A Brief Overview of Pharmacy Calculations for Pharmacy Technicians

Roman Numerals
Ratio & Proportion
Decimals
Rounding Numbers
Systems of Measurement
IV Calculations

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A Brief Overview of Pharmacy Calculations for Pharmacy Technicians

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Speaker Disclosure: Rhomell Calara has no actual or potential conflicts of interest in relation to this program

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A Brief Overview of Pharmacy Calculations for Pharmacy Technicians

Accreditation:
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Target Audience: Technicians

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Program Overview: Accurately performing pharmaceutical calculations is a critical component in providing patient care in every pharmacy practice environment and a vital part of any pharmacy technicians' duty. Although most pharmaceutical calculations are not overly difficult, they do require flawless accuracy. Correct calculations contribute as much to patient outcomes as the newest methods and guidelines for diagnosis, treatment, and prevention; and errors in calculations can turn the best attempts at optimal patient care catastrophic. This session will present an overview of pharmacy calculations for technicians.

Objectives:

- Describe examples of common systems of measurement
- Explain the process of percentage, ratio, and proportion and show how they apply to pharmacy calculations
- Solve common pharmacy calculations using mathematical skills reviewed in this activity

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Introduction

- Speaker's credentials and expertise or experience in this topic.
- State/review the importance of basic math in the practice of pharmacy

Program Objectives

Define the common systems of measurement

Explain the process of percentage, ratio, and proportion and show how they apply to pharmacy calculations

Be able to solve practical problems using mathematical skills discussed in this talk

Roman Numerals

- Used in writing prescriptions.
- Used to specify the amounts of ingredients or quantity to be dispensed.
- Used in the directions to the patient.

Roman Numeral Symbols

ss = one-half

I = one

V = five

X = ten

L = fifty

C = one hundred

M = one thousand

Roman Numerals

- **Three Cardinal Rules:**

#1 If a symbol follows another symbol of equal or greater value, the two symbols are added together

#2 If a symbol follows another symbol of lower value, the lower value is subtracted from the higher value

#3 First perform any necessary subtraction, then add the resulting values together to get the final answer

ss= one-half

I = one

V = five

X = ten

L = fifty

C = one hundred

Roman Numerals

QUESTION 1: IX = ?

QUESTION 2: CXXII = ?

QUESTION 3: 20 = ?

