UNIVERSITY OF MARYLAND, BALTIMORE
SCHOOL OF MEDICINE
DEPARTMENT OF MEDICAL AND RESEARCH TECHNOLOGY

MEDICAL LABORATORY SCIENCE PROGRAM
DOCUMENTS FOR CLINICAL ROTATIONS FOR STUDENTS TO COMPLETE AND SUMIT

SPRING 2023

NATIONAL ACCREDITING AGENCY FOR CLINICAL LABORATORY SCIENCES (NAACLS)

5600 North River Road
Suite 720
Rosemont, IL 60018-5119

(773) 714-8880
(773) 714-8886 – fax

DMRT CONTACT INFORMATION

Dr. Sanford Stass, Chair
Allied Health Building
100 Penn Street, Room 340D
Baltimore, MD 21201
(410) 706-7729

Lorraine Doucette, MS, MLS(ASCP)^{CM}
Program Director
Allied Health Building, Room 440B
Baltimore, MD 21201
Ldoucette@som.umaryland.edu
410-706-1829

http://medschool.umaryland.edu/dmrt

UNIVERSITY OF MARYLAND BALTIMORE
SCHOOL OF MEDICINE

DEPARTMENT OF MEDICAL AND RESEARCH TECHNOLOGY

University of Maryland, Baltimore School of Medicine
Department of Medical and Research Technology
MEDT 472 CLINICAL PRACTICE BLOOD BANKING
Rotation Objectives

COURSE REQUIREMENTS

1. Compliance with all established clinical practice policies.
2. Satisfactory completion of all procedures on technical checklist (if applicable).
4. Laboratory Practical Exams
5. All Evaluations signed
6. Media Lab Pre and Post exams and Post-rotation exams (given by DMRT as part of MEDT 402 course)
7. Media Lab Blood Bank Modules completed
8. Pre-Rotation Objectives completed by students and submitted toward their MEDT 472 grade.
9. During Rotation Objectives completed by students and submitted toward their MEDT 402 grade.
10. Completed student's Evaluation of Clinical Rotation

EVALUATION AND GRADING CRITERIA

1. **Technical Performance Evaluation**
   The technical evaluation is for **blood bank only.**

2. **Laboratory Practical Examinations**
   Student will be given a laboratory practical at the end of the rotation using the enclosed Rubrics for evaluation and grading.

3. **Final Written Examinations**
   This is administered to the student at the end of the rotation at the University.

4. **Professional Qualities Evaluation**

5. Media Lab Modules, Pre Rotation Objectives and During Rotation Objectives are to be completed by the student.

6. **Clinical Practice Grade Form**
   Student's grade is based on the following criteria. A grade of "C" or better is necessary for passing. **A grade less than a "C" (70) will result in repeating the rotation.**

Student Responsibility:	Media Lab Blood Bank Modues	**10%**
	Pre-Rotation Objectives	**5%**
(15% of MEDT 402 grade)	During Rotation Objectives	
	Media Lab Pre and Post Rotation Exams	**10%**
Preceptor responsibility:	Blood Bank Rotation Grade worth 75% of MEDT 467	
	Blood Bank Technical Evaluation & Standards of Clinical Practice	**55%**
	Blood Bank Laboratory Practical	**10%**
	Affective Domain Evaluation	**10%**

University of Maryland, Baltimore School of Medicine
Department of Medical and Research Technology
Medical Laboratory Science Students
Clinical Immunohematology Questions to Answer
BEFORE YOU GO ON YOUR ROTATION
These are submitted in your MEDT 472 course

In preparation for and prior to the rotation, the MLS student will be able to:

I. Specimen Handling and Processing

1. List the minimum information required for labeling samples for blood bank testing.

2. Identify the types of blood samples and collection tubes appropriate for routine testing in the blood bank.

II. Quality Assurance/Quality Control and Regulatory Issues

1. From the information you learned in your blood bank course in the fall, list the quality control activities that are performed monthly, quarterly, bi-annually and annually.

2. List the accrediting and inspection agencies that monitor blood banks and transfusion services.

III. Routine Technical Procedures – ABO/Rh, Ab Screen and DAT

1. Explain the importance of subgroups, specifically subgroup A_1 with regards to ABO testing.

2. Explain the next step/s to be taken to investigate a ABO/Rh discrepancy.

3. Suggest a plan of action for the preliminary investigation of the following ABO discrepancies:

    - Hypogammaglobulinemia
    - Cold reacting alloantibody

- Cold reacting autoantibody
- Subgroup of A with anti-A1
- Mixed field agglutination

4. Explain the next step/s to be taken to investigate a positive antibody screen.

5. Compare and contrast direct and indirect antiglobulin testing with regard to principle, procedure and application.

6. Identify sources of false negative and false positive error in antiglobulin testing.

7. Describe alternatives in routine testing such as gel and solid phase.

IV. Routine Technical Procedures – Cross-Matching and Transfusion Management

1. Explain possible causes of an incompatible crossmatch.

2. Describe the policies for emergency release and massive transfusion.

3. Describe special transfusion donor units to include:

- Sickle Cell
- Irradiated
- CMV negative
- Washed

4. Explain the procedures for RhIg administration including candidate selection, FMH screening, and dosage determination.

5. Compare and contrast the following adverse reactions to transfusion with regard to cause, classic signs & symptoms, and serologic investigation (if applicable):

Immediate Hemolytic	Urticarial
Delayed Hemolytic	Anaphylactic
Febrile Non-hemolytic	Bacterial sepsis
TACO/TRALI	

V. Reference Procedures

1. List 5 antigens of low incidence and 5 antigens of high incidence. Discuss how to select the most appropriate units to crossmatch in these scenarios.

2. Briefly describe the following reference techniques to assist in antibody identification:

   - Selected cell panel
   - Red cell (antigen) phenotyping
   - Enhancement media (PeG & LISS)
   - Acid Elution
   - Saline replacement
   - REST (optional)

3. Compare and contrast the serologic characteristics of antibodies to the following blood group systems:

Rh	Kell
Kidd	Duffy
MNSs	Lewis
Lutheran	I
P_1	

VI. Donor /Components/Product Disposition

1. List the physical and medical criteria used in the selection of the following blood donors:

   - Allogeneic
   - Autologous
   - Directed
   - Therapeutic (optional)

2. Describe the processing of a donor to include:
    - Donor history
    - Physical exam
    - Donor acceptability
    - Proper unit collection and handling

3. Identify the blood bank serologies and viral marker testing required on all allogeneic, autologous and directed units.
4. Explain the preparation of the following components from whole blood:
    - Packed red blood cells
    - Fresh frozen plasma
    - Random platelets
    - Cryoprecipitate
5. Describe the following forms of blood product handling and manipulation:
    - Pooling
    - Aliquoting
    - Washing
    - Irradiating

6. Identify the shelf life, storage requirements and therapeutic use of:
    - Fresh frozen plasma
    - Cryoprecipitate (single unit & pooled)
    - Leukoreduced red blood cells
    - Washed red blood cells
    - Factor VIII & IX concentrates (where applicable)

UNIVERSITY OF MARYLAND, BALTIMORE SCHOOL OF MEDICINE
Medical Laboratory Science Program
Clinical Immunohematology Questions to Answer While ON YOUR ROTATION
These are submitted in your MEDT 402 course

Name:_____

Type or PRINT LEGIBLY your answers to each question in the space below. Some are short answer, some require you to draw and label items. Some will direct you to web sites. Some will have you attach answers to web questions to this packet. The purpose of this review packet is to assist you in studying for your Clinical Immunohematology Post Exam, the Comprehensive Exam and the ASCP Registry exam or the AMT Exam. Use additional paper to answer the questions if necessary.

1. Go to the following web site and review the blood banking tutorial.
   http://library.med.utah.edu/WebPath/TUTORIAL/BLDBANK/BLDBANK.html

   Write down 10 KEY points that you learned in this tutorial in this space.

2. Go to the following web site and review the genetics module.
   http://www.ualberta.ca/~pletendr/tm-modules/genetics/

   Look up ½ of the terms that are given in the lists of terms to look up.
   The enrichment activities are quite good but not required for the During Rotation Questions to answer.
   Complete the quiz 1 and copy it to this packet.

3. Complete the immunology module at the same web site. Pick one of the enrichment activities to perform. Skip the assessments.

4. Read the ABO module. Skip the enrichment exercises and the assessments.

5. Read the Rh module. Skip the enrichment exercises and assessments.

Go to the following web site: http://www.patletendre.com/tm-education.html Scroll down until you see: **Canadian Blood Services**

- Professional Education (Many resources)
- Clinical Guide to Transfusion

6. Read Chapter 12 about Hemolytic Disease of the newborn. Write below 10 KEY points that you learned or reviewed by reading this chapter.

ABO/Rh

List four causes of "false positive" reactions and and four causes of "false negative" reactions in ABO forward and reverse grouping.

If results for ABO reverse typing are unexpectedly negative, what is the next step?

8. What protocol is used when reissuing blood?

9. For the following ABO discrepancies, list the most probable cause(s).

Anti sera			**Cells**			
Anti-A	**Anti-B**	**Anti-A1**	**A1**	**A2**	**B**	**Screen**
a. 4+	O	O	2+	O	4+	O
b. 4+	4+	4+	2+	2+	2+	2+
c. O	O	O	O	O	O	O
d. 4+	2+	4+	O	O	4+	O
e. O	O	O	O	O	4+	O

10. a

    b.

    c.

    d.

    e.

Antibody Identification

11. What is the typical immunohematologic picture of a warm autoimmune hemolytic anemia?

.	**Screening Cells**	**Autocontrol**
RT		
37'		
AHG		

12. List four cold autoagglutinins.

13. List five antibodies typically reactive at the AHG phase.

14. List five antibodies that can cause **in vivo** hemolysis.

15. What is dosage? List two antibodies that demonstrate dosage.

Computability Testing/Blood Product Selection

16. Susan was determined to be B negative and a stat crossmatch for four units of red cells has been ordered. The RBC inventory is as follows:

O pos 4	O neg 2	A pos 4	A neg 1
B pos 4	B neg 2	AB pos 1	AB neg 2

a. Which four units of blood will be crossmatched first?

b. If the transfusion service receives a second order on Susan for four more units of RBCs stat, how will this second order be filled?

17. Molly, a 29-year-old female patient, blood type A negative, needs 10 units of PC. This hospital's supplier has only O positive platelets in stock. How should this situation be handled?

18. Dr. Jones ordered a Type and Screen on Paul a 30 year-old preoperative patient. The patient tested O positive with a negative antibody screen. Previous records show that this patient tested positive for anti-Fy^a 2 years ago. How should the situation be handled?

19. If Terry, a 38 year-old woman, has anti-K and anti-c antibodies, what percentage of group A units donated by whites would be compatible?

20. Eight of ten units crossmatched for John, a white male patient, are incompatible at immediate spin saline. Antibody screens with enzyme-treated reagent cells are negative, but regular screens are positive. Which antibody is probably causing the incompatibility?

Blood Products

21. Fresh frozen plasma should be stored at _____ and should have a dating (expiration date) of _____.

22. Pooled platelets are stored at _____ and must be infused within _____.

23. Washed red cells are stored at _____ for up to _____.

24. Frozen cryoprecipitate is stored at _____ for up to _____.

25. Which factors does cryoprecipitate contain?

26. Why are FFP and cryoprecipitate thawed in a plastic overwrap?

27. What are the storage requirements for platelet concentrates? What is the dating requirement for platelet concentrate units?

28. Give the shelf life for RBCs collected in the following anticoagulant-preservative solutions:

CPD_____; ACPDA-1 _____; AS-1(Adsol)_____; AS-3 (Nutricell) _____;

AS-5(Optisol) _____

29. If the hermetic seal on a unit of blood is broken, what is the new shelf life if stored at 4° C?

30. Platelet concentrate must contain _____platelets with a pH of ____ and a volume of _____ for room temperature storage.

HDN/RhIG

31. For the following maternal or cord blood types determine whether RhIG is indicated after delivery.

.	Mother	Baby	Antibody Screen (mother)	Rosette Test	RhIg Yes or NO
a.	O neg	O pos	Neg	Positive	
b.	A neg	AB pos	Anti-D 1:1028	Negative	
c.	O weak D pos	A pos	anti-K	Negative	
d.	B neg	B weak D pos	Negative	negative	
e.	A pos	O neg	Negative	negative	

32. Group A and B babies of group ____ mothers most frequently have ABO HDN.

33. What is considered a significant antibody titer for performing amniocentesis in Rh-negative pregnant women?

Transfusion Reactions

34. List three procedures required during the immediate investigation of a transfusion reaction.

35. List four diseases that can be acquired from blood transfusion.

36. For each of the following transfusion reactions, **give the causes and symptoms:**

a. allergic

b. febrile, nonhemolytic

c. volume overload

d. bacterial reaction

e. acute hemolytic

f. delayed hemolytic

g. anaphylactic

37. Hives and itching are characteristic of which transfusion reaction?

38. After receiving 100 ml of red cells, a patient immediately develops flushing, nervousness, fever with a temperature of 102° F, shaking, chills, and back pain. The patient's plasma hemoglobin is elevated, and a hemoglobinuria is also present. What is a laboratory investigation of the adverse reaction most likely to show?

Quality Assurance

39. List three factors that are checked for daily as part of reagent QC program.

40. The blood refrigerator alarm must activate at _____° C and at _____° C.

41. Resuspension of the RBC button is difficult at the 20-sec spin indicated on the serofuge for saline spin. How can the optimum centrifugation time be determined?

42. List three reasons why addition of check cells to negative tubes during a crossmatch may result in no agglutination.

43. How often should the RPM and timer be checked on centrifuges for serologic testing?

44. Distinguish between polyspecific and monospecific Coombs' serum.

UNIVERSITY OF MARYLAND, BALTIMORE
SCHOOL OF MEDICINE
DEPARTMENT OF MEDICAL AND RESEARCH TECHNOLOGY
Medical Laboratory Science Program
MEDT 472 CLNICAL PRACTICE BLOOD BANKING PERFORMANCE OBJECTIVES

WHAT THE STUDENT IS GRADED ON AT THE CLINICAL INSTITUTION

Upon completion of the rotation, the MLS student will be able to:

I. <u>Specimen Handling and Processing</u>

1. Following departmental protocol and demonstrate safe work practices by:

    a. Wearing personal protective equipment (PPE) as required.
    b. Handling and disposing of contaminated materials according to standard precautions.
    c. Handling chemicals according to safety procedures.

2. Determine the acceptability of a sample for compatibility testing based on sample age, sample appearance and institutional policy.

II. <u>Quality Assurance/Quality Control and Regulatory Issues</u>

1. Perform daily quality control for routine testing according to the operating procedures of the laboratory with 100% accuracy.

2. Recognize discrepant results in routine ABO, Rh and antibody screen testing with 100% accuracy.

3. Report all discrepant results to the clinical instructor.

4. Perform or observe basic laboratory computer applications where relevant.

III. **Routine Technical Procedures – ABO/Rh, Ab Screen and DAT**

1. Using a "0 to 4+" scale, grade macroscopic agglutination reactions within ± 1 agglutination grade of the instructor.

2. Prepare a 3-5% red cell suspension as needed for tube testing.

3. Label test tubes for routine testing according to laboratory procedure without error.

4. Perform ABO and Rh testing on a **minimum of 25 samples** with 100% accuracy.

5. Interpret the results of ABO and Rh testing without error.

6. Perform weak D testing on designated patient samples when available. (optional)*

7. Perform ABO confirmatory testing on a **minimum of 20 donor segments** with 100% accuracy.

8. Identify mixed field agglutination in 2 samples to the satisfaction of the clinical instructor.

9. Perform antibody screening on a **minimum of 20 samples** to the satisfaction of the clinical instructor.

10. Perform DAT and DAT Battery on a **minimum 2 samples** to the satisfaction of the clinical instructor.

IV. Routine Technical Procedures – Cross-Matching and Transfusion Management

1. Label test tubes for routine compatibility testing according to laboratory protocol without error.

2. Perform the appropriate cross-match procedure, immediate spin (IS) or Full (IAT), on a **minimum of 10 samples** when given the relevant patient information and the policy of the laboratory.

3. Select the most appropriate donor units to crossmatch with a patient when ABO specific red cells are available and when not available.

4. Select the most appropriate donor units when the patient presents with a single alloantibody.

5. Interpret the results of crossmatching with 100% accuracy

6. Distinguish ABO and Rh-related HDN according to clinical and serologic presentation.

7. Perform or discuss the prenatal (mother) and postnatal (mother and newborn) serologic workups for managing cases of HDN.

8. Observe or discuss the procedures for RhIg administration including candidate selection, FMH screening, and dosage determination.

9. Perform or describe a **minimum of 1 transfusion reaction work-up**, according to laboratory protocol.

V. Reference Procedures

1. Perform routine antibody identification panels on a **minimum of 5 samples** according to the acceptable precision of the laboratory.

2. Interpret the results of routine and selected cell panels to determine the specificity of single and multiple antibodies (simple).

