Calculations Review for Pharmacy Technicians

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Financial Disclosure

Abigale Matulewicz has no relevant financial relationships with any commercial interests to disclose

Objectives

Following this presentation, the participant will be able to:

• Identify common conversions and units of measurement needed in practice
• Explain community and hospital-based calculations concepts and their relation to technician practice
• Solve common pharmaceutical calculations encountered in clinical settings

Self-Assessment Question

Complete the following conversions:

5 gr = _____________ mg
8 oz = _____________ mL
210 lbs = _____________ kg

Self-Assessment Question

You dispense 50 mL of 1.5% w/v ibuprofen suspension with the following SIG:

2 tsp QD

How many milligrams of ibuprofen are in each dose?

A. 0.15 mg
B. 0.45 mg
C. 150 mg
D. 450 mg

Self-Assessment Question

How much 85% alligatoromycin must be added to 150 mL of 60% alligatoromycin to make an 80% solution?

A. 450 mL
B. 600 mL
C. 750 mL
D. 800 mL
Self-Assessment Question

A 49-year old, 132-lb man is being started on octreotide for variceal bleeding. He is getting 50 mcg/hr and the drip contains 500 mcg of octreotide in 100 mL NS. What is the flow rate in mL/hr?

A. 1 mL/hr
B. 10 mL/hr
C. 50 mL/hr
D. 100 mL/hr

Topics to Cover

1. Units of measure and conversions
2. Ratio, proportions and percent strength
3. Stock solutions and alligation
4. Clinical-based calculations
5. Parenteral calculations

Roman Numerals

- Reading Roman numerals:
  - Lower number after high number = add | XII
  - Lower number before higher = subtract | IX
  - Smaller number between two larger | XIX
  - Avoid repetition of > 3 occurrences of the same letter | IIIII → VII
  - Power of 10 | IC → XCIX
  - Use only one smaller number before a larger number | IIX → VIII

Practice Problem #1

What number Super Bowl is represented in the image below?

Systems of Measurement

<table>
<thead>
<tr>
<th>Metric</th>
<th>Avoirdupois</th>
<th>Apothecary</th>
</tr>
</thead>
<tbody>
<tr>
<td>Metric System</td>
<td>British-based system</td>
<td>Used in healthcare, primarily used for mass measurements</td>
</tr>
<tr>
<td>Commonly seen units</td>
<td>Commonly seen units</td>
<td>Commonly seen units</td>
</tr>
<tr>
<td>Millimeter, centimeter</td>
<td>Ounce</td>
<td>Grain, dram, scruple</td>
</tr>
<tr>
<td>Millimeter, liter</td>
<td>Pound</td>
<td>Fluid ounce</td>
</tr>
<tr>
<td>Milligram, gram, kilogram</td>
<td>Grain</td>
<td>Pint, quart, gallon</td>
</tr>
</tbody>
</table>

Household Measurements

<table>
<thead>
<tr>
<th>Household Unit</th>
<th>Equivalent</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 teaspoonful (tsp)</td>
<td>5 milliliters (mL)</td>
</tr>
<tr>
<td>1 tablespoonful (tbsp)</td>
<td>15 mL</td>
</tr>
<tr>
<td>1 fluid ounce (fl oz)</td>
<td>30 mL</td>
</tr>
<tr>
<td>1 cup</td>
<td>8 fl oz</td>
</tr>
<tr>
<td>1 pint (pt)</td>
<td>16 fl oz</td>
</tr>
<tr>
<td>4 quarts (qt)</td>
<td>1 gal</td>
</tr>
<tr>
<td>1 gallon (gal)</td>
<td>3.785 L</td>
</tr>
</tbody>
</table>

WEIGHT

1 pound (lb) | 16 oz
Other Conversions

<table>
<thead>
<tr>
<th>Measurement</th>
<th>Equivalent</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 pound (lb)</td>
<td>454 g</td>
</tr>
<tr>
<td>1 kilogram (kg)</td>
<td>2.2 lbs</td>
</tr>
<tr>
<td>1 grain (gr)</td>
<td>65 mg*</td>
</tr>
<tr>
<td>1 dram</td>
<td>5 mL</td>
</tr>
</tbody>
</table>

Practice Problem #2

Complete the following conversions:

1. 5 gr = _____________ mg
2. 8 oz = ______________ mL
3. 210 lbs = _____________ kg

Tips on Remembering

Challenge! 😊

- Drug written?
- Quantity to dispense in mL?
- Amount patient should take per dose?

Key Points

- Pharmacy practice uses principles from all three systems of measurement
- Knowing household equivalents and other conversions is crucial for pharmacy practice

Topics to Cover

1. Units of measure and conversions
2. Ratio, proportions and percent strength
3. Stock solutions and alligation
4. Clinical-based calculations
5. Parenteral calculations
Basic Refresher

- **Ratio** is comparison of two like quantities
  - Fraction (a/b) or ratio strength (2:3)
  - Very common in drug strength notation
- **Proportion** is when two ratios are equal
  - Generally set up as: \( \frac{A}{C} = \frac{B}{D} \)
- 3 Rules to Follow:
  1. Numerators should have **same** units
  2. Denominators should have **same** units
  3. Three of the four “spots” should be known

Practice Problem #3

A prescription is written for a 300mg dose of an oral solution. The pharmacy stocks a 250mg /5mL stock bottle. How much of the stock solution should be taken per dose?

