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## Conversion Table to be Memorized

### Conversion Table

<table>
<thead>
<tr>
<th>Metric Volume</th>
<th>Weights: Apothecary/ Household to Metric</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 L = 1000 mL</td>
<td>1 gr = 60 mg</td>
</tr>
<tr>
<td></td>
<td>15 gr = 1 g</td>
</tr>
<tr>
<td><strong>Metric Weight</strong></td>
<td></td>
</tr>
<tr>
<td>1000 mcg = 1 mg</td>
<td>2.2 lbs = 1 kg</td>
</tr>
<tr>
<td>1000 mg = 1 g</td>
<td></td>
</tr>
<tr>
<td>1000 g = 1 kg</td>
<td><strong>Solutions</strong></td>
</tr>
<tr>
<td></td>
<td>1 g per 100 mL = 1% solution</td>
</tr>
<tr>
<td></td>
<td>25 g per 100 mL = 25% solution</td>
</tr>
<tr>
<td><strong>Length</strong></td>
<td></td>
</tr>
<tr>
<td>1 inch = 2.5 cm</td>
<td>100 g per 100 mL = 100% solution</td>
</tr>
</tbody>
</table>

### Liquids

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1 mL = 1 cc</td>
<td>15 mL = 3 tsp</td>
<td>2 c = 1 pt</td>
</tr>
<tr>
<td>1 mL = 15 gtts</td>
<td>15 mL = 1 Tbs</td>
<td>1000 mL = 1 qt</td>
</tr>
<tr>
<td>1 mL = 15 mins</td>
<td>30 mL = 1 oz</td>
<td>32 oz = 1 qt</td>
</tr>
<tr>
<td>1 mL = 60 microdrops</td>
<td>1 Tbs = 3 tsp</td>
<td>1 L = 1 qt</td>
</tr>
<tr>
<td>4 mL = 1 dram</td>
<td>8 dram = 1 oz</td>
<td>1 L = 1000 mL</td>
</tr>
<tr>
<td>5 mL = 1 tsp</td>
<td>240 mL = 1 c</td>
<td>4 qt = 1 gal</td>
</tr>
<tr>
<td></td>
<td>500 mL = 1 pt</td>
<td></td>
</tr>
</tbody>
</table>
Conversions: Metric, Apothecary, and Household System

Converting from one unit to another using the conversion factor method

- Recall the equivalents
- Multiply or divide

Rule to convert from a larger to a smaller unit measurement, multiply by the conversion factor.

Think: “Larger is going down to smaller, so you will multiply.”

Larger ↓ Smaller → Multiply (X)

Example: How many cups are in 3 quart? You know that 1 quart = 4 cups. Cups are smaller than quarts. THINK: LARGER ↓ SMALLER → MULTIPLY (X)

The conversion Factor is 4 cups /1 quart

Multiply by the conversion factor

Quarts (larger unit) X conversion factor (cups/qt) = cups (smaller unit)

3 qt X 4 cups/qt = 12 cups

Rule to convert from a smaller to a larger unit of measurement, divide by the conversion factor.

THINK: “Smaller is going to larger, so you will divide.” Smaller ↑ Larger → Divide (÷)

Example: How many quarts are in 8 cups?

You know that 1 qt = 4 cups. The conversion factor is 4 cups/1 quart. Quarts are larger than cups. Divide by the conversion factor because it takes fewer of the quart unit to equal the same amount of the cup unit. THINK: SMALLER ↑ LARGER → Divide (÷) 8 cups ÷ 4 cups/qt = 2 qt
Things to consider when Drug Calculation Problems require Conversions

1. Look at what is available and what you want to give. Ask yourself the question, “Are the drugs in the same units of measure?”

2. If the drugs are not in the same units of measure, convert one.

3. *It is best to convert to the metric system*, since it is a decimal system and you will not have to deal with fractions.

4. Sometimes you must convert within the same system of measure to make like units. Example: grams to milligrams.

5. Two steps.

   A. *Convert the dose from the system in which it is ordered to the system in which it is available.*

   B. *Calculate the amount needed to obtain the desired dose.*
Practice Problems 2-2:

Directions: Convert the following weights by moving the decimal point. The answers to the problems can be found at the end of the chapter.

1. 0.5 g = ___________ mg
2. 4 kg = ___________ lb
3. 225 mg = ___________ g
4. 1,555 mcg = __________ mg
5. 0.125 mg = __________ mcg
6. 0.008 g = __________ mg
7. 0.1 mg = __________ mcg
8. 0.02 g = __________ mg
9. 3,000 mL = __________ L
10. 0.15 L = _______ mL
11. 100 mL = _______ L
12. 2.5 L = _______ mL
13. 775 mL = _______ L
14. 0.6 L = _______ mL
15. gr v ss = __________ mg
16. gr vii ss = __________ g
17. 300 mg = gr __________
18. gr 1/150 __________ mg
19. 90 mg = gr __________
20. 400 mcg = gr __________

The answers to the problems can be found at the end of the booklet.
Drug Calculation

(Calculation of Oral and Parenteral Medication)

To prepare you to calculate medication doses, one way is to use the 3 step approach. The three steps are:

1. Convert
2. Compute
3. Critically think

*Step 1: Convert – make sure the medication dose ordered is in the same system of measurement and measurement unit as the medication available.*

For Example: If a medication was ordered in grains and the medication is available in milligrams, you would need to convert the ordered medication to milligrams.

