Objectives

The learner will:

1. identify the calibrations in gtt/mL on IV administration sets
2. calculate flow rates using ratio and proportion
3. calculate flow rate using the rate formula method
4. calculate flow rates by the division factor method
5. recalculate flow rates to correct off-schedule infusions

There are a number of ways to calculate IV flow rates, and this chapter presents three: ratio and proportion, a formula method, and the division factor method. Use whichever method you are most comfortable with.

Large volumes of intravenous fluids are most often ordered on the basis of mL/hr to be administered, for example 125 mL/hr. With the widespread use of electronic infusion devices that can be set to deliver a mL/hr rate, simply setting the rate ordered on the device and making sure it is working properly is all that is required for most infusions. Some infusion devices can also be set at a gtt/min (drop per minute) rate, which is much less frequently ordered than the mL/hr rate.

The most common calculation, which is necessary when an infusion device is not being used, involves converting an IV order to the gtt/min rate necessary to infuse it. This calculation may be required for large-volume orders written designating a mL/hr rate, for example, 1000 mL to infuse at 125 mL/hr; for infusions of mL per multiple hours, for example, 3000 mL/24 hr; or for small-volume orders, usually involving medication administration, for example, 100 mL/40 min.

IV TUBING CALIBRATION

The size of IV drops is regulated by the type of IV set being used, which is calibrated in number of gtt/mL. Unfortunately, not all sets (and their drop size) are the same. Each hospital uses at least two sizes of infusion sets, the standard, or macrodrip set, calibrated at 10, 15, or 20 gtt/mL, which is used for routine adult IV administrations; and a mini, or microdrip set, calibrated at 60 gtt/mL, which is used when more exact measurements are needed, for example, to infuse medications, or in critical care and pediatric infusions.

IV administration sets are calibrated in gtt/mL.
The gtt/mL calibration of each IV set is clearly printed on each package, and the first step in calculating flow rates is to identify the gtt/mL calibration of the set to be used for infusion.

**PROBLEM**

Refer to the IV set packages provided in Figures 16-1 and 16-2 and identify the calibration in gtt/mL of each.

1. __________
2. __________

![Figure 16-1](image1.png)

![Figure 16-2](image2.png)

**Answers** 1. 60 gtt/mL  2. 15 gtt/mL

**CALCULATING LARGE VOLUME gtt/min RATES FROM mL/hr ORDERED**

Usually only one macrodrip calibrated set of either 10, 15, or 20 gtt/mL is used in most hospital or clinical settings, and a mL/hr to gtt/min conversion chart may be available. If one is not available, the following method is one of the safest and most logical to use to convert the mL/hr ordered to a gtt/min flow rate. It can be used if the rate ordered is mL/hr, for example, 125 mL/hr, or mL per multiple hr, for example, 3000 mL/24 hr. Let’s now look at some calculations that involve both of these types of orders.

**Example 1**

An IV is ordered to infuse at a rate of 125 mL/hr using a set calibrated at 10 gtt/mL. Calculate the gtt/min flow rate.

You are calculating gtt/min, so start by determining how many mL/min this order represents. This is done by dividing the 125 mL/hr rate by 60 min.
• Change the mL/hr ordered to mL/min.

\[ 125 \text{ mL} \div 60 \text{ min} = 2 \text{ mL/min} \]

• Calculate the gtt/min rate for the 2 mL/min obtained. To establish consistency in calculations, you may wish to enter the set calibration as the first ratio in the proportion.

\[ \frac{10 \text{ gtt}}{1 \text{ mL}} = \frac{X \text{ gtt}}{2 \text{ mL}} \quad \text{or} \quad \frac{10 \text{ gtt}}{1 \text{ mL}} = \frac{X \text{ gtt}}{2 \text{ mL}} = 20 \text{ gtt} \]

To infuse an IV at 125 mL/hr using a set calibrated at 10 gtt/mL, set the manual drip rate at 20 gtt/min.

**EXAMPLE 2**  
An IV of 150 mL is to infuse in 1 hr using a set calibrated at 15 gtt/mL. Calculate the gtt/min flow rate.

• Change the mL/hr ordered to mL/min.

\[ 150 \text{ mL} \div 60 \text{ min} = 2.5 \text{ mL/min} \]

• Calculate the gtt/min rate.

\[ \frac{15 \text{ gtt}}{1 \text{ mL}} = \frac{X \text{ gtt}}{2.5 \text{ mL}} \quad \text{or} \quad \frac{15 \text{ gtt}}{1 \text{ mL}} = \frac{X \text{ gtt}}{2.5 \text{ mL}} = 37.5 = 38 \text{ gtt} \]

To infuse 150 mL/hr using a set calibrated at 15 gtt/mL, set the manual drip rate at 38 gtt/min.

Flow rates are routinely rounded to the nearest whole number.

Let’s now look at some IVs ordered to infuse in more than 1 hour.

**EXAMPLE 3**  
An IV of 2500 mL is to infuse in 24 hr using a set calibrated at 20 gtt/mL. Calculate the gtt/min flow rate.