3. Perform or discuss the following reference techniques to assist in antibody identification:

   - Selected cell panel
   - Red cell (antigen) phenotyping
   - Enhancement media (PeG & LISS)

- Acid Elution
- Saline replacement
- REST (optional)

V. Donor /Components/Product Disposition

1. Describe, and, if available, perform the processing of a donor to include:
   - Donor history
   - Physical exam
   - Donor acceptability
   - Proper unit collection and handling

2. Discuss or observe the following forms of blood product handling and manipulation:
   - Pooling
   - Aliquoting
   - Washing
   - Irradiating

3. Review the daily inventory and inspection of blood products.

4. Issue or observe the issue (release) of a **minimum of 5 blood products** for administration.

University of Maryland, Baltimore School of Medicine
MEDT 472 CLINICAL PRACTICE BLOOD BANKING
SUGGESTED LABORATORY PRACTICAL TEST & RUBRIC
Medical Laboratory Science Students

TEST ITEM	Exceeds Standards (4 pts)	Meets Standards (3 pts)	Below Standards (2.5 pts)	Fails to Meet Standards (1 pt)
Familiar with test procedures OR consults SOP	Self directed; never needs to ask clinical instructor for assistance	Self directed; but asks clinical instructor 1 or 2 times for assistance	Asks clinical instructor 3 or more times for assistance	Constantly asks questions about procedures
Performs tests	Needs no supervision by clinical instructor; uses proper reagents and supplies; properly labels	Needs minimal supervision by clinical instructor; uses proper reagents and supplies; properly labels	Needs frequent supervision by clinical instructor	Needs constant supervision by clinical instructor
Recording Results	All results recorded according to lab SOP and legibly organized	Most reports recorded according to lab SOP	Half of the reports recorded according to lab SOP	No reports recorded according to lab SOP
Perform and Interpret: Antibody Panels (2 simple panels for MLS; 3 complex panels for MT)	Identifies antibodies correctly with minimal amount of cells needed	Identifies antibodies correctly	Identifies antibodies after assistance	Unable to perform antibody panel, even after review
Perform and Interpret: Crossmatch (2 samples)	Interprets correctly, used appropriate methodology and selected appropriate products	Interprets correctly, used appropriate methodology	Interprets correctly, however used inappropriate methodology	Unable to perform crossmatch, even after review
Perform and Interpret: ABO (5 samples)		100% Accuracy		<100% Accuracy
Perform and Interpret: Rh (5 samples)		100% Accuracy		<100% Accuracy
Perform and Interpret: Antibody Screens (5 samples)		100% Accuracy		<100% Accuracy
Perform and Interpret: DAT (2 samples)		100% Accuracy		<100% Accuracy

Scoring and Grading

_____/(Total Possible Points at Meets Standards or 27) X 100 = ____% (Student's Practicum Score)

(Student's Score divided by total possible points that can be earned at "Meets Standards" level, times 100)

Student's Signature: _____

Evaluator(s) Signatur: _____ **Date:** _____

University of Maryl;and
MEDT 472 CLINICAL PRACTICE BLOOD BANKING TECHNICAL PERFORMANCE EVALUATION
Medical Laboratory Science Students

Instructions

Please rate the student's technical performance **at the end of the rotation.** This should reflect the student's terminal ability and not the normal growth of the student during the rotation. Match the student's performance on each item with the **numerical rating** that most closely describes **his/her performance in comparison to an entry-level MLS employee with no experience or training.** It is recognized that with an entry level MLS, proficiency, speed and level of judgment will increase with experience.

Each task in the Technical Performance Evaluation is evaluated using the scale below:

1.0 *Unacceptable performance*
After appropriate training, the student performs the task with consistent performance errors, needs constant supervision and does not adhere to affiliate policies (e.g., safety) during task performance. The student also appears unwilling to improve performance.

2.0 *Marginal performance*
After appropriate training, the student performs the task with inconsistent technical skills **OR** needs constant and detailed instructions in order to achieve acceptable performance. The student demonstrates an understanding of the principle of the assay or procedure. **Performance at this level is equivalent to a grade of 'C'.**

3.0 *Acceptable performance*
After appropriate training, the student performs the task with average technical skill, but still needs/requires direct supervision. The student demonstrates an understanding of the principle of the assay or procedure and its application. **Performance at this level is equivalent to a grade of 'B'.**

4.0 *Very Good performance*
After appropriate training, the student performs the task with average technical skill with minimal supervision. The instructor feels confident in student performance and outcomes. The student demonstrates an understanding of the principle of the assay or procedure and its application. **Performance at this level is equivalent to a grade of 'A'.**

Using the above criteria, the final score for the Technical Evaluation is calculated as follows:

1. Add the Points Earned on the Technical Tasks.
2. Divide this total by the Total Possible Points (number of tasks actually performed x 4)
3. Multiply that Total x 100 to calculate % Score

Points Earned / (Tasks performed x 4) = Raw score x 100 = % Technical Performance Score

Technical Tasks

_____1. Labels tubes for tests and specimens and maintains unit identity throughout testing *without error.*

_____2. Using a "0 to 4+" scale, grades macroscopic agglutination *within +/- 1 agglutination grade of the clinical instructor.*

_____3. Performs ABO/Rh testing and interprets results *with 100% accuracy*.

_____4. Performs antibody screens *to the satisfaction of the instructor.*

_____5. Recognizes a positive antibody screen and explains the next step(s) to be taken.

_____6. Performs routine antibody identification panels and interprets results *according to the acceptable precision of the laboratory*.

_____7. Performs DAT and DAT battery *to the satisfaction of the clinical instructor.*

_____8. Recognizes a positive antibody screen and explains the next step(s) to be taken.

_____9. Using established laboratory procedures, records or enters results *without error.*

_____10. Recognizes unexpected results of ABO, Rh and antibody screens, repeats unexpected findings, and reports discrepant results to instructor.

_____11. Selects the most suitable donor units for a routine crossmatch when ABO-specific red cells are available.

_____12. Identifies alternative donor units, if the primary choice is unavailable for crossmatch.

_____13. Performs appropriate method of crossmatch when patient presents with a single alloantibody.

_____14. Interprets results of crossmatch *with 100% accuracy.*

_____15. Recognizes incompatible crossmatch results and suggests possible causes.

_____16. Performs routine antibody identification *according to the acceptable precision of the laboratory.*

_____17. Interprets results of routine cell panels to determine the specificity of single and multiple (simple) antibodies.

_____18. Interprets results of selected cell panels to determine the specificity of single and multiple (simple) antibodies.

_____19. Performs or describes 1 transfusion reaction work-up, *according to laboratory protocol*.

_____20. Perform daily quality control for routine testing according to the operating procedures of the laboratory *with 100% accuracy.*

Using the above criteria, the final score for the Technical Evaluation is calculated as follows:

1. Add the Points Earned on the Technical Tasks.
2. Divide this total by the Total Possible Points (number of tasks actually performed x 4)
3. Multiply that Total x 100 to calculate % Score

Points Earned / (Tasks performed x 4) = Raw score x 100 = % Technical Performance Score

Total Points Earned ____ = _____ x 100 = _____% **Technical Score**
Total Possible Points
(# Tasks x 4)

Student's Signature:

_____

Evaluator(s) Signature: _____ Date: _____

University of Maryland, Baltmore School of Medicine
Department of Medical and Research Technology
MEDT 453 CLINICAL PRACTICE CHEMISTRY ROTATION

COURSE REQUIREMENTS

1. Compliance with all established clinical practice policies.
2. Satisfactory completion of all procedures on technical checklist (if applicable).
4. Laboratory Practical Exams
5. All Evaluations signed
6. Media Lab Pre and Post exams and Post-rotation exams (given by DMRT as part of MEDT 402 course)
7. Media Lab Chemistry and if performed, Urinalysis Modules completed
8. Pre-Rotation Objectives completed by students and submitted toward their MEDT 453 grade.
9. During Rotation Objectives completed by students and submitted toward their MEDT 402 grade.
10. Completed student's Evaluation of Clinical Rotation

EVALUATION AND GRADING CRITERIA

1. **Technical Performance Evaluation**
   The technical evaluation is for **clinical chemistry and urinalysis only.**

2. **Laboratory Practical Examinations**
   Student will be given a laboratory practical at the end of the rotation using the enclosed Rubrics for evaluation and grading.

3. **Final Written Examinations**
   This is administered to the student at the end of the rotation at the University.

4. **Professional Qualities Evaluation**

5. Media Lab Modules, Pre Rotation Objectives and During Rotation Objectives are to be completed by the student.

6. **Clinical Practice Grade Form**
   Student's grade is based on the following criteria. A grade of "C" or better is necessary for passing. **A grade less than a "C" (70) will result in repeating the rotation.**

Student Responsibility:	Media Lab Blood Bank Modues	**10%**
	Pre-Rotation Objectives	**5%**
(15% of MEDT 402 grade)	Durring Rotation Objectives	
	Pre-and Post Rotation Exams (Media Lab)	**10%**

Preceptor responsibility: Chemistry Rotation Grade worth 75% of MEDT 463

Chemistry Technical Evaluation & Standards of Clinical Practice	**55%**
Chemistry and UALaboratory Practical	**10%**
Affective Domain Evaluation	**10%**

University of Marland, Baltimore School of Medicine
Department of Medical and Research Technology
CLINICAL PRACTICE CHEMISTRY OBJECTIVES

TO BE COMPLETED BY THE STUDENT *PRIOR TO* THE ROTATION
These are submitted in your MEDT 453 course

In preparation for and prior to the rotation, the MLS student will be able to:

For Clinical Chemistry:

1. Correlate laboratory data with clinical implications and abnormal test results to possible disease states. This includes:
   a. Cardiac enzymes
   b. Creatinine
   c. Liver enzymes
   d. Blood gases
   e. Bilirubin
   f. Iron
   g. Protein
   h. Lipids
   i. Glucose
   j. Endocrine function
   k. Electrolytes
   l. Blood urea nitrogen
   m. Tumor markers
   n. Therapeutic Drugs
   o. Drugs of Abuse

2. Recognize reference serum intervals and panic values for the following tests:
   a. Glucose
   b. Blood urea nitrogen
   c. Total protein
   d. Creatinine
   e. Sodium
   f. Total bilirubin
   g. Potassium
   h. Cholesterol
   i. Chloride
   j. Blood gases
   k. Therapeutic Drugs (peak & trough)

3. Define the following terms:
   a. End-point spectrophotometry
   b. Kinetic spectrophotometry
   c. Ion-selective electrodes

d. Osmometry
e. Electrophoresis
f. Chemiluminescence
g. Peak
h. Trough
i. Immunoassay
j. Fluorescent polarization

For Immunology:

1. Explain the concept of lattice theory in antigen/antibody reactions: prozone, equivalence, and postzone. (and how that might impact patient test results).

2. State how prozone and postzone might impact patient test results.

3. Compare and contrast primary and secondary immune responses.

4 Define the functions of the following cell types in regard to their role(s) in the humoral or cellular immune systems: neutrophil, monocyte, macrophage, eosinophil, basophil, B lymphocyte, T_H lymphocyte, T_C lymphocytes and NK cells.

5. Compare and contrast the terms sensitivity and specificity.

6. Differentiate agglutination and precipitation.

7. Discuss the principles and basic procedures of the following assays:
   - Latex agglutination
   - Hemagglutination
   - Immunodiffusion
   - Direct immunofluorescence
   - Indirect immunofluorescence
   - ELISA (EIA) sandwich technique
   - Western blot

8. For each test listed:
   - RPR
   - VDRL
   - FTA-ABS
   - ASO/Streptozyme
   - EIA and/or Western blot for Lyme Disease

   a. Discuss the principle and procedure.
   b. Correlate the disease manifestation/stage of disease with test results.
   c. Discuss instances where false positive and false negative reactions might occur.

9. Explain the significance of reactive, weakly reactive and non-reactive results in the RPR test.

10. Compare & contrast the RPR and FTA-ABS in terms of sensitivity, specificity and use in diagnosis and monitoring therapy.

11. Correlate viral markers with clinical implications for the following:
    a. Hepatitis A, B, C
    b. EBV
    c. HIV
    d. Rubella
    e. CMV

12. List the viral markers used to screen blood donor units.

13. Explain the theory/principle of screening tests for infectious mononucleosis.

14. Discuss the diagnosis of HIV infection using ELISA and Western blot tests.

15. Discuss the TORCH panel with regard to its use and clinical significance.

16. For each of the following assays:
    - ANA
    - CRP
    - C3, C4
    - CH_{50}
    - RF
    - Thyroid antibodies

    a. Discuss the principles and methodologies.
    b. Correlate test results with clinical implications.
    c. Perform, observe and/or discuss the assay, to the satisfaction of the instructor.
    d. Discuss physiologic causes of problems or unexpected test results that might occur.

University of Maryland, Baltimore School of Medicine
Department of Medical and Research Technology
Medical Laboratory Science Program
Clinical Practice Chemistry Rotation
DURING ROTATION Review Packet
THIS IS SUBMITTED TO THE MEDT 402 COURSE

Name:_____

Type or PRINT LEGIBLY your answers to each question in the space below. Some are short answer, some require you to draw and label items. Some will direct you to web sites. Some will have you attach answers to web questions to this packet. The purpose of this review packet is to assist you in studying for your Clinical Chemistry Post Exams, the Comprehensive Exam and the ASCP Registry exam or the AMT Exam. Use additional paper to answer the questions if necessary. You will complete this packet DURING your chemistry rotation

Instrumentation

1. Draw the schematic of a single beam spectrophotometer. Label each component and in the space below your drawing explain the function of each component.

2. Discuss the calibration and maintenance procedures used for a spectrophotometer. How is stray light detected? How is the wavelength checked? How is linearity checked?

3. You performed an analysis using the single standard method. The absorbance of the standard is 0.784, the concentration of the standard is 150 mg/dL. The absorbance of the unknown is 0.645. What is the concentration of the unknown?

4. Discuss Beer's law and what factors can interfere with it.

5. Compare and contrast nephelometry and turbidimetry including the direction of the path of light and what is actually measured by both methods.

6. Which instrument requires a primary and secondary monochromator?

    a. flame photometer
    b. atomic absorption spectrophotometer
    c. fluorometer
    d. nephelometer

7. Explain the principle of fluorescence polarization as used by the Abbott Axym.

8. If a sample was highly lipemic, and you wanted to analyze electrolytes, would it be better to run it diluted or undiluted? Why?

9. What is the name of the ion selective membrane used to measure potassium?

10. Which electrode is current producing (amperometric) vs voltage producing (potentiometric)?

11. State the 4 colligative properties that are affected by adding one mole per kilogram water of any solute into a solution. Explain how they are affected (do they go up, or down?)

12. Compare and contrast HPLC, and GC. How are they similar, how are they different.

13. Go to the web site http://www.bertholf.net/rlb/Lectures/index.htm and review the power points on spectrophotometry, electrochemistry, immunochemical methods and statistics. You will have to right click each title, and save them to your computer to run them in power point.

Blood Gases

14. Explain what happens to blood gas values if:

    a. The sample is exposed to air.

    b. The sample is drawn into a syringe with an air bubble.

    c. The sample is not mixed sufficiently.

15. Which blood gas parameters are calculations? Write out the calculations that are used to determine each parameter.

16. List the causes of a p50 shift to the left.

17. List the causes of a p50 shift to the right.

Electrolytes

18. Discuss the normal physiological regulation of sodium and potassium in the body.

19. Discuss what happens in Conn's disease and what happens in Addison's disease at it relates to sodium and potassium levels in the serum and urine.

Lipids, Carbohydrates and Diabetes Mellitus

20. State the reference intervals for normal, pre diabetic and diabetic patients for both fasting glucose, 2 hour postprandial glucose and glycated hemoglobin.

21. Compare and contrast the methodologies used in the clinical lab to measure glucose.

Electrophoresis

22. Review the slide presentation on proteins and electrophoresis on http://www.bertholf.net/rlb/Lectures/index.htm You do not have to print them out, just view them on the computer. There are 47 powerpoint slides in the presentation.

23. Draw a picture of a normal serum protein electrophoresis result. Label each peak and discuss the function of each protein that you labeled. Label the anode and cathode.

Renal Function and Cardiac Markers

24. State the calculations used to measure GFR. These are the renal clearance calculation and the estimated clearance calculation. Why would the physician use one vs the other?

25. List the cardiac markers that are commonly measured, the time frame that they are elevated, what help they are to physicians, and how specific each marker is.

26. Draw the Michaelis Menton plot and label zero order, Km, first order, and Vmax.

Endocrinology

27. Review the slides on the endocrine system found on https://www.khanacademy.org/science/health-and-medicine/advanced-endocrine-system/endocrine-system-introduction/v/endocrine-gland-hormone-review

28. Compare and contrast primary, secondary, and tertiary hypo and hyperthyroidism. Include what you would predict the lab values for each would be.

Toxicology

29. Review the toxicology and therapeutic drugs slide shows on http://www.bertholf.net/rlb/Lectures/index.htm

30. List the therapeutic drugs that are measured in the laboratory where you are completing your clinical chemistry rotation. State their trademark name and their common name, the medical rationale for prescribing the drug including the diseases and conditions that the patients may have.

31. List the drugs of abuse that your laboratory measures. State the physiological action of each drug and what metabolite is actually measured.

Liver and Digestive System

32. Discuss the mechanism of the breakdown of hemoglobin including the enzymes used for transport into the liver, the enzymes used within the liver and the further breakdown in the biliary system. Discuss the methodologies used to measure total and direct bilirubin.

33. State the QC rules that are violated when there is a random error, and when there is a systematic error. Define some causes of both types of errors and discuss what you would do to correct the problem.

34. Study the review packet that was given out in MEDT 452 Clinical Chemistry class.

University of Maryland, Baltimore School of Medicine
Department of Medical and Research Technology
MEDT 453 CLINICAL PRACTICE CHEMISTRY
PERFORMANCE OBJECTIVES
WHAT THE STUDENT IS GRADED ON BY THE PRECEPTOR DURING THE ROTATION

Upon completion of the rotation, the MLS student will be able to:

I. Specimen Handling and Processing

1. Comply with the standard operating procedure (SOP) for specimen handling, distribution, and storage.

2. Implement the standard safety precautions for the clinical laboratory.

3. Check for correct identification/labeling of specimens.

4. Evaluate specimens for appropriate anticoagulant, collection time and site of collection.

5. Identify specimens that may be unsuitable for analysis due to inadequate volume, incorrect anticoagulant used, hemolysis, lipemia, icteric, clot and/ or air bubbles.

6. Explain corrective measures for unacceptable specimens.

7. Prepare a minimum of **20 specimens** for analysis by centrifugation and separation of cells from serum/plasma.

8. Dispose of waste according to laboratory protocol.

II. Quality Assurance, Quality Control and Regulatory issues

1. State the name of the quality control program and control material.

2. Prepare reagents, calibrators and control material within the acceptable QA limits *with 100% accuracy.*

3. Perform calibrations.

4. Perform routine maintenance checks.

5. Evaluate the validity of standardization/calibration of the instrument.

6. Document results of calibration, performance, maintenance checks, malfunctions and corrections *without error*.

7. Identify control results not within the accepted quality control limits *with 100% accuracy.*

8. Discuss appropriate actions for unacceptable control results.

9. Observe corrective documentation for unacceptable control values.

10. State possible sources of error, if results are not within limits (e.g. outside instrument limits).

11. Observe basic LIS computer applications, where relevant.

12. Describe various periodic maintenance procedures for the different instruments and maintenance sheets.

13. Comply with regulatory issues.

III. <u>Performance of Procedures</u>

1. Follow the procedure and safety precautions, *without error,* for analytical instrument and manual testing with respect to:
   a. Specimen preparation
   b. Control selection
   c. Intervals at which standards and controls are to be analyzed
   d. Identification and correct positioning of specimens
   e. Operation of the instrument

2. Pipet reagents and samples accurately.

3. Prepare dilutions with *100% accuracy.*

4. Describe the sample path or flow for one instrument.

5. Complete a minimum of 10 runs/assays *with acceptable results within the laboratory's timeframe specified for stat and/or routine turn around time.*

6. Operate at least one analyzer *with minimal supervision in accordance with laboratory protocol.*

7. Observe the sample path or flow in 2 instruments.

8. Discuss the theoretical principles for each analytical methodology.

9. Demonstrate the ability to organize workflow.

10. Recognize common malfunctions of the instrument.

11. Classify the instruments at the site according to the approach of automation (i.e., discrete and parallel analyzers)
12. Describe/ demonstrate basic trouble-shooting skills for common malfunctions.

