MLT-1351: PROBLEM SOLVING TECHNIQUES FOR THE MEDICAL LABORATORY

Cuyahoga Community College

Viewing: MLT-1351 : Problem Solving Techniques for the Medical Laboratory

Board of Trustees:
2011-09-22

Academic Term:
2012-08-28

Subject Code
MLT - Medical Laboratory Technology

Course Number:
1351

Title:
Problem Solving Techniques for the Medical Laboratory

Catalog Description:
Review of basic algebra and measurement systems. Study of formula evaluation, unit analysis and conversions, dilutions, concentrations, calculations specific to clinical analytes and Beer's Law. Construction of standard curves, calculation and application of quality control parameters related to clinical laboratory medicine. Application and activities to build skills in problem solving.

Credit Hour(s):
2

Lecture Hour(s):
2

Requisites

Prerequisite and Corequisite
MATH-1410 Elementary Probability and Statistics I, and departmental approval.

Outcomes

Course Outcome(s):
A. Review basic mathematics skills, manipulate equations/conversions and systems applications.

Objective(s):
1. 1. Review fractions and decimals and associated calculations.
2. 1. Review fractions and decimals and associated calculations.
3. 2. Calculate percentages using correct units.
4. 1. Calculate percentages using correct units.
5. 3. Solve a simple ratio/proportion and evaluate the unknown quantity.
6. 1. Solve a simple ratio/proportion and evaluate the unknown quantity.
7. 4. Rearrange a simple linear equation to make an equivalent equation, then solve.
8. 1. Rearrange a simple linear equation to make an equivalent equation, then solve.
9. 5. Employ proper units of measure and level of significant figures in recording all laboratory calculations.
10. 1. Employ proper units of measure and level of significant figures in recording all laboratory calculations.

Course Outcome(s):
C. Perform solution concentration and conversion.

Objective(s):
1. 1. Interpret the various expressions used to state a dilution instruction.
2. 1. Interpret the various expressions used to state a dilution instruction.
3. 3. Determine the concentration of a reagent after a dilution.

4. 1. Determine the concentration of a reagent after a dilution.
5. 4. Apply factor label skills to determine solution concentration using: percent, molarity and normality.

Course Outcome(s):

D. Perform dilution calculations.

Objective(s):

1. 1. Apply factor label skills to determine solution concentration using: percent, molarity and normality.
2. 1. Differentiate between the dilution and the dilution factor.
3. 1. Differentiate between the dilution and the dilution factor.
4. 2. Apply the correct dilution factor in calculating a final solution concentration for simple and serial dilutions.
5. 1. Apply the correct dilution factor in calculating a final solution concentration for simple and serial dilutions.
6. 1. Calculate the dilution factor for manual blood cell counts.
7. 2. Calculate the volume correction factor for manual blood cell counts.
8. 1. Calculate the volume correction factor for manual blood cell counts.

Course Outcome(s):

E. Perform calculations used in hematology.

Objective(s):

1. 1. Calculate the dilution factor for manual blood cell counts.
2. 3. Nucleated red blood cell (RBC) correction.
3. 1. Nucleated red blood cell (RBC) correction.
4. 4. Percent and absolute counts.
5. 1. Percent and absolute counts.
6. 5. Perform calculations for: reticulocyte count, corrected reticulocyte count (CRC) and the reticulocyte production index (RPI) and explain the significance of results.
7. 1. Perform calculations for: reticulocyte count, corrected reticulocyte count (CRC) and the reticulocyte production index (RPI) and explain the significance of results.
8. 6. Calculate RBC indices of mean corpusular hemoglobin (MCH), mean corpuscular hemoglobin concentration (MCHC), mean corpuscular volume(MCV).
9. 1. Calculate RBC indices of mean corpusular hemoglobin (MCH), mean corpuscular hemoglobin concentration (MCHC), mean corpuscular volume(MCV).

