TRIDENT TECHNICAL COLLEGE

Nursing Division

ADN
Dosage Proficiency Study Guide

DESCRIPTION:

The Associate Degree Nursing (ADN) dosage proficiency study guide is intended to prepare students for successful completion of the placement test in Health Calculations II (AHS 129). Successful completion of the ADN dosage proficiency test (AHS 129) is required prior to entering Mental Health Promotion (NUR 207), Health Promotion for Families II (NUR 208) and Nursing Management and Leadership (NUR 219).

If taking Health Calculations II (AHS 129) for the first time, the student has three attempts on the dosage exam to obtain a satisfactory score of 100. The first attempt is mandatory on the first day of the course. Students who fail to take this first attempt will be dropped from the course and must wait until the next time the course is offered. Students who achieve the required score of 100 on the first day may drop the course. All other students will have two additional attempts to achieve the required dosage exam score. If repeating Health Calculations II (AHS 129), the student has two attempts on the dosage exam to obtain a satisfactory score of 100. The student may choose to take the first dosage exam attempt on the first day of class. If the student chooses to do this, it will count as one of two attempts. When passing on this first attempt, the student cannot drop the course as it must reflect a grade of satisfactory complete on the transcript since it is a prerequisite for NUR 207/208.

TEXTBOOK AND OTHER REQUIRED MATERIALS:

Buchholz, S. (2009). Henke's Med Math: Dosage Calculation, Preparation & Administration (6th ed.). Philadelphia: Lippincott, Williams and Wilkins.

Approved calculators: Texas Instrument TI-1706 SV or Office Max OM96127
2009-2010 Course Materials
Rounding guidelines for answers. Retrieved from course materials @ www.tridenttech.edu/nursing.htm

OBJECTIVES:

This study guide is to assist the student to:

1. convert within and between measurement systems.
2. utilize ratio and proportion to solve dosage calculations.
3. apply the rounding guidelines to all dosage calculation answers.
4. review concepts from AHS 126 Health Calculations: Calculate
    a. oral and parenteral medication dosages for children and adults.
    b. intravenous flow rates in drops per minute (gtts/min).
    c. intravenous flow rates in milliliter per hour (mL/hr).
    d. weight-based medication dosages for a 24 hour period.

5. calculate dosages and flow rates for heparin, insulin and patient controlled analgesics (PCA) intravenous infusions.
6. calculate dosages and flow rates for weight-based and reconstituted medications for intravenous infusions.
7. calculate dosages and flow rates for intravenous mediations push.

For objectives 1, 2, 3, and 4, the information will be a review from the PN dosage proficiency study guide. If more review is needed, please return to the PN study guide.

STUDY GUIDE FOR ADN DOSAGE PROFICIENCY

OBJECTIVE 1: Convert within and between measurement systems

Conversions Within the Metric System

Since the metric system is based on the decimal system and units of 1,000, conversions are easily obtained by moving the decimal point. Therefore, to convert between units either multiply or divide by 1,000, which means moving the decimal point 3 places to the right or left.
If converting from a smaller unit to a larger unit, divide by 1,000 or move the decimal point 3 places to the left. The number should be smaller. See the following example.

Example: 100 mL = 0.1 L which is written as 0.1 L

If converting from a larger unit to a smaller unit, multiply by 1,000 or move the decimal point 3 places to the right. The number should be larger, since it takes more of a smaller unit to make a larger unit.

Example: 10 g = 10,000 mg which is written as 10,000 mg

Converting Within and Between Systems of Measurements

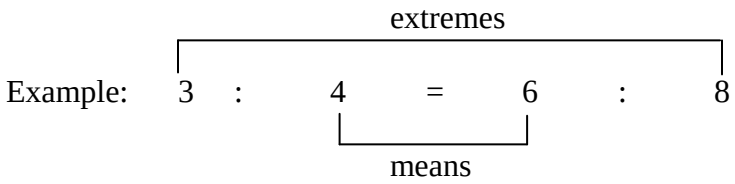
Convert means to change from one form to another. Rules for Converting include:

1. Memorize equivalents/conversions as directed within a system or between systems.
2. Follow basic math principles.
3. Use ratio and proportion to convert and to solve dosage calculations.

The methods of converting are either move the decimal point or use ratio and proportion. Moving the decimal point is used primarily within the metric system. This method was discussed in the previous section. Using the ratio and proportion is one of the easiest methods of converting. It is utilized throughout this study guide. The basics of ratio and proportion will follow in the next section, titled Objective 2.