IV. Interpretation and Reporting of Results

1. Recognize interfering substances for each procedure performed.

2. Identify patient values that are significantly different than normal (e.g. critical values, analytical errors) and bring these to the attention of the technologist immediately.

3. Determine need for repeat analysis on unacceptable reportable ranges.

4. Determine whether results fit the expected pattern with respect to previously obtained results on the same test or other test results on the same patient.

5. Evaluate a **minimum of 50 patient results** according to laboratory protocol for routine, STAT (including telephone results) and critical value results.

6. Perform and interpret **10 routine calculations** to include dilutions, anion gap, 24 hour urine, creatinine clearance, LDL and thyroid index *with 100% accuracy.*

V. For Immunology

1. State the specimen collection and handling requirements for each immunologic test.

2. Evaluate patient specimens for acceptability, using laboratory policy.

3. If patient specimens are determined to be unacceptable, state the resolution.

4. Prepare controls and reagents results within acceptable QA limits.

5. Using established criteria, determine whether or not available controls and reagents are acceptable for use according to lab protocol.

6. Evaluate quality control data for a **minimum of 3 different immunology assays** performed in the laboratory.

7. Discuss appropriate actions for unacceptable control results.

8. Recognize all critical values obtained during patient testing and report this immediately to the clinical instructor.

9. Demonstrate accurate pipetting technique *to the satisfaction of the clinical instructor.*

10. Perform/ observe the following assay methods:
    a. Immunodiffusion
    b. Direct and Indirect immunofluorescence (e.g. ANAs, FTA-Abs)
    c. EIA (e.g. HIV, Hepatitis, Lyme)

11. Perform/ observe on a minimum of 2 specimens:
    a. Streptozyme assay
    b. Screening or confirmatory testing for Lyme disease

12. Perform a **minimum of 5 screening tests for IM** *with 100% accuracy.*

13. **For RPR and FTA-ABS testing:**
    a. Perform **RPR QC/calibration techniques** (temperature, needle, rotator speed) according to laboratory protocol.
    b. Perform a **minimum of 10 RPR tests** *with 100% accuracy.*
    c. Interpret a **minimum of 10 RPR tests** *with 100% accuracy.*
    d. Perform a **minimum of 2 RPR titers** on previously reactive specimens, *matching the technologist's results within +/–1 dilution.*

MEDT 453 CLINICAL PRACTICE CHEMISTRY ROTATION
LABORATORY PRACTICAL SCORING RUBRIC

CLINICAL CHEMISTRY ANALYZER OPERATION
(Minimum of 10 runs/assays)

TEST ITEM	Exceeds Standards (4 pts)	Meets Standards (3 pts)	Meets Standards AFTER REVIEW (2 pts)	Does Not Meet Standards AFTER REVIEW (1 pt)
1. Implement standard safety precautions		Practices standard safety precautions all the time	Practices standard safety precautions AFTER counseling **once**	Fails to practice standard safety precautions **OR** must be counseled more than one time
2. Prepare reagents, calibrators and controls within the acceptable QA limits	Completes all tasks with 100% accuracy	Completes 2 of the 3 tasks with 100% accuracy	Completes 2 of the 3 tasks with 100% accuracy, **AFTER REVIEW**	Fails to complete any tasks with 100% accuracy
3. Prepare dilutions	Prepares all dilutions correctly	Prepares most dilutions correctly	Prepares most dilutions correctly, **AFTER REVIEW**	Prepares less than half dilutions correctly
4. Complete runs/assays with acceptable results and within the laboratory timeframe specified for stat and/or routine TAT	Completes 10 runs with acceptable results and within designated times	Completes 8 of 10 runs with acceptable results and within designated times	Completes 8 of 10 runs with acceptable results and within designated times, **AFTER REVIEW**	Completes < 8 runs with acceptable results and within designated times
5. Organize workflow	Meets SOP standards all of the time	Meets SOP standards most of the time	Meets SOP standards most of the time, **AFTER counseling once**	Fails to meet SOP standards OR counseled more than one time
6. Recognize common malfunctions of the instrument/analyzer	Recognizes all common malfunctions of the instrument and demonstrates troubleshooting skills	Recognizes some of the common malfunctions of the instrument and demonstrates some troubleshooting skills	Recognizes some of the common malfunctions of the instrument and demonstrates some troubleshooting skills, **AFTER REVIEW**	Consistently fails to recognize common malfunctions of the instrument
7. Calculate anion gap and creatinine clearance for a minimum of 5 samples		100% accuracy	100% accuracy, **AFTER REVIEW**	< 100% accuracy, **AFTER REVIEW**
8. Identify patient values that are significantly different than normal (e.g. critical values, analytical errors)	Identifies all values and informs the technologist immediately	Identifies some of the values and informs the technologist immediately	Identifies some of the values and informs the technologist immediately, **AFTER counseling once**	Consistently fails to identify the values **OR** fails to inform the technologist immediately

Scoring and Grading

_____/24 (Total Possible Points) X 100 = _____% (Student's Score)

Student: _____

Evaluator(s): _____ Date: _____

MEDT 453 CLINICAL PRACTICE CHEMISTRY ROTATION
LABORATORY PRACTICAL SCORING RUBRIC

NON-AUTOMATED METHOD (Minimum of 10 runs/assays)

TEST ITEM	Exceeds Standards (4 pts)	Meets Standards (3 pts)	Meets Standards AFTER REVIEW (2 pts)	Does Not Meet Standards AFTER REVIEW (1 pt)
1. Implement standard safety precautions		Practices standard safety precautions all the time	Practices standard safety precautions AFTER counseling **once**	Fails to practice standard safety precautions **OR** must be counseled more than one time
2. Organize workflow	Meets SOP standards all of the time	Meets SOP standards most of the time	Meets SOP standards most of the time, **AFTER counseling once**	Fails to meet SOP standards OR counseled more than one time
3. Prepare reagents and controls within the acceptable QA limits	Completes all tasks with 100% accuracy	Completes 2 of the 3 tasks with 100% accuracy	Completes 2 of the 3 tasks with 100% accuracy, **AFTER REVIEW**	Fails to complete any tasks with 100% accuracy
4. Complete runs/assays with acceptable results and within the laboratory specified timeframe	Complete 10 runs/ assays with acceptable results and within designated times	Completes 8 of 10 runs/ assays with acceptable results and within designated times	Completes 8 of 10 runs/ assays with acceptable results and within designated times, **AFTER REVIEW**	Completes < 8 runs/ assays with acceptable results and within designated times
5. Identify patient values that are significantly different than normal (e.g. critical values, analytical errors)	Identifies all values and informs the technologist immediately	Identifies some of the values and informs the technologist immediately	Identifies some of the values and informs the technologist immediately, **AFTER counseling once**	Consistently fails to identify the values **OR** fails to inform the technologist immediately
6. Document lot numbers, expiration dates, initials, preparation time, patient values, QC results and standard values, where applicable	No errors in documentation	1 error in documentation	1 more error in documentation, **AFTER counseling once**	1 more error in documentation, **AFTER counseling twice**

Scoring and Grading

_____/18 (Total Possible Points) X 100 = _____% (Student's Score)

Student: _____

Evaluator(s): _____ Date: _____

University of Maryland, Baltimore School of Medicine
Department of Medical and Research Technology
IMMUNOLOGY
LABORATORY PRACTICAL TEST & RUBRIC

Medical Laboratory Science Students

Please attach the student's documentation to this evaluation!

TEST ITEM	Exceeds Standards (4 pts)	Meets Standards (3 pts)	Below Standards (2 pts)	Does Not Meet Standards AFTER REVIEW (1 pt)
Implement standard safety precautions		Practices standard safety precautions all the time	Practices standard safety precautions AFTER counseling **once**	Fails to practice standard safety precautions **OR** must be counseled more than one time
Perform, record, evaluate QC		Without error		With any errors
Organize workflow	Meets SOP standards all of the time	Meets SOP standards most of the time	Meets SOP standards most of the time; AFTER counseling **once**	Fails to meet SOP standards OR counseled more than one time
Perform RPR screening tests (5 samples)	All 5 samples match instructor's results	4 of 5 samples match instructor's results	4 of 5 samples match instructor's results AFTER counseling	3 or less of 5 samples match instructor's results
Perform RPR titers (2 samples)	All samples match instructor's results within +/- one dilution factor	1 or 2 samples match instructor's results within +/- one dilution factor	1 or 2 samples match instructor's results within +/- one dilution factor AFTER counseling	None of the samples match instructor's results within +/- one dilution factor
Perform a minimum of 2 additional manual tests (Refer to objectives for examples)		100% accuracy	After review, 100% accuracy	After review, <100% accuracy

Scoring and Grading

_____/18 (Total Possible Points) X 100 = _____% (Student's Score)

Student: _____

Evaluator(s): _____ Date: _____

MEDT 453 CLINICAL PRACTICE CHEMISTRY ROTATION TECHNICAL PERFORMANCE EVALUATION

Instructions

Please rate the student's technical performance **at the end of the rotation**. This should reflect the student's terminal ability and not the normal growth of the student during the rotation. Match the student's performance on each item with the **numerical rating** that most closely describes **his/her performance in comparison to an entry-level MLS employee with no experience or training.** It is recognized that with an entry level MLS, proficiency, speed and level of judgment will increase with experience.

Each task in the Technical Performance Evaluation is evaluated using the scale below; if a technical task is not performed at your site please mark as N/A:

1.0 ***Unacceptable performance***
After appropriate training, student performs the task with consistent performance errors, needs constant supervision and does not adhere to affiliate policies (e.g., safety) during task performance. Student also appears unwilling to improve performance.

2.0 ***Marginal performance***
After appropriate training, student performs the task with inconsistent technical skills **OR** needs constant and detailed instructions in order to achieve acceptable performance. The student demonstrates an understanding of the principle of the assay or procedure. **Performance at this level is equivalent to a grade of "C".**

3.0 ***Acceptable performance***
After appropriate training, student performs the task with average technical skill, but still needs/requires direct supervision. The student demonstrates an understanding of the principle of the assay or procedures and its application. **Performance at this level is equivalent to a grade of "B".**

4.0 ***Very Good performance***
After appropriate training, student performs the task with average technical skill and minimal supervision. Instructor feels confident in student performance and outcomes. Student demonstrates an understanding of the principle of the assay or procedure and its application. **Performance at this level is equivalent to a grade of "A".**

Technical Tasks for Clinical Chemistry

_____1. Checks for correct identification/labeling *without error.*

_____2. Evaluates specimens for appropriate anticoagulant, collection time & site of collection *with 100% accuracy*.

_____3. Identifies specimens that may be unsitable for analysis due to incorrect anticoagulant, hemolysis, lipemia, icteric, clot, and/or air bubble present.

_____4. Describes corrective measures for unacceptable specimens.

_____5. Prepares a **minimum of 20 specimens** for analysis by centrifugation and separation of cells from serum/plasma *to the satisfaction of the technologist.*

_____6. Prepares reagents, calibrators and control material *within the acceptable QA limits*.

_____7. Performs calibrations and routine maintenance checks.

_____8. Evaluates the validity of standardization/calibration of the instrument *with 100% accuracy*.

_____9. Documents results of calibration, performance & maintenance checks, malfunctions and corrections *without error.*

_____10. Identifies control results that are not within the accepted quality control limits *with 100% accuracy*.

_____11. Describes appropriate actions for unacceptable control results.

_____12. States possible sources of error, if QC results are not within limits.

_____13. Describes periodic maintenance procedures for the different instruments.

_____14. Follows procedures and safety precautions for instrument and manual testing *without error,* to include:
- Specimen preparation
- Control selection
- Intervals at which standards and controls are to be analyzed
- Identification and correct positioning of specimens
- Operation of the instrument

_____15. Completes a minimum of 10 runs/assays *with acceptable results within the laboratory's specified timeframe*.

_____16. Pipets reagents and samples *to the satisfaction of the technologist.*

_____17. Prepares dilutions *with 100% accuracy*.

_____18. Recognizes common malfunctions of the instrument.

_____19. Describes or demonstrates basic trouble-shooting skills.

_____20. Recognizes interfering substances for each procedure performed.

Evaluate a minimum of 50 patient results according to laboratory protocol:

_____21. Identifies patient values that are significantly different than normal (e.g. risk values, critical values, analytical errors) and bring these to the attention of the technologist immediately *with 100% accuracy.*

_____22. Determines need for repeat analysis on unacceptable reportable ranges *with 100% accuracy.*

_____23. Determines whether results fit the expected pattern with respect to previously obtained results on the same test or other test results on the same patient.

_____24. Performs and interpret 10 routine calculations (dilutions anion gap, 24 hour urine, creatinine clearance, LDL, thyroid index) *with 100% accuracy.*

Technical Tasks for Immunology

_____25. Performs and interprets results of **5** screen tests for infectious mononucleosis *with 100% accuracy.*

_____27. Performs QC/calibration techniques for the RPR assay, *according to laboratory protocol.*

_____28. Performs **10** RPR tests *with 100% accuracy.*

_____29. Interprets results of **10** RPR tests *with 100% accuracy.*

_____30. Performs **2** quantitative titers on reactive RPR tests matching the *technologist's results within +/- 1 dilution.*

Scoring and Grading

Total Points Earned = _____**% (Student's Score)**
Total Possible Points

To calculate total possible points, add number of tasks completed at site and multiply by 4. (Example: 15 tasks completed 15 x 4 = 60 possible points)

Student: _____

Evaluator(s): _____ **Date:** _____

University of Maryland, Baltimore School of Medicine
Department of Medical and Research Technology
MEDT 421 CLINICAL PRACTICE HEMATOLOGY
Medical Laboratory Science Students

COURSE REQUIREMENTS

1. Compliance with all established clinical practice policies.
2. Satisfactory completion of all procedures on technical checklist (if applicable).
4. Laboratory Practical Exams
5. All Evaluations signed
6. Media Lab Pre and Post exams and Post-rotation exams (given by DMRT as part of MEDT 402 course)
7. Media Lab Chemistry and if performed, Urinalysis Modules completed
8. Pre-Rotation Objectives completed by students and submitted toward their MEDT 421grade.
9. During Rotation Objectives completed by students and submitted toward their MEDT 402 grade.
10. Completed student's Evaluation of Clinical Rotation

EVALUATION AND GRADING CRITERIA

1. **Technical Performance Evaluation**

2. **Laboratory Practical Examination**
   Student will be given a laboratory practical at the end of the rotation using the enclosed Rubric for evaluation and grading.

3. **Final Written Examination**
   This is administered to the student at the end of the rotation **at the College**.

4. **Professional Qualities Evaluation**

5. **Clinical Practice Grade Form**
   Student's grade is based on the following criteria. A grade of "C" or better is necessary for passing. **A grade less than a "C" (73) will result in repeating the rotation.**

Student responsibility: Media Lab Hematology Modules		**10%**
	Pre-Rotation Objectives	**5%**
(15% of MEDT 402 grade)	During Rotation Objectives	
	Pre and Post-Rotation Exam (Media Lab)	**10%**

Preceptor responsibility: Hematology Rotation Grade worth 75% of MEDT 463	
Hematology Technical Evaluation & Standards of Clinical Practice	**55%**
Hematology Laboratory Practical	**10%**
Affective Domain Evaluation	**10%**

University of Maryland, Baltimore School of Medicine
Department of Medical and Research Technology
Medical Laboratory Science Program
Clinical Hematology/Urinalysis
Rotation Objectives BEFORE Your Rotation
These are to be submitted in the MEDT 421 course

In preparation for and prior to the rotation, the MLS student will be able to:

I. Specimen Handling and Processing

1. Describe corrective measures for samples that are lipemic, icteric or contain paraproteins.

2. Describe corrective measures for samples that are rejected due to improper patient identification, quantity not sufficient, improper tube collected, cold agglutinins, clotted, and hemolyzed.

II. Technical Procedures for Hematology

1. Record the normal (reference) values for the following routine assays:
   - WBC count
   - RBC count
   - Hemoglobin
   - Hematocrit
   - RBC indices
   - Platelet count
   - Sedimentation rate
   - Reticulocyte count

3. Explain the principle of the ESR and factors which might interfere with accurate results.

4. Associate abnormal hematological results with possible pathology.

5. Describe the normal and abnormal hemoglobin patterns on electrophoresis at pH 8.6 (A, F, S, C, A_2, E, H, Barts, Lepore) on electrophoretic patterns.

6. Describe the proper preparation, staining, and review of a bone marrow aspirate.

7. Discuss the use of cytochemistry for the classification of acute leukemias.

8. Discuss the use of flow cytometry in the classification of acute leukemias.

9. Compare and contrast the chronic and acute leukemias in terms of onset and major cell type.

10. Discuss the myleoprofliferative and myelodysplastic disorders with reference to FAB and WHO classification, and hematologic lab findings.

III. Technical Procedures for Coagulation

1. Discuss the principles of the following procedures and the reagents used:
   - PT
   - PTT
   - Thrombin time (*where applicable*)
   - Quantitive fibrinogen
   - D-dimer

2. Describe the laboratory testing used to monitor anticoagulant therapy.

3. Describe possible pathologic complications of anticoagulant therapy.

4. Explain the intrinsic and extrinsic coagulation pathways.

5. Propose appropriate laboratory tests to identify factor deficiencies.

6. Identify common pre-analytical variables that may adversely impact patient results, including:
   - Type of anticoagulant
   - Short draw
   - Expiration dates on tubes
   - Clotted sample
   - Hematocrit >55
   - Lipemia
   - Hemolysis
   - Storage

7. Describe possible pathologic complications of anticoagulant therapy, including LMWH, heparin, coumadin and other market-available anticoagulants.

