# ANSWERS

## SELF-TEST 1 CALCULATION OF DRIP RATES

1. This is a continuous IV of 150 mL every 8 hours. There is a pump available.

$$\frac{150 \text{ mL}}{8 \text{ hours}} \qquad 8\overline{)150.0} = 18.7 \qquad \begin{array}{r} 8 \\ \hline 70 \\ 64 \\ \hline 60 \end{array}$$

Label the IV. Set the pump: total volume to infuse = 150 mL; mL/hour = 19.

2. This is a continuous IV. A pump is available. (Dimensional analysis uses the same equation.) The order states mL/hour. There is no calculation needed. Label the IV. Set the pump as follows: total volume to infuse = 250 mL; mL/hour = 25.

3. The order gives 100 mL/hour; mL/hour = gtt/minute microdrip, so you know the microdrip is 100 gtt/minute. Work out the macrodrip factor and choose the tubing.

**Macrodrip**

$$\frac{\text{mL/hour} \times \text{DF}}{\text{Number of minutes}} = \text{gtt/minute}$$

$$\frac{100 \times \overset{1}{\cancel{20}}}{\underset{3}{\cancel{60}} \text{ minutes}} = \frac{100}{3} = 33.3$$

**Dimensional Analysis**

Macrodrip at 33 gtt/minute

$$\begin{array}{c|c|c} \overset{1}{\cancel{20}}\ \text{gtt} & 100\ \cancel{\text{mL}} & 1\ \cancel{\text{hour}} \\ \hline 1\ \cancel{\text{mL}} & 1\ \cancel{\text{hour}} & \underset{3}{\cancel{60}}\ \text{minutes} \end{array} = \frac{100}{3}$$

$$= 33.3 \text{ or } 33 \text{ gtt/minute}$$

Microdrip at 100 gtt/minute (mL/hour = gtt/minute)

Either drip rate could be used. Label the IV.

4. This is a small volume over several hours; use microdrip. Macrodrip would be too slow (5 gtt/minute). Minutes = 6 hours × 60 = 360.

$$\frac{\text{mL/hour} \times \text{DF}}{\text{minutes}} = \text{gtt/minute}$$

$$\frac{180 \text{ mL} \times \overset{1}{\cancel{60}} \text{ gtt}}{\underset{6}{\cancel{360}} \text{ minutes}} = \frac{180}{6} \qquad 6\overline{)180} = 30 \qquad \begin{array}{r} 18 \\ \hline 0 \end{array}$$

**Dimensional Analysis**

$$\begin{array}{c|c|c} \overset{1}{\cancel{60}}\ \text{gtt} & 180\ \cancel{\text{mL}} & 1\ \cancel{\text{hour}} \\ \hline 1\ \cancel{\text{mL}} & 6\ \cancel{\text{hours}} & \underset{1}{\cancel{60}}\ \text{minutes} \end{array} = \frac{180}{6}$$

$$= 30 \text{ gtt/minute}$$

Microdrip is 30 gtt/minute. Label the IV.

5. This is a large volume over several hours. Solve using two steps and decide. Minutes: 8 hours × 60 = 480 minutes

**Microdrip**

$$\frac{\text{mL/hour} \times \text{DF}}{\text{minutes}} = \text{gtt/minute}$$

$$\frac{1000 \text{ mL} \times \overset{1}{\cancel{60}} \text{ gtt}}{\underset{8}{\cancel{480}} \text{ minutes}} = \frac{1000}{8} \qquad 8\overline{)1000.0} = 125. \qquad \begin{array}{r} 8 \\ \hline 20 \\ 16 \\ \hline 40 \end{array}$$

**Dimensional Analysis**

$$\begin{array}{c|c|c} \overset{1}{\cancel{60}}\ \text{gtt} & 1000\ \cancel{\text{mL}} & 1\ \cancel{\text{hour}} \\ \hline 1\ \cancel{\text{mL}} & 8\ \cancel{\text{hours}} & \underset{1}{\cancel{60}}\ \text{minutes} \end{array} = \frac{1000}{8}$$

$$= 125 \text{ gtt/minute}$$

Microdrip will be 125 gtt/minute.

**Macrodrip**

$$\frac{\overset{125}{\cancel{1000}} \times \overset{1}{\cancel{15}}}{\underset{\underset{4}{\cancel{32}}}{\cancel{480}} \text{ minutes}} = \frac{\cancel{125}}{4} \qquad 4\overline{)125.0} = 31.2 \qquad \begin{array}{r} 12 \\ \hline 5 \\ 4 \\ \hline 10 \\ 8 \\ \hline \end{array}$$

**Dimensional Analysis**

$$\begin{array}{c|c|c} \overset{1}{\cancel{15}}\ \text{gtt} & \overset{250}{\cancel{1000}}\ \cancel{\text{mL}} & 1\ \cancel{\text{hour}} \\ \hline 1\ \cancel{\text{mL}} & 8\ \cancel{\text{hours}} & \underset{\underset{1}{\cancel{4}}}{\cancel{60}}\ \text{minutes} \end{array} = \frac{250}{8}$$

$$= 31.2 \text{ or } 31 \text{ gtt/minute}$$

Macrodrip at 31 gtt/minute

Microdrip at 125 gtt/minute

Use macrodrip (less fluid per minute). Label the IV.

6. This is a continuous IV of 250 mL every 8 hours. There is a pump available. It will run 8 hours.

$$\frac{\cancel{250}\ \text{mL}}{8} \quad \begin{array}{r} 31.2\ \text{mL/hour}\\ 8\overline{)250.0}\\ \underline{24}\\ 10\\ \underline{8}\\ 2.0 \end{array}$$

Label the IV. Set the pump: total volume to infuse = 250 mL; mL/hour = 31. (Dimensional analysis method uses the same equation.)

