

**Oakland University Assessment Committee  
Assessment Plan Format**

**Program Name**     **Biomedical Diagnostics and Therapeutic Sciences**    

**1. Applicable statements from Oakland University’s Mission**

The following Oakland University mission statements are of particular relevance to the mission of the Biomedical Diagnostic and Therapeutic Sciences program.

- A. “Oakland University provides rigorous educational programs. A strong core of liberal arts is the basis on which undergraduates develop the skills, knowledge and attitudes essential for successful living and active, concerned citizenship. A variety of majors and specialized curricula prepare students for post-baccalaureate education, professional schools, or careers directly after graduation. Each program provides a variety of courses and curricular experiences to ensure an enriched life along with superior career preparation or enhancement.”
- B. “...research and scholarship reinforce the instructional mission of the university. Wherever possible, students are involved in research projects, and the results of research and scholarship are integrated into related courses of instruction.”
- C. “Oakland University serves its constituents through a philosophy and program of public service that is consistent with its instructional and research missions...to apply the expertise of the university to the issues of society in general or the region in particular so as to further enhance the quality of life...”
- D. “...Oakland University provides basic services and experiences that integrate cognitive learning with the personal growth of the individual student in the emotional, social, physical, cultural, ethical and interpersonal domains. This objective is accomplished through a variety of student enterprises, including campus organizations, athletics and other sponsored activities and events.

The Biomedical Diagnostic and Therapeutic Sciences Program mission statements are as follows:

- A. Provide a preclinical education of the highest quality and relevance that is grounded with a core of liberal arts and sciences and that qualifies the student to successfully obtain a clinical education internship.
- B. Maintain a variety of majors and specialized curricula that are founded on current advances in laboratory sciences such that students are prepared for a graduate degree in laboratory sciences or related basic science areas, or for professional degrees.
- C. Provide opportunities for students to be involved in research (when appropriate) and incorporate research trends into the curriculum of each discipline.
- D. Create a learning environment that advocates practice of student professionalism and promotes excellence in healthcare service to the community.
- E. Sustain a student organization that generates student driven volunteerism to local organizations, an opportunity for student leadership skill development, and advocates student professional networking.

## 2. Program Goals

### To graduate students who:

- A. Demonstrate cognition in their core curricula
- B. Perform basic laboratory skills that are relevant to the demands of an entry-level professional in each discipline.
- C. Communicate effectively with peers and superiors both orally and in written form.

### Curricular objectives to meet these goals:

Upon completion of the Biomedical Diagnostic and Therapeutic Sciences program, the student will be able to:

1. Evaluate, interpret, and diagnose patients given clinical data. (Program Goal A)
2. Demonstrate critical thinking and problem solving when given a clinical case study or relevant information to a particular disorder. (Program Goal A)
3. Apply the principles of evidence-based medicine in assessing clinical data. (Program Goal A)
4. Demonstrate the ability to work safely and autonomously in classroom activities and in the laboratory setting. (Program Goals B and C)
5. Function as part of a team in classroom and laboratory settings. (Program Goals B and C).
6. Demonstrate professionalism in the laboratory setting. (Program Goals B and C)
7. Apply basic research principles to clinically relevant situations in biomedical sciences. (Program Goals A and B)
8. Develop teaching modules for educating students, patients, other professionals, and the public. (Program Goals A and C)
9. Describe the many roles that biomedical science professionals assume. (Program Goals A and C)
10. Document effective written, and verbal communication skills in laboratory reports, examinations, research papers, and oral presentations. (Program Goal C)
11. Demonstrate accurate self-assessment of personal and professional strengths and weaknesses. (Program Goal C)
12. Recognize the value of performing as an integral and contributing member of the healthcare community. (Program Goals A, B and C)

### **3. Student Learning Outcomes**

See appendix SLO for each specialization in Biomedical Diagnostic and Therapeutic Sciences

### **4. Assessment Measures**

#### **Direct Measures.**

- A. A pre-assessment, computerized, exam is administered as a pass/fail (completed/not completed) component of MLS 201, “Careers in Medical Laboratory Sciences”. Each student is required to take the pre-assessment exam that is unique to his or her specialization.
- B. A post-assessment, computerized, exam is administered to
  - 1. The MLS specialization as a component of the capstone, MLS 440, “Clinical Correlations” and will be integrated as a final exam of the course.
  - 2. The specializations NMT, HT and CT, as a component of MLS 423, Immunology or of MLS 402, Molecular Diagnostics (depending on the coursework completed by the student) and is integrated as an assignment of the course.
- C. Correlation with earning a clinical internship.
- D. Performance on Board Certifications exams for each specialization (RTech, RTher, MLS, NMT, HT, CT).