8. Discuss the principle, clinical significance, and reagents used for the following tests:
   - Factor assays
   - Mixing studies
   - Lupus anticoagulant (anticardiolipin assay)
   - Factor 5 Leiden
   - Protein S
   - Protein C
   - Antithrombin assay
   - Anti Xa assay

University of Maryland, Baltimore School of Medicine
Department of Medical and Research Technology
Medical Laboratory Science Program
Clinical Hematology/Urinalysis
Rotation Objectives DURING Your Rotation
These are to be submitted in the MEDT 402 course

Name:_____

Type or PRINT LEGIBLY your answers to each question in the space below. Some are short answer, some require you to draw and label items. Some will direct you to web sites. Some will have you attach answers to web questions to this packet. The purpose of this review packet is to assist you in studying for your Clinical Hematology/Urinalysis Post Exam, the Comprehensive Exam and the ASCP Registry exam or the AMT Exam. Use additional paper to answer the questions if necessary. **You will be completing these objectives DURING your rotation and submitting them into MED 402.**

Blood Cell Formation

1. Draw the maturation sequence of the erythrocyte including drawing the nucleus and cytoplasm. Label each cell.

2. Draw the maturation sequence of the neutrophil including drawing the nucleus and cytoplasm. Label each cell.

3. Draw the maturation sequence of the lymphocyte including drawing the nucleus and cytoplasm. Label each cell.

4. Draw the maturation sequence of platelets. Label the cell(s).

5. Describe the difference between a plasma cell and a lymphocyte.

6. Define poikilocytosis, anisocytosis, hypochromia, microcytosis, polychromasia, and macrocytosis.

7. Discuss diseases and conditions in which you would expect to see the conditions listed in #6.

8. Calculate the manual white blood cell count if a total of 74 WBCs were counted in all 9 squares of a counting chamber. A 1 to 10 dilution was performed.

9. What is the formula for calculating an MCV?

10. What is the formula for calculating an MCH?

11. What is the MCHC formula?

12. Why would you stain red blood cells with Prussian blue stain? What would you expect to see?

13. Make a chart of RBC inclusions and include in the chart the name of the inclusion, and what disease/condition they are seen in.

14. Discuss the osmotic fragility test. How is it performed and what is it used for?

15. Discuss the ESR and what can interfere in its result. Include both problems that can be controlled (tech-made) and those that are patient-caused because of a problem with the patient's cells or plasma.

16. How do you correct for nucleated WBC's in an automated cell counter?

17. In which age group would a finding of 60% lymphocytes be normal?

18. Make a table of the different types of hemoglobinopathies that can be seen in the hematology lab. Include the actual cause of the problem for each and also what the rbc's would look like.

19. Discuss hemoglobin electrophoresis at pH of 8.6, both for normal hemoglobin and abnormal hemoglobins in relation to the electrophoresis pattern you would see.
20. Compare and contrast thallasemia major vs thallasemia minor as far as causation, symptoms, what the rbc's would look like, and treatment.

21. Discuss the megaloblastic anemias as to causation, treatment, and how the rbc's look on a Wright stained smear.

22. Construct a chart that lists the inclusions seen in WBCs. Include the causation of the inclusions, what the inclusion is made of (DNA, RNA, etc) and what the inclusions look like on a peripheral smear.

23. Compare and contrast lymphocytic vs granulocytic Acute Leukemias. Include any inclusions that might be seen, the N:C ratios, the affected patient population, treatment options, and expected outcomes.

24. Compare and contrast lymphocytic vs granulocytic Chronic Leukemias using the same criteria as question 26.

25. Compare and contrast the lymphoproliferative vs myeloproliferative disorders in regards to cells affected, causation, associated rbc and wbc morphology, patient population affected, treatment and outcome.

26. Construct a chart of the stains used in the hematology laboratory and include the name of the stain, what it stains, and what disease/disorder the stain is used for.

27. Draw the Intrinsic Coagulation System that is in our body.

28. Draw the Extrinsic coagulation pathway that is in our body.

29. Draw the common coagulation pathway.

30. Discuss the reagents used in the PT and the PTT test.

31. What factors are tested for in the PT test?

32. What factors are tested for in the aPTT test?

33. Discuss the inhibitors such as Protein C and Protein S, Factor 5 Leiden, etc to clotting in our body and associated thrombotic disorders. Include the tests that would be performed to diagnose these problems and the treatment options given to the patients.

34. Review at least 10 normal and 10 abnormal WBC instrument automated differentials with your preceptor. For abnormal WBC diffs, be able to look at the WBC histograms, and associated lab values and state the next steps you would take.

35. Block out about 1 hour of time. Go to this web site. http://www.pathguy.com/lectures/urine.htm#morenote Click on the white blood cell link, then on the top of the page, click on the icon "notes" Go crazy looking at all the cool images that are there!!!

36. In your own words, describe what the different casts look like under 40x.

37. Describe an interesting patient sample that you worked on during your rotation. What did you see?

38. Discuss the different types of crystals that are present in the urine. Which are found in acidic urine? Which are found in alkaline urine? Which are abnormal, and which are normal? What do they look like?

39. Discuss a body fluid analysis that you either observed or performed. What did you see?

40. What is the difference between a transudate and an exudate?

41. Study the review packet that was given out in class.

University of Maryland, Baltimore School of Medicine
Department of Medical and Research Technology
Medical Laboratory Science Program
MEDT 421 Clinical Practice Hematology/Urinalysis
Performance Objectives
What they will grade you on while on rotation

Upon completion of the Hematology Clinical Rotation, the MLS student will be able to:

I. Specimen Handling and Processing

1. Comply with the standard operating procedure for specimen handling and distribution.

2. Following departmental protocol, demonstrate safe work practices by:
   a. Wearing personal protective equipment (PPE) as required.
   b. Handling and disposing of contaminated materials according to standard precautions.
   c. Handling chemicals according to safety procedures.

3. Accept only specimens that meet standard laboratory protocol.

4. Describe corrective measures for samples that are lipemic, icteric or contain paraproteins.

5. Describe corrective measures for samples that are rejected due to quantity not sufficient, wrong anticoagulant, cold agglutinin, clotted, hemolyzed, improper patient identification, or improper tube collected.

6. Describe how to handle suboptimal fluid samples.

II. Quality Control, Quality Assurance, Regulatory Issues

1. Evaluate Quality Control results according to criteria established for each test.

2. Describe the various periodic (daily, weekly) maintenance routine for each piece of equipment used during clinical rotations.

3. Observe basic computer applications where relevant.

4. Document instrument maintenance and quality control.

5. Complete all work within established turn around time.

6. Report critical and discrepant results to clinical instructor/supervisor

7. State the confidentiality policy of the facility during testing procedures and reporting according to HIPPA guidelines.
8. Describe the process used to implement a new lot number of control material.

Technical Procedure for Hematology

1. Operate automated hematology instrumentation with minimal supervision and within acceptable ranges.
2. Perform non-automated hematology testing with minimal supervision and within acceptable ranges.
3. Using the automated hematology analyzer, perform a minimum of 40 CBC's and differentials.
4. Recognize abnormal flags on automated instrumentation.
5. Recognize all critical values and/or discrepant results on CBC's and differentials.
6. Report all critical values and/or discrepant results on CBC's and differentials to the clinical instructor.
7. Identify the corrective actions necessary for abnormal automated results.
8. Differentiate between normal and abnormal scattergram (plot) patterns.
9. Identify normal(reference) values for the following routine assays:
    - WBC count
    - RBC count
    - Hemoglobin
    - Hematocrit
    - RBC indices
    - platelet count
    - Sedimentation rate
    - Reticulocyte count
10. Demonstrate proper technique in preparing peripheral smears for microscopic examination to the satisfaction of the clinical instructor.
11. Evaluate a minimum of 20-25 peripheral blood smears for acceptable cellular distribution and staining to the satisfaction of the clinical instructor.
12. Perform a minimum of 20- 25 peripheral smears with a combination of normal and abnormal results with 95% proficiency.
13. Prepare a minimum of 20-25 platelets estimates, agreeing with instruments counts within 20%.

14. Identify abnormal red cell morphologies to include: microcytes, macrocytes, ovalocytes, spherocytes,target cells, sickle cells, schistocytes, burr cells, teardrops, acanthocytes, and rouleaux.
15. Grade abnormal red cell morphologies according to laboratory guidelines.
16. Identify qualitative white cell inclusions to include: toxic granulation, toxic vacuolization, Dohle bodies, and Auer rods.
17. Identify red cell inclusions to include: Howell Jolly bodies, Pappenheimer bodies, basophilic stipling, siderotic granules, and Heinz bodies.
18. Grade hypochromia and polychromasia according to laboratory guidelines.
19. Given a peripheral smear or kodachrome slide, identify the stages of immature white cells.
20. Given a peripheral smear or kodachrome slide, identify the stages of immature red blood cells.
21. Correct the WBC count for nucleated red blood cells according to laboratory guidelines.
22. Given a peripheral smear or kodachrome slide, recognize, but not speciate, malarial forms.
23. Recognize abnormal platelet morphology.
24. Perform **or** discuss reticulocyte counts. If performed, the results should be within 20% of technologist-recorded result.
25. Explain the principle of the ESR and factors which might interfere with accurate results.
26. Perform an ESR with minimum supervision and within QC guidelines.
27. Describe or perform a sickle cell screen (solubility test).
28. Interpret a sickle cell screen according to laboratory guidelines.
29. Associate abnormal hematological results with possible pathology.
30. *If available or applicable*, recognize the normal and abnormal hemoglobin patterns on electrophoresis at pH 8.6 (A, F, S, C, A_2, E, H, Barts, Lepore) on electrophoretic patterns,
31. *If available or applicable*, assist in the proper preparation, staining, and review of bone marrow aspirate.
32. Discuss the use of cytochemistry for classification of acute leukemias.
33. Discuss the use of flow cytometry in the classification of acute leukemias.

34. Compare and contrast the chronic and acute leukemias in terms of onset and major cell type.
35. Discuss the myleoproliferative and myelodysplastic disorders with reference to FAB and WHO classification, and hematologic lab findings.
36. Perform at least two **(5) body fluid manual cell count and differential** according to standard operating procedures.
37. Recognize cells specific to each body fluid type to include:
    - Histiocytes,
    - Mesothelial cells
    - Malignant cells
    - Macrophages with inclusion
    - Crystals
    - Bacteria
    - Yeast

Technical Procedures for Coagulation

1. Discuss the principles of the following procedures and the reagents used
    - PT
    - PTT
    - Thrombin time(*where applicable)*
    - Quantitative fibrinogen
    - D-dimer
    - POC testing(*if available)*

2. Describe or perform:
    - Quantitative fibrinogen
    - Thrombin time

    - D-dimer .
    - Describe the laboratory testing used to monitor anticoagulant therapy.

3. Describe possible pathologic complications of anticoagulant therapy.

4. Describe the intrinsic and extrinsic coagulation pathways.

5. Propose appropriate laboratory test to identify factor deficiencies.

6. Perform minor troubleshooting procedures of available coagulation reagent.

7. Identify common pre-analytic variables that may adversely impact patient results,

   including:

- storage
- type of anticoagulant
- short draw
- clotted sample
- Hematocrit >55
- lipemia
- hemolysis
- *expiration dates on tubes*

9. Describe possible pathologic complications of anticoagulant therapy, including LMWH, heparin, coumadin, and other market available anticoagulants.

10. When given patient history and coagulation test results, correlate thrombotic disorders with available patient history and coagulation test results.

11. In addition to the procedures listed above, discuss the principle, clinical significance, and reagents used for the following coagulation tests:

- Factor assays
- Mixing studies
- Lupus anticoagulant (anticardiolipin assay)
- Factor 5 Leiden
- Protein S
- Protein C (this should be included for MLT also)
- Antithrombin assay
- *Anti Xa assay*

13. Describe possible pathologic complications of anticoagulant therapy.

UNIVERSITY OF MARYLAND, BALTIMORE
SCHOOL OF MEDICINE
DEPARTMENT OF MEDICAL & RESEARCH TECHNOLOGY
CLINICAL PRACTICE HEMATOLOGY AND COAGULATION
LABORATORY PRACTICAL TEST & RUBRIC
MEDICAL LABORATORY SCIENCE STUDENTS

Please attach the student's documentation to this evaluation

TEST ITEM	Exceeds Standards (4 pts)	Meets Standards (3.5 pts)	Meets Standards AFTER Review (3.0 pts)	Does Not Meet Standards (2 pt)
Normal peripheral blood smears with platelet estimate (2-5)	All results agree with technologist's	Most results agree with technologist's	**After review,** results agree with technologist's	**After review,** few results agree with technologist's
****Abnormal peripheral smears (include leukemias) (5-10)** **SCORE X 2**	All results agree with technologist's	Results agree with technologist's	**After review**, results agree with technologist's	**After review**, few results agree with technologist's
Fluid differentials (2)	All results match the technologist's results	All results are within 20% of the technologist's results	**After review**, all results are within 20% of technologist's results	**After review**, results are NOT within 20% of technologist's results
OPTIONAL: Manual Platelet Counts – (5)	All results agree with technologist's	4 results agree	**After review**, 4 results agree	**After review**, <4 results agree
OPTIONAL: Manual Retic Counts- (3)	All results agree with technologist's	All results are within 20% of the technologist's results	**After review**, all results are within 20% of technologist's results	**After review**, all results are NOT within 20% of technologist's results

**** WILL include red cell morphology, white cell abnormalities, platelet abnormalities and leukemias**

Scoring and Grading

_____/ (Total Possible Points) X 100 = _____% (Student's Score)

Student: _____

Evaluator(s): _____ Date: _____

UNIVERSITY OF MARYLAND, BALTIMORE
SCHOOL OF MEDICINE
DEPARTMENT OF MEDICAL & RESEARCH TECHNOLOGY
MEDT 421 CLINICAL PRACTICE HEMATOLOGY
TECHNICAL PERFORMANCE EVALUATION

Instructions

Please rate the student's technical performance **at the end of the rotation.** This should reflect the student's terminal ability and not the normal growth of the student during the rotation. Match the student's performance on each item with the **numerical rating** that most closely describes **his/her performance in comparison to an entry-level MLS employee with no experience or training.** It is recognized that with an entry level MLS, proficiency, speed and level of judgment will increase with experience.

Each task in the Technical Performance Evaluation is evaluated using the scale below; if a technical task is not performed at your site please mark as N/A:

1.0 ***Unacceptable performance***
After appropriate training, the student performs the task with consistent performance errors, needs constant supervision and does not adhere to affiliate policies (e.g., safety) during task performance. The student also appears unwilling to improve performance.

2.0 ***Marginal performance***
After appropriate training, the student performs the task with inconsistent technical skills **OR** needs constant and detailed instructions in order to achieve acceptable performance. The student demonstrates an understanding of the principle of the assay or procedure.
Performance at this level is equivalent to a grade of 'C'.

3.0 ***Acceptable performance***
After appropriate training, the student performs the task with average technical skill, but still needs/requires direct supervision. The student demonstrates an understanding of the principle of the assay or procedure and its application. **Performance at this level is equivalent to a grade of 'B'.**

4.0 ***Very Good performance***
After appropriate training, the student performs the task with average technical skill with minimal supervision. The instructor feels confident in student performance and outcomes. The student demonstrates an understanding of the principle of the assay or procedure and its application. **Performance at this level is equivalent to a grade of 'A'.**

Technical Tasks

____1. Operates automated hematology and coagulation instruments *with minimal supervision and producing results within acceptable ranges.*

____2. Performs quality control procedures, including labeling, dating, re-initialing, reagents as well as checking expiration dates and restocking.

____3. Recognizes out-of-control results and can suggest how to correct the value that is outside the limits.

____4. Recognizes common instrument malfunctions and can perform **or** discuss corrective procedures.

____5. Recognizes and reports all critical values and/or discrepant results to the clinical instructor.

____6. Prepares and stains peripheral blood smears for differential, *to the satisfaction of the instructor.*

____7. Recognizes peripheral blood smears with unacceptable cellular distribution and staining, *to the satisfaction of the instructor.*

_____8. Performs **normal** WBC differentials, obtaining results that concur with the laboratory *with 95% accuracy.*

____9. Performs **abnormal** WBC differentials, obtaining results that concur with the laboratory *with 90% accuracy.*

____10. Estimates platelets, *agreeing with instrument counts within 20%*.

____11. Identifies abnormal RBC morphologies and inclusions, *with 95% accuracy.*

____12. Grades abnormal RBC morphologies *according to laboratory guidelines*.

____13. Identifies WBC inclusions, *with 95% accuracy.*

____14. Identifies atypical lymphocytes, blasts, plasma cells and nucleated RBCs, *with 95% accuracy.*

____15. Performs manual cell counts on body fluids, *agreeing with the technologist's count within ± 10%*.

____16. Corrects WBC count for nucleated RBCs *according to laboratory guidelines.*

____17 Correlates Hgb, Hct, RBC, WBC, platelets, indices and differential, and repeats tests when appropriate.

___18. Prepares and reads ESR with minimal supervision and results *agreeing with the technologist's within ±5%.*

___19. Performs and interprets a sickle cell screen *with 100% accuracy.*

___20. Interpret PT, PTT, d-dimer, and fibrinogen times *with 100% accuracy and according to instrument standard.*

___21. Associates abnormal hematological results with possible pathology.

Scoring and Grading

Using the criteria in the Instructions section, the final score for the Technical Evaluation is calculated as follows:

1. Add the Points Earned on the Technical Tasks.
2. If the student did not perform the technical task because the laboratory does not perform the task then score as N/A or not applicable.
3. Divide this total by the Total Possible Points (number of tasks actually performed x 4)
4. Multiply that Total x 100 to calculate % Score

Points Earned / (Tasks performed x 4) = Raw score x 100 = % Technical Performance Score

Total Points Earned **= _____ x 100 = _____% Technical Score**
Total Possible Points
(# Tasks x 4)

Student: _____

Evaluator(s): _____ Date: _____

If Urinalysis is part of the hematology rotation, take 20% of the Urinalysis practicum grade and add it to 80% of the averaged automated and non-automated practicum grade for the TOTAL Hematology Practicum score. (see final evaluation tool at end of packet)

University of Maryland, Baltimore School of Medicine
Department of Medical and Research Technology
MEDT 421/453 CLINICAL URINALYSIS ROTATION
CLINICAL PERFORMANCE OBJECTIVES
Medical Laboratory Science Students: Note: there are NO pre or during objectives for Urinalysis for you to complete.

