \text{gm}} \times \frac{\$24.00}{1\ \text{lb}} = \$5.50$$

29. A prescription calls for 1 lb. bacitracin ointment containing 200 Units of bacitracin per gram. How many grams of bacitracin ointment (500 Units/g) must be used to make this ointment?
    a) 182 g
    b) 200 g
    c) 227 g
    d) 362 g
    e) 400 g

29. A prescription calls for 1 lb. bacitracin ointment containing 200 Units of bacitracin per gram. How many grams of bacitracin ointment (500 Units/g) must be used to make this ointment?

a) 182 g
b) 200 g
c) 227 g
d) 362 g
e) 400 g

$$1\text{ lb} \times \frac{1\text{ kg}}{2.2\text{ lb}} \times \frac{1000\text{ gm}}{1\text{ kg}} \times \frac{200\text{ units}}{1\text{ gm}} = 90{,}909\text{ units}$$

90,909 units/x = 500 units / 1 gm
X = 182 gm

30. A total parenteral nutrition order requires 500 mL of D30W. How many mL of D50W should be used if D30W is not available?

a) 125 mL
b) 200 mL
c) 300 mL
d) 375 mL
e) 400 mL

30. A total parenteral nutrition order requires 500 mL of D30W. How many mL of D50W should be used if D30W is not available?

a) 125 mL
b) 200 mL

c) 300 mL

d) 375 mL
e) 400 mL

Need:
X / 500 mL = 30 gm / 100 mL; x = 150 gm
150 gm / x = 50 gm / 100 mL; x = 300 mL

31. How many grams of 1% hydrocortisone cream must be mixed with 0.5% hydrocortisone cream if the pharmacist wishes to prepare 60 g of a 0.8% w/w preparation?

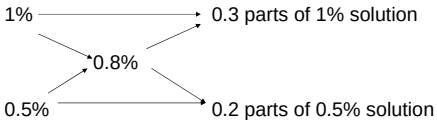
a) 6 g
b) 12 g
c) 24 g
d) 36 g
e) 48 g

31. How many grams of 1% hydrocortisone cream must be mixed with 0.5% hydrocortisone cream if the pharmacist wishes to prepare 60 g of a 0.8% w/w preparation?

a) 6 g
b) 12 g
c) 24 g

d) 36 g

e) 48 g



0.3 parts/ 0.5 parts total = x / 60 gm
X = 36 gm of 1% cream

32. A solution is to be administered by IV infusion at a rate of 55 mL/hr. How many drops/minute should be infused if 1 mL = 20 drops?

a) 15.4
b) 16.5
c) 17.8
d) 18.3
e) 19.1

32. A solution is to be administered by IV infusion at a rate of 55 mL/hr. How many drops/minute should be infused if 1 mL = 20 drops?

a) 15.4
b) 16.5
c) 17.8
d) 18.3
e) 19.1

$$\frac{55\ \text{mL}}{1\ \text{hr}} \times \frac{1\ \text{hr}}{60\ \text{min}} \times \frac{20\ \text{drops}}{1\ \text{mL}} = 18.3\ \text{drops/min}$$

33. How many milligrams of sodium chloride are needed to adjust 30 mL of a 4% cocaine HCl solution to isotonicity. The freezing point depression of a 1% solution of cocaine HCl is 0.09ºC.

a) 62
b) 83
c) 108
d) 120
e) 270

33. How many milligrams of sodium chloride are needed to adjust 30 mL of a 4% cocaine HCl solution to isotonicity. The freezing point depression of a 1% solution of cocaine HCl is 0.09ºC.

a) 62
b) 83
c) 108
d) 120
e) 270

1% / 0.09 = 4% / x; x = 0.36°C
Isotonic solutions have a reduction in freezing points to 0.52°C
0.52°C – 0.36°C = 0.16°C
0.9% NaCl / 0.52°C = x / 0.16°C
X = 0.277% NaCl
X / 30 mL = 0.277 gm / 100 mL
X = 0.083 gm = 83 mg

34. Estimate the milliosmolarity (mOsm/L) for normal saline (Na = 23, Cl = 35.5).

a) 150 mOsm/L
b) 300 mOsm/L
c) 350 mOsm/L
d) 400 mOsm/L
e) 600 mOsm/L

Osmolarity

- Measures osmotic concentration
- Nonelectrolytes (ex: dextrose)
  - 1 mmol = 1 mOsmol
- Electrolytes (ex: NaCl)
  - 1 mmol = 2 mOsmol (Na & Cl)

$$\frac{\text{Wt. of substance (g/L)}}{\text{m.w. (gm)}} \times \text{\# of species} \times 1000 = \text{mOsmol/L}$$