Physician order: Codeine gr ss p.o. every 4 hours for pain prn.

Supply: Codeine 30 mg per tablet

To solve the problem, first you would have to convert gr ss to 30 mg

*Step 2: Compute, computing requires you to determine the data needed to solve the dose problem, to set up the problem correctly and to calculate an answer. Use a formula method or ratio proportion method to solve the problem.*

*Step 3: Critically Think: critical thinking requires you to ask yourself if the answer you obtained seems correct, logical, and sensible.*

Also ask yourself:

- Is there to many tablets or capsules to be giving at one time?
- Dose the dose seem too small or too large for a safe dose?

If so, do not give the medication and then re-evaluate your calculations.
The formula Method: is one method used for calculating medication doses.

\[ D \times V = A \]

\[ H \]

\(D\) = Desired
\(H\) = dosage of medication available or on hand
\(V\) = volume that the medication is available, such as one tablet or milliliter
\(A\) = amount of medication to administer

An example: Medication Order: Erythromycin 750 mg
Medication Available: Erythromycin 250 mg tablets

Example: 1

\[
\frac{750 \text{ mg}}{250 \text{ mg}} \times 1 \text{ tablet} = 1.5 \text{ tablet}
\]

Example: 2

Medication ordered: Pepcid 20 mg oral suspension p.o. b.i.d.
Medication available: Pepcid oral suspension 40 mg/5 mL

\[
\frac{20 \text{ mg}}{40 \text{ mg}} \times 5 \text{ mL} = 2.5 \text{ mL}
\]

The Rule for Maximum Dosage Volume to be Administered Per Intramuscular Injection

- An average 150 lb adult = 3 mL (maximum for deltoid site is 2 mL)
- Children age 6 to 12 years = 2 mL
- Birth to 5 years = 1 mL

The Rule for Rounding Parenteral Dosages

- Round the amount to be administered \((X)\) to tenths if the amount is greater than 1 mL, and measure in a 3 mL syringe.
- Measure amounts of less than 1 mL rounded to hundredths and all amounts less than 0.5 mL in a 1 mL syringe.
- Amounts of 0.5 to 1 mL, calculated in tenths, can be accurately measured in either a 1 mL or a 3 mL syringe.
- Never round a Heparin calculation amount, measure accurately in a 1 mL syringe.
Practice Problems: 2-3

1. Medication order: Phenobarbital gr 1½  
   Medication available: Phenobarbital 60 mg/mL  
   Give: ______________________

2. Medication order: Furosemide 60 mg  
   Medication available: Furosemide 100 mg/mL  
   Give: ______________________

3. Medication order: Digoxin 0.125 mg  
   Medication available: Digoxin 0.05 mg/mL  
   Give: ______________________

4. Medication order: Gantrisin 1.5 mg  
   Medication available: 0.5 mg per tablet  
   Give: ______________________

5. Medication order: Versed 4 mg  
   Medication available: Versed 10 mg/2 mL  
   Give: ______________________

   Medication available: Hytrin 5 mg capsules  
   Give: ______________________

7. Medication order: Prednisone solution 40 mg  
   Medication available: Prednisone 5 mg/1mL  
   Give: ______________________

8. Medication order: Heparin 6000 units SubQ  
   Medication available: Heparin 10,000 units/mL  
   Give: ______________________

9. Medication order: Capastat 0.6 g IM  
   Medication available: Capastat 1 g/1.5 mL  
   Give: ______________________

10. Medication order: AquaMEPHYTON gr %  
    Medication available: AquaMEPHYTON 2 mg/mL 
    Give: ______________________

The answers to the practice problems can be found at the back of the booklet.
Preparing Parenteral Medications from Drugs supplied as a Powder
(Reconstitution)

On the drug label or the package insert will state the diluents to be used and the exact amount to be added. When adding a solution or diluents to the powder, you will notice that the directions will state the volume and dose after the solution has been added.

For example, the directions may read to add 1.8 mL of normal saline to a vial and when added to the powder, the solution contains a total of 2 mL, and after reconstitution the vial contains 250 mg/mL. The reconstituted amount is what you would use to solve the dose amount. In this case 250 mg/mL is the dosage supply amount you would use to solve this problem.

Use the formula method:

A patient is to receive Penicillin 200 mg IV every 6 hours. The label on the vial reads: add 1.8 mL of sterile water diluents. On the label it states, after reconstitution the vial will contain 250 mg/mL (the dosage supply amount).

Use the formula method to calculate the dose:

\[ \text{D} \times \text{V} = \text{A} \]

\[ \begin{align*}
\text{H} & = 200 \text{ mg} \\
250 & = 1 \text{ mL}
\end{align*} \]

You would prepare 0.8 mL to administer in the IV to your patient.