• Calculate the mL/hr to infuse.

\[ 2500 \text{ mL} \div 24 \text{ hr} = 104.1 = 104 \text{ mL/hr} \]

• Calculate the mL/min to infuse.

\[ 104 \text{ mL} \div 60 \text{ min} = 1.7 \text{ mL/min} \]

• Calculate the gtt/min rate.

\[ \frac{20 \text{ gtt}}{1 \text{ mL}} = \frac{X \text{ gtt}}{1.7 \text{ mL}} \quad \text{or} \quad \frac{20 \text{ gtt}}{1 \text{ mL}} = \frac{X \text{ gtt}}{1.7 \text{ mL}} = 34 \text{ gtt} \]

To infuse an IV of 2500 mL in 24 hr using an IV set calibrated at 20 gtt/mL, set the manual flow rate at 34 gtt/min.
An IV of 1000 mL is ordered to infuse in 5 hr using a set calibrated at 15 gtt/mL.

- Calculate the mL/hr to infuse.
  
  \[
  \frac{1000 \text{ mL}}{5 \text{ hr}} = 200 \text{ mL/hr}
  \]

- Calculate the mL/min to infuse.
  
  \[
  \frac{200 \text{ mL}}{60 \text{ min}} = 3.3 \text{ mL/min}
  \]

- Calculate the gtt/min rate.
  
  \[
  \begin{align*}
  \frac{15 \text{ gtt}}{1 \text{ mL}} &= \frac{X \text{ gtt}}{3.3 \text{ mL}} & \text{or} & & \frac{15 \text{ gtt}}{1 \text{ mL}} &= \frac{X \text{ gtt}}{3.3 \text{ mL}} \\
  X &= 49.5 = 50 \text{ gtt} & & \text{or} & & \frac{15}{3.3} &= \frac{X}{50} \\
  49.5 &= 50 \text{ gtt}
  \end{align*}
  \]

To infuse 1000 mL in 5 hr using a set calibrated at 15 gtt/mL, set the rate at 50 gtt/min.

Flow rate answers may vary by 1–2 gtt/min depending on how the numbers are rounded in calculations, or due to calculator setting.

A 1–2 gtt/min variation is considered insignificant for most infusions, because flow rates fluctuate as the patient bends the infusion arm, changes position in bed, or ambulates. Thus, manually set rates are approximate.

**Problem**

Calculate the gtt/min manual IV flow rates for the following infusions. Round rates to the nearest whole number.

1. An IV of 2000 mL is to infuse over 12 hr using a 10 gtt/mL set. __________

2. 3500 mL are ordered to infuse in 24 hr using a set calibrated at 20 gtt/mL. __________

3. Infuse 500 mL in 3 hr using a 15 gtt/mL set. __________

4. A volume of 1500 mL is to infuse in 5 hr using a 15 gtt/mL set. __________

5. 1750 mL are ordered to infuse in 9 hr using a 20 gtt/mL set. __________

6. An IV of 2500 mL is to infuse in 18 hr on a set calibrated at 10 gtt/mL. __________

7. A 3000 mL volume is to infuse in 24 hr on a set calibrated at 20 gtt/mL. __________

8. A volume of 2750 mL is to infuse in 22 hr on a 15 gtt/mL set. __________

9. An IV of 750 mL is ordered to infuse in 8 hr on a 10 gtt/mL set. __________

10. A volume of 1250 mL is to infuse in 12 hr using a 15 gtt/mL set. __________

**Answers**

1. 28 gtt/min  
2. 40 gtt/min  
3. 42 gtt/min  
4. 75 gtt/min  
5. 65 gtt/min  
6. 23 gtt/min  
7. 41 gtt/min  
8. 31 gtt/min  
9. 16 gtt/min  
10. 26 gtt/min  

**Note:** Answers that vary by 1–2 gtt/min may be considered correct.
CALCULATING SMALL-VOLUME gtt/min RATES FROM mL/min ORDERED

Small-volume IV solutions are most frequently ordered to administer medications. Because of the immediacy of IV medication action, each dosage is routinely double-checked for accuracy before administration. A small-volume flush of IV solution is usually ordered to follow the administration to ensure that all the medication has cleared the line. The flush volume may vary from 2 to 15 mL depending on the length of the IV tubing used.

There are three common administrative techniques used for small-volume infusions. Very small volumes are most often administered by syringe, either manually or via syringe pump. If a syringe pump (see Chapter 15, page 214) is used, the primary responsibilities are to make sure the rate is set correctly on the device and that it is working properly.

The two other methods of small-volume administration are via burettes calibrated in 1–2 mL increments, with a capacity of 100–150 mL (Chapter 21, page 296), or via commercial or pharmacy prepared IV bags containing medication in a volume of 50–250 mL (Chapter 15, page 209).