#### **Indirect Measures.**

- A. An electronic “Exit survey” that is sent to students just prior to graduation. (The Assessment Coordinator summarizes the data for all survey items and distributes to faculty. This report is used to measure all program goals.)
- B. An electronic survey that is sent to alumni at 10 months post graduation for those individuals who have earned a clinical internship. (The Assessment Coordinator summarizes the data for all survey items and distributes to faculty. This report is used to measure all program goals.)
- C. Surveys to employers of graduates at 10 months. (The Assessment Coordinator summarizes the data for all survey items and distributes to faculty. This report is used to measure all program goals.)

### **5. Individuals who have primary responsibility for administering assessment activities**

- A. Program Director
- B. Assessment Coordinator

## **6. Procedures to be used to translate assessment results into program changes**

- A. Data from the post-assessment exam are reviewed annually and discussed among full-time BDTs faculty to identify actions for program change.
- B. Student completed course evaluations are reviewed by individual faculty members.
- C. "Exit surveys" sent to students just prior to program completion. The Assessment Coordinator summarizes the data for all survey items and distributes to faculty.
- D. Surveys to alumni at 10 months post program completion. The Assessment Coordinator summarizes the data for all survey items and distributes to faculty.
- E. Survey of alumni at 10 months. The Assessment Coordinator summarizes the data for all survey items and distributes to faculty.
- F. Curriculum review meeting assess data compiled from the assessment coordinator to identify actions for program change.

## Assessment Plan

Goal Cited in OU Mission	Relevant Goal of Unit	Student Learning Objectives	Methods of Assessment	Individual(s) Responsible for Assessment Activities	Procedures for Using Assessment Results to Improve Program
"...rigorous educational program	Graduates demonstrate cognition in their core curricula	Evaluate, interpret, and diagnose patients given clinical data	Post-assessment exam, Correlation with internship, Performance on BCE	Assessment coordinator	Faculty meeting discussions, Curriculum review
		Demonstrate critical thinking and problem solving when given a clinical case study or relevant information to a particular disorder	Post-assessment exam, Correlation with internship, Performance on BCE	Assessment coordinator	Faculty meeting discussions, Curriculum review
		Apply the principles of evidence-based medicine in assessing clinical data	Post-assessment exam, Correlation with internship, Performance on BCE	Assessment coordinator	Review of course evaluations, Curriculum review
		Apply basic research principles to clinically relevant situations in biomedical sciences	Post-assessment exam	Assessment coordinator	Review of course evaluations, Curriculum review
		Develop teaching modules for educating students, patients, other professionals, and the public	Exit survey, Alumni survey, Employer survey	Assessment coordinator, Program Director	Review of course evaluations, Curriculum review, Survey data analysis
		Describe the many roles that biomedical science professionals assume	Post-assessment exam Exit survey	Assessment coordinator	Review of course evaluations, Curriculum review, Survey data analysis

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Goal Cited in OU Mission	Relevant Goal of Unit	Student Learning Objectives	Methods of Assessment	Individual(s) Responsible for Assessment Activities	Procedures for Using Assessment Results to Improve Program
		Recognize the value of performing as an integral and contributing member of the healthcare community	Exit survey, Alumni survey, Employer survey	Assessment coordinator, Program Director	Curriculum review, Survey data analysis
"...prepare students for post-baccalaureate education, professional schools, or careers directly after graduation	Perform basic laboratory skills that are relevant to the demands of an entry-level professional in each discipline	Demonstrate the ability to work safely and autonomously in classroom activities and in the laboratory setting	Exit survey, Correlation with internship	Assessment coordinator	Curriculum review, Survey data analysis
		Function as part of a team in classroom and laboratory settings	Correlation with internship, Exit survey, Alumni survey, Employer survey	Program Director	Review of course evaluations, Curriculum review, Survey data analysis
		Demonstrate professionalism in the laboratory setting	Correlation with internship, Exit survey, Employer survey	Program Director	Review of course evaluations, Survey data analysis
		Apply basic research principles to clinically relevant situations in biomedical sciences	Post-assessment exam Exit survey	Assessment coordinator, Program Director	Review of course evaluations, Curriculum review, Survey data analysis
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	Communicate effectively with peers and superiors both orally and in written form	Demonstrate the ability to work safely and autonomously in classroom activities and in the laboratory setting	Correlation with internship, Exit survey, Alumni survey, Employer survey	Program Director	Curriculum review, Survey data analysis
		Develop teaching modules for educating students, patients, other professionals, and the public	Exit survey, Alumni survey, Employer survey	Program Director	Review of course evaluations, Curriculum review, Survey data analysis
		Function as part of a team in classroom and laboratory settings	Correlation with internship, Exit survey, Alumni survey, Employer survey	Program Director	Review of course evaluations, Curriculum review, Survey data analysis
		Demonstrate professionalism in the laboratory setting	Correlation with internship, Exit survey, Employer survey	Program Director	Review of course evaluations, Survey data analysis
		Describe the many roles that biomedical science professionals assume	Post-assessment exam, Exit survey	Assessment coordinator	Review of course evaluations, Curriculum review, Survey data analysis
		Document effective written, and verbal communication skills in laboratory reports.	Correlation with internship, Post-assessment exam Exit survey, Alumni survey.	Assessment coordinator, Program Director	Review of course evaluations, Curriculum review, Survey data analysis
		Demonstrate accurate self-assessment of personal and professional strengths and weaknesses	Exit survey, Alumni survey, Employer survey	Program Director	Curriculum review, Survey data analysis