7. This is a continuous IV of 500 mL over 2 hours. There is a pump available. It will run 2 hours.

$$\frac{\cancel{500}\ \text{mL}}{2} \quad \begin{array}{r} 250.0\ \text{mL/hour}\\ 2\overline{)500.0}\\ \underline{4}\\ 10\\ \underline{10}\\ 0 \end{array}$$

Label the IV. Set the pump: total volume to infuse = 500 mL; mL/hour = 250. (Dimensional analysis method uses the same equation.)

8. This is a large volume over several hours. Solve using two steps. Minutes: 12 hours × 60 = 720 minutes

$$\frac{\text{mL/hour} \times \text{DF}}{\text{minutes}} = \text{gtt/minute}$$

**Macrodrip**

$$\frac{1000 \times \overset{1}{\cancel{15}}}{\underset{48}{\cancel{720}}\ \text{minutes}} = \begin{array}{r} 20.8\\ 48\overline{)1000.0}\\ \underline{96}\\ 400\\ \underline{384}\\ 6 \end{array}$$

**Microdrip**

$$\frac{1000 \times \overset{1}{\cancel{60}}}{\underset{12}{\cancel{720}}\ \text{minutes}} = \begin{array}{r} 83\\ 12\overline{)1000}\\ \underline{96}\\ 40\\ \underline{36}\\ 4 \end{array}$$

**Dimensional Analysis**
**Macrodrip**

$$\begin{array}{c|c|c} \overset{1}{\cancel{15}}\ \text{gtt} & \overset{250}{\cancel{1000}}\ \cancel{\text{mL}} & 1\ \cancel{\text{hour}} \\ \hline 1\ \cancel{\text{mL}} & 12\ \cancel{\text{hours}} & \underset{\underset{1}{\cancel{4}}}{\cancel{60}}\ \text{minutes} \end{array} = \frac{250}{12}$$

$$= 20.8 \text{ or } 21\ \text{gtt/minute}$$

**Microdrip**

$$\begin{array}{c|c|c} \overset{1}{\cancel{60}}\ \text{gtt} & 1000\ \cancel{\text{mL}} & 1\ \cancel{\text{hour}} \\ \hline 1\ \cancel{\text{mL}} & 12\ \cancel{\text{hours}} & \underset{1}{\cancel{60}}\ \text{minutes} \end{array} = \frac{1000}{12}$$

$$= 83\ \text{gtt/minute}$$

Macrodrip at 21 gtt/minute; microdrip at 83 gtt/minute.
Use macrodrip (less fluid per minute).
Label the IV.

9. This is a large volume at a fast rate. Use macrodrip. (Microdrip would be 150 gtt/minute.) Solve using macrodrip factor. Minutes: 1 hour = 60 minutes.

$$\frac{\text{mL/hour} \times \text{DF}}{\text{minutes}} = \text{gtt/minute}$$

$$\frac{150 \times \overset{1}{\cancel{10}}}{\underset{6}{\cancel{60}}\ \text{minute}} = \frac{150}{6} \quad \begin{array}{r} 25.0\ \text{gtt/minute}\\ 6\overline{)150.0}\\ \underline{12}\\ 30\\ \underline{30}\\ 0 \end{array}$$

**Dimensional Analysis**

$$\begin{array}{c|c|c} \overset{1}{\cancel{10}}\ \text{gtt} & 150\ \cancel{\text{mL}} & 1\ \cancel{\text{hour}} \\ \hline 1\ \cancel{\text{mL}} & 1\ \cancel{\text{hour}} & \underset{6}{\cancel{60}}\ \text{minutes} \end{array} = \frac{150}{6}$$

$$= 25\ \text{gtt/minute}$$

Macrodrip at 25 gtt/minute; microdrip at 150 gtt/minute.
Use macrodrip (less fluid per minute).
Label the IV.

10. This is a large volume over a short time. Use macrodrip tubing. (Microdrip would be 150 gtt/minute.) The rate is 150 mL/hour (150 mL over 1 hour). Solve using macrodrip factor.

$$\frac{\text{mL/hour} \times \text{DF}}{\text{minutes}} = \text{gtt/minute}$$

$$\frac{150 \times \overset{1}{\cancel{20}}}{\underset{3}{\cancel{60}}\ \text{minutes}} = \frac{150}{3} \quad \begin{array}{r} 50\ \text{gtt/minute}\\ 3\overline{)150.0}\\ \underline{15}\\ 0 \end{array}$$

**Dimensional Analysis**

$$\begin{array}{c|c|c} \overset{1}{\cancel{20}}\ \text{gtt} & 150\ \cancel{\text{mL}} & 1\ \cancel{\text{hour}} \\ \hline 1\ \cancel{\text{mL}} & 1\ \cancel{\text{hour}} & \underset{3}{\cancel{60}}\ \text{minutes} \end{array} = \frac{150}{3}$$

$$= 50\ \text{gtt/minute}$$

Macrodrip at 50 gtt/minute; microdrip at 150 gtt/minute.
Use macrodrip (less fluid per minute).
Label the IV.