OBJECTIVE 2: Utilize ratio and proportion to solve dosage calculations

A. A ratio is used to indicate a relationship between 2 numbers. The numbers are separated by a colon (:) Example: 3:4 The colon indicates division.
B. A proportion is an equation of 2 ratios of equal value. The terms of the first ratio have a relationship to the second ratio. Example: 3:4 = 6:8
C. The terms in a proportion are called the means and the extremes. The means are the middle terms. Remember M = middle. The extremes are the outer or end terms. Remember E = end.



In a proportion, the product of the means equals the product of the extremes. From the above example, the product of the means is 4 x 6 = 24 and the product of the extremes is 3 x 8 = 24. Both products are 24. This principle of proportion can be used to solve for the unknown or x.

The rules for solving a problem using ratio and proportion include the following:

Rule	Example
1. State the known ratio.	3 : 4
2a. Add the incomplete ratio to the other side of the equal sign.	3 : 4 = 6 : x
2b. Label all terms and use the same order of terms on both side of the equation.	3 mg : 4 mL = 6 mg : x mL
3. Solve the problem by multiplying the means and extremes keeping the products separated with an equal sign.	3 mg : 4 mL = 6 mg : x mL 3x = 24
4. Solve for x. Divide both sides of the equation by the number in front of x. Label the answer.	$\frac{3x}{3} = \frac{24}{3}$ x = 8 x = 8 mL

Ratio and proportion can also be written vertically. Here is the same problem but written vertically:

$$\frac{3\text{ mg}}{4\text{ mL}} = \frac{6\text{ mg}}{x\text{ mg}} \qquad 3x = 24 \qquad x = 8\text{ mL}$$

First, cross multiply (4 x 6) and then, divide (24 ÷ 3) to solve for x .

It is important to **determine if the answer is logical.** Consider the above answer: If **4 mL** contains **3 mg**; you will need a **larger** volume than **4 mL** to obtain **6 mg**. The answer **8 mL** is larger, therefore, it is logical.

Another method of dosage calculation is dimensional analysis which can be found in the book, Henke's Med Math by Susan Buchholz.

OBJECTIVE 3: Apply the rounding guidelines to all dosage calculation answers

Rounding guidelines are used to finalize dosage calculations answers. Print off a copy from Course Materials and keep with this study guide. After answering every dosage calculation, apply the rounding guidelines. The document, Course Materials, is located on Trident Technical College's Nursing Division's website.

OBJECTIVE 4: Review concepts from AHS 126 Health Calculations

A. Calculate oral and parenteral medication dosages for children and adults

Practice using ratio and proportion and the rounding guidelines on previously learned calculations from AHS 126.

Example A: If a doctor orders a medication of 25 mg p.o. and the available medication is in a dosage strength of 50 mg per 1 mL, ratio and proportion can be used to solve how many mL of medication which will be administered to the patient.

Remember: The **known ratio** is the **dosage strength available**, 50 mg per mL. The **incomplete ratio** is the **dosage to be given**.

Rule	Example
1. State the known ratio with labels	50 mg: 1 mL
2. Add the incomplete ratio	50 mg : 1 mL = 25 mg : x mL
3. Multiply the means and extremes	50x = 25
4. Divide the equation by 50	$\frac{50x}{50} = \frac{25}{50}$
5. The X in the original proportion was mL, so the answer is	x = 0.5 mL

The dosage ordered**, 25 mg**, is **smaller** than the **strength available, 50 mg in 1 mL**. So, the answer should be **smaller than 1 mL**, and it is. The answer is logical.

Example B: When heparin is administered subcutaneously, a 1 mL syringe or tuberculin syringe is utilized. The next example involves heparin subcutaneous (SC).

Medication order: Heparin 5,000 units SC every 12 hours
Available: Heparin 10,000 units/mL
How many mL will you administer? Apply the Rounding Guidelines to the answer.

Rule	Example
1. State the known ratio with labels	10,000 units : 1 mL
2. Add the incomplete ratio	10,000 units : 1 mL = 5,000 units : x mL
3. Multiply the means and extremes	10,000 x = 5,000
4. Divide equation by 10,000	$\frac{10{,}000\ x}{10{,}000} = \frac{5{,}000}{10{,}000}$ Answer is x = 0.5 mL

B. Calculate intravenous flow rates in drops per minute (gtts/min)

A formula is used to calculate the number of drops per minute. The drops are regulated by adjusting the roller clamp on the IV tubing. The drop factor is usually located on front of package and explains how many drops per mL the tubing delivers. To use this formula, the following information is needed.