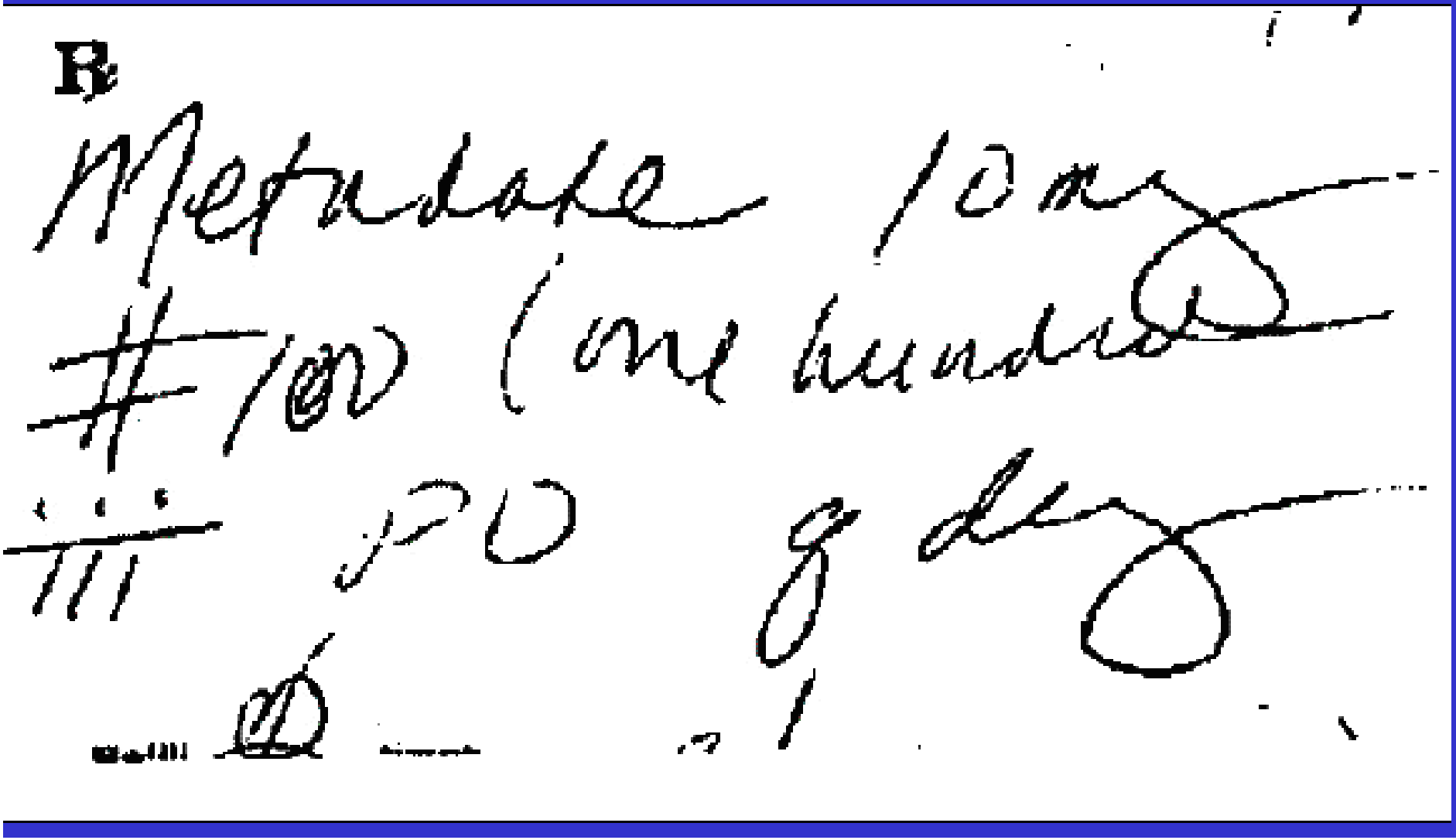
Roman Numerals

QUESTION 1: IX = 9

QUESTION 2: CXXII = 122

QUESTION 3: 20 = XX

Roman Numerals - Real Life



Ratio and Proportion

- Proportions will be your most used pharmacy calculation
- Solve most dosage calculations
- Numerous applications in everyday life
- Used when two expressions are directly related to one another

  For instance, if 1 kg of drug cost us $5, how much will 2 kg cost?

  both expressions contain cost per weight

  if they are set up as ratios, once the problem is solved, both ratios should be equal

Ratio and Proportion

A ratio is the relation between like numbers or values, or a way to express a fractional part of a whole. Ratios may be written:

- As a fraction: 2/3
- With the ratio or colon sign: 2:3
- Using "per": 2 milliliters per 3 hours (2ml/3hr)

Ratio and Proportion

The strength or concentration of various drugs can be expressed as a ratio. First, read the label of the drug and find the strength or concentration. Express this strength as a ratio in fractional form, as in the following examples:

Tolnaftate solution, 10 mg per ml = 10 mg/1 ml

Kanamycin injection, 1.0 gm/3 ml = 1.0 gm/3 ml

Isoproterenol inhalation, 1:200 = 1/200

Ratio and Proportion

A proportion consists of two equal ratios and is essentially a statement of equality between two ratios. For example:

$$\frac{2}{5} = \frac{4}{10}$$

Ratio and Proportion

Example 2.

You have a 10-ml vial of aminophylline labeled "25 mg per ml".

How many milliliters must be injected to administer a dose of 125 mg?

Ratio and Proportion

Example 1.

You have a 10-ml vial of aminophylline labeled "25 mg per ml".

