

## Units of Measurement and Conversions

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### OBJECTIVES/RATIONALE

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Basic math principles are important in providing quality client care when pharmaceuticals are involved and knowledge of various measurement systems is essential in proper dosage calculation for client safety. The student will know the measurement systems associated with pharmacology and make conversions between them to calculate drug dosages.

TEKS: 121.25 1A,1B,1C,1D,1E,2B,3A,5D,5G,6B      TAKS ELA 1, 4  
Algebra I B3A, B4B, B1C, C3C                      Mathematics 1, 2, 3, 4, 5, 8, 9, 10

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### KEY POINTS

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#### Medical Math Conversions

- I. The apothecary system – based on 12-ounce pound
  - A. officially replaced by metric system
  - B. standard unit of measure for weight (solid substances) is the grain (gr)
  - C. liquid volumes (fluids) are measured by minim
  - D. rarely used today
- II. common household system
  - A. Less accurate system of measurement
  - B. primarily used by patients who take medication at home
  - C. practitioner's responsibility to assure consumer is taking correct dose
  - D. necessary for practitioner to know equivalents from "pharmacy language" to every day common household terms
  - E. Conversions
    1. standard teaspoon established to contain approximately 5 ml
    2. 60 gtt. (gtt. = drops) = 1 teaspoonful
    3. 3 teaspoonsful = 1 tablespoon
    4. 1 teaspoonful = approximately 5 Gm or g (gram)
    5. 1 teaspoonful = approximately 60 gr (gr = grain; not to be confused with g = gram)
- III. metric system – most commonly used system in measurement, easy to use since based on parts and multiples of 10
  - A. official system of measure for pharmacy practice
  - B. advantages
    1. simple
    2. brief
    3. adaptable
    4. universal
  - C. metric measures for
    1. length

2. area
  3. volume
  4. weight
  5. temperature
- D. pharmacy mainly concerned with weights and volumes of drugs
- E. decimal system that can be divided into any parts that are multiple of 10 (10, 100, 1000, etc.)
- F. Greek and Latin prefixes indicate what multiple is used, e.g. *milli-*, *centi-*, *deci-*, *micro-*, *kilo-*, etc.
- G. standard unit of metric measure for capacity or volume is *liter*
- H. standard unit of measure for weight is *gram*
- I. May encounter physician's orders or prescriptions requiring conversion.
1. within same system (e.g. convert 0.350 Gm to 350 mg – quantities both metric but using milligrams may be more convenient)
  2. from one system to another (e.g. 170 pounds to 77 kilograms because most drugs dosage requirements are determined by body weight in kg)
  3. translation from one system to another or within the same system is called conversion
  4. most physicians not cognizant of the various existing systems and may write orders that appear to be jumbles quantities
- J. liquid drug preparations
1. creams, and ointments are expressed as percentage concentrations
  2. a certain quantity of the drug is contained in the final quantity of the product
    - a. 1 % hydrocortisone cream contains 1 g of hydrocortisone in 100 g final product (the actual drug plus the cream)
    - b. 5% sodium chloride solution contains 5 g sodium chloride in 100 ml final product ( NaCl and distilled water)
    - c. 1 gram in 100 grams or 1/100 equal to 0.01, or 1%
    - d. 5 grams in 100 milliliters equal to 5/100 or 0.05, or 5%

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## ACTIVITIES

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- I. Complete Practice Problems.
- II. Complete Unit Equivalency Practice.
- III. Complete Dosage Calculations.
- IV. Review actual prescriptions, physician's hospital orders, and /or bulk drug manufacturing requests that require decimals, ratio/proportion, and percentage calculations. Discuss, in small groups, the various systems used for drug calculations, determining preferences and justifying why.

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## MATERIALS

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Actual prescriptions and/or physician's orders for medications (can be obtained from your physician or copies from hospital charts as long as information identifying patient and institution have been sufficiently obliterated – check with hospital administration if needed!)

Conversion charts

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### **ASSESSMENT**

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Successful completion calculation problems

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### **ACCOMMODATIONS**

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For reinforcement, the student will review math conversation and complete the coherent sequence pretest.

For enrichment, the student will develop health care related word and conversion problems directed to middle school mathematics. Include teaching aids to reinforce the relationship between measurements.

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### **REFLECTIONS**

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## Dosage Calculations

**EXAMPLE:** Scenario: The patient is to receive 1L of Lactated Ringer's solution continuous IV q8hr. The primary administration set delivers 15 gtt/ml. At the beginning of the shift the 1L bag is found to contain 250 ml. When checking the drip rate you find the infusion to be running at 30 gtt/min. When will the next bag be due to be hung?

This problem needs to be worked in two separate steps – the first one is to determine the rate required to infuse the ordered dose over the time specified. Remember that the scenario only states what you found – you always have to double check for yourself to ascertain accuracy! Whoever started this IV before your shift may have calculated incorrectly and if you do not correct the rate you will be responsible for any undesirable results as well!