Course Outcome(s):

F. Perform calculations used in clinical chemistry and urinalysis and discuss clinical relevance.

Objective(s):

1. 1. Define conditions of normal renal function, anuria, and oliguria.
2. 1. Define conditions of normal renal function, anuria, and oliguria.
3. 2. Assess renal function by calculating 24 hour urine volume in ml/minute.
4. 1. Assess renal function by calculating 24 hour urine volume in ml/minute.
5. 3. Calculate renal clearances like the creatine clearance, and correlate results with clinical significance.
6. 1. Calculate renal clearances like the creatine clearance, and correlate results with clinical significance.
7. 4. Employ nomogram to obtain body surface area.
8. 1. Employ nomogram to obtain body surface area.
9. 5. Osmolality and electrolytes.
10. Osmolality and electrolytes.
11. 6. Acid-base and buffer systems.
12. 1. Acid-base and buffer systems.
13. a. State the equilibrium equation for the bicarbonate buffer in water.
14. 1. State the equilibrium equation for the bicarbonate buffer in water.
15. b. Use the bicarbonate buffer to predict the change in pH when changes in the carbon dioxide or hydronium ion concentrations occur.
16. 1. Use the bicarbonate buffer to predict the change in pH when changes in the carbon dioxide or hydronium ion concentrations occur.
17. c. Define pH and interpret the changes in hydronium ion concentration and relate it to the change in pH.
18. Define pH and interpret the changes in hydronium ion concentration and relate it to the change in pH.
19. d. Solve the Henderson-Hasselbalch equation and determine acid-base state of patient.
20. 1. Solve the Henderson-Hasselbalch equation and determine acid-base state of patient.
21. e. Solve equations to determine components of lipids, proteins, bilirubin, and thyroid hormone.
22. Solve equations to determine components of lipids, proteins, bilirubin, and thyroid hormone.

Course Outcome(s):

G. Prepare graphs and evaluate graphing data.

Objective(s):

1. 1. Define Beer's Law and apply given a substance's molar absorptivity, concentration and the cell path length data.
2. 1. Define Beer's Law and apply given a substance's molar absorptivity, concentration and the cell path length data.
3. 2. Convert Absorbance to % Transmittance and vice versa.
4. 1. Convert Absorbance to % Transmittance and vice versa.
5. 3. Construct a standard curve using absorbance and concentration data.
6. 1. Construct a standard curve using absorbance and concentration data.
7. 4. Read a standard curve to determine the absorbance or concentration of unknown sample.
8. 1. Read a standard curve to determine the absorbance or concentration of unknown sample.
9. 5. Define linearity and recognize corrective actions for non-linear situations.
10. Define linearity and recognize corrective actions for non-linear situations.
11. 6. Define slope.
12. 1. Define slope.
13. 7. Differentiate between logarithms and antilogs, and respective graphs.
14. 1. Differentiate between logarithms and antilogs, and respective graphs.

Course Outcome(s):

H. Discuss enzyme kinetics

Objective(s):

1. 1. Describe the principle of end point reactions and their measurements.
2. 1. Describe the principle of end point reactions and their measurements.
3. 2. Describe the kinetic reactions, and their measurements.
4. 1. Describe the kinetic reactions, and their measurements.
5. 3. Explain the factors affecting enzyme reactions.
6. 1. Explain the factors affecting enzyme reactions.

Course Outcome(s):

I. Apply the principles and measurements of quality control.

Objective(s):

1. 1. Calculate mean, standard deviation, coefficient variation for a series of numbers.
2. 1. Calculate mean, standard deviation, coefficient variation for a series of numbers.
3. 2. Construct a Levy-Jennings chart, and interpret data distribution.
4. 1. Construct a Levy-Jennings chart, and interpret data distribution.
5. 3. Identify shifts and trends and the causes of both.
6. 1. Identify shifts and trends and the causes of both.
7. 4. Identify out of control situations and select appropriate corrective action.
8. Identify out of control situations and select appropriate corrective action.
9. 5. Evaluate control data and apply Westgard rules appropriately.
10. 1. Evaluate control data and apply Westgard rules appropriately.
11. 6. State Clinical Laboratory Improvement Act (CLIA) requirements for instrument/method quality assurance.
12. 1. State Clinical Laboratory Improvement Act (CLIA) requirements for instrument/method quality assurance.
13. 7. Measures of comparison of test methods such as the t-test.
14. 1. Measures of comparison of test methods such as the t-test.