(*continued*)

## SELF-TEST 2 IV INFUSIONS—HOURS

1. 8.3 hours approximately $\left(\frac{250}{30} = 8.3\right)$ or 8 hours 18 minutes
2. 8.3 hours approximately $\left(\frac{500}{60} = 8.3\right)$ or 8 hours 18 minutes
3. 10 hours (no math needed)
4. 24 hours (no math needed)
5. 7.1 hours approximately $\left(\frac{500}{70} = 7.1\right)$ or 7 hours 6 minutes
6. 10 hours $\left(\frac{500}{50} = 10\right)$
7. 10 hours (no math needed) 7 PM
8. 2.5 hours $\left(\frac{250}{100} = 2.5\right)$ or 2 hours 30 minutes 3:30 PM
9. 6 hours (no math needed)
10. 5 hours (no math needed)

## SELF-TEST 3 IV INFUSION RATES

1. You want vitamin C 500 mg, and the supply is 500 mg in 2 mL. Use a syringe to add the 2 mL to 500 mL D5W. Label the IV. You have microdrip available. The IV is to run at 60 mL/hour. No math necessary. Set the microdrip at 60 gtt/minute (mL/hour = gtt/minute for microdrip). Label the IV.
2. You want 250 mg hydrocortisone sodium succinate (Solu Cortef), and it comes in 250 mg. Use a syringe to reconstitute the hydrocortisone with 2 mL sterile water and add it to 1000 mL D5W. 8 AM–12 MIDNIGHT is 16 hours. Minutes: 16 hour × 60 = 960 minutes
   Label the IV.

$$\frac{1000 \text{ mL} \times \overset{1}{\cancel{60}} \text{ gtt}}{\underset{16}{\cancel{960}} \text{ minutes}} = \frac{1000.0}{16} = 62.5 \text{ or } 63 \text{ gtt/minute}$$

$$\begin{array}{r} 62.5 \\ 16\overline{)1000.0} \\ \underline{96\phantom{.0}} \\ 40\phantom{.} \\ \underline{32\phantom{.}} \\ 80 \\ 80 \end{array}$$

**Dimensional Analysis**

$$\frac{\overset{1}{\cancel{60}} \text{ gtt}}{1 \cancel{\text{mL}}} \times \frac{1000 \cancel{\text{mL}}}{16 \cancel{\text{hours}}} \times \frac{1 \cancel{\text{hour}}}{\underset{1}{\cancel{60}} \text{ minutes}} = \frac{1000}{16} = 62.5 \text{ or } 63 \text{ gtt/minute}$$

3. You want 250 mg aminophylline. Supply is 500 mg/10 mL.

**Formula Method**

$$\frac{250 \text{ mg}}{500 \text{ mg}} \times 10 \text{ mL} = 5 \text{ mL}$$

**Proportion**

EXPRESSED AS TWO RATIOS

10 mL:500 mg : : x mL:250 mg

EXPRESSED AS TWO FRACTIONS

$$\frac{10 \text{ mL}}{500 \text{ mg}} \times \frac{x}{250 \text{ mg}}$$

SOLUTION FOR BOTH PROPORTION METHODS

$$250 \times 10 = 500x$$
$$\frac{2500}{500} = x$$
$$5 = x$$

**Dimensional Analysis**

$$\frac{10 \text{ mL}}{\underset{2}{\cancel{500}} \cancel{\text{mg}}} \times \frac{\overset{1}{\cancel{250}} \cancel{\text{mg}}}{} = \frac{10}{2} = 5 \text{ mL}$$

Add 5 mL aminophylline to 250 mL D5W. Order is 50 mL/hour. You have an infusion pump. No math. Set the pump as follows: total volume to infuse = 250 mL; mL/hour = 50.

# ANSWERS (continued)

**4.** You want KCl 10 mEq. Supply is 20 mEq/10 mL.

**Formula Method**

$$\frac{10\ \text{mEq}}{20\ \text{mEq}} \times 10\ \text{mL} = 5\ \text{mL}$$

**Proportion**

EXPRESSED AS TWO RATIOS

$$10\ \text{mL}:20\ \text{mEq} :: x\ \text{mL}:10\ \text{mEq}$$

EXPRESSED AS TWO FRACTIONS

$$\frac{10\ \text{mL}}{20\ \text{mEq}} \times \frac{x}{10\ \text{mEq}}$$

SOLUTION FOR BOTH PROPORTION METHODS

$$10 \times 10 = 20x$$

$$\frac{100}{20} = x$$

$$5\ \text{mL} = x$$

**Dimensional Analysis**

$$\begin{array}{c|c} 10\ \text{mL} & \overset{1}{\cancel{10}}\ \cancel{\text{mEq}} \\ \hline \underset{2}{\cancel{20}}\ \cancel{\text{mEq}} & \end{array} = \frac{10}{2} = 5\ \text{mL}$$

Add 5 mL KCl to 250 mL D5 1/2 NS. Label the IV. 12 NOON–6 PM is 6 hours; minutes: 6 hours × 60 = 360 minutes.

$$\frac{250\ \text{mL} \times \overset{1}{\cancel{60}}\ \text{gtt}}{\underset{6}{\cancel{360}}\ \text{minutes}} = \frac{\cancel{250}}{6} \quad 6\overline{)250.0}^{\,41.6} = 42\ \text{gtt/minute}$$

$$\begin{array}{r} 41.6 \\ 6\overline{)250.0} \\ \underline{24}\phantom{0.0} \\ 10\phantom{.0} \\ \underline{6}\phantom{.0} \\ 4\,0 \\ \underline{3\,6} \end{array}$$

$$\begin{array}{c|c|c} \overset{1}{\cancel{60}}\ \text{gtt} & 250\ \cancel{\text{mL}} & 1\ \text{hour} \\ \hline 1\ \cancel{\text{mL}} & 6\ \cancel{\text{hours}} & \underset{1}{60}\ \text{minutes} \end{array} = \frac{250}{6}$$

$$= 41.6 \text{ or } 42\ \text{gtt/minute}$$

Set the microdrip at 42 gtt/minute.

## SELF-TEST 4 IVPB DRIP RATES

**1.** Acyclovir (Zovirax) comes in 500 mg powder. Use a reconstitution device to add the powder to 100 mL D5W;
minutes: 1 hour = 60 minutes; DF = 10 gtt/mL for IVPB.

$$\frac{100 \times 10}{60\ \text{minutes}} = \frac{100}{6} \quad 6\overline{)100.0}^{\,16.6} = 17\ \text{gtt/minute}$$

**Dimensional Analysis**

$$\begin{array}{c|c|c} \overset{1}{\cancel{10}}\ \text{gtt} & 100\ \cancel{\text{mL}} & 1\ \cancel{\text{hour}} \\ \hline 1\ \cancel{\text{mL}} & 1\ \cancel{\text{hour}} & \underset{6}{\cancel{60}}\ \text{minutes} \end{array} = \frac{100}{6} = 16.6 \text{ or } 17\ \text{gtt/minute}$$

Label the IVPB.