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"...the results of research and scholarship are integrated into related courses of instruction	Perform basic laboratory skills that are relevant to the demands of an entry-level professional in each discipline	Apply basic research principles to clinically relevant situations in biomedical sciences	Post-assessment exam Exit survey, Alumni survey	Assessment coordinator	Review of course evaluations, Curriculum review, Survey data analysis
"...to apply the expertise of the university to the issues of society in general	Perform basic laboratory skills that are relevant to the demands of an entry-level professional in each discipline	Document effective written, and verbal communication skills in laboratory reports, examinations, research papers, and oral presentations Function as part of a team in classroom and laboratory settings	Post-assessment exam Exit survey, Alumni survey, Employer survey	Assessment coordinator, Program Director	Review of course evaluations, Curriculum review, Survey data analysis
"...integrate cognitive learning with the personal growth of the individual student	Communicate effectively with peers and superiors both orally and in written form	Recognize the value of performing as an integral and contributing member of the healthcare community	Exit survey, Alumni survey, Employer survey	Program Director	Review of course evaluations, Curriculum review, Survey data analysis
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**Biomedical Diagnostic and Therapeutic Sciences**  
**Specialty in Medical Laboratory Sciences**  
**Student Learning Outcomes**

**1. Professional Issues**

- a. Define the terms accreditation and certification.
- b. Identify agencies that facilitate accreditation and those that facilitate certification.

**2. Basic Laboratory Skills and Safety**

- a. Identify personal protective equipment and demonstrate its proper use.
- b. Define the role of OSHA.
- c. Define blood borne pathogens.
- d. Relate engineering controls and work practice controls to risk of infection when working with blood borne pathogens.
- e. Calculate concentrations using percent solution, molarity, and normality.
- f. Convert concentrations using the metric system.
- g. Determine concentrations based on single and serial dilutions.
- h. Demonstrate proper technique using micropipets.
- i. Demonstrate proper technique using straight pipets.
- j. Identify the parts of a microscope.
- k. Demonstrate proper focusing using a microscope.
- l. Demonstrate proper balancing of a centrifuge.

**3. Immunology and Immunohematology**

- a. Differentiate innate and adaptive immune responses.
- b. Compare and contrast the function of B and T cells.
- c. Define antibody and antigen.
- d. Explain the role of Complement in the immune response.
- e. List and briefly describe techniques that utilize immunological principles in the clinical setting.
- f. Describe in detail how an immune response is generated as a reaction to antigen.
- g. Correlate aspects of the immune response with the clinical manifestations resulting from immunodeficiency, autoimmune disease, hypersensitivity, and vaccination.
- h. Explain the principles of blood group inheritance, patterns of inheritance and population genetics.
- i. Discuss the ABO and H blood group systems including inheritance of antigens as well as the significance of antibodies produced to these antigens.
- j. Resolve ABO typing discrepancies.
- k. Describe the Rh blood group system including terminology, major antigens and clinically significant antibodies produced to these antigens.
- l. Interpret ABO and Rh typing results.
- m. Correlate other blood group systems within the more clinically relevant antigens and antibodies.
- n. Describe pre-transfusion testing requirements for recipients including sample requirements, compatibility testing, labeling and issuing units for transfusion.
- o. Select suitable blood products for transfusion to selected recipients.
- p. Analyze antibody identification case studies and be able to interpret and suggest additional tests necessary to complete identification.
- q. Explain the cause of hemolytic disease of the newborn and describe methods for laboratory detection and investigation of this clinical condition.
- r. Discuss the various immune hemolytic anemias including clinical aspects, laboratory work-up, treatment and transfusion.