Practice Problems: 2-4

1. Synthroid 150 mcg intravenous is ordered daily. After reconstitution the vial contains a total of 5 mL and there is 100 mcg/mL.
   Give: ____________

2. Cefazolin sodium 250 mg IV every 8 hours. Reconstitute with 2.5 mL sterile normal saline. After reconstitution the vial contains 225 mg/mL.
   Give: ____________

3. Ampicillin 250 mg IM every 12 hours is ordered. After reconstitution there is 125 mg/mL.
   Give: ____________

4. Cefazolin sodium 125 mg IV every 12 hours is ordered. After reconstitution the vial contains 225 mg/mL.
   Give: ____________

5. Ampicillin 350 mg IM is ordered daily. After reconstitution with 3.5 mL of sterile water, the vial contains a total of 500 mg/mL.
   Give: ____________

The answers to the practice problems can be found at the back of the booklet.
Pediatric Calculations

Accuracy is always important when calculating and administering medications. For infants and children, accuracy takes on a greater importance. A miscalculation may be dangerous due to the small body size, weight, and body surface area of the infant or child. In addition, infants and children differ in their rate of drug absorption, distribution, metabolism, and excretion when compared to adults. It is vital to follow pediatric protocols and guidelines, and use references to verify medication orders to ensure that drug dosages are correct. The safe dose range (SDR) is the upper and lower limits of the dose range as stated by the drug manufacturer and is reported in an approved drug reference. The safe dose range is usually expressed in milligrams per kilograms (mg/kg) of body weight. When preparing to administer a drug to a child, you must first calculate the daily (24 hour) drug dose ordered by the physician based on kilograms of body weight, and then verify the calculated dose with the range stated in an approved drug reference. Each prescribed dose of medication for a child must be calculated, and you must check the prescribed dose against the SDR to make sure that it is an acceptable safe dose for the child.

Two methods are used to calculate pediatric dosages

- Body weight using mg/kg
- Body surface area (BSA)

The method we will be using is the formula method using the body weight (mg/kg)

**Formula Method**

*Example: Your patient weighs 40 pounds and the physician has ordered Ceclor by mouth every 8 hours.*

**Step 1: Convert**  
First, convert the child’s weight into kilograms by dividing the child’s weight in pounds by 2.2

The formula is:

2.2 lbs = 1 kg

The child’s weigh is 40 lbs, so divide:

40 lb divide by 2.2 lbs/kg = 18.18 kg
Step 2: Compute
Now determine the medication dose for the SDR using a calculator and the current pediatric recommendations. Multiply the minimum dose by the weight of the child in kilograms to determine the medication dose. Then, take the maximum dose times the weight of the child in kilograms to get the safe range. Finally, compare the 24 hour prescribed dose with the recommended SDR found in an approved drug reference.

The drug order:
Ceclor suspension 200 mg orally every 8 hours
Medication available:
Ceclor suspension 125 mg/5 mL
Child weight: 40 pounds (18.18 kg)
The SDR is 6.7 to 13.4 mg/kg every 8 hours

Minimum safe range: 18.18 kg X 6.7 mg = 121.8 mg

Maximum safe range: 18.18 kg X 13.4 mg = 243.6 mg

The safe dose range is 121.8 to 243.6 mg every 8 hours. Therefore, 200 mg every 8 hours is a safe dose.
To calculate the medication dose using the available Ceclor suspension, 125 mg/5 mL
\[
\text{D} \times V = \frac{200 \text{ mg}}{5 \text{ mL}} = \frac{1000 \text{ mL}}{125} = 8 \text{ mL}
\]
The answer to the problem is 8 mL

Step 3: Critically Think
Ask yourself – Does this answer seem logical, correct, and plausible?
This answer is reasonable and plausible in that it meets the safe standard for the amount of liquid medication given at this time.

Rounding off Children’s Dosages and Weights
Generally, when caring for children, calculations are carried out to the nearest thousandth (three digits to the right of the decimal- 0.000) and rounded to the nearest hundredth (two digits to the right of the decimal – 0.00). However, when the medication is more than 1 mL, calculate to the nearest hundredth and round to the nearest tenth.
If the dosage is 1 mL or more, calculate to the hundredth place (0.00) and round to the nearest tenth (0.0)

If the dosage is less than 1 mL, calculate thousandths (0.000) and round off to the nearest hundredth (0.00), a tuberculin syringe is used to measure the dosage in hundredths.

CALCULATIONS USING mg/kg FOR WEIGHT STATED IN POUNDS AND OUNCES
Sometimes the weight is stated as pounds and ounces (10 lbs 2 oz). In that case, the ounces must be changed to pounds, and then the pounds can be converted to kilograms.

Step 1 Convert
First change the ounces to pounds
Conversion equivalent: 1 lb = 16 oz
2 oz divide by 16 oz = 0.125 pound
Add the computed pounds amount to the total pounds as follows:
10 lbs + 0.125 lbs = 10.125 lbs

Therefore, the child weighs 10.125 pounds. Next, convert the total weight to kg: 10.125 lb divide by 2.2 lbs/kg = 4.60 (4.6) kg (must drop trailing zero)
The child’s weight in kilogram is 4.6 kg

When converting pounds (lbs) to kilograms (kg), calculate to the thousandth place and then round to nearest hundredths.

Say if the prescriber ordered Amoxicillin 50 mg by mouth every 8 hours. With the above calculation, the child weight is 4.60 (4.6) kg, must drop trailing zero. The drug reference states that the dose for children’s 20-40 mg/kg/24 hours. You must determine the safe dose per day and per dose.