34. Estimate the milliosmolarity (mOsm/L) for normal saline (Na = 23, Cl = 35.5).

a) 150 mOsm/L
b) 300 mOsm/L
c) 350 mOsm/L
d) 400 mOsm/L
e) 600 mOsm/L

$$\frac{9\ \text{gm}}{(23 + 35.5)} \times 2 \times 1000 = \text{mOsmol/L}$$

35. How many mL of isopropyl rubbing alcohol (70% v/v) will be needed to prepare one pint of 50% isopropyl alcohol?
    a) 70
    b) 170
    c) 338
    d) 400
    e) 480

35. How many mL of isopropyl rubbing alcohol (70% v/v) will be needed to prepare one pint of 50% isopropyl alcohol?
    a) 70
    b) 170
    c) 338
    d) 400
    e) 480

    X / 473 mL = 50 gm / 100 mL; X = 236.5 gm
    236.5 gm / x = 70 gm / 100 mL; X = 338 mL

36. What is the percentage strength (w/v) of 50 mg of cefuroxime dissolved in water to make a 500 mL D5W solution?
    a) 0.01%
    b) 0.025%
    c) 0.1%
    d) 0.2%
    e) 2.5%

36. What is the percentage strength (w/v) of 50 mg of cefuroxime dissolved in water to make a 500 mL D5W solution?
    a) 0.01%
    b) 0.025%
    c) 0.1%
    d) 0.2%
    e) 2.5%

    0.05 gm / 500 mL = x / 100 mL
    X = 0.01%

37. What is the percentage strength (w/w) for zinc oxide if 20 grams are mixed with 80 grams of petrolatum?
    a) 25%
    b) 20%
    c) 15%
    d) 30%
    e) 22.5%

37. What is the percentage strength (w/w) for zinc oxide if 20 grams are mixed with 80 grams of petrolatum?
    a) 25%
    b) 20%
    c) 15%
    d) 30%
    e) 22.5%

    20 gm / 100 gm = x / 100 gm
    X = 20%

38. What is the percentage strength of the final solution if 250 mL of 1% lidocaine is diluted in 500 mL?
    a) 0.5%
    b) 1%
    c) 1.5%
    d) 2%
    e) 5%

38. What is the percentage strength of the final solution if 250 mL of 1% lidocaine is diluted in 500 mL?
    a) 0.5%
    b) 1%
    c) 1.5%
    d) 2%
    e) 5%

    X / 250 mL = 1 gm / 100 mL; X = 2.5 gm
    2.5 gm / 500 mL = x / 100 mL; x = 0.5 gm

39. How many milliliters of water are needed to dilute 500 mL of 90% ethanol to a 50% concentration?
    a) 400 mL
    b) 500 mL
    c) 600 mL
    d) 800 mL
    e) 900 mL

39. How many milliliters of water are needed to dilute 500 mL of 90% ethanol to a 50% concentration?
    a) 400 mL
    b) 500 mL
    c) 600 mL
    d) 800 mL
    e) 900 mL

    90 gm / 100 mL = x / 500 mL; X = 450 gm
    450 gm / x mL = 50 gm / 100 mL; X = 900 mL
    900 mL – 500 mL = 400 mL

40. How many mEq of KCl are present in 200 mL of a 5% KCl solution?
    a) 1.34 mEq
    b) 13.4 mEq
    c) 100 mEq
    d) 134.23 mEq
    e) 200 mEq

40. How many mEq of KCl are present in 200 mL of a 5% KCl solution?
    a) 1.34 mEq
    b) 13.4 mEq
    c) 100 mEq
    d) 134.23 mEq
    e) 200 mEq

    5 gm / 100 mL = X / 200 mL; X = 10 gm
    mEq = (10,000 mg x 1) / 74.6 mg = 134 mEq

41. How many mOsm/L of KCl are present in 1000 mL of a 5% solution?
   a) 13.42 mOsm/L
   b) 134.2 mOsm/L
   c) 342 mOsm/L
   d) 1342 mOsm/L
   e) 2345 mOsm/L

41. How many mOsm/L of KCl are present in 1000 mL of a 5% solution?
   a) 13.42 mOsm/L
   b) 134.2 mOsm/L
   c) 342 mOsm/L
   d) 1342 mOsm/L
   e) 2345 mOsm/L

5 gm / 100 mL = X / 1000 mL; X = 50 gm

$$\frac{50 \text{ gm}}{74.6} \times 2 \times 1000 = \text{mOsmol/L}$$

42. How many milligrams of sodium chloride are required to make the following prescription?
- Cocaine HCl 10 mg
- Purified water qs 100 mL
- Sodium chloride qs to make an isotonic solution
   a) 8.98 mg
   b) 9.65 mg
   c) 89.84 mg
   d) 98.65 mg
   e) 898.4 mg