How many milliliters must be injected to administer a dose of 125 mg?

$$\frac{25\ \text{mg}}{1\ \text{ml}} = \frac{125\ \text{mg}}{X\ \text{ml}}$$

$$25\text{mg}\ (X) = (1\ \text{ml})\ (125\ \text{mg})$$

$$X = 5\ \text{ml}$$

Ratio and Proportion

Example 2. How many milliliters must be injected from an ampule of Prochlorperazine labeled "10 mg/2 ml" in order to administer a dose of 7.5 mg?

Ratio and Proportion

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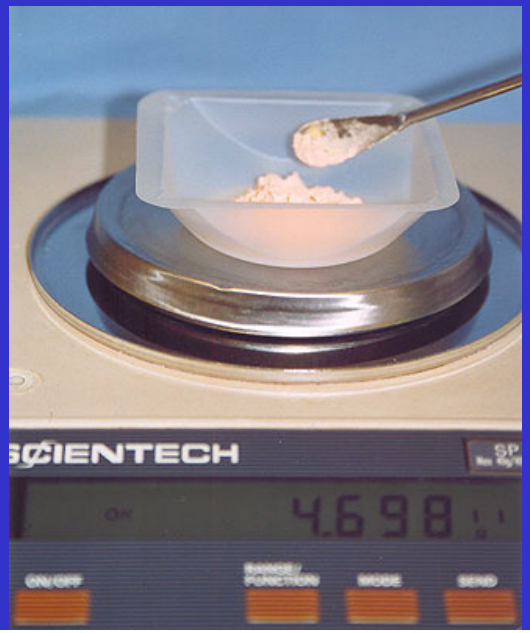
$$\frac{10\ \text{mg}}{2\ \text{ml}} = \frac{7.5\ \text{mg}}{X\ \text{ml}}$$

$$10\text{mg}\ (X) = (2\ \text{ml})\ (7.5\ \text{mg})$$

$$X = 1.5\ \text{ml}$$

Ratio and Proportion

A formula calls for 42 capsules of 300mg of drug. How many milligrams would be required to make 24 capsules?



Ratio and Proportion

A formula calls for 42 capsules of 300mg of drug. How many milligrams would be required to make 24 capsules?

$$\frac{300\text{mg}}{42\text{ caps}} = \frac{x}{24\text{ caps}} \qquad \frac{7{,}200}{42} = 171.4\text{ mg}$$

Ratio and Proportion – Real Life

One person's error killed Elisha Crews Bryant, hospital officials said:

"a miscalculation overdosed the pregnant 18-year-old with a magnesium sulfate meant to slow her labor. She got 16 grams when she should have gotten 4 grams. The young mother began having trouble breathing, went into cardiac arrest and could not be revived."

Ratio and Proportion – Real Life

- Patient received 16 gms Mag. Sulfate, fatal dose.

- Patient should have received 4 gms.

  How many ML @ 25 gm/50 ml should she have received?

Ratio and Proportion – Real Life

- How many ML @ 25 gm/50 ml should she have received to obtain 4 gms??

$$\frac{25\ \text{gm}}{50\ \text{ml}} = \frac{4\ \text{gm}}{X\ \text{ml}}$$

$25\text{gm}\ X = 200\ \text{gm/ml}$

$X = 8\ \text{ml}$

Percentage Preparations

Three types of percentage preparations

- Percent weight-in-weight (wt/wt)
  X Grams / 100 Grams
- Percent volume-in-volume (v/v)
  X Milliliters / 100 Milliliters
- ***Percent weight-in-volume (wt/v)****
  X Grams / 100 Milliliters
  Most Common

Percentage Preparations

- Example 1. How much Potassium Chloride in grams is needed to prepare a 1 Liter solution of 3% KCl solution?

Percentage Preparations

- Example 1. How much Potassium Chloride in grams is needed to prepare a 1 Liter solution of 3% KCl solution?