1. Find the pertinent solution required to solve the problem in the above scenario and mentally eliminate the rest.

**Pertinent information:** 1 L/8 hrs (one entire dose); 15 gtt/ml; 30 gtt/min; 250 ml/dose (remainder from whole dose)

2. Determine what unit equivalency conversions you need.

**Unit equivalency conversion:** 1000 ml/L; 60 min/hr

3. Determine the desired units; what is the problem asking for?

Desired units: (1) gtt/min; (2) time in hr and/or min

## PRACTICE PROBLEMS

Solve the following problems:

1. How many cc in  $\frac{1}{2}$  tsp?
2. Convert 20 gtt to cc.
3. How many qt in 4 fl oz?
4. Convert 1.5 inches to cm.
5. Convert 0.05 g to  $\mu\text{g}$ .
6. Convert 0.0025 L to cc.
7. Convert 0.25 g to gr.
8. Convert  $\frac{1}{40}$  gr to mg.
9. How many tsp in 2 Tbs?
10. Convert 88 lb to kg.

Solve the following problems by making sure you list all the available information provided, extract the conversion factors from the information provided, and set up the conversion factors for the cancellation of the unwanted units.

1. ordered: Furosemide 40 mg p.o.  
available: Furosemide 20 mg tablets  
  
Calculate the number of tablets per dose
2. ordered: Tylenol 500 mg p.o. stat.  
available: acetaminophen 500 mg tablets  
  
Calculate the number of tablets per dose
3. ordered: Premarin 1.25 mg PO  
available: conjugated estrogens 0.625 mg tablets  
  
Calculate the number of tablets per dose
4. ordered Procardia XL 60 mg b.i.d.  
available: Procardia XL 30 mg capsules  
  
Calculate the number of capsules per dose
5. ordered: Biaxin 500 mg po bid  
available: Biaxin 250 mg tablets  
  
Calculate the number per dose

6. ordered: diphenhydramine 25 mg IM now  
available: Benadryl 50 mg/ml in 10 ml vial

Calculate the number of ml/dose

7. ordered: Epinephrine 0.3 mg SQ stat  
available: Epinephrine 1 mg/ml in 5 ml vial

Calculate the number of ml per dose

8. ordered: Fer-In-Sol 5 mg PO qd  
available: Fer-In-Sol 15 mg/0.6 cc

Calculate the number of ml for a 90 d supply.

9. ordered: Phenobarbital  $\frac{1}{4}$  gr PO qid  
available: Phenobarbital 15 mg tablets

Calculate the number of tablets/dose.

10. ordered: Rocephin 1 g in 100 ml D<sub>5</sub>W IV b.i.d.  
available: Rocephin sterile crystalline 250 mg/vial

Calculate the number of vials per dose.

### Answer Key: Practice Problems

1. 2.5 cc
2. 1.3 cc
3. 0.125 qt
4. 3.81 cm
5. 50,000  $\mu$ g
6. 2.5 cc
7. 4.17 gr
8. 1.5 mg
9. 6 tsp
10. 40 kg

#### Dosage Problems:

1. 40 mg/dose; 20 mg/tab;  $\frac{40\text{mg}}{\text{dose}} ; \frac{20\text{ mg}}{\text{tab}} \rightarrow 2\text{ tab/dose}$
2. 500 mg/dose; 500 mg/tab;  $\frac{500\text{ mg}}{\text{dose}} ; \frac{500\text{ mg}}{\text{tab}} \rightarrow 1\text{ tab/dose}$
3. 1.25 mg/dose; 0.625 mg/tab;  $\frac{1.25\text{ mg}}{\text{dose}} ; \frac{0.625\text{mg}}{\text{tab}} \rightarrow 2\text{ tab/dose}$
4. 60 mg/dose; 30 mg/cap; 2 dose/d;  $\frac{60\text{ mg}}{\text{dose}} ; \frac{30\text{ mg}}{\text{cap}} \rightarrow 2\text{ cap/dose}$
5. 500 mg/dose; 250 mg/tab; 2 dose/d;  $\frac{500\text{ mg}}{\text{dose}} ; \frac{250\text{ mg}}{\text{tab}} \rightarrow 2\text{ tab/dose}$
6. 25 mg/dose; 50 mg/ml; 10 ml/vial;  $\frac{25\text{ mg}}{\text{dose}} ; \frac{50\text{ mg}}{\text{ml}} \rightarrow \frac{1}{2}\text{ ml/dose}$
7. 0.3 mg/dose; 1 mg/ml; 5 ml/vial;  $\frac{0.3\text{ mg}}{\text{dose}} ; \frac{1\text{ mg}}{\text{ml}} \rightarrow 0.3\text{ ml/dose}$
8. 5 mg/dose; 15 mg/0.6 cc; 1 dose/d; 90 d;  $\frac{5\text{ mg}}{\text{dose}} ; \frac{15\text{ mg}}{0.6\text{ ml}} \rightarrow 18\text{ cc}$
9.  $\frac{1}{4}\text{ gr/dose}$ ; 15 mg tab; 4dose/d; 60 mg/gr (unit equivalence);  
 $\frac{1\text{ gr}}{4\text{ tab}} ; \frac{15\text{ mg}}{\text{gr}} ; \frac{60\text{ mg}}{\text{gr}} \rightarrow 1\text{ tab/dose}$
10. 1 g/dose; 1 g/100 ml; 250 ml/vial; 2 dose/d; 1000 mg/g (unit equivalence);  
 $\frac{1\text{ g}}{\text{dose}} ; \frac{250\text{ mg}}{\text{vial}} ; \frac{1000\text{ mg}}{1\text{ g}} \rightarrow 4\text{ vial/dose}$