1. Volume (mL) to be infused
2. Time the volume is to be infused
3. Drop factor of the IV tubing being used

The formula is:

$$\frac{\text{Volume of the infusion (V1)}}{\text{Time in hours (T1)}} \text{ x } \frac{\text{Volume of drip factor (V2)}}{\text{Time in minutes (T2)}} = \text{gtt / min}$$

Example: Administer an IV fluid at 125 mL/hour.
Drop Factor: 10 gtt/min

$$\frac{125 \text{ mL x } 10 \text{ gtts}}{1 \text{ hour x } 60 \text{ min}} = 20.8 \text{ gtts / min} = 21 \text{ gtts / min}$$

The number of minutes, specified in every IV order. If the order reads "hour" then you convert to minutes by multiplying by 60 (60 minutes = 1 hr). This is necessary because the drops are counted per minute. The answer, 20.8 gtt/min, is **rounded to a whole number** because 0.8 of a drop cannot be counted (Rounding Guidelines).

C. Calculate intravenous flow rates in milliliter per hour (mL/hr)

IV pumps are also utilized to infuse IV fluids. Ratio and proportion is utilized to determine the flow rate (mL/hr) which is used to set or program the pump. Often when antibiotics are administered, the infusion time is less than an hour. The right side of the following equation represents mL/hr (pump infusion rate) although it is written as mL/60 min. The answer, mL per hr, is rounded to the tenth place after the decimal point (Rounding Guidelines). Remember the same order of terms and labels are used on both sides of the equation. The physician will write an order of fluids and rate. Pharmacy will mix the medication and have it available for the nurse to use.

Medication order: Cefazolin (Ancef) 500 mg every 6 hours IVPB
Available: Cefazolin (Ancef) 500 mg in 50 mL D_5W to infuse over **45 minutes**
How many mL/hr will you set the IV pump?

Rule	Example
1. State the known ratio with labels	50 mL : 45 min
2. Add the incomplete ratio	50 mL : 45 min = x mL : 60 min
3. Multiply the means and extremes	45 x = 3,000
4. Divide equation by 45	$\frac{45x}{45} = \frac{3{,}000}{45}$ Answer is x = 66.7 mL/hr

D. Calculate weight-based medication dosages for a 24 hour period.

For pediatric and many adult dosages, calculations are often based on body weight. This provides a more accurate way to dose a medication.

Principles for weight based calculations

1. Ratio and proportion is utilized to calculate the dosage.
2. Convert lb. to kg. The conversion factor is 2.2lb = 1kg. Apply the rounding guidelines after the conversion.
3. Pediatric dosage answers are frequently smaller and micrograms are often used. Apply the rounding guidelines to the answer.
4. Often pediatric dosages are based on mg per kg in a 24 hour period (mg/kg/day). When performing the calculation a series of steps is needed.

Steps to solve weight-based calculations

1. Convert weight (lb) to Kg, dividing by 2.2 or making sure weight is in Kg.
2. Calculate the safe daily dose
3. Calculate the safe divided dose
4. Calculate ordered dose in mL using ratio and proportion

Determine whether a dose is safe or not:
Medication order: Gentamicin 50 mg IVPB every 8 hours for a child weighing 40 lb
Recommended dose: Gentamicin 6 – 7.5 mg/kg/day in divided doses every 8 hours

1. Convert the weight: 40 lb divided by 2.2 lb = 18.18 kg = 18.2 kg
2. Calculate the safe daily dose:
   A. Safe lower daily dose: 6 mg x 18.2 kg = 109.2 mg for a 24 hr period or day
   B. Safe upper daily dose: 7.5 mg x 18.2 kg = 136.5 mg for a 24 hr period or day
   The safe daily dose range is 109.2 mg – 136.5 mg in twenty four hours
3. Calculate the safe divided dose:
   Divide the recommended daily dose by the number of times a day the dose will be given.
   A. Safe lower divided dose: 109.2 mg ÷ 3 doses = 36.4 mg
   B. Safe upper divided dose: 136.5 mg ÷ 3 doses = 45.5 mg
   The safe divided dose range is between 36.4 mg – 45.5 mg

Determine if the ordered dose is within the safe divided dose range. The ordered amount of 50 mg every 8 hours is greater than the safe divided dose range, 36.4 – 45.5 mg. Therefore, gentamicin 50 mg is not a safe dose. Remember that there may be a reason for an increased dose, however; call the doctor to verify the order. In practice, it is recommended that the nurse use a reference to determine the safe dose range in milligrams per kilograms.