It is when a burette or small-volume IV solution bag is to be infused without the use of an electronic device that a gtt/min flow rate will need to be calculated. With regard to burettes one precaution must be particularly stressed: although most are calibrated in 60 gtt/mL microdrips, this calibration cannot be taken for granted. Some burettes are specifically manufactured for use with electronic volumetric pumps and may have, for example, a 20 gtt/mL calibration. When pumps are used with their companion tubings their setting accommodates for the gtt size, and the main administrative precaution becomes matching the correct tubing to its pump, setting the rate correctly, and, as always, making sure the device is working properly.

Let’s now look at calculation of small-volume flow rates when no infusion device is used.

**EXAMPLE 1**

An IV medication of 100 mL is to be infused in 40 min using a set calibrated at 15 gtt/mL. Calculate the gtt/min flow rate.

- **Calculate the mL/min to be administered.**

  \[
  100 \text{ mL} : 40 \text{ min} = \frac{X \text{ mL}}{1 \text{ min}} \quad \text{or} \quad \frac{100 \text{ mL}}{40 \text{ min}} = \frac{X \text{ mL}}{1 \text{ min}} = 2.5 \text{ mL/min}
  \]

- **Calculate the gtt/min rate.**

  \[
  15 \text{ gtt} : 1 \text{ mL} = \frac{X \text{ gtt}}{2.5 \text{ mL}} \quad \text{or} \quad \frac{15 \text{ gtt}}{1 \text{ mL}} = \frac{X \text{ gtt}}{2.5 \text{ mL}} = 37.5 = 38 \text{ gtt}
  \]

To administer an infusion of 100 mL in 40 min using a 15 gtt/mL calibrated set, the flow rate must be 38 gtt/min.
An IV medication of 60 mL is ordered to infuse in 30 min. The set calibration is 20 gtt/mL. Calculate the gtt/min flow rate.

- Calculate the mL/min to be administered.

\[
\frac{60 \text{ mL}}{30 \text{ min}} = \frac{X \text{ mL}}{1 \text{ min}} \quad \text{or} \quad \frac{60 \text{ mL}}{30 \text{ min}} = \frac{X \text{ mL}}{1 \text{ min}} = 2 \text{ mL/min}
\]

- Calculate the gtt/min rate.

\[
\frac{20 \text{ gtt}}{1 \text{ mL}} = \frac{X \text{ gtt}}{2 \text{ mL}} \quad \text{or} \quad \frac{20 \text{ gtt}}{1 \text{ mL}} = \frac{X \text{ gtt}}{2 \text{ mL}} = 40 \text{ gtt}
\]

To administer an infusion of 60 mL in 30 min using a set calibrated at 20 gtt/mL, set the flow rate at 40 gtt/min.

A volume of 50 mL is ordered to infuse in 20 min using a 10 gtt/mL calibrated set. Calculate the gtt/min flow rate.

- Calculate the mL/min to be administered.

\[
\frac{50 \text{ mL}}{20 \text{ min}} = \frac{X \text{ mL}}{1 \text{ min}} \quad \text{or} \quad \frac{50 \text{ mL}}{20 \text{ min}} = \frac{X \text{ mL}}{1 \text{ min}} = 2.5 \text{ mL/min}
\]

- Calculate the gtt/min rate.

\[
\frac{10 \text{ gtt}}{1 \text{ mL}} = \frac{X \text{ gtt}}{2.5 \text{ mL}} \quad \text{or} \quad \frac{10 \text{ gtt}}{1 \text{ mL}} = \frac{X \text{ gtt}}{2.5 \text{ mL}} = 25 \text{ gtt}
\]

To infuse a volume of 50 mL in 20 min using a set calibrated at 10 gtt/mL, set the flow rate at 25 gtt/min.

Calculate the flow rates in gtt/min for the following small-volume infusions. Round rates to the nearest whole gtt.

1. A medication of 75 mL is to be administered in 50 min using a set calibrated at 10 gtt/mL.

2. A set calibrated at 15 gtt/mL is to be used to infuse 80 mL in 50 min.

3. A volume of 40 mL is to be infused in 20 min using a set calibrated at 20 gtt/mL.

4. A 10 gtt/mL set is being used to administer 20 mL in 20 min.

5. A 70 mL volume is to infuse in 40 min using a 15 gtt/mL set.

**Answers**

1. 15 gtt/min  
2. 24 gtt/min  
3. 40 gtt/min  
4. 10 gtt/min  
5. 26 gtt/min  

Note: Answers that vary by 1–2 gtt/min may be considered correct.
FORMULA METHOD OF FLOW RATE CALCULATION

The flow rate can also be determined by using the following formula, which is useful when the rate can be expressed as mL/60 min or less.

\[
\text{Flow Rate} = \frac{\text{Volume} \times \text{Set Calibration}}{\text{Time (in min)}}
\]

**Example 1**

An IV is ordered to infuse at 125 mL/hr. Calculate the gtt/min rate for a set calibrated at 10 gtt/mL.