- s. Discuss the criteria for selection of blood donors and the testing required by the FDA and AABB for processing blood products.
- t. Discuss the various methods of producing red blood cell, plasma, platelets and cryoprecipitate components and the storage conditions and expiration dates for these components.
- u. Discuss blood component therapy including the indications and contraindications for selected components.
- v. Describe the types of adverse effects that may occur as a result of transfusion and the appropriate measures to prevent these effects as well as the investigation of transfusion reactions.

#### **4. Clinical Chemistry**

- a. Describe basic biochemistry and related physiological processes of metabolism.
- b. Apply principles of chemistry and physiology to analyze and evaluate human specimens for the purpose of assessing and monitoring health status.
- c. Describe correct patient preparation and specimen collection, handling and processing.
- d. Explain the effect of demographic factors and lifestyle on laboratory test results.
- e. Compare and contrast analytical methods used in the clinical chemistry laboratory.
- f. Identify reference and commonly used analytical methods in a modern clinical chemistry laboratory.
- g. Explain analytical specificity and interference when the patient results are erroneously high or low.
- h. Interpret analytical results for a particular disease process.
- i. Correlate patient health status and test results.

#### **5. Urinalysis and Body Fluids**

- a. Analyze multitest reagent strip results and correlate the findings to normal and disease conditions.
- b. List the expected microscopic findings in normal urine sediments.
- c. Differentiate formed elements in urine microscopically and explain their significance.
- d. Define: synovial fluid, pleural fluid, pericardial fluid, peritoneal (ascitic) fluid, ascites, serous fluid, effusion, arthrocentesis, thoracentesis, pericardiocentesis, peritoneocentesis, paracentesis, amniocentesis.
- e. State the physical characteristics of normal body fluids and discuss how each characteristic is modified in disease.
- f. Describe the technique used to count and identify cells found in various body fluids (other than blood and urine) and calculate the number of cells present in a fluid specimen, given the appropriate data.

#### **6. Hematology**

- a. Analyze complete blood count data for the presence of abnormalities and discrepancies and suggest solutions to the problems detected.
- b. Identify normal and abnormal blood cells.
- c. Evaluate hematology test data and follow-up test data to determine the most likely diagnosis of hematologic disease.
- d. Suggest follow-up testing based on the initial hematology data.
- e. Describe and summarize the pathophysiology of hematologic diseases.
- f. Describe and explain the principles of bone marrow analysis, cytochemistry, cytogenetics, flow cytometry and molecular analysis as used in the diagnosis and treatment of hematologic disease.
- g. Describe and explain the principles of instrumental analysis for routine and special hematology assays.
- h. Describe the microscopic appearance of RBCs, WBCs, and platelets when fixed to glass slides and stained with a Romanowsky stain.

## **7. Hemostasis**

- a. Analyze clinical data for the presence of abnormalities and discrepancies and suggest solutions to the problems detected.
- b. Evaluate hemostasis test data and follow-up testing data to determine the most likely diagnosis of hemostatic disease.
- c. Suggest follow-up testing based on initial hemostasis data.
- d. Differentiate the pathophysiologic processes of hemostatic disorders.
- e. Describe and explain the principles of instrumental analysis for routine and special hemostasis assays.
- f. Describe the structure and function of thrombocytes.

## **8. Microbiology**

- a. Discuss the etiology of an infectious disease at a given body site, including predisposing and risks factors.
- b. Differentiate the three major disease-causing mechanisms employed by microbial agents.
- c. Name the organisms that make up the normal flora, as well as the potential pathogens found at a particular body site.
- d. For each site of infection, complete the following:
  - i) describe the signs and symptoms of the infectious disease.
  - ii) recommend the appropriate specimen to culture.
  - iii) suspect the common etiologic agents to be recovered.
- e. Describe the proper specimen collection and handling of clinical materials appropriate for the cultivation of a suspected agent of infectious disease.
- f. Select the culture media for isolation, special stains (if necessary) and other special procedures required to recover specific agents of disease.
- g. Given the clinical presentation and epidemiological information, determine the most probable causative agent of an infectious disease.
- h. For each infectious disease presented, assess the methods of recovery, the typical microscopic, colonial and biochemical characteristics of the suspected agent.
- i. Recognize how ethnicity, gender, race, and socioeconomic status affect an individuals risk for developing a given disease.
- j. Discuss the effect of ethnicity, gender, and race on laboratory test results.