Concentrations

- **Weight / weight (w/w)**
  - Represented as **GRAMS PER 100 GRAMS**
  - Used for solids, semisolids
- **Volume / volume (v/v)**
  - Represented as **MILLILITERS PER 100 MILLILITERS**
  - Not used very often in practice; chemicals?
- **Weight / volume (w/v)**
  - Represented as **GRAMS PER 100 MILLILITERS**
  - Example: 5% = 5 grams / 100 mL
  - Most common way to express concentration in practice

Ratio Strength

- Written as \( X:Y \), where \( X \) is usually 1
- Often used to show the concentration of “weak” preparations
  - Example: 0.2% (w/v) = 1:500 (w/v)
- Same rules as percent strength for units
- Used frequently in hospital practice

Converting Between

- If given in percent strength...
  \[ 4\% \text{ (w/v)} \rightarrow \frac{4 \text{ g}}{100 \text{ mL}} = \frac{1}{X} \rightarrow X = 25 \text{ (1:25)} \]
- If given as ratio strength...
  \[ 1:80 \text{ (w/w)} \rightarrow \frac{1}{80} = \frac{X \text{ g}}{100 \text{ g}} \rightarrow X = 1.25 \text{ (1.25%)} \]

Practice Problem #4

You dispense 50 mL of 1.5% w/v ibuprofen suspension with the following SIG:

\[ 2 \text{ tsp QD} \]

How many milligrams of ibuprofen are in each dose?
Challenge! 😊

A formula for tinea capitis shampoo contains 1:62.5 (w/v) selenium sulfide. How many capsules, each containing 350 mg of selenium sulfide, would be needed to prepare 1 pint of shampoo?

Key Points

- Remember to always match your units when setting up proportions
- Percent strength is represented as “_____ per 100”
- Whether using ratio or percent strength, you can always solve for quantity needed by setting up proportions

Topics to Cover

1. Units of measure and conversions
2. Ratio, proportions and percent strength
3. Stock solutions and alligation
4. Clinical-based calculations
5. Parenteral calculations

Stock Solutions

- Concentrated solutions used to prepare weaker ones
  - Diluting gives smaller concentration in higher volume for easier dosing
- General Rules:
  - Working with percent strength is typically easiest
  - May require multiple steps to be the most accurate

Liquids vs. Solids

- Liquid Dilutions:
  - Changes the concentration (↑ or ↓)
  - Usually know 3 of 4 necessary components
  - Proportion-based calculation is easiest
- Solid Dilutions:
  - Adding base to creams and ointments
  - Usually lowering the concentration

Using Proportions

\[
\frac{\text{volume of stock}}{\text{desired \% strength}} = \frac{\text{volume needed}}{\text{\% strength of stock}}
\]

OR

\[
\frac{\text{\% strength of stock}}{\text{desired \% strength}} = \frac{\text{volume of stock}}{\text{volume needed}}
\]
**Practice Problem #5**

How many milliliters of 1:500 w/v solution is needed to make 3 L of a 1:2000 w/v solution?

**Using Algebra**

\[ C_1 \times V_1 = C_2 \times V_2 \]

- \( C \) = strength (concentration)
- \( V \) = volume (quantity)
- Usually set up as **HAVE = WANT**
- Any units work as long as they match on either “side”
- **KEY CONCEPT:** base has a strength of 0%

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**Practice Problem #6**

If 200 mL of an 8% w/v potassium chloride solution is diluted to 1500 mL, what is the new percent strength of the diluted solution?

**Alligation**

- Two different types:
  - **Medial** ➔ for determining new % strength when combining multiple strengths of same ingredient
    - Completely math based
  - **Alternate** ➔ for determining volume needed to get new % strength
    - Visual/grid based

**Alligation Medial**

- Two ways to tackle
  1. Use total volume of solutions, total grams of ingredients in solution and set up proportion
  2. Convert percent strength into decimals and multiply by their volumes, then calculate new strength
- Both methods produce same answer 😊

**Alligation Medial**

What is the new percent strength when 100 mL of 50% dextrose is mixed with 250 mL of 40% dextrose and 450 mL of 70% dextrose?