- **Convert the hr to min.**
  \[
  \frac{125 \text{ mL} \times 10 \text{ gtt/mL}}{60 \text{ min}}
  \]
- **Calculate the gtt/min rate.**
  \[
  \frac{125 \times 10}{60} = 20.8 = 21 \text{ gtt/min}
  \]

**Example 2**

Administer an IV medication of 100 mL in 40 min using a set calibrated at 15 gtt/mL.

\[
\frac{100 \times 15}{40} = 37.5 = 38 \text{ gtt/min}
\]

**Example 3**

A 75 mL volume of IV medication is ordered to infuse in 45 min. The set is calibrated at 20 gtt/mL.

\[
\frac{75 \times 20}{45} = 33.3 = 33 \text{ gtt/min}
\]

**Problem**

Calculate the flow rate in gtt/min for the following infusions using the formula method.

1. Administer an IV of 110 mL/hr using a set calibrated at 20 gtt/mL.
2. An IV solution is ordered at 200 mL/hr using a set calibrated at 15 gtt/mL.
3. A volume of 80 mL is to be infused in 20 min using a 10 gtt/mL set.
4. An IV is ordered to infuse at 150 mL/hr using a 10 gtt/mL calibrated set.
5. An IV rate of 90 mL/hr is ordered using a 15 gtt/mL calibrated set.

**Answers**

1. 37 gtt/min  2. 50 gtt/min  3. 40 gtt/min  4. 25 gtt/min  5. 23 gtt/min  
   **Note:** Consider answers within 1 gtt/min correct.
When an IV is ordered to infuse in more than 1 hour, the formula method can still be used. However, to keep the numbers you are working with as small as possible, it is best to add a preliminary step and determine the mL/hr the ordered volume will represent.

**EXAMPLE 1**

Calculate the gtt/min flow rate for an IV of 1000 mL to infuse in 8 hr on a set calibrated at 20 gtt/mL.

- **Calculate the mL/hr.**
  
  \[
  \frac{1000 \text{ mL}}{8 \text{ hr}} = 125 \text{ mL/hr}
  \]

- **Calculate the gtt/min flow rate.**
  
  \[
  \frac{125 \text{ (mL)} \times 20 \text{ (gtt/mL)}}{60 \text{ (min)}} = 41.6 \approx 42 \text{ gtt/min}
  \]

**EXAMPLE 2**

Calculate the gtt/min flow rate for a volume of 2500 mL to infuse in 24 hr on a set calibrated at 10 gtt/mL.

- **Calculate the mL/hr.**
  
  \[
  \frac{2500 \text{ mL}}{24 \text{ hr}} = 104 \text{ mL/hr}
  \]

- **Calculate the gtt/min flow rate.**
  
  \[
  \frac{104 \times 10}{60} = 17.3 \approx 17 \text{ gtt/min}
  \]

**EXAMPLE 3**

An IV of 1200 mL is to infuse in 16 hr on a set calibrated at 15 gtt/mL.

- **Calculate the mL/hr.**
  
  \[
  \frac{1200 \text{ mL}}{16 \text{ hr}} = 75 \text{ mL/hr}
  \]

- **Calculate the gtt/min flow rate.**
  
  \[
  \frac{75 \times 15}{60} = 19 \text{ gtt/min}
  \]

**PROBLEM**

Calculate the gtt/min flow rate for the following infusions using the formula method.

1. A volume of 2000 mL to infuse in 24 hr on a set calibrated at 15 gtt/mL ________
2. A volume of 300 mL to infuse in 6 hr on a 60 gtt/mL microdrip set ________
3. A volume of 500 mL to infuse in 4 hr on a 15 gtt/mL calibrated set ________
4. A 10-hr infusion of 1200 mL using a 20 gtt/mL set ________
5. An infusion of 500 mL in 5 hr on a set calibrated at 10 gtt/mL ________

*Answers: 1. 21 gtt/min  2. 50 gtt/min  3. 31 gtt/min  4. 40 gtt/min  5. 17 gtt/min  Note: Answers that vary by 1–2 gtt/min may be considered correct.*
DIVISION FACTOR METHOD OF CALCULATION

In a clinical setting where all the macrodrip IV sets have the same calibration, either 10, 15, or 20 gtt/mL, an alternate “division factor” method can be used to calculate flow rates. However, this method can only be used if the rate is expressed in mL/hr (mL/60 min). Let’s start by looking at how the division factor is obtained.

Administer an IV at 125 mL/hr. The set calibration is 10 gtt/mL. Calculate the gtt/min rate. Express the hr rate as 60 min.

\[
\frac{125 \text{ (mL)}}{60 \text{ (min)}} \times \frac{1 \text{ (gtt/mL)}}{10 \text{ (gtt/mL)}} = 20.8 = 21 \text{ gtt/min}
\]

Look at the completed equation, and noted that because you are restricting the time to 60 min, the set calibration (10) will be divided into 60 (min) to obtain a constant number (6). This constant (6) is the division factor for a 10 gtt/mL calibrated set.

The division factor can be obtained for any IV set by dividing 60 by the calibration of the set.

PROBLEM

Determine the division factor for the following IV sets.