Set the rate at 17 gtt/minute.

*(continued)*

2. Ceftazidime (Ceptaz) comes in a 1-g powder.

Use a reconstitution device to add the powder to 50 mL D5W; use 30 minutes; DF, 10 gtt/mL for IVPB.

$$\frac{50 \times 10}{30 \text{ minutes}} = \frac{50}{3} = 16.6 = 17 \text{ gtt/minute}$$

**Dimensional Analysis**

$$\frac{\overset{1}{\cancel{10}}\ \text{gtt}}{1\ \cancel{\text{mL}}} \,\Big|\, \frac{50\ \cancel{\text{mL}}}{\underset{3}{\cancel{30}}\ \text{minutes}} = \frac{50}{3} = 16.6 \text{ or } 17 \text{ gtt/minute}$$

Label the IVPB.

Set the rate at 17 gtt/minute.

3. Cefotaxime (Claforan) comes as a 1-g powder.

Use a reconstitution device to add the powder to 50 mL D5W; use 30 minutes; DF, 10 gtt/mL for IVPB.

$$\frac{50 \times 10}{30 \text{ minutes}} = 16.6 = 17 \text{ gtt/minute}$$

**Dimensional Analysis**

$$\frac{\overset{1}{\cancel{10}}\ \text{gtt}}{1\ \cancel{\text{mL}}} \,\Big|\, \frac{50\ \cancel{\text{mL}}}{\underset{3}{\cancel{30}}\ \text{minutes}} = \frac{50}{3} = 16.6 \text{ or } 17 \text{ gtt/minute}$$

Label the IVPB.

Set the rate at 17 gtt/minute.

4. Ampicillin (Omnipen) comes as a 2-g powder. Reconstitute in 4.5 mL diluent = total volume 5 mL 2 g = 2000 mg in 5 mL.

**Formula Method**

$$\frac{500 \text{ mg}}{2000 \text{ mg}} \times 5 \text{ mL} = 1.25 \text{ mL}$$

**Proportion**

EXPRESSED AS TWO RATIOS

5 mL : 2000 mg : : x mL : 500 mg

EXPRESSED AS TWO FRACTIONS

$$\frac{5 \text{ mL}}{2000 \text{ mg}} \times \frac{x}{500 \text{ mg}}$$

SOLUTION FOR BOTH PROPORTION METHODS

$$5 \times 500 = 2000x$$

$$\frac{2500}{2000} = x$$

$$1.25 \text{ mL} = x$$

**Dimensional Analysis**

Use conversion factor: 1 g/1000 mg

$$\frac{5\ \text{mL}}{2\ \cancel{\text{g}}} \,\Big|\, \overset{1}{\cancel{500}}\ \cancel{\text{mg}} \,\Big|\, \frac{1\ \cancel{\text{g}}}{\underset{2}{\cancel{1000}}\ \cancel{\text{mg}}} = \frac{5}{4} = 1.25 \text{ mL}$$

Add 1.25 mL to 50 mL D5W. Total minutes = 30; DF = 60 gtt/mL.

$$\frac{50 \times \overset{2}{\cancel{60}}}{\underset{1}{\cancel{30}} \text{ minutes}} = 100 \text{ gtt/minute}$$

**Dimensional Analysis**

$$\frac{60\,\text{gtt}}{1\text{ mL}}\left|\frac{50\text{ mL}}{30\text{ minutes}}\right. = 50 \times 2 = 100$$

Label the IVPB.

Set the rate at 100 gtt/minute.

5. Tobramycin (Nebcin) comes as 80 mg in 2 mL after reconstitution.

| Formula Method | Proportion | Dimensional Analysis |
|---|---|---|
| $\frac{50\text{ mg}}{80\text{ mg}} \times 2\text{ mL} = 1.25\text{ mL}$ | EXPRESSED AS TWO RATIOS<br>2 mL:80 mg : : x mL:50 mg<br>EXPRESSED AS TWO FRACTIONS<br>$\frac{2\text{ mL}}{80\text{ mg}} \times \frac{x}{50\text{ mg}}$<br>SOLUTION FOR BOTH PROPORTION METHODS<br>$2 \times 50 = 80x$<br>$\frac{100}{80} = x$<br>$1.25\text{ mL} = x$ | $\frac{2\text{ mL}}{\cancel{80}\ \cancel{\text{mg}}}\left|\frac{\cancel{50}\ \cancel{\text{mg}}}{}\right. = \frac{10}{8} = 1.25\text{ mL}$ |

Add 1.25 mL to 100 mL D5W.

Total minutes = 60; DF = 15 gtt/mL.

$$\frac{\text{mL} \times \text{DF}}{\text{minutes}} = \text{gtt/minute}$$

$$\frac{100 \times \overset{1}{\cancel{15}}}{\underset{4}{\cancel{60}}\text{ minutes}} = 25\text{ gtt/minute}$$

**Dimensional Analysis**

$$\frac{\overset{1}{\cancel{15}}\,\text{gtt}}{1\ \cancel{\text{mL}}}\left|\frac{100\ \cancel{\text{mL}}}{\underset{4}{\cancel{60}}\text{ minutes}}\right. = \frac{100}{4} = 25\text{ gtt/minute}$$

Label the IVPB.

Set the rate at 25 gtt/minute.