To set up the problem:
4.6 kg X 20 mg = 92 mg minimum per day
4.6 kg X 40 mg = 184 mg maximum per day

92 mg divide by 3 doses/day = 30.7 mg minimum per dose
184 mg divide by 3 doses/day = 61.3 mg maximum per dose

Therefore, Amoxicillin 50 mg per dose is a safe amount to give.
Practice Problems: 2-5

1. Order: Ceclor suspension 250 mg orally every 8 hours
   Supply: Ceclor suspension 125 mg/5 mL
   Wt: 50 pounds   =   _______________________kg
   SDR- 6.4 to 13.5 mg/kg every 8 hours
   Calculate the SDR
   Is it safe? ______________ If safe what to administer. ______________
   If not safe, what would you do? ________________________________
   2. Order: Lasix Liquid 20 mg by mouth daily.
   Supply: Lasix liquid 40 mg/5 mL
   Child weight: 50 lbs
   The SDR is 2 – 4 mg/kg p.o. daily
   What is the weight: ___________kg?
   What is the minimum SDR? __________
   What is the Maximum SDR? __________
   Is the dose ordered safe? __________
   If so, how much would you administer? __________
   If not, what would you do? ________________________________
   3. Order: Ibuprofen 60 mg p.o. every 6 hours
   Supply: Ibuprofen suspension 100 mg/5 mL
   Child weight: 26 pounds   __________kg
   The safe dose range is 5- 10 mg/kg every 6-8 hours for a maximum of 40 mg/kg/day
   What is the safe dose range Minimum _________________ dose?
       Maximum _________________ dose
       Minimum _________________ daily
       Maximum _________________ daily
   Is the dose safe? ______________ If so, how much would you administer? ________
   If not, what would you do? ________________________________
   4. Order: Morphine 2 mg subcutaneous every 6 hours
   Supply: Morphine 1mg/mL for subcutaneous injection
   Child weighs 46 lbs ______________kg
   The SDR is 0.1 mg to 0.2 mg/kg/day in 4 divided doses
   What is the safe range Minimum ______________ daily?
       Maximum ______________ daily
       Minimum ______________ dose
       Maximum ______________ dose
   Is the dose safe? ______________ If so, how much would you give? __________
   If not, what would you do? ________________________________
   5. Order: Phenobarbital 10 mg p.o. every 12 hours
   Supply: Phenobarbital 15 mg/5 mL
   Child weighs 38 pounds ______________kg
   The SDR is 1 to 6 mg /kg in two divided doses not to exceed 100 mg/day
   What is the safe range Minimum ______________daily?
       Maximum ______________ daily
       Minimum ______________ dose
       Maximum ______________ dose

The answers to the practice problems can be found at the back of the booklet
Intravenous fluids (IV) Administration

Intravenous fluids can be administered two ways by:

- **Gravity** - is used for short term IV therapy and when precise hourly intake is not absolutely critical.
- **Electronic Pump** - is used when precise maintenance of hourly intake is critical for titration of drugs, secondary IVPB’s, and for any central line infusion.

Gravity Flow

- The IV bag must hang higher than the patient’s heart and the higher the bag is hung the faster the IV will flow.
- The roller clamp is adjusted to regulate the rate of flow.
- IV fluids that run by gravity must be checked hourly or more often for readjustment of the infusion rate.
- The infusion rate can vary considerably with changes of position, from running too fast to not running at all. Gravity IV’s are “positional”.

Nurses responsibilities for IV flow rates for gravity:

- **Determine the number of milliliters per hour that the patient should receive.**
- **Determine the drop factor of the IV tubing.**
- **Calculate the IV flow rate from mL per hour to drop per minute.**
- **Observe the drip chamber and regulate the rate of flow with the roller clamp until the number of drops per minute is correct. Count the number of drops for one minute.**
- **Check the infusion rate hourly or more frequently if necessary.**
Drop Factor:
The drop factor is the number of drops per mL and depends on the size of the opening in the drip chamber; IV tubing is not all alike. Tubing comes in various drop factors. The drop factor is indicated on the IV tubing package and varies from one company to another.

**Macrodrip Tubing:**
Examples of 3 sizes of Macrodrip Tubings
Some IV drip chambers deliver 10 drops per mL, others 12 drops per mL and others 15 drops per mL. The amounts below are all considered macrodrops. *Macrodrip means a large drop.* Large amounts of IV fluids are administered in macrodrops. A general rule when administering more than 100 mL per hour is to select a macrodrip tubing.

**Microdrip Tubing:**
A microdrip chamber delivers 60 drops per mL. Most electronic pump rates are set by mL per hour.
To Solve IV Drip Rate

METHOD: FORMULA
Calculation of IV Drip Rate Using an Electronic Pump
Solve: The physician orders 1 L of D5 W over 12 hours
Formula mL/hour:
\[
\text{Total Volume to infuse (mL)} = \frac{\text{mL/h}}{\text{Time (h)}}
\]
\[
1 \text{ L} = 1000 \text{ mL}
\]
\[
\frac{1000 \text{ mL}}{12} = 83 \text{ mL/hour}
\]
In summary, the electronic pump infusion rate must be set at 83 mL/hour.