1. 20 gtt/mL
2. 15 gtt/mL
3. 60 gtt/mL
4. 10 gtt/mL

Answers: 1. 3 2. 4 3. 1 4. 6

Once the division factor is known, the gtt/min rate can be calculated in one step, by dividing the mL/hr rate by the division factor. Look again at the example.

\[
\frac{125 \text{ (mL)}}{60 \text{ (min)}} \times \frac{1 \text{ (gtt/mL)}}{10 \text{ (gtt/mL)}} = 20.8 = 21 \text{ gtt/min}
\]

or \(125 \text{ (mL/hr)} \div 6 = 20.8 = 21 \text{ gtt/min}\)

The 125 mL/hr flow rate divided by the division factor 6 gives the same 21 gtt/min rate.

The gtt/min flow rate can be calculated for mL/hr IV orders in one step by dividing the mL/hr to be infused by the division factor of the administration set.

EXAMPLE 1

Infuse an IV at 100 mL/hr using a set calibrated at 10 gtt/mL. Determine the division factor: \(60 \div 10 = 6\) Calculate the flow rate: \(100 \text{ mL} \div 6 = 16.6 = 17 \text{ gtt/min}\)

EXAMPLE 2

Infuse an IV at 125 mL/hr using a set calibrated at 15 gtt/mL. \(60 \div 15 = 4\) \(125 \text{ mL} \div 4 = 31.2 = 31 \text{ gtt/min}\)
A set calibrated at 20 gtt/mL is used to infuse 90 mL per hr.

\[
60 \div 20 = 3 \quad 90 \text{ mL} \div 3 = 30 \text{ gtt/min}
\]

The division factor is of enormous assistance in clinical practice because hospitals and clinics generally use only one size macrodrip set. This means that the same division factor can be used for all IV flow rate calculations.

**Problem**

Calculate the flow rates in gtt/min for the following infusions using the division factor method.

1. A rate of 110 mL/hr via a set calibrated at 20 gtt/mL
2. A set is calibrated at 15 gtt/mL. Infuse at 130 mL/hr.
3. Infuse 150 mL/hr using a 10 gtt/mL set.
4. A set calibrated at 20 gtt/mL is used to infuse 45 mL/hr.
5. Infusion is ordered at 75 mL/hr with a set calibrated at 15 gtt/mL.

Answers: 1. 37 gtt/min 2. 33 gtt/min 3. 25 gtt/min 4. 15 gtt/min 5. 19 gtt/min

**Note:** Answers that vary by 1–2 gtt/min may be considered correct.

All of the preceding examples and problems using the division factor method were for macrodrip sets. Let’s now look what happens when a microdrip set calibrated at 60 gtt/mL is used.

**Example**

Infuse at 50 mL/hr using a 60 gtt/mL microdrip.

\[
60 \div 60 = 1 \quad 50 \text{ mL} \div 1 = 50 \text{ gtt/min}
\]

Because the set calibration is 60, and the division factor is based on a 60-min (1 hr) time, the division factor is 1. So, for microdrip sets the gtt/min flow rate will be identical to the mL/hr ordered.

**Problem**

What is the drip rate in gtt/min for the following infusions if a microdrip is used?

1. 120 mL/hr
2. 90 mL/hr
3. 100 mL/hr
4. 75 mL/hr
5. 80 mL/hr

Answers: 1. 120 gtt/min 2. 90 gtt/min 3. 100 gtt/min 4. 75 gtt/min 5. 80 gtt/min

The division factor method can be used to calculate the flow rate of any volume that can be expressed in mL/hr. Larger volumes can be divided, and smaller
volumes can be multiplied and expressed in mL/hr. This does require an extra step, and if you find it confusing you may elect not to use it.

\[
2400 \text{ mL/24 hr} = 2400 \div 24 = 100 \text{ mL/hr}
\]

\[
1800 \text{ mL/8 hr} = 1800 \div 8 = 225 \text{ mL/hr}
\]

\[
10 \text{ mL/30 min} = 10 \times 2 \times (2 \times 30 \text{ min}) = 20 \text{ mL/hr}
\]

\[
15 \text{ mL/20 min} = 15 \times 3 \times (3 \times 20 \text{ min}) = 45 \text{ mL/hr}
\]

**REGULATING FLOW RATE**

Manual flow rates are regulated by counting the number of drops falling in the drip chamber. The standard procedure for doing this is to hold a watch next to the drip chamber and actually count the number of drops falling. The roller clamp is adjusted during the count until the required rate has been set. A 15-sec count is most commonly used because there is less chance of attention wandering during the count. This means that the ordered gtt/min (60 sec) rate must be divided by 4 to obtain the 15-second drip count (15 sec × 4 = 60 sec).

An IV is to run at a rate of 60 gtt/min. What will the 15-sec count be?

60 gtt/min \div 4 = 15 gtt

Adjust the rate to 15 gtt/15 sec.

A 70 gtt/min IV rate is ordered. What will the 15-sec count be?

70 gtt/min \div 4 = 17.5 = 18 gtt

Adjust the rate to 18 gtt/15 sec.