(*continued*)

6. Ticarcillin (Timentin) comes as a 1-g powder. Reconstitute in 4.5 mL of diluent = 5 mL (1 g or 1000 mg = 5 mL)

**Formula Method**

$$\frac{500\text{ mg}}{1000\text{ mg}} \times 5\text{ mL} = 2.5\text{ mL}$$

**Proportion**

EXPRESSED AS TWO RATIOS

5 mL:1000 mg : : x mL:500 mg

EXPRESSED AS TWO FRACTIONS

$$\frac{5\text{ mL}}{1000\text{ mg}} \times \frac{x}{500\text{ mg}}$$

SOLUTION FOR BOTH PROPORTION METHODS

$$5 \times 500 = 1000x$$

$$\frac{2500}{1000} = x$$

$$2.5\text{ mL} = x$$

**Dimensional Analysis**

Use conversion factor: 1 g/1000 mg

$$\frac{5\text{ mL}}{1\ \cancel{\text{g}}} \Bigg| \frac{\overset{1}{\cancel{500}}\ \cancel{\text{mg}}}{} \Bigg| \frac{1\ \cancel{\text{g}}}{\underset{2}{\cancel{1000}}\ \cancel{\text{mg}}} = \frac{5}{2} = 2.5\text{ mL}$$

Add 2.5 mL to 50 mL D5W.

Total minutes, 30; DF, 15 gtt/mL.

$$\frac{\text{mL} \times \text{DF}}{\text{minutes}} = \text{gtt/minute}$$

$$\frac{50 \times \overset{1}{\cancel{15}}}{\underset{2}{\cancel{30}}\text{ minutes}} = 25\text{ gtt/minute}$$

**Dimensional Analysis**

$$\frac{\overset{1}{\cancel{15}}\text{ gtt}}{1\ \cancel{\text{mL}}} \Bigg| \frac{50\ \cancel{\text{mL}}}{\underset{2}{\cancel{30}}\text{ minutes}} = \frac{50}{2} = 25\text{ gtt/minute}$$ Label the IVPB. Set the rate at 25 gtt/minute.

## SELF-TEST 5 CALCULATION OF TUBE FEEDINGS

1. 206.25 mL of Isocal. 68.75 mL water.
2. 56.25 mL Magnacal. 18.75 mL water.
3. 50 mL Osmolite. 50 mL water.
4. 21.25 mL Ensure. 63.75 mL water.
5. 100 mL Renalcal. 300 mL water.
6. 200 mL Suplena. 200 mL water.

## SELF-TEST 6 FLUID INTAKE

1. 900 mL at 100 mL/hour = 9 hours to run. If the IV starts at 9 AM, + 9 hours = 6 PM.
2. IVPB is 75 mL q6h or four times in 24 hours.

$$\begin{array}{r} 75 \\ \times\ 4 \\ \hline 300\text{ mL} \end{array}$$

## ANSWERS (*continued*)

The client is receiving 125 mL for 20 hours (24 hours – 4 hours that the IVPB is running).

$$\begin{array}{r} 125 \\ \times\ 20 \\ \hline 2500 \end{array} \text{ mL}$$

$$\begin{array}{r} 2500 \text{ mL} \\ +\ 300 \text{ mL} \\ \hline 2800 \text{ mL} \end{array} \text{ in 24 hours}$$

**3.** IV is infusing at 10 microdrips/minute. (a) (You can think "10 microdrips/minute = 10 mL/hour. So 8 hours would be 8 × 10 = 80 mL/hour") or (b) 60 microdrips = 1 mL; every 6 minutes 1 mL infuses ($\frac{60}{10}$ = 6 minutes),

10 mL in 60 minutes (1 hour).

$$\begin{array}{l} 10 \text{ mL in 60 minutes (1 hour)} \\ \times\ 8 \text{ hr} \\ \hline 80 \text{ mL in 8 hours} \end{array}$$

**4.** The IV is 0.5 g or 500 mg in 500 mL. This is equal to 1 mg/mL. The client receives 50 mL/hour, so he or she receives 50 mg each hour.

**5.** The IV is infusing at 30 mL/hour, and the solution is 500 mL.

$$\frac{500 \text{ mL}}{30 \text{ mL/hour}} = \frac{50}{3} = 16.7 \text{ hours (approximately) or 16 hours 42 minutes}$$

**6.** IVPB is 50 mL q8h or three times in 24 hours.

$$\begin{array}{r} 50 \\ \times\ 3 \\ \hline 150 \end{array} \text{ mL}$$

The client is receiving 100 mL for 21 hours (24 hours – 3 hours that the IVPB is running).

$$\begin{array}{r} 100 \\ \times\ 21 \\ \hline 2100 \end{array} \text{ mL}$$

$$\begin{array}{r} 2100 \text{ mL} \\ +\ 150 \text{ mL} \\ \hline 2250 \end{array} \text{ mL in 24 hours}$$

**7.** 500 mL at 50 mL/hour = 10 hours to run. If the IV starts at 6 AM, + 10 hours = 4 PM.

**8.** The IV is infusing at 125 mL/hour and the solution is 1000 mL.

$$\frac{1000 \text{ mL}}{125 \text{ mL/hour}} = 8 \text{ hours}$$

**9.** IVPB is 250 mL q6h or four times in 24 hours.

$$\begin{array}{r} 250 \\ \times\ 4 \\ \hline 1000 \end{array} \text{ mL in 24 hours}$$

**10.** The IV is 100 units in 100 mL or 1 unit/mL. The client receives 10 mL/hour, so he or she receives 10 units each hour.