## **9. Mycology/Virology/Parasitology**

- a. Describe the general characteristics of clinically significant fungi, viruses and parasites including developmental and sexual structure characteristics.
- b. Describe and select the appropriate specimen collection procedures, staining methods, and culture techniques used in the identification of clinically significant fungi, viruses and parasites.
- c. Correlate morphological characteristics of isolated fungi with the correct clinical diagnosis.
- d. Discuss the risk factors and clinical manifestations of the most common human mycoses, viral and parasitic infections.
- e. List the five general characteristics that are used to describe all viruses.
- f. Compare and contrast serologic methods with molecular methods for the diagnosis of viral infections.
- g. Discuss the classification of blood and tissue parasites with regard to clinical disease, life cycle, diagnostic stages and public health concerns.

## **10. Genetics and Molecular Diagnostics**

- a. Differentiate mitosis and meiosis.
- b. Define locus, allele, polymorphism and mutation.
- c. Construct a pedigree highlighting dominant and recessive traits and sex-linked inheritance.

- d. Define the central dogma of molecular biology and summarize nucleic acid chemistry and the processes of replication, translation and transcription.
- e. Differentiate mitosis and meiosis.
- f. Diagram and assemble nucleotides to form nucleic acids, DNA and RNA.
- g. Diagram cellular ultrastructure, focusing on chromosomes.
- h. Detail the four levels of protein structure.
- i. Correlate DNA, mRNA, and protein with gene structure.
- j. Differentiate polymorphism and mutation.
- k. Demonstrate how to isolate nucleic acid from blood and solid tissues.
- l. Compare agarose with polyacrylamide gel separation, transfer, handling, and fragment recovery properties of DNA and proteins.
- m. Describe the principle of PCR and correlate PCR modifications to qualitative and quantitative nucleic acid analysis.
- n. Identify means of detecting aberrations in DNA, chromosomes, and proteins and apply those techniques to disease detection.
- o. Identify nucleic acid amplification products using nucleic acid probes and hybridization.
- p. Explain the principles and list the steps for DNA sequencing.
- q. Explain the principles and list the steps for microarray testing.
- r. List quality assurance practices associated with molecular assays.
- s. Explain the principles and list the steps for karyotyping and fluorescent in situ hybridization.
- t. Troubleshoot molecular assays.
- u. Apply molecular testing to forensic science, anthropology, and parentage confirmation.
- v. Detect human mutations and single nucleotide polymorphisms.
- w. Detect and identify microorganisms using molecular assays.
- x. Detect and identify hematologic and oncologic disease using molecular assays.
- y. Detect and identify thrombotic disease using molecular assays.
- z. Correlate molecular to current phenotypic laboratory and clinical findings.

## **11. Statistics and Research**

- a. Define terms related to statistical analysis and method validation.
- b. Describe sources of error and how they relate to method validation.
- c. Discuss approaches to setting QC target values and reference intervals.
- d. Discuss CLIA '88 technical regulations & external QC programs.
- e. Design and interpret: linearity, precision & sensitivity style experiments.
- f. Design and interpret research methods and comparison experiments.
- g. Apply principles of statistical analysis in evaluation of laboratory results and quality management

## Pre-Assessment Exam

1. On a polychrome (Wright's) stained blood smear, most RBCs appear microcytic and hypochromic. Which of the following would be expected?

- a. diagnosis of aplastic anemia
- \*b. possible chronic GI bleeding
- c. possible vitamin B12 deficiency
- d. high reticulocyte count

2. The following CBC data was reported:

WBC  $6.0 \times 10^9/L$

Differential:

Neutrophils: 30%

Lymphs: 60%

Monos: 3%

Eos: 7%

What is the absolute neutrophil count?

- a.  $0.3 \times 10^9/L$
- b.  $1.0 \times 10^9/L$
- c.  $1.2 \times 10^9/L$
- \*d.  $1.8 \times 10^9/L$

3. A patient was admitted to the hospital with the following laboratory findings:

Hemoglobin: 8.0 g/dL

Hematocrit: 18%

MCV: 65 fL

Reticulocyte Count: 4%

Hemoglobin A = 30%,

Hemoglobin A2 = 36%

Hemoglobin F = 34%

These results are characteristic of:

- a. Megaloblastic anemia
- b. Iron deficiency anemia
- c. Alpha thalassemia
- \*d. Beta thalassemia