Upon completion of the urinalysis rotation the student will be able to:

I. LABORATORY SAFETY

1. Comply with the standard operating procedure (SOP) for specimen handling, distribution, and storage including correct triage of specimen for in house and send out laboratory testing.

2. Following departmental protocol, demonstrate safe work practices by:

    1. Wearing personal protective equipment (PPE) as required.
    2. Handling and disposing of contaminated materials according to standard precautions.
    3. Handling chemicals according to safety procedures

3. Dispose of waste according to laboratory protocol.

II. SPECIMEN HANDLING

1. Check for correct identification/labeling of specimens according to the current National Patient Safety guidelines from JCAHO.

2. Explain the importance of proper collection and transport of specimens.

3. List criteria for evaluating specimen quality and corrective actions to resolve problems.

III. QUALITY ASSURANCE

1. List substances that will cause false negative and false positive results in a routine urinalysis.

2. Summarize the advantages and disadvantages of commonly used urine preservatives

3. State the confidentiality policy of the facility during testing procedure and reporting in accordance with HIPAA guidelines.

4. Observe basic computer applications where relevant.

5. Report or record quality control results according to the standard operating procedures of the laboratory *with 100% accuracy*.

IV. TESTING OF SAMPLE

1. For a minimum of 25 urine specimens *with 95% accuracy*:

    - Describe the physical appearance.
    - Perform specific gravity analysis using the refractometer and/or dipstick methods.
    - Perform chemical analysis of the urine specimens.
    - Interpret results obtained from chemical analysis.
    - Where applicable, confirm abnormal results with appropriate confirmatory tests for a minimum of **5** different abnormal urine specimens.
    - Interpret the confirmatory test results.
    - Perform microscopic analysis on urine specimens according to the standard operating procedure of the laboratory.
    - Given a specimen or image, identify normal and abnormal constituents in a microscopic analysis of urine specimens with 95% accuracy. These constituents include:
        - Erythrocytes
        - Leukocytes
        - Epithelial cells: squamous, transitional, renal
        - Bacteria
        - Yeast
        - Casts: hyaline, fine and coarse granular, rbc, wbc, waxy
        - Crystals: uric acid, calcium oxalate, triple phosphate, tyrosine, cystine, ammonium biurate
        - Oval fat bodies
        - Contaminants: fibers, talc, glass, etc.

2. Operate automated dipstick readers *with 100% accuracy*.

3 For the following procedures, it is essential that the student receive hands-on experience and perform with 95% accuracy in whichever department the procedure is performed:

    - Cerebrospinal fluid analysis to include cell count, differential, chemistry
    - Fecal occult blood
    - Urine/serum pregnancy test

4. Recognize cells specific to each body fluid type to include histiocytes, mesothelial cells, malignant cells, macrophage with inclusions, crystals, yeast, bacteria and others.

5. Discuss or perform body fluid analysis on synovial, serous, and other fluids.

V. INTERPRETATION AND REPORTING OF RESULTS

1. State the reference (normal) values for all routine assays performed in the urinalysis laboratory.

2. With 95% accuracy, correlate quantitative data with microscopic data.

3. Correlate abnormal results with associated common disease states.

4. Interpret the results obtained from performing body fluid analysis on synovial, serous, and other fluids.

5. Report all divergent or discordant results between quantitative and microscopic data to the clinical instructor.

6. Recognize all critical values and report these findings to the clinical instructor.

VI. ANALYTICAL PRINCIPLES

1. Explain the physiological role of the components of the urinary system.

2. Explain the principle and methodology limitations of refractometry for urine specific gravity.

3. Correlate the origin and significance of the chemical constituents usually found in urine by the multitest reagent strip methodology to include:

- pH
- protein
- glucose
- ketone
- bilirubin
- nitrite
- urobilinogen
- specific gravity

4. Explain the principle and methodology limitations of each test on the multitest strip.

5. Discuss the significance of the confirmatory tests used in the chemical analysis of urine (i.e., icotest, sulfosalicylic acid, Clinitest, Acetest).

6. Explain the principle and methodology limitation s of each of the following confirmatory tests: ictotest sulfosalicylic acid, Clinitest Acetest.

University of Maryland, Baltimore School of Medicine
Department of Medical and Research Technology

MEDT 421/453 URINALYSIS ROTATION
SUGGESTED LABORATORY PRACTICUM SCORING RUBRIC

Please attach the student's test record to this evaluation

Urinalysis Analyzer Operation

TEST ITEM	Exceeds Standards (4 pts)	Meets Standards (3.5 pts)	Meets Standards AFTER REVIEW (2.5 pts)	Does Not Meet Standards (1.5 pt)
Implement the standard safety precautions in the clinical laboratory- 12 runs	Exceed the standard safety precautions	Meet the standard safety precautions	Fail to meet the standard safety precautions, counseled one time	Fail to meet the standard safety precautions, counseled more than I time
Prepare reagents, calibrators and control material within the acceptable QA limits for a minimum of 10 different runs with 100% accuracy	Complete all of the tasks	Complete 2 of the 3 tasks	Complete 1 of the 3 tasks	Fail to complete any of the tasks
Prepare a dilution with 100% accuracy	Prepare 8 of the 10 dilutions correctly	Prepare 6 of the 10 dilutions correctly	Prepare 4 of the 10 dilutions correctly	Prepare 2 of the 10 dilutions correctly
Complete a minimum of 10 runs/assays with acceptable results and within the laboratory timeframe specified for stat and/or routine turn-around time	Complete 10 runs with the acceptable results and designated times	Complete 8 of the 10 runs with acceptable results and designated times	Complete 6 of the 10 runs with acceptable results and designated times	Complete less than 6 of the runs with acceptable results and designated times
Organize the workflow	Exceed Standard Operation Procedures (SOP)- by writing suggestions for improvement	Meet SOP standards	Fail to meet SOP standards-counseled one time	Fail to meet SOP standards-counseled more than one time
Recognize common malfunctions of the instrument/analyzer	Recognize common malfunctions of the instrument and demonstrate troubleshooting skills	Recognize some of the common malfunctions of the instrument and demonstrate some troubleshooting skills	Fail to recognize all common malfunctions of the instrument **or** fail to inform technologist of problem	Fail to recognize all common malfunctions of the instrumentation **and** fail to inform technologist of problem
Calculate creatinine clearance for a minimum of 5 samples		100% accuracy	**After review**, 100% accuracy	**After review**, < 100% accuracy
Perform a minimum of 2 manual tests		100% accuracy	**After review**, 100% accuracy	**After review**, < 100% accuracy
Identify patient values that are significantly different (e.g. risk values, panic values, analytical errors) and to bring these to the attention of the technologist immediately	Identify all values and inform the technologist for all values	Identify some of the values and inform the technologist for some of the values	Identify the values but fail to inform the technologist of the values	Fail to identify the values and fail to inform the technologist of the values

Scoring and Grading

_____/ 31.5_____ X 100 = _____% Automated Practicum Score
(Student's Score divided by total possible points at "Meets Standards" level, times 100)

University of Maryland, Baltimore School of Medicine
Department of Medical and Research Technology
MEDT 453/463 URINALYSIS ROTATION
SUGGESTED LABORATORY PRACTICUM SCORING RUBRIC
Medical Laboratory Science Students

Please attach the student's test record to this evaluation.

Non Automated Method

TEST ITEM	Exceeds Standards (4 pts)	Meets Standards (3.5 pts)	Meets Standards AFTER REVIEW (2.5 pts)	Does Not Meet Standards (1.5 pt)
Implement the standard safety in the clinical laboratory -12 samples	Exceed the standard safety precautions	Meet the standard safety precautions	Fail to meet the standard safety precautions, counseled one I time	Fail to meet the standard safety precautions, counseled more than I time
Organize the workflow	Exceed Standard Operation Procedures (SOP)- by writing suggestions for improvement	Meet SOP standards	Fail to meet SOP standards for one of the two	Fail to organize the work of operations
Prepare reagents, calibrators and control material within the acceptable QA limits or a minimum of 10 different assays with 100% accuracy	Complete all of the tasks	Complete 2 of the 3 tasks	Complete 1 of the 3 tasks	Failed to complete any of the tasks
Complete a minimum of 10 runs/assay with acceptable results and within the laboratory timeframe specified for stat and/or routine turn-around time	Complete 10 runs with the acceptable results and designated times	Complete 8 of the 10 runs with acceptable results and designated times	Complete 6 of the 10 runs with acceptable results and designated times	Complete less than 6 of the runs with acceptable results and designated times
Identify patient values that are significantly different (e.g. risk values, panic values, analytical errors) and to bring these to the attention of the technologist immediately	Identify all values and inform the technologist for all values	Identify some of the values and inform the technologist for some of the values	Identify the values but fail to inform the technologist of the values	Fail to identify the values and fail to inform the technologist of the values
Document manually lot numbers, expiration dates, initials, prep. time, patient values, QC results and standard values if applicable	No error in the documentation	Errors in 2 of the documentation	Errors in 4 of the documentation	Errors in 5 of the documentation

Scoring and Grading for Non Automated Lab Practicum

_____/ 21____ X 100 = ____% Urinalysis Practicum Score

Student's Score divided by the total possible points that can be earned at the "Meets Standards" level, times 100 = Urinalysis Practicum Score.

Student's Signature: _____

Evaluator(s) Signature_____Date: _____

Total Urinalysis Score: Average the Automated, Non-Automated and Urinalysis Practicums = _____%

Note: If Urinalysis practical part of the Hematology rotation, take 20% of the Urinalysis practicum plus 80% of the averaged hematology practicum for the TOTAL HEMATOLOGY/URINALYSIS Practicum Score: _____%

Student's Signature: _____

Evaluator(s) Signature_____Date: _____

If Urinalysis is part of the hematology rotation, take 20% of the Urinalysis practicum grade and add it to 80% of the averaged automated and non-automated practicum grade for the TOTAL Urinalysis Practicum score.

NOTE: Urinalyis does not have a technical checklist.

University of Maryland, Baltimore School of Medicine
Department of Medical and Research Technology
MEDT 473 CLINICAL PRACTICE MICROBIOLOGY
Medical Laboratory Science Students

COURSE REQUIREMENTS

1. Compliance with all established clinical practice policies.
2. Satisfactory completion of all procedures on technical checklist (if applicable).
4. Laboratory Practical Exams
5. All Evaluations signed
6. Media Lab Pre and Post exams and Post-rotation exams (given by DMRT as part of MEDT 402 course)
7. Media Lab Chemistry and if performed, Urinalysis Modules completed
8. Pre-Rotation Objectives completed by students and submitted toward their MEDT 473 grade.
9. During Rotation Objectives completed by students and submitted toward their MEDT 402 grade.
10. Completed student's Evaluation of Clinical Rotation.

EVALUATION AND GRADING CRITERIA

1. **Technical Performance Evaluation**
   The technical evaluation is for **microbiology only.**

2. **Laboratory Practical Examinations**
   Student will be given a laboratory practical at the end of the rotation using the enclosed Rubrics for evaluation and grading.

3. **Final Written Examinations**
   This is administered to the student at the end of the rotation at the University.

4. **Professional Qualities Evaluation**

5. Media Lab Modules, Pre Rotation Objectives and During Rotation Objectives are to be completed by the student.

6. **Clinical Practice Grade Form**
   Student's grade is based on the following criteria. A grade of "C" or better is necessary for passing. **A grade less than a "C" (70) will result in repeating the rotation.**

Student Responsibility:	Media Lab Microbiology Modues	**10%**
	Pre-Rotation Objectives	**5%**
(15% of MEDT 402 grade)	During Rotation Objectives	
	Pre-Rotation Exam	**10%**

Preceptor responsibility: Microbiology Rotation Grade worth 75% of MEDT 473

Microbiology Technical Evaluation & Standards of Clinical Practice	**55%**
Micriobology Laboratory Practical	**10%**
Affective Domain Evaluation	**10%**

University of Marland, Baltimore School of Medicine
Department of Medical and Research Technology
MEDT 473 CLINICAL PRACTICE MICROBIOLOGY OBJECTIVES

TO BE COMPLETED BY THE STUDENT *PRIOR TO* THE ROTATION
These are submitted in your MEDT 473 course

Name:_____

Instructions: Responses to questions must be typed or printed legibly.

Microbiology Case Studies

1. The patient was a 19-year-old female with a history of a urinary tract infection (UTI) 4 months prior to admission for which she was treated with oral ampicillin without complications. Five days prior to this admission she began to note nausea without vomiting. One day later she developed left flank pain, fevers, and chills and noted increased urinary frequency. She noted foul-smelling urine on the day prior to admission. She presented with a temperature of 38.8°C, and physical examination showed left costovertebral angle tenderness. Urinalysis of a clean-catch urine sample was notable for >50 WBCs per HPF, 3-10 RBCs per HPF, and 3+ bacteria. Urine culture was subsequently positive for >100,000 CFU of a beta-hemolytic, lactose fermenting, gram-negative rod that was found to be spot indole positive.

   a. Why were the numbers of organisms in her urine quantitated on culture? How would you interpret the culture results in this case?

   b. Which gram-negative rods are lactose fermenters? Which one is also beta-hemolytic?

   c. UTIs are more frequent in women than men. Why?

d. What organism is causing this patient's UTI? What would you expect the TSI, IMViC, Urea, and Motility results to be?

2. This 18-year-old female presented to the emergency room with complaints of cramp-like abdominal pain for days and vaginal bleeding. She denied urinary tract infection symptoms or abnormal vaginal discharge and had not noted any chills or fever. She had no nausea or vomiting. The pain increased in the 24 hour period prior to presentation, and at the time of examination she also noted pain in the right upper quadrant. She was sexually active with one male sexual partner in the preceding 3 months, and claimed to use condoms as a method of birth control. She is the mother of one child.

On examination, her temperature was 38.3°C and there was exquisite tenderness in the right upper quadrant as well as left lower quadrant. On pelvic exam, cervical motion tenderness was present, as well as right and left adnexal (ovarian, fallopian tube, etc.) tenderness. No masses were palpated.

a. Clinically, this patient was believed to have pelvic inflammatory disease (PID) and was admitted to the hospital for antibiotic treatment. What bacteria have been associated with PID?

b. An endocervical swab was obtained from the patient and used to inoculate McCoy cells. After 48 hours of incubation, the McCoy cells were stained with an immunofluorescent reagent that demonstrated the presence of inclusions. This finding established the presence of what infectious agent? Briefly describe the life cycle of this organism in McCoy cells.

c. In addition to PID,(where this organism may well have a significant role) in what other clinical situations might this organism be recovered from?

3. The patient was a 70-year-old female who was diagnosed with multiple myeloma one year previously. She had been treated with five cycles of immunosuppressive drugs including prednisone, with the last cycle completed six weeks previously. The patient presented with a 2-day history of dyspnea and a cough productive of phlegm. She denied hemoptysis, night sweats, fever, chills, abdominal pain, nausea, vomiting, or chest pain. On physical examination, she had a fever of 38.8°C, pulse of 120/minute, and respiratory rate of 20/minute. Chest examination

showed bilateral, diffuse pulmonary infiltrates with effusion. White blood cell count was1,700 cells per microliter. She had a pO_2 of 38 mm Hg which was corrected by receiving oxygen by nasal cannula. Two sets of blood cultures were obtained, and she was started on cefotaxime and clindamycin therapy intravenously for presumed bacterial pneumonia. Gram stain of the organism recovered from the blood showed gram-positive elongated shaped diplococci. Antimicrobial susceptibility testing showed resistance to multiple antimicrobial agents including penicillin G, erythromycin, and trimethoprim-sulfamethoxazole and reduced susceptibility to cefotaxime. There was zone of no growth surrounding the optochin disc.

a. What is the organism causing this patient's causing this patient's infection?

b. What risk factors does this woman possess for developing infection with this organism?

c. What is the major virulence factor of this organism and its role in the pathogenesis of disease?

4. This 48-year-old man had a long history of alcoholism (including alcoholic hepatitis and alcoholic hallucinosis) and was admitted to the intensive care unit with profound hypotension and gastrointestinal bleeding. He was intubated, given intravenous fluids and transfused with packed red blood cells. He remained intubated and ventilator dependent for several weeks. He developed fevers and was treated with broad-spectrum antibiotics. Culture of his tracheal aspirate initially showed *Staphylococcus aureus*. After further antibiotic therapy, Gram stain of his tracheal aspirate showed polymorphonuclear leukocytes and gram-negative rods. His chest radiograph demonstrated an infiltrate and changes consistent with multiple small abscesses. Culture of the tracheal aspirate showed an oxidase-positive non-lactose fermenter on MacConkey agar and the colonies produced a silver-green metallic sheen on sheep blood agar.

a. What is the likely agent of infection?
b. What factors put the patient at risk for developing infection with this organism?

c. What biochemical testing would be performed to confirm the identification of this organism and what would the expected results be?

5. The patient was a 4-year-old male who presented to the emergency room with a 2-hour history of vomiting, diarrhea, fever, irritability and lethargy. The child had gone to sleep on the living room couch at 11 p.m. His grandmother found him on the floor at 3 a.m. covered with feces. When she picked him up to carry him to the bathtub, she noticed he was febrile. She bathed him, and brought him to the emergency room. The patient's medical history was significant for being in group daycare.

In the emergency room, he had two episodes of vomiting. His temperature was 38.9°C, pulse 160 beats per minute, and respiratory rate of 36/minute, and he was noted to be dehydrated. His stool contained bloody streaks, and a methylene blue stain of his feces showed a large number of WBCs. Other laboratory studies included a cerebrospinal fluid examination, done because of his lethargy, which was within normal limits; a peripheral white blood cell count of 13,200/microliter with 85% neutrophils; a negative blood culture; and a negative stool examination for ova and parasites.

Stool culture showed a non-lactose fermenting gram-negative rod which gave a TSI reaction of K/A without H_2S, was urea and indole negative, and nonmotile.

a. Why were white blood cells present in his stool?
b. Given his clinical picture, what bacterial pathogens are likely in this patient?

c. Based on the laboratory results given, what organism is most likely causing his illness?

d. What was the significance of his being in a group day care? What special characteristics of this organism lead to its spread?