*(continued)*

## SELF-TEST 7 IV DRIP RATES

1. **Macrodrip** $12 \times 60 = 720$ minutes

$$\frac{\text{mL/hour} \times \text{DF}}{\text{minutes}} = \text{gtt/minute} \qquad \frac{1500\text{ mL} \times \overset{1}{\cancel{10}}\text{ gtt}}{\underset{72}{\cancel{720}}\text{ minutes}} = 72\overline{)1500.0}^{\,20.8}$$

$$\begin{array}{r} 144 \\ \hline 600 \\ 570 \\ \hline \end{array}$$

$= 21$ gtt/minute

**Dimensional Analysis**

$$\frac{\overset{1}{\cancel{10}}\text{ gtt}}{1\ \cancel{\text{mL}}} \Bigg| \frac{1500\ \cancel{\text{mL}}}{12\ \cancel{\text{hours}}} \Bigg| \frac{1\ \cancel{\text{hour}}}{\underset{6}{\cancel{60}}\text{ minutes}} = \frac{1500}{72} = 20.8 \text{ or } 21 \text{ gtt/minute}$$

Round to 21 gtt/minute.

2. $$\frac{250\text{ mL} \times \overset{1}{\cancel{60}}\text{ gtt}}{\underset{12}{\cancel{720}}\text{ minutes}} = \frac{\cancel{250}}{12}\overline{)250.0}^{\,20.8} = 21 \text{ gtt/minute}$$

$$\begin{array}{r} 24 \\ \hline 100 \\ 96 \\ \hline \end{array}$$

**Dimensional Analysis**

$$\frac{\overset{1}{\cancel{60}}\text{ gtt}}{1\ \cancel{\text{mL}}} \Bigg| \frac{250\ \cancel{\text{mL}}}{12\ \cancel{\text{hour}}} \Bigg| \frac{1\ \cancel{\text{hour}}}{\underset{1}{\cancel{60}}\text{ minutes}} = \frac{250}{12} = 20.8 \text{ or } 21 \text{ gtt/minute}$$

You could also say mL/hour = gtt/minute microdrip, so 21 mL/hour = 21 gtt/minute. Round to 21 gtt/minute.

3. $$\frac{15\cancel{0}\text{ mL}}{2\cancel{0}\text{ mL/hour}} = \frac{\cancel{15}}{2}\overline{)15.0}^{\,7.5}\ \text{hour} \text{ or 7 hours 30 minutes}$$

   a. The drip rate is 20 mL/hour. No math is necessary. Set the infusion pump.
   
   b. The IV will last approximately $7\frac{1}{2}$ hours.

4. a. $$\frac{\overset{10}{\cancel{1000}}\text{ mL}}{\cancel{100}\text{ mL/hour}} = 10 \text{ hours}$$

   b.

| Formula Method | Proportion | Dimensional Analysis |
|---|---|---|
| $\frac{15\text{ mEq}}{\underset{2}{\cancel{40}}\text{ mEq}} \times \overset{1}{\cancel{20}}\text{ mL} = \frac{15}{2}$ <br> $= 7.5$ mL | **EXPRESSED AS TWO RATIOS** <br> 20 mL : 40 mEq : : x mL : 15 mEq <br> **EXPRESSED AS TWO FRACTIONS** <br> $\frac{20\text{ mL}}{40\text{ mEq}} \times \frac{x}{15\text{ mEq}}$ <br> **SOLUTION FOR BOTH PROPORTION METHODS** <br> $\frac{300}{40} = 7.5$ mL | $\frac{\overset{1}{\cancel{20}}\text{ mL}}{\underset{2}{\cancel{40}}\ \cancel{\text{mEq}}} \Big\| \frac{15\ \cancel{\text{mEq}}}{} = \frac{15}{2} = 7.5$ mL |

**c. Microdrip**

$$\frac{100 \text{ mL} \times \cancel{60} \text{ gtt}}{\cancel{60} \text{ minutes}} = 100 \text{ gtt/minute}$$

**Dimensional Analysis**

$$\frac{\cancel{60} \text{ gtt}}{1 \cancel{\text{mL}}} \bigg| \frac{100 \cancel{\text{mL}}}{1 \cancel{\text{hour}}} \bigg| \frac{1 \cancel{\text{hour}}}{\cancel{60} \text{ minutes}} = 100 \text{ gtt/minute}$$

Order states to run at 100 mL/hour. mL/hour = gtt/minute microdrip, so microdrip = 100 gtt/minute.

**Macrodrip**

$$\frac{100 \times \overset{1}{\cancel{20}}}{\underset{3}{\cancel{60}}} = \frac{100}{3} = 33 \text{ gtt/minute}$$

**Dimensional Analysis**

$$\frac{\overset{1}{\cancel{20}} \text{ gtt}}{1 \cancel{\text{mL}}} \bigg| \frac{100 \cancel{\text{mL}}}{1 \cancel{\text{hour}}} \bigg| \frac{1 \cancel{\text{hour}}}{\underset{3}{\cancel{60}} \text{ minutes}} = \frac{100}{3} = 33 \text{ gtt/minute}$$

Choose either tubing.

**d.** 33 gtt/minute macrodrip: 100 gtt/minute microdrip

**5. a.** You desire 1 g. Aminophylline comes 1 g in 10 mL. Add 10 mL to the IV of 500 mL D5W and label.

**b.** You have an infusion pump; there is no math.

Set the pump:

total volume to be infused = 500 mL; mL/hour = 75

**6.** 0.4 g = 400 mg

**a.**

**Formula Method**

$$\frac{\overset{8}{\cancel{400}} \cancel{\text{mg}}}{\underset{5}{\cancel{250}} \cancel{\text{mg}}} \times 1 \text{ mL}$$

$$\frac{8}{5} = 8.0 \div 5 = 1.6 \text{ mL}$$

**Proportion**

EXPRESSED AS TWO RATIOS

1 mL:250 mg : : x mL:400 mg

EXPRESSED AS TWO FRACTIONS

$$\frac{1 \text{ mL}}{250 \text{ mg}} \times \frac{x}{400 \text{ mg}}$$

SOLUTION FOR BOTH PROPORTION METHODS

$$400 = 250x$$

$$\frac{400}{250} = x$$

$$1.6 \text{ mL} = x$$

**Dimensional Analysis**

Use conversion factor: 1000 mg/1 g

$$\frac{1 \text{ mL}}{\underset{1}{\cancel{250}} \cancel{\text{mg}}} \bigg| \frac{0.4 \cancel{\text{g}}}{} \bigg| \frac{\overset{4}{\cancel{1000}} \cancel{\text{mg}}}{1 \cancel{\text{g}}} = 0.4 \times 4 = 1.6 \text{ mL}$$

**b.** Add 1.6 mL amikacin (Amikin) to 100 mL D5W.

DF = 10 gtt/mL for IVPB. Total minutes, 30.

