Many healthcare organizations require that nurses demonstrate the ability to calculate **IV drip rates** (drops/minute) in the event of an emergency that disables IV infusion pumps. Review the formula for calculating IV drip rate in drops per minute.

To calculate the infusion rate: IV drip rate in drops per minute =

\[
\frac{\text{Volume to be infused (mL) over 1 hour}}{\text{Drop factor constant}} = \frac{12}{1} = 12 \text{ drops/min}
\]

<table>
<thead>
<tr>
<th>Common drop factors</th>
<th>Drop factor constant</th>
</tr>
</thead>
<tbody>
<tr>
<td>60 gtts/mL - minidrip set</td>
<td>1</td>
</tr>
<tr>
<td>10 gtts/mL – regular drip set</td>
<td>6</td>
</tr>
<tr>
<td>15 gtts/mL – regular drip set</td>
<td>4</td>
</tr>
</tbody>
</table>

Common drop factors are also known as the clock method – drop factors are obtained by dividing 60 minutes by the number of gtts per mL that the IV set delivers.

Review correct **procedure and precautions** for the following routes of **administration**:

- Ear drops
- Enteral feeding tube
- IM, subcut injections
- Inhaler
- IV therapy, including IVP and IVPB

Review **monitoring and precautions** related to **medication allergy**

Review **monitoring and precautions** related to **blood transfusion**

Review **indications, action of medications, adverse effects, monitoring, precautions, and patient teaching implications** related to:

- **ADHD Medications, such as amphetamine and dextroamphetamine (Adderall®)**, especially indications of effectiveness
- **Analgesics**
  - Acetaminophen (Tylenol®), also antipyretic use
    - Especially risks, maximum recommended dosage
  - Ibuprofen (Motrin®)
  - Morphine
    - Especially adverse effects
Toxicity, signs/symptoms and treatment

- **Antibiotics, such as**
  - Amoxicillin
  - Gentamicin (Garamycin®)
  - Vancomycin (Vancocin®)
    - Especially adverse effects

- **Anticoagulants, such as heparin**
  - Emphasis on safety

- **Anticonvulsants, uses such as**
  - Lorazepam (Ativan®)
    - Especially precautions
  - Phenobarbital
    - Especially indications

- **Asthma medications including Bronchodilators, such as** albuterol (Proventil®)
  - Especially adverse effects
  - Treatment of acute asthma

- **Cardiovascular Medications, such as digoxin**
  - Especially indications of toxicity and pertinent lab values

- **Diuretics, such as furosemide (Lasix®)**
  - Especially monitoring

- **Electrolytes such as IV potassium chloride (KCl)**
  - Especially monitoring

- **Emergency medications, such as epinephrine**

- **Glucocorticosteroids, such as prednisone**
  - Especially adverse effects

- **Insulin preparations, including rapid-acting insulins such as lispro (Humalog®)**
  - Especially indications of hyperglycemia and correct management

- **Reversal Agents/Antidotes, such as**
  - Flumazenil (Romazicon®)
  - Naloxone (Narcan®)

- **Sedatives such as ketamine**
  - Especially adverse effects
Review **Calculations, including**

- IV drip rate
- mL/hr IV rate
- Number of milliliters to obtain ordered dose
- Fluid calculations
- Dosage and fluid 24-hour calculations
- Use of protocols such as insulin sliding scale and recommended fluid requirements

Review **laboratory tests used to monitor medication therapy**, including

- Hematocrit
- Peaks and troughs
- Serum bilirubin
- Serum electrolytes, particularly potassium
- Serum glucose
Calculation Review

Why are calculations included in our exams?

Although most facilities have pharmacy calculate and deliver unit dose medications, and have IV pumps to calculate IV rates, the nurse remains responsible for the delivery of the correct dose of medications and IVs. Nurse Directors from our client facilities have indicated that they consider calculations to be a critical part of our evaluation process.

Conversions

<table>
<thead>
<tr>
<th>Conversion</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Milligram to Gram</td>
<td>1000 mg = 1 G</td>
</tr>
<tr>
<td>Microgram to milligram</td>
<td>1000 mcg = 1 mg</td>
</tr>
<tr>
<td>Pounds to kilogram</td>
<td>2.2 pounds = 1 kg</td>
</tr>
<tr>
<td>Centimeter to inch</td>
<td>2.54 cm = 1 inch</td>
</tr>
<tr>
<td>Milliliter to liter</td>
<td>1000 mL = 1L</td>
</tr>
<tr>
<td>mL (cc) to ounces</td>
<td>30 mL (cc) = 1 ounce</td>
</tr>
</tbody>
</table>

Medication Calculations

You have an order to administer phenytoin (Dilantin) oral suspension 100 mg TID per feeding tube.