6. The patient was a 55-year old male with a 2-month history of fever, night sweats, increased cough with sputum production, and a 25-lb weight loss. The patient denied intravenous drug use or homosexual activity. He has had multiple sexual encounters, "sips" a pit of gin a day, was jailed 2 years ago in New York City, and has a history of gunshot and stab wounds. His physical examination was significant for bilateral anterior cervical and axillary adenopathy and a temperature of 39.4°C. His chest radiograph showed paratracheal adenopathy and bilateral interstitial infiltrates. His laboratory findings were significant for a positive HIV serology and a low absolute CD4+ lymphocyte count. An acid-fast organism grew from the sputum and bronchoalveolar lavage fluid from the right middle lobe.

a. Which organisms can be positive on an acid-fast stain?

b. Given his medical history, which organism is this likely to be? How does the finding that the patient is HIV positive affect this decision?

c. Which factors in his medical history do you think are important in his contracting this infection with acid-fast bacteria?

7. This 29-year old male was admitted for evaluation of a 2-week history of non-productive cough, fever, and shortness of breath on minimal exertion. The patient has been sexually active since age 15 and has reportedly had more than 100 sexual partners, the majority of which were male. He sough medical attention from an outside physician and was given oral amoxicillin. His cough persisted, and he developed a rash while taking the amoxicillin. He saw a doctor for the rash who took a chest x-ray. The radiograph was abnormal, demonstrating bilateral pulmonary infiltrates with both interstitial and alveolar markings. The patient was referred to the hospital emergency room. On examination, the patient was febrile to 38.3°C and had a respiratory rate of 24/min. Laboratory studies were remarkable for an arterial blood gas (obtained while the patient was breathing room air) with a pO2 of 56 mm Hg. The patient was treated with intravenous trimethoprim-sulfamethoxazole and underwent bronchoscopy with bronchoalveolar lavage.

a. The patient's sexual history placed him at high risk for infection with which virus?

b. A silver-stained preparation of bronchoalveolar lavage fluid demonstrated cysts. What is the etiology of this individual's pulmonary infection?

c. How is infection with this organism treated?

8. This 71-year-old man with metastatic adenocarcinoma of the prostate and with end-stage chronic obstructive pulmonary disease (COPD) was in his usual state of poor health (requiring home oxygen and corticosteroids) until he had an exacerbation of his COPD. He was seen by his home health nurse, who noted shortness of breath, and trimethoprim-sulfamethoxazole was prescribed by his physician, with subsequent improvement. Five days after discontinuing his antibiotic, he had another exacerbation of his COPD, this one requiring hospitalization, an increase in his dose of corticosteroids, and intravenous antibiotics. After discharge from the hospital, the patient began to have nausea and vomiting, as well as shortness of breath and purulent sputum. A wet mount of his sputum showed a filariform larvae.

a. List the nematodes that have a lung phase. Which one do you think is most likely in this patient? Does it help you decide if you learn on further history-taking that this

patient was a Vietnam War veteran who had revisited Vietnam and Laos in the recent past?

b. Describe the life cycle of this parasite. How long can this parasite persist within the gut? How is it able to persist for this period of time?

c. If this organism were to invade the central nervous system, how might this be manifested clinically?

9. The patient was a 44-year old male with a past medical history significant for hypertension, non-insulin-dependent diabetes, hypercholesterolemia, and a history of heavy smoking (2 packs per day for 15 years). He presented to the emergency room with complaints of chest pain and was found to have suffered a myocardial infarction. A cardiac catheterization on hospital day 3 showed three-vessel coronary artery disease, and he underwent triple coronary artery bypass graft surgery on hospital day 5. On hospital day 7, he developed septic shock with acute renal and respiratory failure requiring intubation. At that time, he had a fever to 39.3°C, his arterial blood gas revealed a pO2 of 89 mm Hg on 100% O2, and he had a white blood cell count of 27,000/microliter. Two blood cultures were obtained. A chest radiograph showed a left lower lobe infiltrate with pleural effusion. A chest tube was placed to drain the effusion. On hospital day 11, pus was noted to be seeping from his sternal wound. His wound was debrided and rib biopsy was performed. Blood cultures, drainage from his chest tube, tracheal aspirates, pus from his sternal wound, and a rib biopsy all grew a beta-hemolytic gram-positive cocci, which, on Gram stain, showed a cluster morphology.

a. What is the most likely organism causing his infection? Briefly describe the evolution of his infection and discuss the four different types of infections he had with this organism.

b. Upon Kirby-Bauer susceptibility testing, this organism was found to be resistant to oxacillin. What does this tell us about the particular strain of the organism causing this patient's infections?

c. Five other patients on the same hospital floor were found to have the same organism. A typing system was used and it was determined that all 6 patients were infected with the same strain of organism. What steps would you take to prevent further infections from occurring? In your discussion, explain how this organism can be spread.

10. This 21-year-old man presented to the emergency room with 3 days of abdominal pain, which began as a diffuse, dull, continuous, pain. The pain became cramp-like in the midgastric and lower abdomen. He noted a decrease in appetite but no nausea, vomiting, or diarrhea. On examination, the patient was febrile to 39.2°C, tachycardic with a heart rate of 150 beats/min, had abnormally fast breathing with a respiratory rate of 52/min, and had a blood pressure of 108/60 mm Hg. His physical examination was notable for midgastric and right lower quadrant tenderness. The white blood cell count was normal. Blood cultures were obtained on admission and were subsequently positive for an anaerobic, gram-negative rod, at which time the patient was taken to the operating room for an exploratory laparotomy.

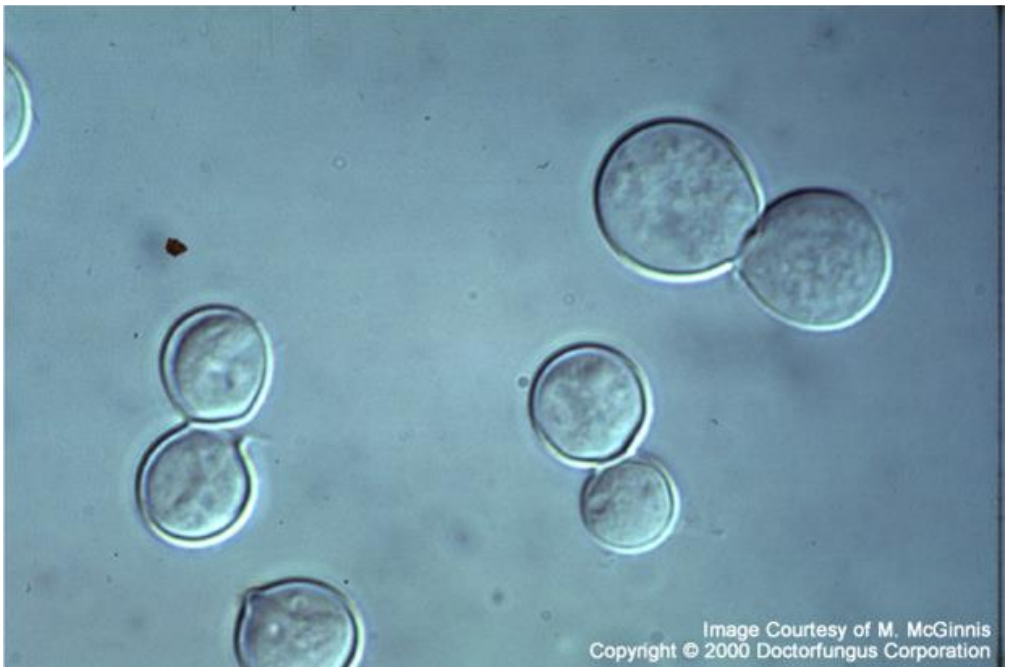
a. To which genus do you think this organism belongs to and why?

b. Upon learning of the positive blood culture, the surgical team opted for abdominal surgery. What type of lesion would you suspect they would find in the abdomen?

c. What other types of infections does this organism cause?

Case Studies adapted from *Cases in Medical Microbiology and Infectious Diseases*, Peter H. Gilligan (ASM Press)

11. A 54 year-old man works as a sugar cane farmer in Alexandria, LA. This man presented to his family care physician with a chronic dry cough, fever, weight loss, chest pain and a non-healing lesion on his arm. A KOH prep was performed on a scraping from the skin lesion. The structure below was seen in the KOH prep:



a) What about the patient history leads you to the identification of this organism?

b) What predisposes someone to an infection of this kind?

c) What domestic animal do we typically worry about getting infections with this organism?

d) What is the likely cause of this infection?

12. A man (63 years old) was brought to the hospital from an assisted living community. At the hospital he presented with shortness of breath and a fever. Blood cultures were drawn upon his admission. He was admitted and shortly thereafter was found to be in acute respiratory distress and had to be intubated. A purulent sputum specimen was collected during the procedure. Imaging studies revealed several large pulmonary nodules. The patient developed meningitis and slipped into a coma. The blood cultures turned positive 22hrs after admission.

a) What quality guidelines must be followed when examining a sputum specimen?

b) Differentiate the organisms associated with community acquired pneumonia from those that cause Nosocomial pneumonia.

c) If the organism identified is *Streptococcus pneumoniae,* how would the susceptibility testing be performed? How would the report differ based on the origin of the organism isolated (CSF vs Blood culture)?

d) The organism identified from the Blood culture is Staphylococcus aureus, What antimicrobial susceptibility testing methods are adequate for the detection of vancomycin-intermediate*Staphylococcus aureus*?

e) What antimicrobial testing method is available to check for inducible Beta lactamase production in *Staphylococcus spp*?

13) A 58 year old woman on peritoneal dialysis presents with fatigue and intermittent fevers over approximately one week. Peritoneal dialysate is collected and submitted to the microbiology laboratory for culture. After approximately 48 h incubation, small colonies are observed on blood and chocolate agar. No growth is observed on MacConkey agar.
A Gram stain is performed, revealing a small, Gram-positive short coccobacillus.
The isolate was catalase and Nitrate positive. It was urease and motility negative.

a) With these results, what organisms are the likely suspects?

b) What other biochemical test would aid in acquiring a definitive identification of the organism?

c) Upon the supervisor's review, it was noted that the daily Gram stain QC failed but no one was notified nor was it corrected. *Escherichia coli* used for QC tested gram positive. QC was redone with a new set of Gram stain reagents and this time, the results were as expected.
Due to the validity of the QC, the patient specimen is re-tested and the results show a small GNR coccobacillus. Biochemical results are still the same: catalase and Nitrate positive. The isolate is urease and motility negative. Oxidase is Positive.
With the addition of a corrected gram stain report, what organism(s) is/are now suspect?

d) What is the most likely source of this woman's infection? (Where is this organism found as Normal Flora?)

e) What biochemical result excludes Brucella spp as the causative agent?

University of Maryland, Baltimore School of Medicine
Department of Medical and Research Technology
Medical Laboratory Science Program
Clinical Practice Microbiology Rotation
Rotation Objectives DURING Your Rotation
These are to be submitted in the MLS 402 course

. The purpose of this review packet is to assist you in studying for your Clinical Microbiology Post Exams, the Comprehensive Exam and the ASCP Registry exam or the AMT Exam. Use additional paper or extend the answer area to answer the questions if necessary.

1. State the purpose of each component used to perform a gram stain.
    a. Crystal violet
    b. Iodine
    c. Acetone
    d. Safranin

2. What substance is found in a higher concentration in the cell wall of gram positive bacteria?

3 State the gram stain reaction **and** morphology for the following. **Be specific.**
    a. Staph aureus
    b. Neisseria
    c. Corynebacterium
    d. Haemophilus
    e. Listeria
    f. Pseudomonas
    g. Streptococci
    h. E. coli
    i. Proteus
    j. Clostridium
    k. Salmonella
    l. Bacillus
    m. Micrococcus
    n. Strep pneumoniae
    o. Enterococci
    p. Campylobacter

4. State the time, temperature and pressure requirements associated with autoclaving.

5. For each of the following types of media, state if the media is nutrient, differential and/or selective.
    a. MacConkey
    b. Chocolate
    c. CNA
    d. EMB
    e. PEA

6. State the appearance of a lactose fermenter and non-lactose fermenter on:
    a. MAC
    b. EMB

7. What is the only type of media that can be used to judge hemolysis of a gram positive organism?

8. What term is used to describe bacteria that require CO_2 for growth?

9. Which Staph species can be described as a beta-hemolytic, yellow colony?

10. For a coagulase test,
    a. what reagent is used?
    b. what indicates a positive test?
    c. which gram positive organism gives a positive result?

11. A technologist performs a slide coagulase test on a gram positive cocci which appears to be Staph aureus. The coagulase test is negative. What should be the tech's next step, and why?

12. What test will separate Staph species from Strep species? Give the expected reaction for each genus.

13. Give the reaction for each of the following on OF glucose media. (For each organism, state if the organism oxidizes and/or ferments glucose.)
    a. Micrococcus
    b. Staph

14. What substance found in the cell wall of beta hemolytic Strep is used for serotyping?

15. a. Write the reaction that occurs in a positive hippurate hydrolysis test .
    b. What reagent is used to detect the production of glycine?
    c. What color is a positive test?

16. What biochemical is used to differentiate Group D Enterococci from Group D non-Enterococci?
    Give the result of this test for each organism.

17 Which alpha-hemolytic Strep produces a capsule and is a common cause of respiratory tract infections?

18. What is a positive reaction for the :
    a. Bile esculin test
    b. 6.5 % NaCl test

19. Which *type of Haemophilus influenzae* may cause meningitis in children under 2 years of age if not properly vaccinated?

20. Which other type of infection due to Haemophilus influenzae may be life-threatening in adults?

21. Which species of Haemophilus can cause pinkeye (conjunctivitis)?

22. For each of the following Haemophilus species, state if the species requires factor X and/or V.
    a. H. influenzae,
    b. H. ducreyi
    c. H. parainfluenzae & parahemolyticus
    d. H. aegyptius
    e. H. aphrophilus
    f. H. hemolyticus

23. Name the two pathogenic Neisseria species and list the major infection(s) caused by each.

24. Which of the pathogenic Neisseria species may be resistant to penicillin and must have a beta-lactamase test performed?

25. Can gonorrhoeae be diagnosed from a vaginal gram stain from a female without doing a culture? (explain your answer)

26. a. Name two selective media used for isolating on C. diphtheria.
    b. What color colonies are formed on these selective media by C. diphtheria?

27. What test must be done on an isolate of C. diphtheriae in order to prove that it is pathogenic?

28. List the following characteristics of Listeria monocytogenes.
    a. gram stain
    b. hemolysis
    c. growth at 4 ^{o}C
    d. catalase
    e. bile esculin
    f. motility at room temperature
    g. transmission (give 2 methods)

29. What is the only aerobic non-sporeforming gram positive rod that produces H_2S?

30. Name four genus of aerobic, curved gram negative rods which may cause diarrhea.

31. Give the appearance of V. cholerae on the following media.
    a. MAC
    b. TCBS

32. a. What reagent is used in the "string test"?
    b. What is a positive test result?

33. What type of stool specimen is characteristic of infection with Vibrio cholerae?

34. Give the temperature and atmospheric condition requirements for growth of Campylobacter in the lab.

35. a. What organism (formerly a member of Campylobacter) causes peptic ulcer disease?

    b. What rapid biochemical is done to diagnose peptic ulcer disease from a gastric biopsy?

36. Give the following characteristics of any member of the Enterobacteriaceae family.
    a. gram stain
    b. glucose fermentation
    c. oxidase
    d. nitrate reduction
    e. ability to form spores

37. TSI
    a. Name the three carbohydrates found in TSI .
    b. Which is present in the lowest concentration?
    c. Name the two reaction areas on a TSI.

38. Give the color reactions that identify the following results on TSI.
    a. alkaline/alkaline
    b. alkaline/acid
    c. acid/acid
    d. acid/acid with H_2S

39. State which carbohydrate(s) was (were) fermented to give the following results on TSI.
    a. alkaline/alkaline
    b. alkaline/acid
    c. acid/acid

40. For the methyl red (MR) test,
    a. what process is being detected?
    b. what indicator is used?
    c. what color is a positive test?

41. For the Voges Proskauer (VP) test,
    a. what process is being detected?
    b. what reagents are used ?
    c. what color is a positive test?
    d. what is the relationship between an organisms MR and VP result?

42. For the H_2S test,
    a. what substance is used as the source of sulfur?
    b. what indicator is used?
    c. what color is a positive test?

43. What member(s) of the Enterobacteriaceae,
    a. are pathogenic if isolated from the stool (4 answers)? Be specific.
    b. is the number one cause of UTI ?
    c. produces mucoid, pink colonies and upper respiratory tract infections?
    d. produces brick red colonies?
    e. causes bubonic plague?

44. What is the IMViC reaction of E. coli?

44. What reaction on MAC suggests the presence of a stool pathogen rather than normal flora?

45. Where are the following antigens located on a bacterial cell?
    a. O
    b. H
    c. K

46. Which reaction on the TSI separates Salmonella and Shigella? State the expected result for each genus.

47. A technologist serotypes an organism that is presumptively identified as Salmonella using the appropriate antisera, but gets all negative results. What should be the next step in identifying this organism?

48. What one biochemical can be used to differentiate Proteus mirabilis and P. vulgaris? Give the reaction for each organism.

49. a. What two biochemicals can be used to differentiate Klebsiella and Enterobacter?
    b. Which genus is positive for both biochemicals?

50. What one biochemical can be used to differentiate Serratia and the other Enterobacteriaceae?

51. a. How does Yersinia enterocolitica appear on CIN media?
    b. What type of infection does it cause?

52 For Pseudomonas aeruginosa,
    a. what pigment gives the colony a green sheen?
    b. what type of hemolysis is formed ?
    c. what is the oxidase result?

53.For Bordetella pertussis,
    a. what is the preferred specimen?
    b. what selective media is used ?
    c. what do colonies look like ?
    d. what vaccine is used to prevent infection ?

54.For Brucella
    a. what is the preferred specimen?
    b. how long should cultures be held before discarding as negative?
    c. how does the organism appear on a gram stain?

55. For Legionella,
    a. what species causes Legionnaire's disease?
    b. what media should be used for isolation?
    c. what type of specimen is preferred ?