42. How many milligrams of sodium chloride are required to make the following prescription?
- Cocaine HCl 10 mg
- Purified water qs 100 mL
- Sodium chloride qs to make an isotonic solution
   a) 8.98 mg
   b) 9.65 mg
   c) 89.84 mg
   d) 98.65 mg
   e) 898.4 mg

Sodium Chloride equivalent of cocaine = 0.16
900 mg of sodium chloride makes 100 mL isotonic
Need to account for sodium equivalents of cocaine
0.16 x 10 mg = 1.6
900 – 1.6 = 898.4 mg

43. A 20% fat emulsion yields 2.1 kcal/mL. How many mL will provide 1200 kilocalories?
   a) 567 mL
   b) 569 mL
   c) 571 mL
   d) 583 mL
   e) 591 mL

43. A 20% fat emulsion yields 2.1 kcal/mL. How many mL will provide 1200 kilocalories?
   a) 567 mL
   b) 569 mL
   c) 571 mL
   d) 583 mL
   e) 591 mL

2.1 kcal / 1 mL = 1200 kcal / X
X = 571 mL

44. If the dose of a drug is 50 mcg, how many doses are contained in 0.035 g?

a) 500 doses
b) 600 doses
c) 700 doses
d) 800 doses
e) 900 doses

44. If the dose of a drug is 50 mcg, how many doses are contained in 0.035 g?

a) 500 doses
b) 600 doses
c) 700 doses
d) 800 doses
e) 900 doses

0.035 gm = 35 mg = 35,000 mcg
35,000 mcg / 50 mcg = 700 doses

45. How many milliliters of a liquid medicine would provide a patient with 2 tablespoonfuls twice a day for 5 days?

a) 300 mL
b) 350 mL
c) 400 mL
d) 450 mL
e) 500 mL

45. How many milliliters of a liquid medicine would provide a patient with 2 tablespoonfuls twice a day for 5 days?

a) 300 mL
b) 350 mL
c) 400 mL
d) 450 mL
e) 500 mL

2 tablespoons BID = 60 mL / day
60 x 5 = 300 mL

46. Calculate the rate for a child (Wt = 22 kg) receiving fentanyl (100mcg/2mL) 3mcg/kg/hr?

a) 1.3 mL/hr
b) 1.7 mL/hr
c) 2.1 mL/hr
d) 2.6 mL/hr
e) 3.0 mL/hr

46. Calculate the rate for a child (Wt = 22 kg) receiving fentanyl (100mcg/2mL) 3mcg/kg/hr?

a) 1.3 mL/hr
b) 1.7 mL/hr
c) 2.1 mL/hr
d) 2.6 mL/hr
e) 3.0 mL/hr

22 kg x 3 mcg/kg/hr = 66 mcg/hr
66 mcg/hr / 50 mcg/mL = 1.3 mL / hr

47. How many milligrams of mercury bichloride are needed to make 200 mL of a 1:500 w/v solution?
    a) 100 mg
    b) 200mg
    c) 300 mg
    d) 400 mg
    e) 500 mg

47. How many milligrams of mercury bichloride are needed to make 200 mL of a 1:500 w/v solution?
    a) 100 mg
    b) 200mg
    c) 300 mg
    d) 400 mg
    e) 500 mg

    1 gm / 500 mL = x / 200 mL
    X = 0.4 gm = 400 mg

48. How many grams of dextrose (molecular weight 180) would be needed to provide 120 mOsm?
    a) 20.7 g
    b) 21.3 g
    c) 21.6 g
    d) 22.3 g
    e) 23.1 g

48. How many grams of dextrose (molecular weight 180) would be needed to provide 120 mOsm?
    a) 20.7 g
    b) 21.3 g
    c) 21.6 g
    d) 22.3 g
    e) 23.1 g

$$\frac{X \text{ gm}}{180} \times 1 \times 1000 = 120 \text{ mOsmol/L}$$

49. How many liters of a 2.5% w/v solution can be prepared using 42.5 g of solute?
    a) 1.42 L
    b) 1.7 L
    c) 1.9 L
    d) 2.1 L
    e) 2.3 L

49. How many liters of a 2.5% w/v solution can be prepared using 42.5 g of solute?
    a) 1.42 L
    b) 1.7 L
    c) 1.9 L
    d) 2.1 L
    e) 2.3 L

    2.5 gm / 100 mL = 42.5 gm / X
    X = 1.7 L

50. The usual dose of sulfamethoxazole/trimethoprim (Bactrim®) is 150 mg TMP/m2/day in divided doses every 12 hours for PCP prophylaxis. What would be the usual dose for SG who is a 2 year old male (Wt = 12 kg, Ht = 34")?
    a) 5 mg
    b) 10 mg
    c) 20 mg
    d) 40 mg
    e) 80 mg