4. Characteristic laboratory findings in hemolytic anemia include:

- a. increased TIBC
- b. decreased WBC count
- c. decreased bilirubin and LD
- \*d. increased reticulocytes

5. To calculate the MCHC, one must know the results of the:

- \*a. hemoglobin and hematocrit
- b. hemoglobin and MCHC
- c. RBC and hemoglobin
- d. hemoglobin and MCH

6. The following results were found on a patient:

MCV = 112 fL  
MCH = 36 pg  
MCHC = 33 %

On the peripheral smear you should see:

- \*a. macrocytic, normochromic RBCs
- b. macrocytic, hypochromic RBCs
- c. microcytic, hypochromic RBCs
- d. normocytic, normochromic RBCs

7. A finger stick WBC count on a 20 yr old female is performed using a Unopette to dilute the blood and a standard hemocytometer to count the cells. 100 microliters (uL) of blood was diluted with 1.9 milliliters (mL) of diluent. 100 platelets were counted in 1 square measuring 1mm x 1 mm on one side of a standard hemocytometer. Hemocytometer depth = 0.1 mm. Calculate the platelet count.

- a.  $10 \times 10^9/L$
- \*b.  $20.0 \times 10^9/L$
- c.  $125 \times 10^9/L$
- d.  $250 \times 10^9/L$

8. A burn patient develops leukocytosis and a "shift to the left" to the metamyelocyte stage. Large light blue staining inclusions are found near the periphery of many neutrophils. These inclusions are probably:

- a. Barr bodies
- b. Auer bodies
- \*c. Dohle bodies
- d. Siderotic granules

9. Hemoglobin A2 is composed of the following globin chains:

- a. alpha2 beta2
- b. alpha2 gamma2
- \*c. alpha2 delta2
- d. alpha2 epsilon2

10. On the low hemoglobin control, the 95% confidence limits are 5.7 g/dL and 6.5 g/dL.

Therefore the **mean** and **1 standard deviation** are:

- \*a. Mean= 6.1; S.D. = 0.2 g/dL
- b. Mean = 6.1; S.D. = 0.4 g/dL
- c. Mean = 6.5; S.D. = 0.4 g/dL
- d. impossible to determine from this data

11. Given: WBC =  $23.1 \times 10^9/L$

Differential:

Segs=77

Bands=13

Lymphs=6

Monos=1

Eos=3

These results would be expected in which of the following situations:

- a. acute lymphoblastic leukemia
- \*b. patient with a bacterial infection
- c. normal 45 year old male
- d. normal 3 year old child

12. The following CBC data was found on a patient:

Hemoglobin: 9.5 g/dL

RBC count =  $2.40 \times 10^{12}/L$

30 reticulocytes counted in 1000 RBCs

Calculate the **absolute** reticulocyte count.

- a.  $48 \times 10^9/L$
- \*b.  $72 \times 10^9/L$
- c. 3.0 %
- d. 5.0 %

13. The primary granules of neutrophils contain the enzyme:

- \*a. peroxidase
- b. glycogen
- c. non-specific esterase
- d. terminal deoxyribonucleotidal transferase (TdT)

14. An EDTA sample is found to be hemolyzed. Which of the following tests would be affected the **least**?

- \*a. hemoglobin
- b. hematocrit
- c. RBC count
- d. MCHC

15. The anemia due to a substitution of an amino acid in the beta globin polypeptide chain is:

- a. Beta thalassemia
- b. Hereditary spherocytosis
- \*c. Sickle cell anemia
- d. G6PD deficiency

16. A 25 year old female had the following CBC data:

RBC:  $3.35 \times 10^{12}/L$

Hgb: 11.0 g/dL

MCV: 84 fL

Calculate the actual Hematocrit using the values above (do not use the rule of 3):

- \*a. 28 %
- b. 33 %
- c. 34 %
- d. 36%

17. What discrepancy do you see in the data below?

RBC =  $4.00 \times 10^{12}/L$

Hgb = 125 g/L

Hct = 0.37 %

MCV = 83 fL

MCHC = 39%

RBC Morphology – Only normal RBCs seen

- \*a. the MCHC does not match the microscopic findings
- b. the Hgb does not match the RBC count
- c. the MCV does not match the microscopic findings
- d. the hemoglobin does not match the hematocrit



18. A patient has a normocytic normochromic anemia, leukopenia and thrombocytopenia. A bone marrow exam indicates the presence of increased myeloblasts (8%) and megaloblastoid changes in the erythrocyte precursors. This patient is most likely to have which of the following:

- \*a. Refractory Anemia with Excess Blasts
- b. Sideroblastic anemia
- c. Acute Myeloid Leukemia
- d. Agnogenic Myeloid Metaplasia

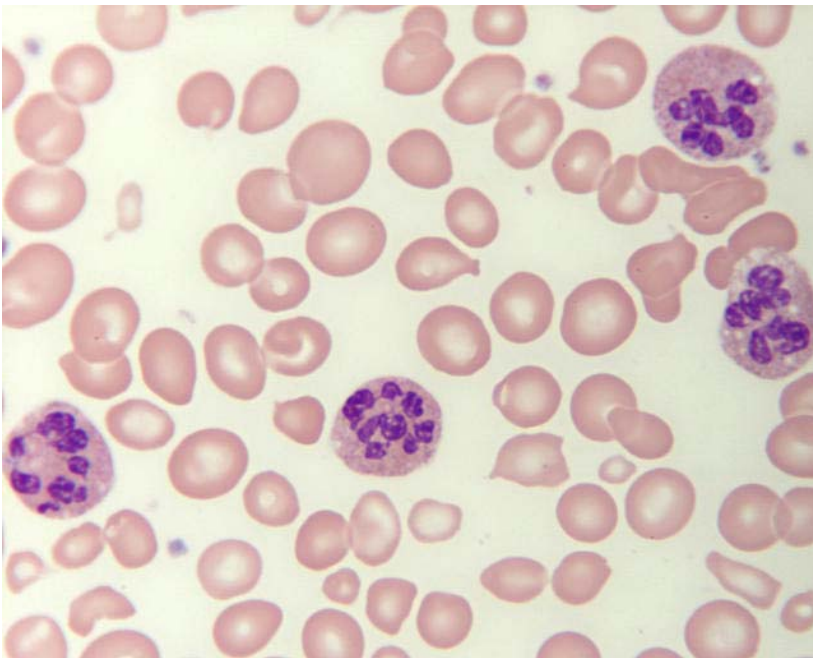
19. In cases of thrombotic thrombocytopenic purpura the following are usually found:

- a. codocytes and spherocytes
- \*b. fragmented RBCs
- c. drepanocytes and codocytes
- d. platelet satellitism

20. A myeloproliferative disorder characterized by very high red cell counts and occasionally an increase in WBCs:

- a. erythroblastic leukemia
- b. essential thrombocytosis
- \*c. polycythemia vera
- d. multiple myeloma

21. The findings of the abnormal nucleated cells and abnormal RBCs in the image below is indicative of:



- a. G6PD deficiency
- b. Iron deficiency anemia
- \*c. Vitamin B12 deficiency
- d. G6PD deficiency

22. The purpose of methylene blue in polychrome stains is to:

- \*a. stain structures with an acid pH
- b. stick the cells to the slide
- c. stain structures with an alkaline pH
- d. preserve the cell morphology

23. Cold agglutinins are likely to cause which of the following unexpected results:

- \*a. MCHC = 54 %
- b. Rouleaux on the smear
- c. Calculated hematocrit = 72%
- d. Hemoglobin = 19 g/dL

24. A platelet count on an automated hematology analyzer is found to be  $75 \times 10^9/L$ .

A manual phase platelet count on the same EDTA sample is found to be  $68 \times 10^9/L$ .

A manual platelet count on a capillary sample is reported as  $235 \times 10^9/L$ .

What is a likely explanation for the results above?

- a. an instrument malfunction
- b. idiopathic thrombocytopenic purpura
- \*c. EDTA induced platelet clumping
- d. essential thrombocythemia