- Answer: 3% = 3 grams / 100mls
  1 Liter = 1000 mls

  Next:

$$\frac{3 \text{ grams}}{100 \text{ mls}} = \frac{X \text{ grams}}{1000 \text{ mls}}$$

  Finally: x = 30 grams

Decimals

- Three general rules when working with decimals

#1 Never leave a decimal point “uncovered”

- too easy to misread and make a mistake

#2 Unless working with money, Never add zeros to the right of the decimal point

-the end signifies the accuracy of the number

#3 The answer you get can be only as accurate as the least accurate number used in the calculation

Rounding Numbers

- If the number following the place you are rounding to is 5 or higher, you round up
- If the number following the place you are rounding to is 4 or lower, you round down

Try some rounding

10.359 to tenths

10.4

0.143 to hundredths

0.14

9.9982 to thousandths

9.998

Systems of Measurement

THREE SYSTEMS

- Avoirdupois
  - **-(household system)**
- Metric
- Apothecary
  - **-(rarely used)**

Metric System

CONVERSION FACTORS

Micro – one millionth
Milli – one thousandth
Centi – one hundredth
Deci – one tenth
Kilo – one thousand

Metric System

1000mcg = 1mg

1000mg = 1g

1000g = 1kg

1000ml = 1L

Metrics are expressed in the form of decimals

ie.) 300ml = 0.3L

Avoirdupois Conversion Factors

3 tsp = 1 tbsp

2 tbsp = 1 oz

16 oz = 1 pt

2 pt = 1 qt

4 qt = 1 G

16oz = 1 lb

Conversion Factors Between Systems

1 tsp = 5 ml

1 tbsp = 15 ml

1 oz = 30 ml (29.57ml)

1 pt = 480 ml (473ml)

1 G = 3840 ml(3784ml)

1 g = 15.4 gr

1 gr = 60 mg (64.8mg)

1 kg = 2.2 lb

1 lb = 454 g

1 oz = 30 gm

Conversions

6.3 oz = ? ml

Arrange the units so they will cancel and solve

Value x Conversion Factor = Answer

$$\mathbf{6.3\ oz \times \frac{30ml}{1oz} = 189\ ml}$$

The units of ounces cancel, and you are left with milliliters

Try This One

1.3 kg = ? grams

Value x Conversion Factor x Conversion Factor = Answer

$$\textbf{1.3 kg} \times \frac{\textbf{2.2 lb}}{\textbf{1kg}} \times \frac{\textbf{\textit{454g}}}{\textbf{1lb}} = \textbf{1,298g}$$

Or

Approximatley 1,300 gm

Conversion

You receive a prescription for Cefzil 250mg/5mls with directions to take 1 teaspoonful by mouth twice daily for 10 days.

- How much drug in milligrams, is in one teaspoonful?
- How much Cefzil in milliliters do you have to give the patient to last the full 10 days?

Parenteral (IV) Calculations

- Parenteral calculations deal with administration of IV fluids
- Two main concepts you will learn

- Flow Rate
- Dose per Time

Flow Rate Calculations

- Flow rate is the speed at which an IV solution is delivered
- Function of ***Volume per Time***

- usually reported in milliliters per hour

- The magical formula

volume ÷ time = flow rate

Always be sure which time and volume units you are being asked to solve for

Is it ml/min ? Or l/hr? Something else?

Flow Rate Calculations

A patient receives 1 L of IV solution over a 3 hour period. Calculate the flow rate in ml/hr.

Note: the volume given is in liters, but the answer asks for milliliters. If the conversion wasn't so obvious, we would first need to do a conversion of L → ml.

volume ÷ time = flow rate

1000 ml ÷ 3 hours = **333 ml/hr**

Another Rate Problem

A patient receives 0.75L of IV solution over a 4 hour period. Calculate the flow rate in ml/hr

Another Rate Problem

A patient receives 0.75L of IV solution over a 4 hour period. Calculate the flow rate in ml/hr

Now the conversion is a bit harder, so we do the math

$$\frac{0.75\ L}{1} \times \frac{1000ml}{1L} = 750ml$$

750 ml ÷ 4 hours = 188 ml/hr

Solve for Time

- By manipulating the rate formula, we can solve for time
- The equation becomes:

  volume ÷ rate = time

Solving for Time

If an IV is run at 125ml/hr, how long will 1 L last?