Calculate the ordered dose in mL:
Medication order: Dicloxacillin 50 mg every 6 hours for a child weighing 35.2 lb
Recommended dose: Dicloxacillin 12.5 mg/kg/day
Available: Dicloxacillin 62 mg per 5 mL

1. Convert the weight: 35.2 lb ÷ 2.2 lb = 16 kg
2. Calculate the safe daily dose: 12.5 mg x 16 kg = 200 mg/day
3. Calculate the safe divided dose: 200 mg ÷ 4 doses = 50 mg per dose
   The ordered dose of 50 mg equals the calculated dose of 50 mg per dose. Therefore, the ordered medication dose is safe.
4. Calculate the ordered dose in mL using ratio and proportion. Apply the Rounding Guidelines.

1. State the known ratio with labels	62 mg : 5 mL
2. Add the incomplete ratio	62 mg : 5 mL = 50 mg : x mL
3. Multiply the means and extremes	$62x = 250$
4. Divide equation by 62	$\frac{62\ x}{62} = \frac{250}{62}$ x = 4.03, round to 4 Answer is x = 4 mL

LEARNING ACTIVITIES FOR OBJECTIVE 4:

Read Henke's Med Math, Chapter 10 (pages 280-290, 295-304)
Complete SELF TEST 1 & 2 (pages 283, 287-290)
Complete SELF TEST 5 (pages 303-304)

OBJECTIVE 5: Calculate dosages and flow rates for heparin, insulin and patient controlled analgesics (PCA) infusions.

Heparin intravenous rates are calculated using ratio and proportion. Heparin is packaged in many different dosage strengths. Reading labels carefully is crucial. Accuracy is critical when administering heparin due to the serious complications that occur when too little or too much heparin is administered.

IV Heparin Rate: mL/hr

The doctor orders a heparin infusion to be started. The nurse starts the infusion according to the dose ordered. In the following calculation, the ratio on the right side of the equation represents hourly rate in both units and mL per hour.

Medication order: Heparin 1,000 units/hr IV
Available: Heparin 20,000 units per 500 mL D_5W
How many mL/hr will the pump be set ? 20,000 units : 500 mL = 1,000 units : x mL
20,000 x = 500,000
Answer is x = 25 mL/hr

IV Heparin Rate: units/hr

During report, the nurse learns that a patient is on a heparin infusion which is reported as, mL per hour (mL/hr). It is the nurse's responsibility to know how much heparin is being administered in units/hour. The nurse needs to convert between mL/hr and units/hr.

Medication order: Heparin 25 mL/hr IV infusion
Available: Heparin 12,500 units in 250 mL of D_5W
How many units/hr of heparin is the patient receiving?
12,500 units : 250 mL = x units : 25 mL
250 x = 312,500
Answer is x = 1,250 units/hr

Caution: Do not use the letter "u" when writing units. The word "unit(s)" should be written. *(Refer to official "Do Not Use" list* in syllabus, pg. 8.)

Principles for intravenous insulin dosage calculations

1. Ratio and proportion is utilized to calculate the dosage.
2. Begin with the known amount of medication in the total solution. Most pharmacies use a standard of: 100 units of Human Regular insulin in 100 mL NS
3. Human Regular Insulin is the **only** type of insulin that can be given by continuous IV infusion
4. The infusion is started according to the dose ordered. The physician may order a bolus dose prior to the initiation of the continuous infusion.
5. Often the dosage is titrated (adjusted up or down) according to a patient's blood glucose level.
6. It is important to follow the facility's policy regarding the protocol for titration.
7. Insulin is a **high-alert** drug and should be checked by two licensed nurses.