Adjust an IV to a rate of 50 gtt/min using a 15-sec count.

50 gtt/min \div 4 = 13 gtt

Adjust the rate to 13 gtt/15 sec.

**PROBLEM**

Answer the following questions about 15-second drip rates.

1. The 15-second count of an IV flow rate is 7 gtt. A 29 gtt/min rate is required. Is this rate correct?

2. You are to regulate a newly started IV to deliver 67 gtt/min. Using a 15-second count, how would you set the flow rate?

3. An IV is to run at 48 gtt/min. What must the 15-second drip rate be?

4. How many gtt will you count in 15 seconds if the rate is 55 gtt/min?

5. An IV is to run at 84 gtt/min. What will the 15-second rate be?

**Answers**

1. Yes
2. 17 gtt/15 sec
3. 12 gtt/15 sec
4. 14 gtt/15 sec
5. 21 gtt/15 sec

*Note: Answers that vary by 1 gtt/min may be considered correct.*
Individual hospitals and/or states/provinces may require a 30- or 60-sec (1 min) count. When a 60-sec count is required, particular care must be taken not to let your attention wander during the count, which can easily happen in this longer time frame. A 60-sec count will require a full min count, whereas a 30-sec count will require the gtt/min rate to be divided by 2 (60 sec ÷ 2 = 30 sec).

**EXAMPLE 1**

An IV is to be infused at 56 gtt/min. What is the 30-sec rate?

\[
56 \text{ gtt/min} \div 2 = 28 \text{ gtt}
\]

*Adjust the rate to 28 gtt/30 sec.*

**EXAMPLE 2**

A rate of 72 gtt/min has been ordered. What will the 30 sec count be?

\[
72 \text{ gtt/min} \div 2 = 36 \text{ gtt}
\]

*Adjust the rate to 36 gtt/30 sec.*

**PROBLEM**

Calculate the 30-sec count for the following IVs.

1. An IV is to be run at a rate of 48 gtt/min. Calculate a 30-sec count.

2. An IV is ordered to infuse at 52 gtt/min.

**Answers**

1. 24 gtt/30 sec  
2. 26 gtt/30 sec

**CORRECTING OFF-SCHEDULE RATES**

Because a patient’s positional changes can alter the rate slightly, IVs occasionally infuse ahead of or behind schedule. When this occurs, the usual procedure is to recalculate the flow rate using the volume and time remaining and to adjust the rate accordingly. However, each situation must be individually evaluated, especially if the discrepancy is large. If too much fluid has infused, immediately assess the patient’s response to the increased intake and take appropriate action. If too little fluid has infused, it will first be necessary to assess the patient’s ability to tolerate an increased rate and, secondly, to consider the type of fluid/medication involved. Some medications and fluids have restrictions on rate of administration. Both of these factors must be considered before rates can be increased to “catch up.” In addition, many hospitals will have specific policies to cover over or under infusion due to altered flow rates, and you will be responsible for knowing these.

The following are some examples of how the rate can be recalculated. Because IVs are usually checked hourly, the focus will first be on recalculation using exact hours. Some recalculation have also been included using fractions of hours, rounded to the nearest quarter hour: 15 min = 0.25 hr, 30 min = 0.5 hr, and 45 min = 0.75 hr. These equivalents are close enough for uncomplicated infusions, because the exact time of completion is not totally predictable. IVs needing exact infusion would hopefully be monitored by electronic infusion devices.
An IV of 1000 mL was ordered to infuse over 10 hr at a rate of 25 gtt/min. The set calibration is 15 gtt/mL. After 5 hr a total of 650 mL have infused instead of the 500 mL ordered. Recalculate the new gtt/min flow rate to complete the infusion on schedule.

**Time remaining** 10 hr − 5 hr = 5 hr

**Volume remaining** 1000 mL − 650 mL = 350 mL

350 mL ÷ 5 hr = 70 mL/hr

Set calibration is 15 gtt/mL.

70 ÷ 4 (division factor) = 17.5 = 18 gtt/min

**Slow the rate from 25 gtt/min to 18 gtt/min.**

An IV of 800 mL was to infuse over 8 hr at 20 gtt/min. After 4 hr 15 min only 300 mL have infused. Recalculate the gtt/min rate to complete on schedule. The set calibration is 15 gtt/mL.

**Time remaining** 8 hr − 4.25 hr = 3.75 hr

**Volume remaining** 800 mL − 300 mL = 500 mL

500 mL ÷ 3.75 hr = 133.3 = 133 mL/hr

Set calibration is 15 gtt/mL.

133 ÷ 4 (division factor) = 33.2 = 33 gtt/min

**Increase the rate to 33 gtt/min.**

An IV of 500 mL is infusing at 28 gtt/min. It was to complete in 3 hr, but after 1½ hr only 175 mL have infused. Recalculate the gtt/min rate to complete the infusion on schedule. Set calibration is 10 gtt/mL.