METHOD: FORMULA
Calculation of IV Drip Rate Using Gravity Flow
The physician orders 1 liter of D5 W over 12 hours (83 mL/hr)
Drop factor 12 drops = 1 mL
Formula: Flow rate drops/minute
\[
\text{Volume in mL/h} \times \text{drop factor} = \text{Flow rate in drops per minute}
\]
\[
\frac{83 \times 12}{60} = 996 = 16.6 \text{ or } 17 \text{ drops per minute}
\]
In summary, 17 drops per minute will deliver 83 mL per hour.
METHOD: FORMULA

IV FLOW RATES FOR PIGGYBACK MEDICATION PER GRAVITY.

The patient is to receive Zincef 1 g in 50 mL D5W over 30 minutes

Formula:
Volume in mL X drop factor = Flow rate in drops/minute
Time in minutes

\[
50 \text{ mL} \times 15 \text{ gtts} = 750 = 25 \text{ gtts per minute}
\]
\[
30 \text{ minutes} \quad 30
\]

In summary, 25 gtts per min will deliver 50 mL D5W over 30 minutes.

METHOD FORMULA:
Calculating The Infusion Time

EX. 1000 mL of D5W is to infuse at 125 mL/hour. How many hours will it take for this liter of fluid to be completed?

Formula for Infusion Time
Total volume to infuse = Infusion time (h)
\[
1000 \text{ mL} = 8 \text{ hours}
\]

125 mL/h

In summary, 1000 mL at 125 mL/hour will take 8 hours.
Calculating IV Infusion Time

To calculate the total infusion time:

Total volume = Total hours/mL/h

Example 1
LR 1,000 mL IV to run at 125 mL/h. How long will this IV last?
1,000 mL = 8 hours
125 mL/h

Example 2
D5W 1,000 mL IV to infuse at 60 mL/h to begin at 0600. At what time will this IV be completed?
1,000 mL = 16.6 h = 16 2/3 h; 2/3 hX60 min/h = 40 min; Total time: 16 hour 40 min
The IV will be completed at 0600+ 1640 = 2240 (or 10:40 P.M.)

You can also determine the infusion time if you know the volume, flow rate in gtt/min, and drop factor: Calculate the infusion time by using the \( V \times C = R \) formula; \( T \), time in minutes, is unknown.
Use the formula method to calculate time (T):
\[
V \times C = R \\
T
\]
Remember Time (T) is the unknown (use X in your formula)
Rule for Calculating IV Fluid Time and Volume

The formula to calculate IV infusion time, when mL is known:

- **Total Volume** = Total hours mL/h

- The formula to calculate IV infusion time, when flow rate in gtt/min, drop factor, and volume are known: \( \frac{V \times C}{T} = R \); \( T \) is the unknown

- The formula to calculate total infusion volume, when mL/h are known:
  \( \text{Total hours} \times \text{mL/h} = \text{Total Volume} \)

- The formula to calculate IV volume, when flow rate (gtt/min), drop factor, and time are known:
  \( \frac{V \times C}{T} = R \); \( V \) is the unknown.

Practice Problems 2-6: Calculate the infusion time and rate (as requested)

1. Order: D5W 500 mL IV at 30 gtt/min
   Drop factor: 20 gtt/mL
   Time:_______h and _______min

2. Order: D5 Lactated Ringer’s 800 mL at 25 gtt/min
   Drop factor: 15 gtt/mL
   Time:_______h and _______min

3. Order: Normal Saline120 mL IV to run at 20 mL/h
   Drop factor: 60 microdrops/mL
   Time_______h Flow rate_______gtt/min

Calculate the completion time and the complete infusion time

4. At 1600 hours the nurse started Lactates ringers 1200 mL at 27 gtt/min. The Drop factor 15 gtt/mL.
   Infusion time: __________h
   Completion time________

5. At 1530 hours the nurse starts D5W 2,000 mL IV to run at 125 mL/h. The infusion set used is calibrated for a drop factor of 10 gtt/mL.
   Infusion time: _______ h Completion time_______
Complete the total volume (mL) to be infused per 24 hours

6. An IV is flowing at 12 gtt/min and the Infusion set has a drop factor of 15 gtt/mL.
   Total volume: __________ mL per 24 hour

7. An IV of D5 W is flowing at 21 gtt/min and the infusion set has a drop factor of 10 gtt/mL.
   Total Volume:___________mL per 24hour

Calculate total volume and time

8. Order: 0.45% NaCl IV at 45 gtt/min for 4 h.
   Drop factor: 20 gtt/mL
   Infusion Time:______________min
   Volume:___________________ mL

9. Order: D5W IV infusing at 150 mL/h for 2 hour
   Volume :______________mL
   Infusion Time:______________ min

10.Order: D5 LR IV at 75 mL/h for 8 h
    Volume: ______________mL
    Infusion Time: ____________min
Practice Problems: 2-7

Calculate the infusion rate first for gravity flow and then for electronic infusion pump. Round off the answer to the nearest whole number.