56.What organisms belong to the HACEK group?

57.What concentration of each of the following substances is maintained in anaerobic chambers?
    a. Nitrogen
    b. Hydrogen
    c. Carbon dioxide gas

58.What genus of anaerobes is most commonly isolated from clinical specimens?

59.How is an aerotolerance test for anaerobes performed? Explain fully.

60.What reagent is used to perform a spot indole test on anaerobes and what is a positive color?

61. What is the genus name for anaerobic :
    a. Staph
    b. Strep
    c. gram positive, sporeforming rods

62.a. What species of Clostridium is associated with AAPC (antibiotic associated pseudomembranous colitis)
    b. What media should be inoculated in order to isolate this organism from a stool?

63. Which anaerobic gram positive rod is associated with the formation of pus containing sulfur granules?

64. Which anaerobic gram negative rod(s):
    a. can grow in the presence of bile?
    b. are saccharolytic and bile sensitive?
    c. are asaccharolytic and bile sensitive?
    d. produce long, thin tapered ends?

65. What species of Prevotella produces black colonies on agar after several days?

66. When processing specimens for AFB:
    a. what is the purpose of the N-acetyl-L-cysteine?
    b. what is the purpose of the sodium hydroxide?

67. What is the name of the media that contains malachite green that is used for AFB cultures?

68. What is the name of the following stain used for AFB?
    a. cold stain using carbolfuchsin
    b. hot stain using carbolfuchsin
    c. fluorescent

69. On which stain do AFB have the following appearance?
    a. red beaded rods (name 2)
    b. yellow rods against black background

70. What species of Mycobacterium can cause the following:
    a. infections in AIDS patients
    b. swimming pool granuloma
    c. leprosy

71. What is the term used to refer to species of Mycobacterium which:
    a. develop pigment only after exposure to light
    b. develop pigment in the dark or light
    c. do not produce pigment at all
    d. produce visible growth in 3 – 5 days

72.a. Which 2 genus of bacteria do not possess a cell wall?
    b. Which member of the Mycoplasma causes “walking pneumoniae”?
    c. What stain must be used to examine Mycoplasma ?

73. What organism causes Lyme’s disease ?

74. Name the type of infection caused by each of the following Chlamydia species :
    a. C. psittaci
    b. C. trachomatis
    c. C. pneumoniae

75. What term describes the following related to antibiotic testing?
    a. antibiotic only inhibits growth of bacteria
    b. antibiotic kills 98 % of bacteria inoculum
    c. combined use of 2 antibiotics elicits a greater effect than the 2 individual effects added together
    d. use of one antibiotic reduces the effect of another antibiotic
    e. the lowest concentration of an antibiotic that inhibits growth of an isolate
    f. the lowest concentration of an antibiotic that kills an isolate

76. What media is used for performing Kirby Bauer testing for the following organisms:
    a. gram negative rods
    b. Strep pneumoniae
    c. Haemophilus

CLINICAL PRACTICE MICROBIOLOGY ROTATION
CLINICAL PERFORMANCE OBJECTIVES
TO BE COMPLETED BY THE STUDENT
AT THE CLINICAL INSTITUTION
What you are graded on

Upon completion of the rotation, the MLS student will be able to:

I. SPECIMEN HANDLING AND PROCESSING

1. Following departmental protocol, demonstrate safe work practices by:
    a. Wearing personal protective equipment (PPE) as required.
    b. Handling and disposing of contaminated materials according to standard precautions.
    c. Handling chemicals according to safety procedures.
    d. Properly using the biological safety cabinet when processing specimens.

2. Apply proper specimen handling to microbiological specimens to the satisfaction of the clinical instructor in regards to:
    a. Timeliness
    b. Appropriateness of specimen submitted for analysis requested
    c. Safety and security of collection system
    d. Completeness of essential patient information

3. Document rejected specimens according to laboratory's procedures for specimen rejection.

4. Given plating instructions and media selection criteria:
    a. Process a **minimum of 20 bacterial specimens** of different types and prepare smears for Gram stain (if appropriate), to the satisfaction of the clinical instructor.
    b. Demonstrate proper aseptic technique and streaking method, obtaining isolated colonies.

II. QUALITY CONTROL, QUALITY ASSURANCE AND REGULATORY ISSUES

1. Perform or state the daily or weekly maintenance checks on equipment (e.g. refrigerators, incubators, water baths, and instruments) with 100% accuracy.

2. Perform quality control procedures (e.g. stains, media, biochemical tests, antisera, and susceptibility tests) with 100% accuracy.

3. Record all QC results with 100% accuracy.

4. Report divergent results to instructor and suggest corrective actions.

5. Observe basic laboratory computer operations where relevant.

III. BACTERIOLOGY

1. Perform Gram stains on a **minimum of 15 samples**, including both direct smears and cultured colonies, following established laboratory procedures.
2. Evaluate stained smears for stain quality, according to established criteria.
3. Read a **minimum of 15 direct Gram smears**, matching the interpretation of the technologist 80% of the time:
   a. Describe Gram reaction and morphology.
   b. Quantify bacteria and polymorphonuclear cells within +/-1 gradation of the technologist.
4. Demonstrate the ability to select isolated colonies from a culture plate, streak for isolation, and obtain isolated colonies.
5. Correlate Gram stain results with isolates on culture plates, to the satisfaction of the clinical instructor.
6. Screen sputum smears for the quality of the specimen, to the satisfaction of the clinical instructor.
7. Recognize alpha (□), beta (□) and gamma (□) hemolysis with 100% accuracy.
8. Distinguish between gram-positive and gram-negative organisms using Gram stain characteristics and/or growth on selective media with 100% accuracy.
9. Determine the required biochemical tests for a cost-effective identification of the unknown pathogens.
10. Inoculate all biochemical media and identification systems used in the laboratory, within a reasonable time limit as determined by the clinical instructor.
11. Determine a positive or negative reaction for each test to include (but not limited to or exclusive of) the following, matching the technologist's results:

a. Catalase	g. Hippurate hydrolysis/CAMP
b. Slide/tube coag/Latex agg.	h. Optochin/bile solubility
c. Novobiocin susceptibility	i. Commercial bacterial ID system(s)
d. Bile esculin/6.5% NaCl	j. Haemophilus ID & Neisseria ID systems
e. PYR/bacitracin/SXT	k. Oxidase
f. Spot indole	l. Streptococci grouping

12. Using the information obtained from Gram stain, isolation on select media, and biochemical testing, demonstrate the ability to utilize flow charts and coded systems to identify the following organisms with a 90% rate of success in identification.

E. coli	*Neisseria gonorrhoeae*
Klebsiella / Enterobacter / Serratia	*N. meningitidis*
Citrobacter spp.	Moraxella catarrhalis
Salmonella spp.	*Haemophilus influenzae*
Shigella spp.	*Haemophilus* non-influenza species
Proteus / Providencia / Morganella	*Campylobacter jejuni*
Yersinia enterocolitica	*Corynebacterium spp.*
Staphylococcus aureus	*Clostridium perfringens*
Staphylococcus saprophyticus	*Bacteroides fragilis* group
Staphylococcus-coagulase-negative	*Fusobacterium nucleatum*
Group D *Streptococcus*	*Prevotella* spp.
Enterococcus faecalis / faecium	*Aeromonas sp.*
viridans streptococci	*Acinetobacter baumannii*
Streptococcus pneumoniae	*Pseudomonas aeruginosa*
Beta streptococci Gp A / Gp B / others	*Stenotrophomonas maltophilia*
Vibrio spp.	*Listeria monocytogenes*
MRSA	VRE

13. **Urine Cultures:**

    a. Recognize urethral contaminants vs. potential pathogens.
    b. Differentiate lactose vs. non-lactose-fermenters with 100% accuracy.
    c. Quantify colony counts according to laboratory protocol, matching the instructor's counts.
    d. Perform/observe appropriate identification and susceptibility tests on significant isolates to the satisfaction of the instructor.

14. **Respiratory Specimens:**

    a. Recognize normal respiratory flora on a **minimum of 10 samples**, to the satisfaction of the clinical instructor.
    b. Using laboratory criteria, determine which isolates are considered significant for identification and susceptibility tests.
    c. Rule out group A streptococci in throat cultures with 100% accuracy
    d. Perform or discuss the test procedure for rapid GAS antigen test.

15. **Genital Cultures:**

    a. Recognize normal vaginal flora, i.e. lactobacilli.
    b. Evaluate specimens for the presence of potential pathogens (e.g. *Neisseria gonorrhoeae* and group B streptococci).
    c. Perform/observe presumptive identification procedures, confirmatory tests and susceptibility tests on suspected pathogens to the satisfaction of the instructor.

16. **Blood Cultures:**

    a. After performing staining of suspicious or positive cultures, detect the presence/ absence of organisms in the smears to the satisfaction of the instructor.

b. Using proper sterile techniques, subculture positive cultures to appropriate media, obtaining isolated colonies.
c. Using laboratory protocol, perform/observe rapid identification testing (e.g. FISH), where applicable.

17. **Wound/Body Fluid Cultures:**

a. Using laboratory criteria, determine which isolates are considered significant for identification and susceptibility tests.
b. Perform/observe appropriate identification and susceptibility tests of isolated pathogens, to the satisfaction of the instructor.

18. **Anaerobic Cultures:**
a. Observe or isolate suspected anaerobic colonies.
b. Perform/observe appropriate identification and susceptibility tests (if applicable) of isolated pathogens, to the satisfaction of the instructor.

19. **Susceptibility testing:**

a. Perform the Kirby-Bauer disk diffusion procedure, according to the procedure manual.
b. Measure zone sizes, obtaining results within 1-2 mm of the technologist's results.
c. Using CLSI charts, interpret and record results without error.
d. Perform MICs and/or E-tests to the satisfaction of the clinical instructor.
e. Interpret results of MICs, matching the technologist's results.
f. Perform and interpret a test for beta-lactamase with 100% accuracy.

IV. MYCOBACTERIOLOGY

1. Observe, perform or discuss the Ziehl-Neelsen, Kinyoun, or fluorochrome acid-fast stain, where applicable.

2. Recognize AFB in clinical or QC stained slides, where applicable.

3. Observe the digestion and concentration procedure on culture specimens for mycobacteriae, if performed in lab.

V. MYCOLOGY

1. Recognize yeast vs. filamentous fungi on culture media.

2. Identify the presence of *Candida spp.* using germ tube test, cornmeal agar, CHROMagar, PNA-FISH or equivalent rapid test with 100% accuracy.

3. Perform the yeast identification system used in the laboratory with 100% accuracy.

4. Perform latex agglutination test for detection of cryptococcal antigen with 100% accuracy.

5. Perform or observe lacto-phenol cotton blue and/or calcofluor/KOH preps, to the satisfaction of the clinical instructor.

VI. VIROLOGY

1. Discuss or observe specimen processing of specimens for viral detection and other viral assays.

2. Perform or discuss rapid viral antigen detection assays satisfaction of the instructor.

3. Perform or discuss at least one additional immunoassay viral detection assay to the satisfaction of the instructor.

VII. MOLECULAR AND RAPID DIAGNOSTIC TESTING

1. Discuss and/or perform molecular testing, e.g. GC/*Chlamydia, Mycobacterium,* and *C. difficile toxin.*

University of Maryland, Baltimore
School of Medicine
Department of Medical and Research Technology
MEDT 473 CLINICAL PRACTICE MICROBIOLOGY

Student should interpret AT LEAST 5 SMEARS FROM DIFFERENTIAL BODY SITES.

TEST ITEM	Meets Standards for ALL slides (4 pts)	Meets Standards for 80% of slides (3.5 pts)	Meets Standards for 60% of slides (3 pts)	Meets Standards for ≤ 50% slides (2 pts)	Student Score
1. *QC slides:* Gram-positive and gram-negative organisms stained accurately		X	X		
2. Recognizes quality of stained smears. Follows SOP for rejection of sputum specimens					
3. *Using SOP:* ▪ Accurately identifies PMNs and SECs ▪ Matches technologist within +/-1 gradation for quantification of cells					
4. *Using SOP:* ▪ Accurately identifies bacteria by Gram reaction & morphology ▪ Matches technologist within +/-1 gradation for quantification of bacteria					
5. Interprets slides correctly with regard to body site					

Scoring and Grading

Student_____

_____ divided by 20 (Total possible points) X 100 = _____% (Student's Score)
Student's Points

Evaluator: _____ Date: _____

University of Maryland, Baltimore, SOM
Department of Medical and Research Technology
MEDT 473 CLINICAL PRACTICE MICROBIOLOGY
BACTERIOLOGY UNKNOWNS

TEST ITEM	Exceeds Standards (4)	Meets Standards (3.5)	Below Standards (3)	Does NOT Meet Standards (2)	Student Points
1. Determines pathogens that warrant ID, according to SOP	Determines organisms for ID & AST with **minimal supervision**	Determines organisms for ID & AST with **occasional supervision**	Determines organisms for ID & AST, but with **frequent supervision**	Unable to determine organisms for ID & AST without **constant supervision**	
2. Semi-quantification/ Colony counts (when appropriate)	Matches technologist **within +/-1 gradation for ALL unknown cultures**	Matches technologist **within +/-1 gradation for MOST unknown cultures**	Matches technologist **within +/-1 gradation for SOME unknown cultures**	Fails to quantify when needed	
3. Test performance	**Minimal supervision** 1. Choosing tests, according to SOP 2. Performing tests correctly	**Occasional supervision** 1. Choosing tests, according to SOP 2. Performing tests correctly	**Frequent supervision** 1. Choosing tests, according to SOP 2. Performing tests correctly	**Constant supervision** 1. **Unable to choose** correct tests 2. Performs tests **incorrectly OR requires constant assistance**	
4. ID of Unknowns	Correctly interprets results Identifies **All** unknowns correctly	Correctly interprets results Identifies **8-9 of 10** unknowns correctly	Correctly interprets most results Identifies **7 of 10** unknowns correctly	Incorrectly interprets many results Identifies **6 of 10** unknowns correctly	
5. Reporting results	1. **All** results recorded: - According to SOP - Organized - Legible 2. TAT expected of entry-level MLS for **All unknowns**	1. **Most** results recorded: - According to SOP - Organized - Legible 2. TAT expected of entry-level MLS for **Most unknowns**	1. **Half** results recorded - According to SOP - Organized - Legible 2. TAT expected of entry-level MLS for **Some unknowns**	1. **< Half** results recorded - According to SOP - Organized - Legible 2. TAT **longer** than expected of entry-level MLS for most unknowns	

Student_____

_____ divided by 20 (Total possible points) X 100 = _____% (Student's Score)
Student's Points

Comments: *Please explain any marks of "Below Standards / Does NOT Meet Standards.*

_____

_____

Evaluator: _____ Date: _____

MEDT 473 CLINICAL PRACTICE MICROBIOLOGY TECHNICAL PERFORMANCE EVALUATION

Medical Laboratory Science Students

Instructions

Please rate the student's technical performance **at the end of the rotation.** This should reflect the student's terminal ability and not the normal growth of the student during the rotation. Match the student's performance on each item with the **numerical rating** that most closely describes **his/her performance in comparison to an entry-level MLS employee with no experience or training.** It is recognized that with an entry level MLS, proficiency, speed and level of judgment will increase with experience.

Each task in the Technical Performance Evaluation is evaluated using the scale below:

1.0 *Unacceptable performance*
After appropriate training, the student performs the task with consistent performance errors, needs constant supervision and does not adhere to affiliate policies (e.g., safety) during task performance. The student also appears unwilling to improve performance.

2.0 *Marginal performance*
After appropriate training, the student performs the task with inconsistent technical skills **OR** needs constant and detailed instructions in order to achieve acceptable performance. The student demonstrates an understanding of the principles of the assays or procedures. **Performance at this level is equivalent to a grade of 'C'.**

3.0 *Acceptable performance*
After appropriate training, the student performs the task with average technical skill, but still needs/requires direct supervision. The student demonstrates an understanding of the principles of the assays or procedures and their application.
Performance at this level is equivalent to a grade of 'B'.

4.0 *Very Good performance*
After appropriate training, the student performs the task with average technical skill with minimal supervision. The instructor feels confident in student performance and outcomes. The student demonstrates an understanding of the principles of the assays or procedures and their application. **Performance at this level is equivalent to a grade of 'A'.**

Using the above criteria, the final score for the Technical Evaluation is calculated as follows:

1. Add the Points Earned on the Technical Tasks.
2. Divide this total by the Total Possible Points (number of tasks actually performed x 4)
3. Multiply that Total x 100 to calculate % Score

Points Earned / (Tasks performed x 4) = Raw score x 100 = % Technical Performance Score

Specimen Handling and Processing

____1. Evaluates specimens for acceptability and documents rejected specimens *according to the laboratory's standard procedures.*

____2. Given plating instructions & media selection criteria, processes a minimum of 20 bacteriology specimens *to the satisfaction of the instructor.*

____3. Demonstrates proper aseptic technique and streaking methods, *obtaining isolated colonies*.

____4. Prepares Gram smears, with correct staining characteristics of organisms and cellular constituents, on a minimum of 15 smears.

____5. Reads direct Gram smears, *matching the interpretation of the technologist 80% of the time.*

____6. Screens sputum smears to determine the quality of the specimen, *to the satisfaction of the clinical instructor.*

Bacteriology

___ 7. Correlates Gram stain results with isolates on culture plates, *to the satisfaction of the clinical instructor.*

___ 8. Selects and isolates colonies from mixed cultures, *obtaining isolated colonies*.

___ 9. Recognizes alpha, beta, and gamma hemolysis with 100% accuracy.

___ 10. Distinguishes between gram positive and gram negative organisms based on staining and/or growth on selective media *with 100% accuracy*.