Dilantin oral suspension is supplied to you in a 5 mL bottle which contains 125 mg/mL. How many mL per dose will you administer?

You can use either method below (or an alternate method) to determine the answer.

<table>
<thead>
<tr>
<th>Method #1: Ratio Proportion</th>
<th>Method #2: Formula Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\frac{125 \text{ mg}}{1 \text{ mL}} = \frac{100 \text{ mg}}{“x” \text{ mL}}$</td>
<td>$100 \text{ mg} \text{ (dose desired)} \times 1 \text{ mL} = “x” \text{ mL}$</td>
</tr>
</tbody>
</table>
| Cross-multiply and solve for “x”.

\[ \frac{125 \text{ mg}}{1 \text{ mL}} = \frac{100 \text{ mg}}{“x” \text{ mL}} \]

\[ 125 \text{ “x”} = 100 \]

\[ “x” = 100/125; “x” = 0.8 \text{ mL} \]

<table>
<thead>
<tr>
<th>Method #2: Formula Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Solve for “x”.</td>
</tr>
</tbody>
</table>

\[ 100/125 = “x” \]

\[ “x” = 0.8 \text{ mL} \]

You will administer **0.8 mL**.
Your 4 year old pediatric patient weighs 40 pounds. She is febrile. You need to administer acetaminophen (Tylenol) 15mg/kg. How many mg will you administer?

First covert 40 pounds into kilograms.

<table>
<thead>
<tr>
<th>Method #1: Ratio Proportion</th>
<th>Method #2: Formula Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\frac{1 \text{ kg}}{2.2 \text{ pounds}} = \frac{x \text{ kg}}{40 \text{ pounds}}$</td>
<td>$\frac{40 \text{ pounds}}{2.2 \text{ pounds}} \times \frac{1 \text{ kg}}{x \text{ kg}}$</td>
</tr>
<tr>
<td>Cross-multiply and solve for $x$.</td>
<td>$x = 18.18 \text{ kg}$</td>
</tr>
<tr>
<td>$\frac{1 \text{ kg}}{2.2 \text{ pounds}} \times \frac{x \text{ kg}}{40 \text{ pounds}}$</td>
<td></td>
</tr>
<tr>
<td>$2.2x = 40$</td>
<td>$x = 18.18 \text{ kg}$</td>
</tr>
<tr>
<td>$x = 18.18 \text{ kg}$</td>
<td></td>
</tr>
</tbody>
</table>

Since you will administer 15mg of acetaminophen per 1 kg, you will multiply 15mg with the weight of 18.18 kg.

$15mg \times 18.18kg = 272.7$.

You will administer 272.7 mg.

Need more practice? Check out practice calculations in the Critical Thinking: Nursing Calculations Part 2 course on [www.RN.com](http://www.RN.com).
IV Rate Calculations

Each method below gives the same result. Use the one most familiar to you.

Method #1

Use drop factor constant

<table>
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<tr>
<th>Common Drop Factors</th>
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<td>10 gtt/mL – regular drip set</td>
<td>6</td>
</tr>
<tr>
<td>15 gtt/mL – regular drip set</td>
<td>4</td>
</tr>
</tbody>
</table>

IV drip rate in drops per minute = Volume to be infused (mL) over 1 hour / Drop factor constant

Example:

Rate is 100 mL/hr. You have a regular drip set – 10 gtt/mL. Drop factor constant is 6.
At how many drops per minute will you set the rate?

\[
100 \text{ mL} \times \frac{6 	ext{ drops}}{1 	ext{ mL}} = \frac{100}{6} = 16.66 \text{ (round to 17) drops per minute}
\]

Method #2

Determine the rate per hour
Multiply the rate per hour by the drip rate
Divide the total by 60 (minutes) – converts rate per hour to rate per minute.

Example:

Rate is 125 mL/hr
IV set delivers 15 drops per mL

\[
125 \text{ mL/hr} \times 15 \text{ drops/mL} = 31.25, \text{ rounded to 31 drops per minute}
\]

60 minutes
Sample Problems

Problem #1
Your patient has an order for terbutaline (Brethine) 0.25 mg subcut. The pharmacy delivers a syringe with 1mg/mL. What is the correct volume to deliver to the patient? (See next page for answer.)

Problem # 2
You receive an order for 60 mg of meperidine (Demerol) IM for your post surgical patient. The injection syringe is pre-packaged with 75 mg/ mL. How much will you administer? (See next page for answer.)