1. Proportion:
2. Decimals:
Alligation Alternate

• Think of it as math “tic-tac-toe”

Key Points

• When working with stock solutions, using percent strength is generally easiest
• When using alligation alternate, correct set-up is key to success!
• Units and conversion factors apply to almost every scenario

Topics to Cover

1. Units of measure and conversions
2. Ratio, proportions and percent strength
3. Stock solutions and alligation
4. Clinical-based calculations
5. Parenteral calculations

Clinical Calculations

• Factors to consider:
  - Age
  - Weight
  - Body surface area (BSA)
  - Key organ function (liver, kidneys, etc)
• Common scenarios/drugs encountered:
  - Antibiotics
  - Chemotherapy

Practice Problem #7

How much 85% alligatormycin must be added to 150 mL of 60% alligatormycin to make an 80% solution?
Pediatrics

• Anyone under age of 18

<table>
<thead>
<tr>
<th>Category</th>
<th>Age Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Neonate</td>
<td>Birth – 1 month</td>
</tr>
<tr>
<td>Infant</td>
<td>1 month – 2 years</td>
</tr>
<tr>
<td>Child</td>
<td>2 years – 12 years</td>
</tr>
<tr>
<td>Adolescent</td>
<td>13 – 17 years</td>
</tr>
</tbody>
</table>

• 3 Common Mechanisms for Dosing:
  • Clark’s Rule
  • Young’s Rule
  • Weight-based dosing

Clark’s and Young’s Rule

• Clark’s Rule
  • Weight of patient and adult dose
  \[
  \text{weight (lbs)} \times \text{adult dose} = \text{child dose}
  \]

• Young’s Rule
  • Age of patient and adult dose
  \[
  \frac{\text{age}}{\text{age} + 12} \times \text{adult dose} = \text{child dose}
  \]

Practice Problem #8

A 6-year-old child weighs 42 lbs. The adult dose of an antibiotic is 375 mg. What is the child’s dose?

Calculate using both Clark’s and Young’s Rule

Practice Problem #9

A dose of enoxaparin sodium is 1 mg/kg Q 12h SC. If a prefilled syringe containing 80mg/0.8 mL is used, how many milliliters should be administered per dose to a 154-lb patient?

Weight-Based Dosing

• Given as dose per body weight of patient
  • Examples: milligrams per kilogram grams per pound
  • Most accurate way to dose for any patient
  • May be mg/kg/day OR mg/kg/dose
  • Pay attention to units and use conversions

Day Supply

• How long a prescription will last the patient
  \[
  \frac{\text{maximum amount used in 1 day}}{\text{total amount dispensed}}
  \]
  • What do you do in practice when the day supply ends up NOT being a whole number?
    • Round up?
    • Round down?
Day Supply

• What about prescriptions for topicals?
  • Fingertip unit (FTU)
• What about ear and eye drops?
  • 1 mL = ?? drops

Practice Problem #10

A patient has the following directions for their insulin:
15 units AC, 10 units QHS
You are dispensing two (2) 10-mL vials of insulin. How long will the vials last the patient?

Key Points

• PEDIATRICS DOSING
  • Clark’s and Young’s Rules can be used to estimate doses but may be inaccurate
• WEIGHT-BASED DOSING
  • Double check units of dosing before calculating
  • Always the most accurate dosing mechanism

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Common Calculations

• Flow rates
  • Given in milliliters per time [hour/min]
  
  \[
  \text{Volume (mL)} = \frac{\text{Rate}}{\text{Time (hr)}}
  \]
• Drop sets
  • Given in drops per time [hour/min]

Flow Rate

• Intravenous fluids must have rate of admin
  • Volume < 250mL = IV piggyback; run for set time
  • Volume ≥ 500mL = large volume; run continuously
• Your role= determining how many IV bags to make to last the patient
  • Usually for 24-hour period in hospital
Practice Problem #11

A 49-year old, 132-lb man is being started on octreotide for variceal bleeding. He is getting 50 mcg/hr and the drip contains 500 mcg of octreotide in 100 mL NS. What is the flow rate in mL/hr?

Challenge! 😊

A 1liter IV runs from 0700 to 1500.
A. What is the flow rate in mL/hr?
B. How much of the solution is remaining after 5 hours?
C. What is the drop rate (in mins) for a 15 gtt/mL tubing set?

Drop Set

- IV solutions given via tubing set
  - Each set has specific number of drops in 1 mL

<table>
<thead>
<tr>
<th>Common Tubing Set Drop Rates</th>
</tr>
</thead>
<tbody>
<tr>
<td>10 gtt/mL</td>
</tr>
<tr>
<td>15 gtt/mL</td>
</tr>
<tr>
<td>20 gtt/mL</td>
</tr>
<tr>
<td>60 gtt/mL (microdrip)</td>
</tr>
</tbody>
</table>

\[
gtts/min = \frac{\text{volume/hr}}{60 \min / \text{hr}} \times \text{drop rate}
\]

Practice Problem #12

An IV is being administered at 75 mL/hr. What is the drip rate in minutes for a 20 gtt/mL tubing set?

Key Points

- Institutional pharmacy uses military time for medication administration and duration
  - 0000 = midnight 1200 = noon 1800 = 6PM
- Flow rates are generally given in mL per hr
- Drip rates are generally given in gtt per min

Self-Assessment Question

Complete the following conversions:

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Self-Assessment Question

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B. 10 mL/hr
C. 50 mL/hr
D. 100 mL/hr

Questions?

References

- Zentz LC. Math for Pharmacy Technicians. Sudbury, MA: Jones and Bartlett Learning; 2010.