___ 11. Performs and interprets rapid tests on appropriate organisms (i.e., oxidase, coagulase, catalase,
spot indole, PYR) *with 100% accuracy.*

___ 12. Inoculates all biochemical media and identification systems, *within a reasonable time limit as determined by the instructor.*

___ 13. Identifies positive vs. negative reactions for all routinely performed tests *with 100% accuracy.*

___ 14. Identifies bacteria using flow charts and coded systems *with 90% success rate.*

___ 15. Recognizes normal respiratory flora of sputum and throat cultures*, to the satisfaction of the clinical instructor.*

___ 16. Rules out group A streptococci (GAS) on throat cultures, *with 100% accuracy.*

___ 17. Estimates colony counts on urine cultures according to laboratory protocol, *matching the clinical instructor's counts.*

___ 18. Using laboratory criteria, determines which colony counts/isolates require ID and AST.

___ 19. Distinguishes lactose fermenters vs. non-lactose fermenters on selective differential media.

___ 20. Recognizes suspicious colonies of possible enteric pathogens on selective enteric media.

___ 21. After performing staining of suspicious or positive blood cultures, detects the presence/absence of organisms in smears *with 90% accuracy.*

___ 22. Performs and interprets a beta-lactamase test *with 100% accuracy*.

___ 23. Performs Kirby-Bauer antimicrobial susceptibility tests, *according to the procedure manual.*

___ 24. Measures zone sizes, *obtaining results within 1-2 mm of technologist's results.*

___ 25. Using CLSI charts, interprets and records results, *without error.*

___ 26. Performs MIC and/or E test antimicrobial tests (if available), *to the satisfaction of the clinical instructor*.

___ 27. Interprets results of MICs, *matching the results of the technologist.*

Mycology

___ 28. Performs tests to identify *Candida albicans* (i.e. germ tube test, chlamydospores, CHROM agar, yeast identification system) wit*h 100% accuracy.*

___ 29. Performs rapid test for the detection of *Cryptococcus neoformans with 100% accuracy.*

___ 30. Prepares LPCB or calcofluor/KOH preps, *to the satisfaction of the clinical instructor.*

Mycobacteriology

___ 31. Prepares acid-fast smears, *to the satisfaction of the clinical instructor.*

___ 32. Recognizes AFB in clinical or QC stained slides.

Quality Control (OPTIONAL)

___ 33. Where applicable, performs quality control procedures (i.e., stains, media, biochemicals, antibiotic discs, typing sera) *with 100% accuracy.*

Other

___ 34. Perform *C. difficile* toxin detection test *with 100% accuracy.*

___ 35. Perform an immunoassay for viral detection *to the satisfaction of the instructor.*

Total Points Earned / Total Possible Points (# Tasks x 4) = _____ x 100 = _____% **Technical Score**

Student's Signature:_____

Evaluator(s) Signature:_____

Date:_____

University of Maryland, Baltimore School of Medicine
Department of Medical and Research Technology
Medical Laboratory Science Program
Student Mid-Term/ Clinical Contact Report

Student's Name _____ Evaluation Date _____

Affiliate Name _____ Laboratory Area _____

Circle Rotation 1 2 3 4 Number of late occurrence_____

Please evaluate each student, by circling either Yes/No. Use the descriptors provided for reference.

Interest: (Yes No)
Student is prepared, a self starter, and actively participates in duties

Responsibility: (Yes No)
Student complies with institutional policies, adheres to safety standards and seeks help when appropriate.

Professional Behavior: (Yes No)
Student maintains HIPPA policies, promotes a working atmosphere with other professionals, adheres to scheduling protocols

Knowledge: (Yes No)
Student demonstrates understanding of basic theoretical concepts

Technique: (Yes No)
Student performs tasks at the expected level of a student at this point of the rotation

Rationale must be given for any "No" Responses:

_____

_____

_____

Comments:

_____

_____

Evaluator _____ Date _____

Student _____ Date _____

UNIVERSITY of MARYLAND
SCHOOL OF MEDICINE

DEPARTMENT OF MEDICAL & RESEARCH TECHNOLOGY
UNIVERSITY OF MARYLAND SCHOOL OF MEDICINE

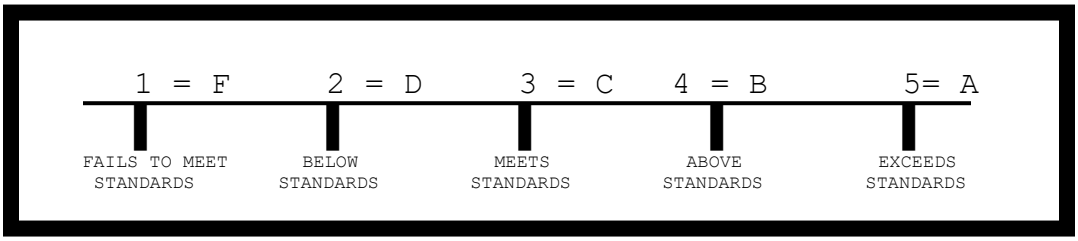
FINAL CLINICAL EVALUATION

Student: _____ Evaluation Date: _____

Rotation Number: _____ Affiliate: _____

Discipline: _____

The primary objective of this assessment is to ensure that each student enters the clinical laboratory science profession with an understanding of its behavioral and skill standards by demonstrating a willingness to adhere to those standards. Circle the number, which corresponds to the student's performance in each category using the following rating scale as a guide.



1. ***Fails to Meet Standards –*** Performance is below entry-level expectations. Student does not meet minimum standards. Performance is unacceptable.

2. ***Below Standards –*** Performance is marginally below entry-level expectations. Student needs to improve to meet minimum standards.

3. ***Meets Standards –*** Meets entry-level expectations and minimum standards.

4. ***Above Standards –*** Consistently meets entry-level expectations and minimum standards. Excels in certain areas. Student has demonstrated a high level of initiative and independent functioning.

5. ***Exceeds Standards –*** Clearly outstanding. Consistently exceeds entry-level expectations and minimum standards. Student has demonstrated a high level of initiative and independent functioning.

STANDARDS OF CLINICAL PRACTICE Please circle the number that matches the student's knowledge or technique.

1 =F, 2 = D, 3 = C, 4 = B, 5 = A.

- **KNOWLEDGE**

❖ Demonstrates understanding of basic theoretical concepts.

1 2 3 4 5

❖ Demonstrates knowledge of general quality assurance principles and practices.

1 2 3 4 5

❖ Correlates pathological significance of test results with laboratory data.

1 2 3 4 5

❖ Recognizes patient abnormal results and takes appropriate action.

1 2 3 4 5

❖ Identifies problems, errors, or malfunctions appropriately at an entry level.

1 2 3 4 5

- **TECHNIQUE**

❖ Applies theoretical principles to current tasks.

1 2 3 4 5

❖ Completes assigned tasks within an acceptable time frame.

1 2 3 4 5

❖ Accomplishes tasks with minimal supervision.

1 2 3 4 5

❖ Reports accurately and efficiently.

1 2 3 4 5

❖ Demonstrates appropriate entry-level troubleshooting skills.

1 2 3 4 5

OVERALL SUMMARY OF STANDARDS OF CLINICAL PRACTICE

Please rank student's overall performance:

1 – FAILS TO MEET STANDARDS
<60%

2 – BELOW STANDARDS
60 – 69.4%

3 – MEETS STANDARDS
69.5 – 79.4%

4 – ABOVE STANDARDS
79.5 – 89.4%

5 – EXCEEDS STANDARDS
89.5 – 100%

FINAL EVALUATION: PROFESSIONAL QUALITIES EVALUATION				
SKILLS	**Satisfactory (5 pts)**	**Needs Improvement (4 pts)**	**Unsatisfactory** (1 pt)**	**Average of CIs**
1. Punctuality	▪ Only late 1x ▪ Does not abuse breaks	▪ Occasionally late **or** ▪ Occasionally abuses breaks	▪ Frequently late **and** ▪ Takes too long on breaks	
2. Initiative	▪ Prepared, ready to work ▪ Reads procedures thoroughly ▪ Self-starter, requires minimal help	▪ Usually prepared ▪ Reads procedures thoroughly, **but** ▪ Requires some help getting started	▪ Not well prepared ▪ Procedures not read beforehand or not read thoroughly ▪ Constantly needs help getting started	
3. Willingness to Learn	▪ Uses downtime constructively ▪ Asks insightful questions; participates in discussions	▪ Sometimes uses downtime constructively ▪ Asks few questions or unnecessary questions	▪ Does nothing constructive in downtime ▪ Assimilates information passively, indifferently	
4. Follows Instructions	▪ Follows directions / instructions without coaching	▪ Often follows directions / instructions without additional coaching	▪ Has difficulty following directions / instructions, even with coaching.	
5. Organization Skills	▪ Organizes work in a logical sequence ▪ Produces required quantity of work with accuracy & within assigned time frame	▪ Usually organizes work in a logical sequence ▪ Usually produces required quantity of work with accuracy & within assigned time frame	▪ Consistently requires help with organization ▪ Can NOT complete required quantity of work with accuracy & within assigned time frame	
6.Professional Judgment	▪ Independently carries out responsibilities ▪ Recognizes own limitations ▪ Seeks help when needed	▪ Checks routinely before proceeding ▪ Usually recognizes own limitations; ▪ Usually seeks help when needed	▪ Does not recognize own limitations, even after instructor points it out; ▪ Proceeds on own without checking with clinical instructor; ▪ Refuses to seek help	
7. Accountability	▪ Usually recognizes mistakes **and** ▪ Takes corrective action when necessary	▪ Sometimes recognizes mistakes **and** ▪ Takes corrective action when necessary	▪ Never recognizes mistakes ▪ Corrective action initiated by instructor	
8. Adaptability	▪ Functions well in stressful/ unexpected situations; rarely gets flustered. ▪ Flexible to change in student's schedule.	▪ Able to function adequately in unexpected/ stressful situations; occasionally gets flustered. ▪ Somewhat flexible to change in schedule.	▪ Cannot function in unexpected/ stressful situations; gets extremely flustered ▪ Inflexible to change in student's schedule	
9. Attitude	▪ Willingly performs assigned tasks ▪ **Seeks input on his/her performance** ▪ Responds readily to constructive criticism ▪ Respects others' professional roles ▪ Professional in all communication	▪ Willingly performs assigned tasks ▪ Responds to constructive criticism with some resistance ▪ Usually respects others' professional roles ▪ Usually professional in most communication	▪ Willfully insubordinate **OR** ▪ Unresponsive or hostile towards criticism **OR** ▪ Unprofessional or abusive to others	
10. Adherence to Policies	**(5 pts) Does:** ▪ Maintain patient and institutional confidentiality ▪ Comply with safety policy and practices ▪ Adhere to department policies for use of computers, electronic devices ▪ Follow the dress code	**(0 pts) Does NOT**: ▪ Maintain patient and institutional confidentiality ▪ Comply with safety policy and practices ▪ Adhere to department policies for use of computers, electronic devices ▪ Follow the dress code	X	
			Total Points in Ave. column x 100 **50**	**%**

Overall Student Grade for Rotation

Please write the numerical grade that the student has earned during this rotation. This includes the practicum score and the technical score.

Student's Rotation Numerical Grade for the **Practicum Exam:** _____ x 0.10 = ____ **(1)**

Student's Rotation Numerical Grade for the **Technical Skills**: _____ x 0.55 = ____ **(2)**

Student's Rotation Numerical Grade for the
Professional Qualities Evaluation: _____ x 0.10 = ____ **(3)**

TOTAL _____ **highlest score 75%**

NOTE: Practicum, technical skills and professional qualities evaluations equals up to 75% of rotation grade remaining 25% is calucaled from media labs and student objectives.

Clinical Staff Signature: _____Date: _____

The evaluation should be given to the student on the last day of the clinical rotation.

Student: Review this evaluation and **CHECK ONE** of the statements below.

_____ I have read this evaluation and have no comments.
_____ I have read this evaluation and my comments are on the reverse side of the page.

Student signature: _____ **Date:** _____

Final Evaluation by University of Maryland, Baltimore School of Medicine, Department of Medical and Research Technology's Medical Laboratory Science Program:

_____Passing

_____Failing

Days Absent:_____Days Tardy:_____Days Made Up:_____

_____ _____
Program Director Date

PRECEPTOR COMMENTS:

I recommend that the student receive a final evaluation of:

___ Passing with Excellence

___ Passing

___ Failing

Days Absent ____ Days Tardy ____ Days Left Early ____ Time Made-up ___

Evaluated by: _____ _____ _____
Affiliate Signature Title Date

_____ _____ _____
Affiliate Signature Title Date

- I have reviewed this evaluation and agree with its content:

_____ _____
Student Signature Date

- Student has returned affiliate's badge (if applicable) ☐ Yes ☐ No ☐ NA

_____ _____ _____
Affiliate Signature Title Date

STUDENT COMMENTS:

Final Evaluation By DMRT:

___ Passing with Excellence >89.5%

___ Passing > or = to 69.5-89.4%

___ Failing < or = to 69.4%

_____ _____
Program Director Date

UNIVERSITY of MARYLAND BALTIMORE

MEDT 402

Student Name: _____

Site and Rotation: _Rotation 1_Week 1_____

Department of Medical and Research Technology Medical Lab Science Rotation Time Sheet- Per Day

DATE	TIME IN	TIME OUT	General Activities/Staff Person Supervising
Day 1			
Day 2			
Day 3			
Day 4			

UNIVERSITY of MARYLAND BALTIMORE

MEDT 402

Student Name: _____

Site and Rotation: _Rotation 1_Week 2_____

Department of Medical and Research Technology Medical Lab Science Rotation Time Sheet- Per Day

DATE	TIME IN	TIME OUT	General Activities/Staff Person Supervising
Day 5			
Day 6			
Day 7			
Day 8			

UNIVERSITY of MARYLAND BALTIMORE

MEDT 402

Student Name: _____

Site and Rotation: _Rotation 1_Week 3_____

Department of Medical and Research Technology Medical Lab Science Rotation Time Sheet- Per Day

DATE	TIME IN	TIME OUT	General Activities/Staff Person Supervising
Day 9			
Day 10			
Day 11			
Day 12			

UNIVERSITY of MARYLAND BALTIMORE

MEDT 402

Student Name: _____

Site and Rotation: _Rotation 1_Week 4_____

Department of Medical and Research Technology Medical Lab Science Rotation Time Sheet- Per Day

DATE	TIME IN	TIME OUT	General Activities/Staff Person Supervising
Day 13			
Day 14			
Extra Days			
Extra Days			

UNIVERSITY of MARYLAND BALTIMORE

MEDT 402

Student Name: _____

Site and Rotation: _Rotation 2_Week 1_____

Department of Medical and Research Technology Medical Lab Science Rotation Time Sheet- Per Day

DATE	TIME IN	TIME OUT	General Activities/Staff Person Supervising
Day 1			
Day 2			
Day 3			
Day 4			

UNIVERSITY of MARYLAND BALTIMORE

MEDT 402

Student Name: _____

Site and Rotation: _Rotation 2_Week 2_____

Department of Medical and Research Technology Medical Lab Science Rotation Time Sheet- Per Day

DATE	TIME IN	TIME OUT	General Activities/Staff Person Supervising
Day 5			
Day 6			
Day 7			
Day 8			

UNIVERSITY of MARYLAND BALTIMORE

MEDT 402

Student Name: _____

Site and Rotation: _Rotation 2_Week 3_____

Department of Medical and Research Technology Medical Lab Science Rotation Time Sheet- Per Day

DATE	TIME IN	TIME OUT	General Activities/Staff Person Supervising
Day 9			
Day 10			
Day 11			
Day 12			

UNIVERSITY of MARYLAND BALTIMORE

MEDT 402

Student Name: _____

Site and Rotation: _Rotation 2_Week 4_____

Department of Medical and Research Technology Medical Lab Science Rotation Time Sheet- Per Day

DATE	TIME IN	TIME OUT	General Activities/Staff Person Supervising
Day 13			
Day 14			
Extra Days			
Extra Days			

UNIVERSITY of MARYLAND BALTIMORE

MEDT 402

Student Name: _____

Site and Rotation: _Rotation 3_Week 1_____

Department of Medical and Research Technology Medical Lab Science Rotation Time Sheet- Per Day

DATE	TIME IN	TIME OUT	General Activities/Staff Person Supervising
Day 1			
Day 2			
Day 3			
Day 4			

UNIVERSITY of MARYLAND BALTIMORE

MEDT 402

Student Name: _____

Site and Rotation: _Rotation 3_Week 2_____

Department of Medical and Research Technology Medical Lab Science Rotation Time Sheet- Per Day

DATE	TIME IN	TIME OUT	General Activities/Staff Person Supervising
Day 5			
Day 6			
Day 7			
Day 8			

UNIVERSITY of MARYLAND BALTIMORE

MEDT 402

Student Name: _____

Site and Rotation: _Rotation 3_Week 3_____

Department of Medical and Research Technology Medical Lab Science Rotation Time Sheet- Per Day

DATE	TIME IN	TIME OUT	General Activities/Staff Person Supervising
Day 9			
Day 10			
Day 11			
Day 12			

UNIVERSITY of MARYLAND BALTIMORE

MEDT 402

Student Name: _____

Site and Rotation: _Rotation 3_ Week 4_____

Department of Medical and Research Technology Medical Lab Science Rotation Time Sheet- Per Day

DATE	TIME IN	TIME OUT	General Activities/Staff Person Supervising
Day 13			
Day 14			
Extra Days			
Extra Days			

UNIVERSITY of MARYLAND BALTIMORE

MEDT 402

Student Name: _____

Site and Rotation: _Rotation 4_Week 1_____

Department of Medical and Research Technology Medical Lab Science Rotation Time Sheet- Per Day

DATE	TIME IN	TIME OUT	General Activities/Staff Person Supervising
Day 1			
Day 2			
Day 3			
Day 4			

UNIVERSITY of MARYLAND BALTIMORE

MEDT 402

Student Name: _____

Site and Rotation: _Rotation 4_Week 2_____

Department of Medical and Research Technology Medical Lab Science Rotation Time Sheet- Per Day

DATE	TIME IN	TIME OUT	General Activities/Staff Person Supervising
Day 5			
Day 6			
Day 7			
Day 8			

UNIVERSITY of MARYLAND BALTIMORE

MEDT 402

Student Name: _____

Site and Rotation: _Rotation 4_Week 3_____

Department of Medical and Research Technology Medical Lab Science Rotation Time Sheet- Per Day

DATE	TIME IN	TIME OUT	General Activities/Staff Person Supervising
Day 9			
Day 10			
Day 11			
Day 12			

UNIVERSITY of MARYLAND BALTIMORE

MEDT 402

Student Name: _____

Site and Rotation: _Rotation 4_ Week 4_____

Department of Medical and Research Technology Medical Lab Science Rotation Time Sheet- Per Day

DATE	TIME IN	TIME OUT	General Activities/Staff Person Supervising
Day 13			
Day 14			
Extra Days			
Extra Days			