(continued)

$$\frac{100\text{ mL} \times 10}{30} = \frac{100}{3} = 33.3 = 33\text{ gtt/minute}$$

**Dimensional Analysis**

$$\begin{array}{c|c} \overset{1}{\cancel{10}}\text{ gtt} & 100\ \cancel{\text{mL}} \\ \hline 1\ \cancel{\text{mL}} & \underset{3}{\cancel{30}}\text{ minutes} \end{array} = \frac{100}{3} = 33.3\text{ or }33\text{ gtt/minute}$$

Label the IV.

Round to 33 gtt/minute.

**7.** Minutes: 8 hours × 60 = 480

$$\frac{500\text{ mL} \times \overset{1}{\cancel{60}}\text{ gtt}}{\underset{8}{\cancel{480}}\text{ minutes}} = \frac{500}{8} \quad \begin{array}{r} 62.5 \\ 8\,\overline{)500.0} \\ \underline{48} \\ 20 \\ \underline{16} \\ 4\,0 \\ \underline{4\,0} \end{array} = 63\text{ gtt/minute}$$

**Dimensional Analysis**

$$\begin{array}{c|c|c} \overset{1}{\cancel{60}}\text{ gtt} & 500\ \cancel{\text{mL}} & 1\ \cancel{\text{hour}} \\ \hline 1\ \cancel{\text{mL}} & 8\ \cancel{\text{hours}} & \underset{1}{\cancel{60}}\text{ minutes} \end{array} = \frac{500}{8} = 62.5\text{ or }63\text{ gtt/minute}$$

Round to 63 gtt/minute.

**8.** Minutes: 24 hours × 60 = 1440 minutes

$$\frac{1000\text{ mL} \times \overset{1}{\cancel{15}}\text{ gtt}}{\underset{96}{\cancel{1440}}\text{ minutes}} = \begin{array}{r} 10.4 \\ 96\,\overline{)1000.0} \\ \underline{96} \\ 40 \\ \underline{0} \\ 400 \end{array}$$

10 gtt/minute

**Dimensional Analysis**

$$\begin{array}{c|c|c} \overset{1}{\cancel{15}}\text{ gtt} & 1000\ \cancel{\text{mL}} & 1\ \cancel{\text{hour}} \\ \hline 1\ \cancel{\text{mL}} & 24\ \cancel{\text{hours}} & \underset{4}{\cancel{60}}\text{ minutes} \end{array} = \frac{1000}{96} = 10.4\text{ or }10\text{ gtt/minute}$$

Round to 10 gtt/minute.

**9.** $$\frac{250\text{ mL}}{20\text{ mL/hour}} = \frac{250}{20} \quad \begin{array}{r} 12.5 \\ 20\,\overline{)250.0} \\ \underline{20} \\ 50 \\ \underline{40} \\ 10\,0 \end{array}$$

The IV will last 12.5 hours or 12 hours 30 minutes.

**10.** Minutes: 4 hours × 60 = 240 minutes

$$\frac{500\text{ mL} \times \overset{1}{\cancel{20}}\text{ gtt}}{\underset{12}{\cancel{240}}\text{ minute}} = 12\overline{)500.0}\quad 41.6$$

$$\begin{array}{r} 41.6 \\ 12\overline{)500.0} \\ \underline{48\phantom{.0}} \\ 20\phantom{.} \\ \underline{12\phantom{.}} \\ 80 \end{array}$$

= 42 gtt/minute

**Dimensional Analysis**

$$\frac{\overset{1}{\cancel{20}}\text{ gtt}}{1\ \cancel{\text{mL}}}\bigg|\frac{500\ \cancel{\text{mL}}}{4\ \cancel{\text{hours}}}\bigg|\frac{1\ \cancel{\text{hour}}}{\underset{3}{\cancel{60}}\text{ minutes}} = \frac{500}{12} = 41.6 \text{ or } 42 \text{ gtt/minute.}$$ Round to 42 gtt/minute.

## SELF-TEST 8 IV PROBLEMS

**1. a.** Add 18 mL sterile water for injection to the vial of 5 million units.

**b.** Solution is 5 milliunits/20 mL (milliunits = million units).

**c.** You want 1 milliunit.

| Formula Method | Proportion | Dimensional Analysis |
|---|---|---|
| $\frac{1\text{ milliunit}}{\cancel{5}\text{ milliunits}} \times \overset{4}{\cancel{20}}\text{ mL} = 4\text{ mL}$ | EXPRESSED AS TWO RATIOS<br>20 mL:5 milliunits : : x mL:1 milliunit<br>EXPRESSED AS TWO FRACTIONS<br>$\frac{20\text{ mL}}{5\text{ milliunits}} \times \frac{x}{1}$<br>SOLUTION FOR BOTH PROPORTION METHODS<br>$20 = 5x$<br>$\frac{20}{5} = x$<br>$4\text{ mL} = x$ | $\frac{20\text{ mL}}{5\ \cancel{\text{milliunits}}}\bigg|\frac{1\ \cancel{\text{milliunit}}}{} = \frac{20}{5} = 4\text{ mL}$ |

**d.**

$$\frac{\overset{25}{\cancel{100}}\text{ mL} \times \cancel{10}}{\underset{1}{\cancel{40}}} = 25 \text{ gtt/minute}$$

**Dimensional Analysis**

$$\frac{\cancel{10}\text{ gtt}}{1\ \cancel{\text{mL}}}\bigg|\frac{100\ \cancel{\text{mL}}}{\cancel{40}\text{ minutes}} = \frac{100}{4} = 25 \text{ gtt/minute}$$

(continued)

**2.** 1000 mL is infusing at 100 mL/hour, so the IV will take

$$\frac{\cancelto{10}{1000}}{\cancelto{1}{100}} = 10 \text{ hours to complete.}$$

If it starts at 8 AM, it should finish 10 hours later at 6 PM.