**Time remaining** 3 hr − 1.5 hr = 1.5 hr

**Volume remaining** 500 mL − 175 mL = 325 mL

325 mL ÷ 1.5 hr = 216.6 = 217 mL/hr

Set calibration is 10 gtt/mL.

217 ÷ 6 (division factor) = 36.1 = 36 gtt/min

**Increase the rate to 36 gtt/min.**

A volume of 250 mL was to infuse 56 gtt/min in 1½ hr using a set calibrated at 20 gtt/mL. After 30 min 175 mL have infused. Recalculate the flow rate.

**Time remaining** 1.5 hr − 30 min = 1 hr
Volume remaining 250 mL − 175 mL = 75 mL

Set calibration is 20 gtt/mL.

75 ÷ 3 (division factor) = 25 gtt/min

Decrease the rate to 25 gtt/min.

Problem

Recalculate the following IV rates so that the infusions will complete on schedule.

1. An IV of 500 mL was ordered to infuse in 3 hr using a 15 gtt/mL set. With 1½ hr remaining you discover that only 150 mL is left in the bag. At what rate will you need to reset the flow?

2. An IV of 1000 mL was scheduled to run in 12 hr. After 4 hr only 220 mL have infused. The set calibration is 20 gtt/mL. Recalculate the rate for the remaining solution.

3. An IV of 1000 mL was ordered to infuse in 8 hr. With 3 hr of infusion time left you discover that 600 mL have infused. The set delivers 20 gtt/mL. Recalculate the drip rate and indicate how many drops you will count in 15 sec to set the new rate.

4. An IV of 750 mL was ordered to run over 6 hr with a set calibrated at 10 gtt/mL. After 2 hr you notice that 300 mL have infused. Recalculate the flow rate, and indicate how many drops you will count in 15 sec to reset the rate.

5. An IV of 800 mL was started at 9 a.m. to infuse in 4 hr. At 10 a.m. 150 mL have infused. The set is calibrated at 15 gtt/mL. Recalculate the flow rate in gtt/min.

Answers 1. 24 gtt/min  2. 33 gtt/min  3. 44 gtt/min; 11 gtt/15 sec  4. 19 gtt/min; 4–5 gtt/15 sec  5. 54 gtt/min  Note: Answers that vary by 1–2 gtt/min may be considered correct.

Summary

This concludes the chapter on IV flow rate calculation and monitoring. The important points to remember from this chapter are:

- IVs are ordered as mL/hr or mL/min to be administered.
- Manual flow rates are counted in gtt/min.
- IV tubings are calibrated in gtt/mL.
- Macrodrip IV sets will have a calibration of 10, 15, or 20 gtt/mL.
- Mini or microdrip sets have a calibration of 60 gtt/mL.
The formula for calculating flow rates is

\[
\frac{\text{Volume} \times \text{Set Calibration}}{\text{Time (in min)}}
\]

The division factor method can only be used to calculate flow rates if the volume to be administered is specified in mL/hr (60 min).

The division factor is obtained by dividing 60 by the set calibration.

Flow rate by the division factor method is determined by dividing the mL/hr to be administered by the division factor.

Because micro/minidrip sets have a calibration of 60 gtt/mL, their division factor is 1, and the flow rate in gtt/min is the same as the mL/hr ordered.

If an IV runs ahead of or behind schedule, a possible procedure is to use the time and mL remaining to calculate a new flow rate.

If a rate must be increased to compensate for running behind schedule, the type of fluid being infused and the patient's ability to tolerate an increased rate must be assessed.

If an IV is determined to have infused ahead of schedule immediate assessment of the patient's tolerance to the excess fluid is required, and appropriate action taken.

Summary Self-Test

Answer the following questions as briefly as possible.

1. Determine the division factor for the following IV sets.
   a) 60 gtt/mL
   b) 15 gtt/mL
   c) 20 gtt/mL
   d) 10 gtt/mL

2. How is the flow rate determined in the division factor method?

3. The division factor method can only be used if the volume to be administered is expressed in

4. An IV is to infuse at 50 gtt/min. How will you set it using a 15-sec count?

5. You are to adjust an IV at a rate of 60 gtt/min. What will the 15-sec count be?

Calculate the flow rate in gtt/min for each of the following IV solutions and medications. Don't let the types of solutions confuse you. Concentrate on locating the information you need for your calculations.

6. D5W 2000 mL has been ordered to run 16 hr. Set calibration is 10 gtt/mL.

7. The order is for 500 mL of normal saline in 8 hr. The set is calibrated at 15 gtt/mL.
8. Administer 150 mL of sodium chloride 0.45% over 3 hr. A microdrip is used.

9. 1500 mL D5W with 40 mEq KCl/L has been ordered to run over 12 hr. Set calibration is 20 gtt/mL.

10. An IV medication of 30 mL is to be administered over 30 min using a 15 gtt/mL set.

11. Administer 100 mL of 0.9% NaCl in 1 hr using a 15 gtt/mL set.

12. Infuse 500 mL of intralipids IV in 6 hr. Set calibration is 10 gtt/mL.

13. The doctor orders a liter of D5W to infuse over 10 hr. At the end of 8 hr you notice that there are 500 mL left in the bag. What would the new flow rate be if the set calibration is 10 gtt/mL?