50. The usual dose of sulfamethoxazole/trimethoprim (Bactrim®) is 150 mg TMP/m2/day in divided doses every 12 hours for PCP prophylaxis. What would be the usual dose for SG who is a 2 year old male (Wt = 12 kg, Ht = 34")?
    a) 5 mg
    b) 10 mg
    c) 20 mg
    d) 40 mg
    e) 80 mg

    34" = 86.36 cm
    BSA = $\sqrt{[(86.36 \times 12)/3600]} = 0.54\ m^2$
    $0.54\ m^2 \times 150 = 81$ mg / day = 40 mg BID

51. A patient is to receive 2000 mL of a solution by intravenous infusion over a period of 24 hours. What rate or infusion (drops/minute) should be utilized if 1 mL = 20 drops?
    a) 26 drops/minute
    b) 28 drops/minute
    c) 30 drops/minute
    d) 32 drops/minute
    e) 40 drops/minute

51. A patient is to receive 2000 mL of a solution by intravenous infusion over a period of 24 hours. What rate or infusion (drops/minute) should be utilized if 1 mL = 20 drops?
    a) 26 drops/minute
    b) 28 drops/minute
    c) 30 drops/minute
    d) 32 drops/minute
    e) 40 drops/minute

$$\frac{2000\ mL}{24\ hrs} \times \frac{1\ hr}{60\ min} \times \frac{20\ drops}{1\ mL} = 28\ drops / min$$

52. A prescription calls for 24 mmol of potassium chloride. How many grams of KCl are required (molecular weight KCl = 74.6)?
    a) 1.73 g
    b) 1.79 g
    c) 1.84 g
    d) 1.93 g
    e) 2.12 g

52. A prescription calls for 24 mmol of potassium chloride. How many grams of KCl are required (molecular weight KCl = 74.6)?
    a) 1.73 g
    b) 1.79 g
    c) 1.84 g
    d) 1.93 g
    e) 2.12 g

    MW KCl = 74.6
    1 mole = 74.6 gm
    1 mmol = 0.0746 gm
    0.0746 gm / 1 mmol = X / 24 mmol
    X = 1.79 gm

53. A TPN formula for 2 L is to contain 25% dextrose. What volume of 70% dextrose injection will supply the needed sugar?

a) 685 mL
b) 700 mL
c) 714 mL
d) 719 mL
e) 725 mL

53. A TPN formula for 2 L is to contain 25% dextrose. What volume of 70% dextrose injection will supply the needed sugar?

a) 685 mL
b) 700 mL
c) 714 mL
d) 719 mL
e) 725 mL

25 gm / 100 mL = X / 2000 mL; X = 500 gm
500 gm / x mL = 70 gm / 100 mL; X = 714 mL

54. A pharmacist combines 140 mL of a 0.9% sodium chloride solution with 250 mL of a 3.4% sodium chloride solution. Calculate the percentage strength of the final mixture.

a) 1.75%
b) 2%
c) 2.25%
d) 2.45%
e) 2.5%

54. A pharmacist combines 140 mL of a 0.9% sodium chloride solution with 250 mL of a 3.4% sodium chloride solution. Calculate the percentage strength of the final mixture.

a) 1.75%
b) 2%
c) 2.25%
d) 2.45%
e) 2.5%

0.9 gm / 100 mL = X / 140 mL; X = 1.26 gm
3.5 gm / 100 mL = X / 250 mL; X = 8.75 gm
8.75 gm + 1.26 gm = 10.01 gm
140 mL + 250 mL = 390 mL
10.01 gm / 390 mL = X / 100 mL
X = 2.5%

55. If city water contains 2.5 ppm of NaF, calculate the number of milliequivalents of fluoride ingested by a person who drinks 1.5 L of water (molecular weight of NaF = 42).

a) 0.073 mEq
b) 0.075 mEq
c) 0.079 mEq
d) 0.089 mEq
e) 0.090 mEq

55. If city water contains 2.5 ppm of NaF, calculate the number of milliequivalents of fluoride ingested by a person who drinks 1.5 L of water (molecular weight of NaF = 42).

a) 0.073 mEq
b) 0.075 mEq
c) 0.079 mEq
d) 0.089 mEq
e) 0.090 mEq

2.5 parts/1,000,000 = X / 100; X = 0.00025%
0.00025 gm / 100 mL = X / 1500 mL; X = 0.00375 gm
1 mEq = 42 mg
1 mEq / 42 mg = X / 3.75 mg; X = 0.089 mEq

GOOD LUCK ON YOUR NAPLEX!