**3. a.**

**Formula Method**

$$\frac{\cancelto{3}{60}\ \cancel{\text{mg}}}{\cancelto{2}{40}\ \cancel{\text{mg}}} \times 1 \text{ mL} = \frac{3}{2}$$

$$= 1.5 \text{ mL}$$

**Proportion**

EXPRESSED AS TWO RATIOS

1 mL:40 mg : : x mL:60 mg

EXPRESSED AS TWO FRACTIONS

$$\frac{1 \text{ mL}}{40 \text{ mg}} \times \frac{x \text{ mL}}{60 \text{ mg}}$$

SOLUTION FOR BOTH PROPORTION METHODS

$$60 = 40x$$

$$\frac{60}{40} = x$$

$$1.5 \text{ mL} = x$$

**Dimensional Analysis**

$$\begin{array}{c|c} 1 \text{ mL} & \cancelto{3}{60}\ \cancel{\text{mg}} \\ \hline \cancelto{2}{40}\ \cancel{\text{mg}} & \end{array} = \frac{3}{2} = 1.5 \text{ mL}$$

Add 1.5 mL gentamicin.

**b.** $\frac{50 \text{ mL} \times \cancel{20}}{\cancel{30} \text{ minutes}} = \frac{\cancel{100}}{3} \quad \begin{array}{r} 33.3 \\ 3\overline{)100.00} \end{array} = 33 \text{ gtt/minute}$

**Dimensional Analysis**

$$\begin{array}{c|c} \cancelto{2}{20}\ \text{gtt} & 50\ \cancel{\text{mL}} \\ \hline 1\ \cancel{\text{mL}} & \cancelto{3}{30}\ \text{minutes} \end{array} = \frac{100}{3} = 33.3 \text{ or } 33 \text{ gtt/minute.}$$

**4.** 12 hours × 60 = 720 minutes

$$\frac{1500 \text{ mL} \times \cancelto{1}{10} \text{ gtt}}{\cancelto{72}{720} \text{ minute}} = \begin{array}{r} 20.8 \\ 72\overline{)1500.0} \\ \underline{194\phantom{.0}} \\ 60\ 0 \\ \underline{57\ 6} \end{array} = 21 \text{ gtt/minute}$$

**Dimensional Analysis**

$$\begin{array}{c|c|c} \cancelto{1}{10}\ \text{gtt} & 1500\ \cancel{\text{mL}} & 1\ \cancel{\text{hour}} \\ \hline 1\ \cancel{\text{mL}} & 12\ \cancel{\text{hours}} & \cancelto{6}{60}\ \text{minutes} \end{array} = \frac{1500}{72} = 20.8 \text{ or } 21 \text{ gtt/minute. Set the rate at 21 gtt/minute.}$$

**5.** Intralipid 500 mL q6h means the client is receiving 500 mL four times every 24 hours.

$$\begin{array}{r} 500 \\ \times\ 4 \\ \hline 2000 \text{ mL} \end{array}$$

The IV is infusing 80 mL/hour. There are 24 hours in a day, so

$$\begin{array}{r} 24 \\ \times\ 80 \\ \hline 1920 \end{array}$$

Adding these, we have $\begin{array}{r} 2000 \text{ mL} \\ +1920 \text{ mL} \\ \hline 3920 \text{ mL} \end{array}$

**6. a.** You have 1000 mL running at 50 mL/hour, therefore

$$\begin{array}{r} 20 \\ 50\overline{)1000} \\ 100 \\ \hline 0 \end{array} = 20 \text{ hours}$$

**b.** Microdrip 60 gtt/minute
Minutes: 20 hours × 60 = 1200 minutes

$$\frac{1000 \text{ mL} \times \overset{1}{\cancel{60}} \text{ gtt}}{\underset{20}{\cancel{1200}} \text{ minutes}} = \frac{1000}{20} = 50 \text{ gtt/minute}$$

$$\begin{array}{c|c|c} \overset{1}{\cancel{60}} \text{ gtt} & 1000 \cancel{\text{mL}} & 1 \cancel{\text{hour}} \\ \hline 1 \text{ mL} & 20 \cancel{\text{hours}} & \underset{1}{\cancel{60}} \text{ minutes} \end{array} = \frac{1000}{20} = 50 \text{ gtt/minute}$$

Macrodrip tubing 10 gtt/mL

$$\frac{10\cancel{00} \text{ mL} \times 10 \text{ gtt}}{12\cancel{00} \text{ minutes}} = \frac{100}{12} = 8.3 \text{ or } 8 \text{ gtt/minute}$$

**Dimensional Analysis**

$$\begin{array}{c|c|c} \overset{1}{\cancel{10}} \text{ gtt} & 1000 \cancel{\text{mL}} & 1 \cancel{\text{hour}} \\ \hline 1 \cancel{\text{mL}} & 20 \cancel{\text{hours}} & \underset{6}{\cancel{60}} \text{ minutes} \end{array} = \frac{1000}{120} = 8.3 \text{ or } 8 \text{ gtt/minute}$$

**c.** The drip factor will be 50 gtt/minute. It is not incorrect to choose the macrodrip at 8 gtt/minute. However, because the IV will run so many hours, a good flow might help to keep the IV running.