14. An IV was started at 9 a.m. with orders to infuse 500 mL over 6 hr. At 12 noon the IV infiltrated with 350 mL left in the bag. At 1 p.m. the IV was restarted. The set calibration is 20 gtt/mL. Calculate the new flow rate to deliver the fluid on time.

15. A 50 mL piggyback IV is to infuse over 15 min. The set calibration is 15 gtt/mL. After 5 minutes the IV contains 40 mL. Calculate the flow rate to deliver the volume on time.

16. An IV of 1000 mL D5 1/4 NaCl with 20 mEq KCl is ordered to run at 25 mL/hr using a microdrip set.

17. Ringer’s lactate 800 mL has been ordered to run in 5 hr. Set calibration is 10 gtt/mL.

18. Administer 1500 mL of D5 lactated Ringer’s solution over 8 hr using a set calibrated at 20 gtt/mL.

19. The order is for D5 1/2 NaCl 750 mL to run in 6 hr. Set calibration is 15 gtt/mL.

20. An IV of 1000 mL was ordered to run in 8 hr. After 4 hr only 250 mL have infused. The set calibration is 20 gtt/mL. Recalculate the rate for the remaining solution.

21. The order is to infuse 50 mL of a piggyback antibiotic over 1 hr. The set calibration is a microdrip.

22. An IV of 500 mL D5W is to infuse over 6 hr. You will be using a set calibration of 10 gtt/mL.

23. Infuse 120 mL gentamicin via IVPB over 1 hr. Set calibration is 10 gtt/mL.

24. Administer 12 mL of an IV medication in 22 min using a microdrip set.

25. A patient is to receive 3000 mL of D5W in 20 hr. Set is calibrated at 20 gtt/mL.

26. Infuse 1 liter of D5W in 5 hr using a set calibration of 15 gtt/mL.

27. A hyperalimentation solution of 1180 mL is to infuse in 12 hr using a set calibration of 20 gtt/mL.
28. 150 mL of an antibiotic solution is to infuse in 30 min. At the end of 20 min you discover that 100 mL have infused. The set calibration is 10 gtt/mL. Should the flow rate be adjusted? If so, what is the new rate? ____________

29. Two 500 mL units of whole blood are ordered. Both units are to be completed in 5 hr. The set calibration is 20 gtt/mL. ____________

30. Infuse 15 mL of IV medication in the next 14 min using a 20 gtt/mL set. ____________

31. The patient is to receive 1000 mL 0.9% NaCl in 10 hr using a 20 gtt/mL calibration. ____________

32. A minidrip is used to administer 12 mL in 17 min. ____________

33. Infuse 2750 mL in 20 hr using a 10 gtt/mL set. ____________

34. D5W 1800 mL is to infuse in the next 15 hr with a 15 gtt/mL set. ____________

35. Infuse 600 mL of intralipids IV in 6 hr with a 10 gtt/mL set. ____________

36. Administer 22 mL of an IV antibiotic solution in 18 min using a minidrip set. ____________

37. 1800 mL of D5W with 30 mEq of KCl per liter have been ordered to infuse in 10 hr. Set calibration is 20 gtt/mL. ____________

38. Infuse 8 mL in 9 min using a minidrip. ____________

39. A patient is to receive 4000 mL D5W IV in the next 20 hr. A 20 gtt/mL set is used. ____________

40. An IV of 500 mL D5W that was to infuse in 2 hr is discovered to have only 150 mL left after 30 min. Recalculate the flow rate. Set calibration is 15 gtt/mL. ____________

**Answers**

<table>
<thead>
<tr>
<th>Question</th>
<th>Answer</th>
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<tbody>
<tr>
<td>1. a) 1 b) 4 c) 3 d) 6</td>
<td></td>
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<tr>
<td>2. mL/hr = division factor (mL/60 min)</td>
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<tr>
<td>3. mL/hr</td>
<td>7. 16 gtt/min</td>
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<td>4. 13 gtt/15 sec</td>
<td>8. 50 gtt/min</td>
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<td>5. 15 gtt/15 sec</td>
<td>9. 42 gtt/min</td>
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<td>6. 21 gtt/min</td>
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<td>11. 25 gtt/min</td>
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<td>13. 42 gtt/min</td>
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<td>15. 60 gtt/min</td>
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<td>17. 27 gtt/min</td>
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<td>21. 50 gtt/min</td>
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<td>23. 20 gtt/min</td>
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<td>25. 50 gtt/min</td>
<td>26. 50 gtt/min</td>
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<tr>
<td>27. 33 gtt/min</td>
<td>28. No, rate is correct at 50 gtt/min</td>
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<td>29. 67 gtt/min</td>
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<td>31. 33 gtt/min</td>
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<td>39. 67 gtt/min</td>
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**Note:** Consider answers that vary by 1–2 gtt/min accurate.