## UNIT EQUIVALENCY PRACTICE

Convert the following units:

1. 1 g to mg
2. 5 mg to  $\mu\text{g}$
3. 0.0025 L to ml
4. 10 gr to mg
5. 68 lb to kg
6. 15 cc to tsp
7. 500 cc to L
8.  $36.8^{\circ}\text{C}$  to  $^{\circ}\text{F}$
9. 15 ml to Tbs
10. 120  $\mu\text{gtt}$  to cc
11. 15 ml to gtt
12. 1 fl oz to ml
13. 2 gr to g
14. 25 cc to ml
15. 1 tsp to cc
16. 10 km to ft
17. 180 lb to kg
18. 0.0005 mg to  $\mu\text{g}$
19. 500  $\mu\text{g}$  to kg
20.  $98.6^{\circ}\text{F}$  to Celsius
21. 25 gr to mg
22. 1 hr to min
23. 20 kg to lb
24. 1 pt to fl oz
25. 15 gtt to  $\mu\text{gtt}$
26. 1 pt to ml

## ANSWER KEY TO UNIT EQUIVALENCY EXERSIZE

1.  $1 \text{ g} = 1000 \text{ mg} \rightarrow 1000 \text{ mg}$
2.  $1 \text{ mg} = 1000 \mu\text{g} \rightarrow 5000 \mu\text{g}$
3.  $1000 \text{ ml} = 1 \text{ L} \rightarrow 2.5 \text{ ml}$
4.  $60 \text{ mg} = 1 \text{ gr} \rightarrow 600 \text{ mg}$
5.  $2.2 \text{ lb} = 1 \text{ kg} \rightarrow 30.9 \text{ kg}$
6.  $5 \text{ cc} = 1 \text{ tsp} \rightarrow 3 \text{ tsp}$
7.  $1000 \text{ ml} = 1 \text{ L}, 1 \text{ cc} = 1 \text{ ml} \rightarrow 0.5 \text{ L}$
8.  $98.2^\circ \text{ F}$
9.  $5 \text{ ml} = 1 \text{ tsp}, 3 \text{ tsp} = 1 \text{ Tbs} \rightarrow 1 \text{ Tbs}$
10.  $1 \text{ ml} = 60 \mu\text{gtt} \rightarrow 2 \text{ cc}$
11.  $1 \text{ ml} = 15 \text{ gtt} \rightarrow 225 \text{ gtt}$
12.  $1 \text{ fl oz} = 30 \text{ ml} \rightarrow 30 \text{ ml}$
13.  $1 \text{ gr} = 60 \text{ mg}, 1000 \text{ mg} = 1 \text{ g} \rightarrow 0.12 \text{ g}$
14.  $1 \text{ cc} = 1 \text{ ml} \rightarrow 25 \text{ ml}$
15.  $5 \text{ cc} = 1 \text{ tsp} \rightarrow 5 \text{ cc}$
16.  $2.54 \text{ cm} = 1 \text{ in}, 12 \text{ in} = 1 \text{ ft} \rightarrow 32,808.4 \text{ ft}$
17.  $2.2 \text{ lb} = 1 \text{ kg} \rightarrow 81.82 \text{ kg}$
18.  $1000 \mu\text{g} = 1 \text{ mg} \rightarrow 0.5 \mu\text{g}$
19.  $1,000,000 \mu\text{g} = 1 \text{ kg} \rightarrow 0.0005 \text{ kg}$
20.  $37^\circ \text{ C}$
21.  $60 \text{ mg} = 1 \text{ gr} \rightarrow 1500 \text{ mg}$
22.  $60 \text{ min} = 1 \text{ hr} \rightarrow 60 \text{ min}$
23.  $2.2 \text{ lb} = 1 \text{ kg} \rightarrow 44 \text{ lb}$
24.  $16 \text{ fl oz} = 1 \text{ pt} \rightarrow 16 \text{ fl oz}$
25.  $1 \text{ ml} = 15 \text{ gtt}, 1 \text{ ml} = 60 \mu\text{gtt} \rightarrow 60 \mu\text{gtt}$
26.  $1 \text{ pt} = 16 \text{ fl oz}, 30 \text{ cc} = 1 \text{ fl oz} \rightarrow 480 \text{ ml}$