Problem #3
Your patient has been receiving digoxin (Lanoxin)125 mcg Q AM. Today his doctor writes a new order:

Digoxin 0.25 mg PO Q AM start now

How many 125 mcg tablets will you administer? (See next page for answer.)

Problem #4
An IV is ordered to run at 60 mL/hr. The IV drip set delivers 15gtt/mL. How many drops per minute will you set the IV at? (See next page for answer.)

Problem #5
An IV is ordered to run at 175/hr. The IV drip set delivers 10 gtt/mL. How many drops per minute will you set the IV at? (See next page for answer.)
**Answer to Problem #1**

<table>
<thead>
<tr>
<th>Method #1: Ratio Proportion</th>
<th>Method #2: Formula Method</th>
</tr>
</thead>
</table>
| \[
\frac{1 \text{ mL}}{1 \text{ mg}} = \frac{x \text{ mL}}{0.25 \text{ mg}}
\]
| Cross-multiply and solve for \(x\). |
| \[
\frac{1 \text{ mL}}{1 \text{ mg}} = \frac{x \text{ mL}}{0.25 \text{ mg}}
\] |
| \[
0.25x = 1
\] |
| \[x = \frac{0.25}{0.25} \text{ mL}
\] |

**Answer to problem # 2**

<table>
<thead>
<tr>
<th>Method #1: Ratio Proportion</th>
<th>Method #2: Formula Method</th>
</tr>
</thead>
</table>
| \[
\frac{75 \text{ mg}}{1 \text{ mL}} = \frac{60 \text{ mg}}{x \text{ mL}}
\]
| Cross-multiply and solve for \(x\). |
| \[
\frac{75 \text{ mg}}{1 \text{ mL}} = \frac{60 \text{ mg}}{x \text{ mL}}
\] |
| \[
75x = 60
\] |
| \[x = \frac{60}{75} \text{ mL}
\] |

You will administer 0.8 mL.
### Answer to Problem #3

<table>
<thead>
<tr>
<th>Method #1: Ratio Proportion</th>
<th>Method #2: Formula Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>[ \frac{0.125 \text{ mcg}}{1 \text{ tablet}} = \frac{0.25 \text{ mcg}}{x \text{ mL}} ]</td>
<td></td>
</tr>
<tr>
<td>Cross-multiply and solve for x.</td>
<td></td>
</tr>
<tr>
<td>[ \frac{0.125 \text{ mcg}}{1 \text{ tablet}} = \frac{0.25 \text{ mg}}{x \text{ tablet}} ]</td>
<td></td>
</tr>
<tr>
<td>[ 0.125x = 0.25 ]</td>
<td></td>
</tr>
<tr>
<td>[ x = \frac{0.25}{0.125} ]</td>
<td></td>
</tr>
<tr>
<td>[ x = 2 \text{ tablets} ]</td>
<td></td>
</tr>
</tbody>
</table>

You will administer 2 tablets.

### Answer to Problem #4

<table>
<thead>
<tr>
<th>Method #1: Drop Factor Constant</th>
<th>Method #2: Calculation</th>
</tr>
</thead>
<tbody>
<tr>
<td>[ \frac{60 \text{ mL/hr}}{4 \text{ (drop factor constant)}} = x \text{ drops per minute} ]</td>
<td></td>
</tr>
<tr>
<td>Divide and solve for x</td>
<td></td>
</tr>
<tr>
<td>[ \frac{60}{4} = 15 ]</td>
<td></td>
</tr>
<tr>
<td>[ x = 15 \text{ drops per minute} ]</td>
<td></td>
</tr>
</tbody>
</table>

You will set rate at 15 drops per minute.
<table>
<thead>
<tr>
<th>Method #1: Drop Factor Constant</th>
<th>Method #2: Calculation</th>
</tr>
</thead>
<tbody>
<tr>
<td>175 mL/hr = x drops per minute</td>
<td>175 (mL/hr) x 10 (drops/mL) = x drops per minute</td>
</tr>
<tr>
<td>6 (drop factor constant)</td>
<td>60 (minutes)</td>
</tr>
<tr>
<td>Divide and solve for x</td>
<td>Solve for x.</td>
</tr>
<tr>
<td>175/6 = 29.16</td>
<td>175 x 10 = 29.16</td>
</tr>
<tr>
<td>x = 29 drops per minute</td>
<td>60</td>
</tr>
<tr>
<td></td>
<td>x = 29 drops per minute</td>
</tr>
</tbody>
</table>

You will set rate at 29 drops per minute