1. The physician orders 1000 mL of D5W over 8 hours.

   Drop Factor: 12 drops = 1 mL
   a. The IV is infused by gravity.
      Calculate the flow rate in drops/min
      _______________________
   b. The IV is infused by pump. Calculate the flow rate in mL/h
      _______________________

2. Order: D5W 3,000 mL IV at 125 mL/h
   Drop Factor: 10 gtt/mL
   _____________ gtt/min

3. Order: LR 250 mL IV at 50 mL/h
   Drop Factor: 60 gtt/mL
   _____________ gtt/min

4. Order: Hyperalimentation solution 1,240 mL IV to infuse in 12 hours
   Drop factor: 15 gtt/mL
   _____________ gtt/min
   _____________ mL/hr

5. Order: D5 0.45% NaCl 1,000 mL IV to infuse over 8 hour
   Drop factor: On electronic infusion pump
   Flow rate: _____________mL/h
6. Order: 100 mL IV antibiotic to infuse in 30 minutes via pump
   Flow rate: ___________ mL/h

7. Order: 50 mL IV antibiotic to infuse in 20 min via pump
   Flow rate: _________ mL/h

8. Order: 150 mL IV antibiotic to infuse in 45 minutes via pump
   Flow rate: _________ mL/h

9. Order: D5W 1,500 mL IV for 12 h
   Drop factor: 15 gtt/mL
   Flow rate: ___________ mL/h
   Flow rate: ___________ gtt/min

10. Order: Theophylline 0.5 g IV in 250 mL D5W to run for 2 h by infusion pump
    Drop Factor: 60 gtt/mL
    Flow rate: ___________ mL/h
    Flow rate: ___________ gtt/min

The answers to the problems is located in the back of the booklet
Critical Care IV Calculations

IV Heparin
- Heparin is an anticoagulant for the prevention of clot formation
- It is measured in USP units. IV Heparin is frequently ordered in units per hour (units/h) and should be administered by an IV pump.
- For precautions the Heparin order, dosage, vial, and amount to give should be checked by another nurse before administration.

Calculating Safe IV Heparin Flow Rate
When IV Heparin is ordered in units/h, use \( \frac{D \times Q}{H} = R \) (mL/h)

Rule
To calculate IV heparin flow rate in mL/h:
\( \frac{D}{H} \times \frac{Q}{Q} = \frac{R}{Q} \) (mL you have available) = \( \frac{R}{Q} \) (mL/h rate)

Note: This rule applies to drugs ordered in units/h, milliunits/h, mg/h, mcg/h, g/h, or meq/h.

In the formula \( \frac{D \times Q}{H} = R \) (mL/h):
- \( D \) = Dosage desired: units/h
- \( H \) = Dosage you have available: units
- \( Q \) = Quantity of solution you have available: mL
- \( R \) = Flow rate: mL/h

Example 1:
Order: D5W 500 mL with Heparin 25,000 units IV at 1,000 units/h
What is the flow rate in mL/h?
Calculate the flow rate in mL/h, which will administer 1,000 units/h
\( D \times Q = \frac{1,000 \text{ units/h}}{25,000 \text{ units}} \times 500 \text{ mL} = \frac{R}{50} \) (mL/h)
\( H \)
\( 25,000 \text{ units} \)
\( 1,000 \text{ units/h} \times 500 \text{ mL} = 1,000 \text{ mL/h} = 20 \text{ mL/h} \)
\( \frac{25,000 \text{ units}}{50} \)

Example 2:
Order: D5W 500 mL with Heparin 25,000 units IV at 850 units/h
Calculate the flow rate in mL/h
\( D \times Q = \frac{850 \text{ units/h}}{25,000 \text{ units}} \times 500 \text{ mL} = \frac{850 \text{ mL/h}}{50} \) = 17 mL/h
\( H \)
\( 25,000 \text{ units} \)
\( 50 \)
Critical Care IV Calculations: Calculating Flow Rate of an IV Medication to be given over a Specified Time Period

IV Medication Ordered per Minute

Rule:
To determine the flow rate (mL/h) for IV medications ordered per minute (such as mg/min):

Step 1: Calculate the dosage in mL/min

\[ D \times Q = R \text{ (mL/min)} \]

Step 2: Calculate the flow rate of the quantity to administer in mL/h:

\[ \text{mL/min} \times 60 \text{ min/h} = \text{mL/h} \]

In the formula \[ D \times Q = R \text{ (mL/min)} \]

\[ D = \text{Dosage desired: mg/min} \]

\[ H = \text{Dosage you have available: mg} \]

\[ Q = \text{Quantity of solution you have available: mL} \]

\[ R = \text{Flow rate: mL/min} \]

Example #1:
Order: Lidocaine 2 g IV in 500 mL D5W at 2 mg/min via infusion pump. You must prepare and hang 500 mL of D5W IV solution that has 2 g of Lidocaine added to it. Then, you must regulate the flow rate so the patient receives 2 mg of lidocaine every minute. Determine the flow rate in mL/h.