IV Insulin Rate: mL/hr

Patient admitted to hospital with blood glucose level of 326 mg/dL. Weight 70kg
Medication order:

1. If blood glucose is > 150 mg/dL, give IV regular insulin per following protocol:
   - Bolus (given over a short period of time) of 0.1 unit per kg followed by starting IV infusion at the calculated dose of: **Blood glucose level minus 50 x 0.02 units/hr**

Available: Regular Insulin 100 units in 100 mL NS

1st step: Calculate the **bolus dose**: 0.1 unit x 70 = 7 units of Regular Insulin IV
2nd step: Calculate the **infusion rate:**
Blood glucose 326 -50 x 0.02 units = 276 x 0.02 units = 5.5 units
3rd step 100 units: 100 mL = 5.5 units: x mL
100 x =550
Answer is x = 5.5 mL/hr
Set infusion pump at 5.5 mL/hr. Recheck blood glucose level in 1 hour and follow established protocol.

Medication order: Regular insulin 8 units/hr IV infusion
Available: 100 units of Regular Insulin in 100 mL NS
How many mL/hr will infuse 8 units /hr?
How many hours will the infusion run?

Rule	Example
1. State the known ratio with labels	100 units: 100 mL NS
2. Add the incomplete ratio	100 units : 100 mL = 8 units : x mL
3. Multiply the means and extremes	$100x = 800$
4. Divide the equation by 100	$\frac{100x}{100} = \frac{800}{100}$
5. The X in the original proportion was mL, so the answer is	x = 8 mL/ hr

Rule	Example
1. State the known ratio with labels	8 mL/hr
2. Add the incomplete ratio	8 mL : 1 hr = 100 ml : x hr
3. Multiply the means and extremes	$8x = 100$
4. Divide the equation by 8	$\frac{8x}{8} = \frac{100}{8}$
5. The X in the original proportion was hr, so the answer is	x = 12.5 hr

Insulin is known to adhere to IV tubing; so, the nurse should be aware of the administration guidelines regarding insulin infusion.
Note: Insulin has many incompatibilities including antibiotics and cardiac medications. The nurse should avoid piggybacking any other medication into an insulin infusion.

Patient Controlled Analgesic (PCA) pump

The use of a PCA pump allows the patient to self-administer intravenous (IV) narcotic medication. All parameters of the PCA pump are ordered by the physician and monitored by the registered nurse (RN). To ensure safe use of self-administered narcotic medication, the physician order addresses the following parameters which the RN follows.

1. Medication concentration (mg/mL)
2. Self-administered or incremental dosage (mg)
3. Lockout interval or delay between self-administered dosages (minutes)
4. One hour limit (mg/hr) includes the total of all possible self-administered dosages

EXAMPLE: The patient has morphine sulfate concentration 1 mg/1mL ordered for the PCA pump. The patient to self-administer morphine 0.5 mg. What is the total medication one hour limit? ____ mg/hr

1. Self administered dose	1. 0.5 mg
2. Lock-out interval	2. Every 6 minutes or 10 times in 60 minutes
3. Total dose per hour	3. 10 times x 0.5 mg dose = 5mg
4. TOTAL one hour limit	4. 5 mg/hr = Answer

LEARNING ACTIVITIES FOR OBJECTIVE 5:

Read Henke's Med Math, Chapter 9 (pages 252-262)
Complete SELF TEST 1 (page 283)
Complete SELF TEST 2 (pages 287-290)

OBJECTIVE 6: Calculate dosages and flow rates for weight-based intravenous infusions

There are many medications that are administered using continuous infusions. The dosages may be ordered in milligrams (mg) or micrograms. They are often weight based and may be ordered per minute or per hour. Like heparin, hospitals require that these medications be delivered using an IV pump. Examples of rates include:

micrograms/hr
micrograms/min
mg/hr
mg/min
mg/kg/hr
micrograms/kg/min

Calculating dosages per hour

Medication order: Infuse aminophylline at 13.5 mL/hr IV
Available: Aminophylline 500 mg in 250 mL D_5W
How many mg/hr is the patient to receive? Again, the right side of the equation represents hourly rate in both mg and mL per hour. Solve for x mg.

500 mg : 250 mL = x mg : 13.5 mL
250 x = 6750
Answer is x = 27 mg/hr

Calculating dosages per hour

In the following problem, convert the time from minutes to hour.

Medication order: Infuse lidocaine at 4 mg/min IV

Available: Lidocaine 1 g in 250 mL D_5W

How many mg/hr? Lidocaine is ordered 4 mg/min. To change from minutes to hours, multiply 4 mg x 60 minutes. The answer is 240 mg/hr.