Solving for Time

If an IV is run at 125ml/hr, how long will 1 L last?

volume ÷ rate = time

$$\frac{\textbf{1000 ml}}{\textbf{125ml/hr}} = \textbf{8 hours}$$

Milliliters cancel and you are left with the units of hours

Solving for Volume

- Play with the formula some more, and now we can solve for volume
- The equation becomes:

rate x time = volume

Solving for Volume

How many ml of IV solution would be required to run an IV for 12 hours at a rate of 60 ml/hr?

Solving for Volume

How many ml of IV solution would be required to run an IV for 12 hours at a rate of 60 ml/hr?

rate x time = volume

IT'S REALLY JUST A CONVERSION PROBLEM!

$$\frac{60\ ml}{1hr} \times \frac{12\ hr}{1} = 720\ ml$$

Solving for Volume

What volume would we need to have on hand if an IV solution is to be run for 100 ml/hr for 8.3 hrs?

Solving for Volume

What volume would we need to have on hand if an IV solution is to be run for 100 ml/hr for 8.3 hrs?

$$\frac{\textbf{100 ml}}{\textbf{1 hr}} \times \textbf{8.3 hr} = \textbf{830 ml}$$

Any Questions?

ARE YOU READY FOR THE

“PHARMACY TECHNICIAN MATH CONTEST”

ON-LINE COMPETITION!

This is Pope John the 22nd, what would that be in Roman Numerals?

This is Pope John the 22nd, what would that be in Roman Numerals?

Pope John XXII

Question: What number super bowl is illustrated below, and, what team won the game?

Question: What number super bowl is illustrated below, and, what team won the game?

Super Bowl 43, won by the Pittsburgh Steelers

What is the sum of
XLVI + IX
in Roman Numerals?

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XLVI + IX
in Roman Numerals?

46 + 9 = 55 or LV

- If a customer asked to buy 10 packages of Sudafed, containing 20 tablets of 30 mg Pseudoephedrine, how many milligrams of Pseudoephedrine is she purchasing?

- Why would she want so much Sudafed?

- If a customer asked to buy 10 packages of Sudafed, containing 20 tablets of 30 mg Pseudoephedrine, how many milligrams of Pseudoephedrine is he purchasing?

10 Packs X 20 Tabs X 30 mg = 6000 mg

- Why would she want so much Sudafed?
  - Key ingredient in the making of methamphetamine

The addict after and before the meth addiction

- Your customer now has 6000 mg of Pseudoephedrine. If it takes 1800 mg of Pseudoephedrine to make 6 gm of crystal meth, how many grams can she make?

- Your customer now has 6000 mg of Pseudoephedrine. If it takes 1800 mg of Pseudoephedrine to make 6 grams of crystal meth, how many grams can she make?

$$\frac{1800 \text{ mg PSE}}{6 \text{ gm Crys Meth}} = \frac{6000 \text{ mg PSE}}{X \text{ gm Crys Meth}}$$

(1800mg PSE)(X)=(6000 mg PSE)(6gm Cry Meth)

1800 mg X = 36000 mg/gm

X = 20 gm

- Your Meth addict now has 20 gm of drug.
- She wants to make a nasal solution containing 25% crystal meth. How many ml of normal saline solution does she need to make a 25% solution?

- Your Meth addict now has 20 gm of drug.
- She wants to make a nasal solution containing 25% crystal meth. How many ml of normal saline solution does she need to make a 25% solution?

$$\frac{25 \text{ gm}}{100 \text{ ml}} = \frac{20 \text{ gm PSE}}{X \text{ ml Saline}}$$

(25 gm(X)=(20 gm PSE)(100 ml)

X = 80 ml

Pharmacy Technician Josh is traveling in Europe. He needs to fill up his rental car. Gas cost only $1.25 per liter. Technician Josh is excited that gas is so cheap.