Step 1. Calculate mL/min

Apply the formula \[ D \times Q = R \text{ (mL/min)} \]

\[ D = \text{dosage desired} = 2 \text{ mg/min} \]

\[ H = \text{dosage you have available} = 2 \text{ g} = 2,000 \text{ mg} \]

\[ Q = \text{quantity of available solution} = 500 \text{ mL} \]

\[ D \times Q = \frac{2 \text{ mg/min} \times 500 \text{ mL}}{2,000 \text{ mg}} = R \text{ (mL/min)} \]

\[ 0.5 \text{ mL/min} \]

Step 2: Determine the flow rate in mL/h. You know there are 60 minutes per hour, so you can multiply by 60 min/h.

\[ \text{mL/min} \times 60 \text{ min/h} = \text{mL/h} \]

\[ 0.5 \text{ mL/min} \times 60 \text{ min/h} = X \text{ mL/h} \]

\[ 30 \text{ mL/h} \]

Regulate the flow rate to 30 mL/h to deliver 2 mg/min of lidocaine that is prepared at the concentration of 2 g per 500 mL of D5W IV solution.
IV Medication Ordered per Kilogram per Minute

An electronic infusion device is always used to administer fluids mL/hour. To determine the flow rate (mL/h) for IV medications ordered per minute (such as mg/kg/min):

1. Convert to like units, such as mcg to mg, lb to kg
2. Calculate desired dosage per minute: mg/kg/min x kg = mg/min
3. Calculate the dosage flow rate in mL/min:
   \[
   \frac{D \times Q}{H} = \text{R (mL/min)}
   \]
4. Calculate the flow rate in mL/h of the volume to administer per minute: mL/min X 60 min/h = mL/h

Example:
Order: 250 mL of IV solution with 225 mg of a medication to infuse at 3 mcg/kg/min via infusion pump for a person who weighs 110 lbs.
Determine the flow rate in mL/h
Step 1. Convert mg to mcg: 1 mg = 1,000 mcg; 225 mg = 225,000 mcg
   Convert lb to kg: 1 kg = 2.2 lb; 110 lb = 50 kg
Step 2. Calculate desired mcg/min.
   3 mcg/kg/min X 50 kg = 150 mcg/min
Step 3. Calculate mL/min
   \[
   \frac{D \times Q}{H} = \frac{150 \text{ mcg/min} \times 250 \text{ mL}}{225,000 \text{ mcg}} = \frac{150 \text{ mL/min}}{900} = 0.166 \text{ mL/min} = 0.17 \text{ mL/min}
   \]
Step 4: Calculate mL/h. You already know that 1 hour = 60 min.
   mL/min X 60 min/hour = 0.17 mL/min X 60 min/hour
   = 10.2 mL/h = 10 mL/h
   The rate is 10 mL/h
Practice Problems: 2-8

1. Order: Thiamine 100 mg per Liter of D5 W IV to infuse at 5 mg/h
   ____________ mL/h

2. Order: A patient is to receive D5W 500 mL with Heparin 20,000 units at 1,400 units/h
   ________________ mL/h

3. Order: Xylocaine 1 g IV in 250 mL D5W at 3 mg/min.
   ________________ mL/h

4. Order: Dobutamine 250 mg IV in 250 mL D5W to infuse at 5 mcg/kg/min. Pt weighs 80 kg.
   ________________ mL/h

5. Order: Cardizem 250 mg in 250 mL of 0.9 % NaCl to infuse at 10 mg/hour
   ________________ mL/hr

6. Order: Dopamine 400 mg in 250 mL of 5% dextrose and water infusing at 9 mL/hour. The patient wt. 92 kg. How many mcg/kg/min is the patient receiving?
   __________ mcg/kg/min
   __________ mcg/hour
   __________ mg/min
   __________ mg/hour

7. Order: Morphine sulfate 100 mg in 100 mL of 0.9% NaCl infusing at 3 mL/hour. How many mg/hour is the patient receiving?
   ________________ mg/hour
   ________________ mg/min
   ________________ mcg/hour
   ________________ mcg/min
8. Order: Nitroprusside 100 mg in 250 mL of 0.9% NaCl infusing at 65 mL/hour. The patient weighs 72 kg. How many mcg/kg/min is the patient receiving?

_______________ mcg/kg/min
_______________ mcg/hr
_______________ mg/min
_______________ mg/hr

9. Neo – Synephrine 50 mg in 250 mL of 5% dextrose in water infusing at 36 mL/h. How many mcg/min is the patient receiving?

_______________ mcg/min
_______________ mcg/hr
_______________ mg/min
_______________ mg/hr

10. Dopamine 400 mg in 250 mL of 5% dextrose in water infusing at 35 mL/hour. The patient weighs 67 kg. How many mcg/kg/min is the patient receiving?

_______________ mcg/kg/min
_______________ mcg/hr
_______________ mg/min
_______________ mg/hr

The answers to the problems can be found at the end of the booklet.
Practice Problem Answers

Practice Problems Answers: 2-2
1. 500 mg
2. 8.8 lb
3. 0.225 g
4. 1.555 mg
5. 125 mcg
6. 8 mg
7. 100 mcg
8. 20 mg
9. 3 L
10. 150 mL
11. 0.1 L
12. 2500 mL
13. 0.775 L
14. 600 mL
15. 330 mg
16. 0.5 g
17. gr 5
18. 0.4 mg
19. gr 1.5
20. gr 0.006666