Calculation mL per hour

The ordered dose is in mg and the available drug is in grams (g). Convert grams to milligrams, 1 g = 1,000 mg. This conversion keeps the terms with labels the same on both sides of the equation. Using ratio and proportion, solve this problem. The left side of the equation represents the concentration of the medicine and the right side represents mg or mL per hour.

1,000 mg : 250 mL = 240 mg : x mL

1,000 x = 60,000

x = 60 mL/hr Set the pump for 60 mL/hr

Calculating mL/hr from micrograms/kg/min

In the following example, complete multiple conversions before solving the problem.

Medication order: Infuse dopamine 2 micrograms/kg/min IV

Available: Dopamine 400 mg in 250 mL D_5W

Pt Weight: 150 lbs

How many mL/hr will you set the IV pump?

1. Convert the weight to kg: 150 lb divided by 2.2 lb = 68.18 or 68.2 kg
2. Determine the dose per minute: 2 micrograms x 68.2 kg = 136.4 micrograms/min
3. Determine the dose per hour: 136.4 microgram/min x 60 minutes = 8,184 micrograms/hr
4. Convert microgram to mg since the available drug is in mg: 8.184 mg/hr (do not round)
5. Solve the problem using ratio and proportion:

   400 mg : 250 mL = 8.184 mg : x mL

   400 x = 2,046

   x = 5.115 mL/hr = 5.1 mL/hr Set the IV pump for 5.1 mL/hr.

The IV infusion rate, 5.115 mL/hr, is rounded to the tenth place after the decimal point. (Rounding Guidelines).

Calculating weight-based medications using the volumetric syringe (mL/hr)

Given the weight-based divided dosage from a reconstituted medication, calculate the total volume of medication and diluent. From the total volume, calculate the flow rate (mL/hr) of administration for this single dose. Administer the medication using a syringe or volumetric pump. An example follows.

A patient has ordered cefazolin (Ancef) 625 mg IV every six hours. The ordered dose is verified as a safe dose for this pediatric patient who weighs 25 kg. The 1 gram vial is diluted with sterile water and yields 93 mg/mL. Administer the **dose** slowly over 5 minutes. How many mL/hr will the IV syringe pump be set for one dose? Apply the rounding guidelines

First step 93 mg : 1 mL = 625 mg : x mL 93 x = 625 Apply x = 6.720 rounding guidelines x = 6.7 mL	**Second step** 6.7 mL : 5 min = x mL : 60 min 5 x = 402 x = 80.4 mL/60 min mL/60 min is the same as x = 80.4 mL/hr

LEARNING ACTIVITIES FOR OBJECTIVE 6:

Read Henke's Med Math, Chapter 9 (pages 237, 248), Chapter 10 (pages 295-306)
Complete SELF TEST 1 - 3 (pages 237- 249)
Complete SELF TEST 5 (page 304, except # 8)

OBJECTIVE 7: Calculate dosages and flow rates for intravenous pushes

For this objective, the majority of information is provided in this study guide. The textbook provides limited information for intravenous push (IVP) medications. When administering IVP medications, the nurse needs to consider the following factors:

1. How much medication will be withdrawn from the ampule or vial?
2. Does the medication require dilution? If so, how much diluent will be added?
3. Using ratio and proportion, determine the rate at which the IV medication will be pushed.
   A. How many mL per minute will be administered?
   B. How many minutes will it take to give the medication? Apply Rounding Guidelines.

Examples follow:

<u>How much medication will be withdrawn from the ampule?</u>

Medication order:	Digoxin 0.125 mg IVP
Available:	Digoxin 0.5 mg/mL
Directions:	Dilute medication in normal saline for a total volume of 10 mL and administer 0.25 mg/min

Using ratio and proportion, determine the amount of medication to be withdrawn from the ampule.

0.5 mg : 1 mL = 0.125 mg : x mL
0.5 x = 0.125
x = 0.25 mL

Digoxin 0.25 mL of medication will be withdrawn from the ampule.

<u>How much diluent will be added to the medication?</u>

To determine whether an IVP medication is administered diluted or undiluted, refer to a drug resource book. For the purposes of the test, this information will be provided.

Once the amount of medication to be withdrawn from the ampule or vial has been determined, subtract the amount of the medication from the total volume to be infused. In the above example, the amount of medication withdrawn is 0.25 mL of Digoxin. The directions instruct to **dilute for a total of 10 mL**. This means that normal saline (NS) is added to the 0.25 mL of medication to total 10 mL. Example:

10 mL (digoxin and NS) – 0.25 mL digoxin = 9.75 mL or 9.8 mL of NS (Rounding Guidelines)

Therefore, 9.8 mL of NS is added to the syringe to have an approximate total volume of 10 mL.