Course Outcome(s):

B. Apply systems of measure.

Objective(s):

1. 2. Determine the amount of diluent and stock to prepare a dilution.
2. 1. Determine the amount of diluent and stock to prepare a dilution.
3. 6. Employ scientific notation appropriately.
4. 1. Recognize the proper English and metric units for mass, length, temperature, volume and pressure.
5. 1. Recognize the proper English and metric units for mass, length, temperature, volume and pressure.
6. 2. Convert English units to metric units and vice versa.
7. 1. Convert English units to metric units and vice versa.
8. 3. Compare freezing, boiling, and room temperatures; perform conversion calculations for Fahrenheit, Celsius, Kelvin.
9. 1. Compare freezing, boiling, and room temperatures; perform conversion calculations for Fahrenheit, Celsius, Kelvin.

Methods of Evaluation:

1. Written assignments
2. Case studies
3. Examinations
4. Quizzes
5. Practice problems and worksheets

Course Content Outline:

1. Review of basic math skills
   a. Fractions and decimals
   b. Percent
   c. Ratios and proportions
   d. Solving linear equations
   e. Scientific notation
   f. Significant figures
2. Temperature scales
   a. Fahrenheit
   b. Celsius
   c. Kelvin
3. Systems of measure
   a. Metric system
      i. Mass
      ii. Length
      iii. Temperature
      iv. Volume
      v. Pressure
   b. United States Customary System (English)
      i. Mass
      ii. Length
      iii. Temperature
      iv. Volume
      v. Pressure
4. Solution concentration and conversion problems
   a. Percent
   b. Molarity
   c. Normality
5. Dilution calculations
   a. Dilution vs. dilution factors
   b. Simple
   c. Serial
6. Hematology calculations
   a. Manual blood cell counts
   b. Nucleated RBC correction
   c. Percent and absolute counts
   d. Reticulocyte
   e. RBC indices
7. Clinical chemistry calculations
   a. Renal function
   b. Osmolality and electrolytes
   c. Acid-base and buffer systems
      i. Bicarbonate equilibrium
      ii. pH balance
      iii. Henderson-Hasselbalch equation
   d. Lipids, proteins, bilirubin, thyroid
8. Graphs and graphing
   a. Beer"s Law
   b. Absorbance/% Transmittance conversions

c. Construction and application of standard curves
d. Linearity
e. Slope
f. Logarithms,

9. Enzyme kinetics
   a. End point reactions
   b. Kinetic reactions
      i. Zero order
      ii. First order
10. Quality control
    a. Mean
    b. Standard deviation
    c. Coefficient variation
    d. Levy-Jennings charts
    e. Westgard rules

Resources

Turgeon, Mary Louise. *Clinical Laboratory Science, The Basics and Routine Techniques.* 6th ed. St. Louis: Mosby/Elsevier, 2012.

Essridge, Barbara and Reynolds, Anna. *Basic Clinical Laboratory Techniques.* 5th ed. Albany, NY: Delmar, 2008.

Doucette, Lorraine. *Mathematics for the Clinical Laboratory.* 2nd ed. Maryland Hts., MO, 2011.

Campbell, Joe, and June Campbell. *Laboratory Mathematics Medical and Biological Applications.* 5th ed. Mosby Publishers, 1997.

Lesmeister, Michele. *Math Basics for the Health Care Professional.* 3rd ed. Upper Saddle River, NJ: Pearson, 2009.

Johnson, Catherine W., Timmons, Daniel L., Hall, Pamela E. *Essential Laboratory Mathematics.* 2nd ed. Long Grove, Il: Waveland Press, 2010.

"MLO Articles" various.

"Advance Articles" various.

ASCLS. "Clinical Laboratory Science" various.

ASCP. "Laboratory Medicine" various.

Resources Other

The following websites are recommended as references for this course:

1. Clinical Laboratory Improvement Act: http://www.cms.gov/clia/
2. Easy Calculator, links to calculation formulas: http://www.easycalculation.com/statistics/standard-deviation.php
3. Westgard Rules: http://www.westgard.com/

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