Practice Problems Answers: 2-3
1. 1.5 mL
2. 0.6 mL
3. 2.5 mL
4. 3 tablets
5. 0.8 mL
6. 3 capsules
7. 8 mL
8. 0.6 mL
9. 0.9 mL
10. 5 mL
Practice Problems Answers: 2-4
1. 1.5 mL
2. 1.1 mL
3. 2 mL
4. 0.56 mL
5. 0.7 mL

Practice Problems Answers: 2-5
1. 22.73 kg: 145.5 mg- 306.9 mg: yes: 10 mL
2. 22.73 kg: 45.5 mg: 90.9 mg: No: I would not administer any medication: Call the MD to verify order
3. 11.82 kg: 59.1 mg: 118.2 mg: 236.4 mg:472.8 mg: Yes: 3 mL
4. 20.9 kg: 2.1 mg: 4.2 mg: 0.53 mg: 1.1 mg: No: I would not administer any medication: Call the MD to verify order
5. 17.27 kg: 17.2 mg: 103.6 mg: 8.6 mg: 51.8 mg

Practice Problems Answers: 2-6
1. 5 h: 33 min
2. 8 h
3. 6h 20 min
4. 11 h 7 min: 0300 the next morning
5. 16 h: 0730 the next morning
6. 1,152 mL
7. 3024 mL
8. 240 min: 540 mL
9. 300 mL: 120 min
10. 600 mL: 480 min
Practice Problems Answers: 2-7
1. 25 gtt/min: 125 mL/hr
2. 21 gtt/min
3. 50 gtt/min
4. 26 gtt/min: 103 mL/hr
5. 125 mL/hr
6. 200 mL/hr
7. 150 mL/hr
8. 200 mL/hr
9. 125 mL/hr: 31 gtt/min
10. 125 mL/hr: 125 gtt/min

Practice Problems Answers: 2-8
1. 50 mL/hr
2. 35 mL/hr
3. 45 mL/hr
4. 11 mL/hr
5. 10 mL/hr
6. 2.6 mcg/kg/min: 14400 mcg/hr: 0.24 mg/min: 14.4 mg/hr
7. 3 mg/hr: 0.05 mg/min: 3000 mcg/hr: 50 mcg/min
8. 6 mcg/kg/min: 26000 mcg/hr: 0.43 mg/min: 26 mg/hr
9. 120 mcg/min: 7200 mcg/hr: 0.12 mg/min: 7.2 mg/hr
10. 13.9 mcg/kg/min: 56000 mcg/hr: 0.9333 mg/min: 56 mg/hr
### Official “Do not use” List
Approved by Joint Commission

<table>
<thead>
<tr>
<th>Do not Use</th>
<th>Potential Problem</th>
<th>Use instead</th>
</tr>
</thead>
<tbody>
<tr>
<td>U 9unit)</td>
<td>Mistaken for “0” (zero), the number “4” (four) or “cc”</td>
<td>Write “unit”</td>
</tr>
<tr>
<td>IU (International Unit)</td>
<td>Mistaken for IV (intravenous) or the number 10 (ten)</td>
<td>Write “International Unit”</td>
</tr>
<tr>
<td>Q.D., QD, q.d., qd (daily) Q.O.D, QOD, q.o.d, qod (every other day)</td>
<td>Mistaken for each other Period after the Q mistaken for “I” and the “Q” mistaken for “I”</td>
<td>Write “daily” Write “every other day”</td>
</tr>
<tr>
<td>Trailing zero (X.0 mg) Lack of leading zero (X mg)</td>
<td>Decimal point is missed</td>
<td>Write X mg Write 0.X mg</td>
</tr>
<tr>
<td>MS MSO4, and MgSO4</td>
<td>Can mean morphine sulfate or magnesium sulfate Confused for one another</td>
<td>Write “morphine sulfate” Write “magnesium sulfate”</td>
</tr>
</tbody>
</table>

### Additional Abbreviations, Acronyms and Symbols

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Potential Problem</th>
<th>Use instead</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt; (greater than)</td>
<td>Misinterpreted as the number “7” (seven) or the letter “L” Confused for one another</td>
<td>Write “greater than” Write “less than”</td>
</tr>
<tr>
<td>&lt; (less than)</td>
<td>Misinterpreted due to similar abbreviations for multiple drugs</td>
<td>Write drug names in full</td>
</tr>
<tr>
<td>Abbreviations for drug names</td>
<td>Unfamiliar to many practitioners Confused with metric units</td>
<td>Write metric units</td>
</tr>
<tr>
<td>Apothecary units</td>
<td>@ (at) Mistaken for the number “2” (two)</td>
<td>Write “at”</td>
</tr>
<tr>
<td>CC</td>
<td>Misinterpreted for U (units) when poorly written</td>
<td>Write “mL” Or “ml” or “milliliters” (“mL” is preferred)</td>
</tr>
<tr>
<td>Ug</td>
<td>Mistaken for mg (milligrams) resulting in one thousand-fold overdose</td>
<td>Write “mcg” or “micrograms”</td>
</tr>
</tbody>
</table>

Applies to all orders and all medications,-related documentation that is handwritten (including free-text computer entry) or on preprinted forms.

Exception: A “trailing zero” may be used only where required to demonstrate the level of precision of the value being reported, such as for laboratory results, imaging studies that report size of lesions, or catheter tube sizes. It may not be used in medication orders or other medication-related documentation.
References