<u>How many mL per minute will be administered</u>?

The recommended rate of administration is found in a drug resource book. For the purposes of the test, this information will be provided. Using ratio and proportion, solve this problem.

Medication order:	Versed 6 mg IVP
Available:	Versed 10 mg/2 mL
Directions:	Dilute medication in normal saline for a total volume of 10 mL and administer 2 mg/min

The **concentration of the medication** is the amount of ordered medication per total volume to be infused. The known ratio is 6 mg : 10 mL. The **recommended rate of administration** is found in the directions. For this example, it is 2 mg/per minute. If the nurse can give 2 mg in 1 minute, then how many mL represents 2 mg per minute? Therefore, the unknown is 2 mg : x mL. The left side of the proportion represents the known ratio and right side represents mg or mL per minute.

6 mg : 10 mL = 2 mg : x mL
6 x = 20
x = 3.333 or 3.3 mL/min

Therefore, the rate of administration is 3.3 mL per minute (Rounding Guidelines).

Next, try the same problem but with an undiluted medication. Example:
Medication order: Phenytoin (Dilantin) 300 mg IVP
Available: Phenytoin 100 mg/5 mL
Directions: May give undiluted at a rate not to exceed 25 mg per minute

How many mL/min will you administer? First, calculate mL of medication.

100 mg : 5 mL = 300 mg : x mL
100 x = 1,500
x = 15 mL

In this problem, the medication is not diluted. The concentration is determined by using the medication order and the available drug form. After the first step, it is now known that phenytoin 300 mg represents 15 mL of medication.

In the second step of this calculation, Phenytoin 300 mg : 15 mL is the known ratio. Solve for how many mL/min. The right side of your proportion represents mg or mL per minute.

300 mg : 15 mL = 25 mg : x mL
300 x = 375
x = 1.25 mL 1.3 mL/min is the answer (Rounding Guidelines)

Determine the total time to administer an undiluted IVP medication.
In this problem, consider the **ordered medication** and the **recommended rate of administration**. Using ratio and proportion, solve this problem.

Medication order: Dilantin 200 mg IVP
Available: Dilantin 100 mg/5 mL
Directions: May give undiluted at a rate not to exceed 25 mg per minute
How many minutes will it take to give the medication?

If the nurse can administer 25 mg every 1 minute, then find how many minutes the ordered medication of 200 mg can be given.

25 mg : 1 min = 200 mg : x min
25 x = 200
x = 8 minutes

It will take 8 minutes to administer the medication.

LEARNING ACTIVITIES FOR OBJECTIVE 7:

Read Henke's Med Math, Chapter 7 (pages 144-146, 163, 166-175)
Complete SELF TEST 7 (pages 172-175)
Complete Practice IV Push dosage Calculations. Answers are provided.

Determine the total time to administer a diluted IVP medication
(when maximum dosage and time is specified).

To ensure safe administration of some medications i.e. narcotic analgesics, antihypertensives, etc.), the manufacturer will specify a limit on the amount to be given over a specific amount of time. The nurse may be instructed to administer the dosage as "up to" or "not to exceed" a certain amount (x mg) over a certain amount of time (minutes).

In this problem, consider the total volume (mL) ordered and the recommended rate of administration. Using ratio and proportion solve the problem.

The physician orders famotidine 20 mg IV push every 12 hours for a patient's gastric distress. The nurse has available 10 mg per 1 mL vial. The direction state to dilute the ordered dose in normal saline for a total volume of 5 mL; up to 20 mg may be administered over 2 minutes. How many mL per minute should the dose be administered?

5 mL: 2 min = X mL: X min
2x =5
X = 2.5 mL per minute

Calculating mg/mcg per minute from milliliters per hour

In the following example, using ratio and proportion complete the following problem:

Medication order: Infuse isoproterenol 10 mL/hr IV
Available: Isoproterenol 1 mg in 250 mL D5W
How many micrograms per minute will the patient receive?
Convert 1 mg to 1000 microgram = 1000 mcg: 250 mL = x mcg: 10 mL
250 X= 10000
X = 40 mcg/60 = _____ 0.67 _____ mcg per min

To convert milligrams (mg) or micrograms (mcg) per hour to mg/mcg per minute, you will divide your answer by 60.