What would the cost of gas be in gallons?

Hint: 1 pint =

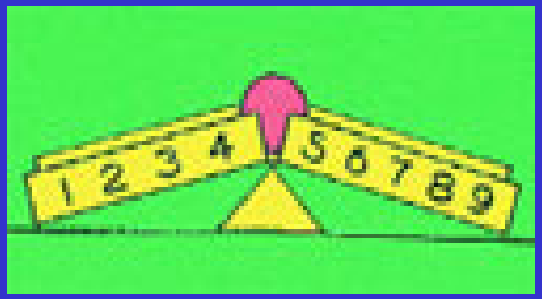
Pharmacy Technician Josh is traveling in Europe. He needs to fill up his rental car. Gas cost only $1.25 per liter. Technician Josh is so excited that gas is so cheap.

What would the cost of gas be in gallons?

$$\frac{473\ \text{ml}}{} \times \frac{8\ \text{pint}}{} \times \frac{1\ \text{liter}}{} \times \frac{\$1.25}{} = \frac{}{1\ \text{pint}} \quad \frac{}{1\ \text{gal}} \quad \frac{}{1000\ \text{ml}} \quad \frac{}{1}$$

$4.73 gal

Round to the nearest Thousand



1) 14,389 _____

2) 29,610 _____

3) 3,492 _____

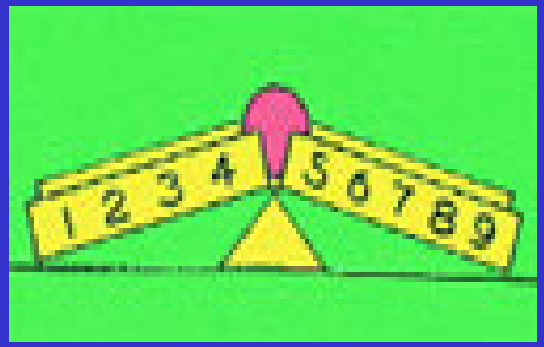
Round to the nearest Thousand

1) 14,389 → 14,000

2) 29,610 → 30,000

3) 3,492 → 3,000

Round to the nearest tenth



1) 0.89 _____

2) 2.673 _____

3) 2.57 _____

Round to the nearest tenth

1) 0.89 → 0.9

2) 2.673 → 2.7

3) 2.57 → 2.6

What is the flow rate in ml/hr if 1 liter Starbucks Coffee with 100% french roast is given over 12 hours???

83.3 ml/hr

(1 liter = 1000 ml)

1000 ml/12 hours = 83.3ml/hr

Try and solve this problem ;o)

The Recommended dose of meperidine (demerol) is 6mg/kg/24hrs for pain. It is given in divided doses of every 4 to 6 hours. How many milliliters (ml) of demerol injection (50 mg/ml) should be administered to a 33 pound child as a single dose every 6 hours?

1. The first step is to calculate the daily dose for a 33 pound child

$$\frac{6 \text{ mg}}{1 \text{ Kg (2.2 pounds)}} = \frac{x \text{ mg}}{33 \text{ pounds}}$$

*By inserting the conversion unit 2.2 pounds for 1kg in the ratio there is no need to do a separate calculation of the number of kilograms in 33 pounds.

X = 90 mg of demerol per day (24 hours)

2. The next step is to calculate the number of milliliters of demerol injection (50 mg/ml) needed for the total daily dose

$$\frac{50\text{mg}}{1\text{ ml}} = \frac{90\text{mg}}{x\text{ ml}}$$

$$50x = 90$$

$$X = 1.8 \text{ ml every 24 hours}$$

3. The final step is to calculate the number of milliliters to be given every 6 hours

$$\frac{1.8 \text{ ml}}{24 \text{ hrs}} = \frac{x \text{ ml}}{6 \text{ hrs}}$$

$$24x = 10.8$$

$$x = 0.45 \text{ ml}$$

**So therefore the amount of demerol (50mg/ml) to be administered is 0.45 ml every 6 hours **

Any Questions?

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