25. In all cases of this acute leukemia the t(15:17) translocation is found:

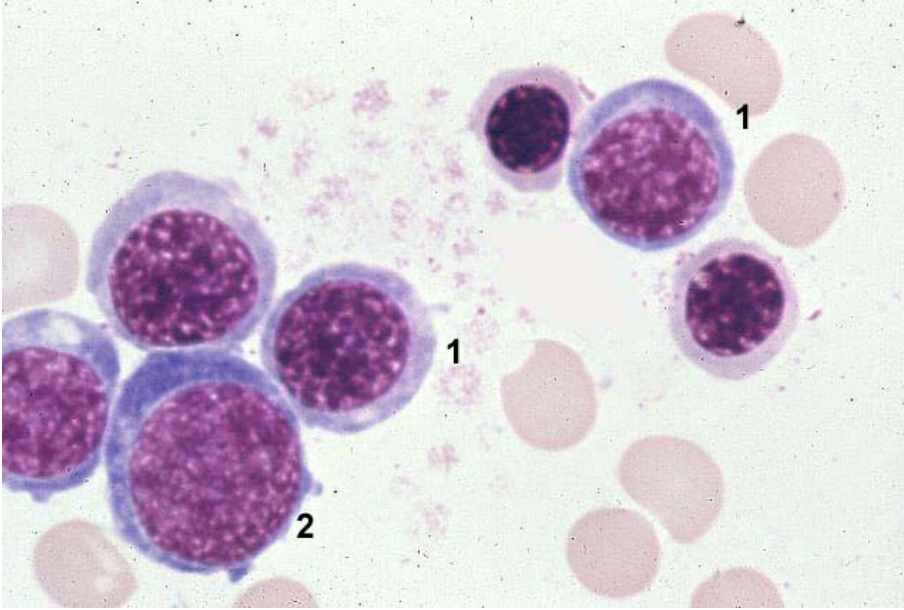
- a. AML – M1
- b. CML
- \*c. Acute promyelocytic leukemia
- d. Acute pre-B lymphoblastic leukemia

26. Which of the following sets of results suggest that spherocytes would be present on the smear?

MCV; MCH; MCHC

- a. 116; 29; 35
- b. 66; 20; 29
- c. 90; 31; 32
- \*d. 86; 36; 39

27. What name should be given to the cells labeled 1 in the image below?



- \*a. early rubricytes
- b. metarubricytes
- c. rubriblasts
- d. stem cells

28. Hydrodynamic focusing in flow cytometry is important because it:

- a. directs the laser light.
- b. intensifies the laser light with mirrors.
- c. collects the scattered light.
- \*d. creates a core of individually aligned cells.

29. A male with sickle cell trait (heterozygous) has a child with a female who also has sickle cell trait. What is the chance that the child has sickle cell trait?

- a. 0%
- b. 25%
- \*c. 50%
- d. 100%

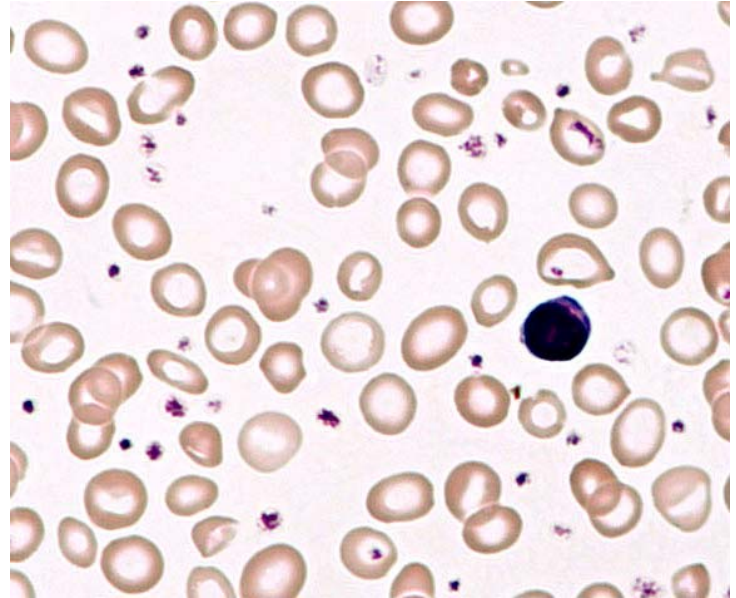
30. A decrease in the ratio of albumin to globulins in the plasma would likely cause an increase in the:

- a. plasma hemoglobin
- b. haptoglobin and transferrin levels
- \*c. erythrocyte sedimentation rate
- d. reticulocyte count

31. A patient was found to have circulating blasts. The marrow blast count was 43%.  
No Auer rods were identified, and the peroxidase and non-specific esterase were negative. Flow cytometry immunophenotyping revealed the presence of CD 13, CD 33 and CD 34 on the abnormal cells. CD 41, CD 19 and TdT were negative. Which of the following is the most likely cause of these findings?
- a. acute lymphoblastic leukemia
  - \*b. acute myeloid leukemia
  - c. chronic lymphocytic leukemia
  - d. chronic myeloid leukemia
32. A normocellular bone marrow M:E ratio is 3:1. This indicates:
- a. decreased erythropoiesis
  - b. increased erythropoiesis
  - \*c. normal leukopoiesis
  - d. increased leukopoiesis
33. An RDW of 19% would correlate with which finding on the peripheral blood smear?
- a. high MCV and low MCHC
  - b. poikilocytosis
  - \*c. anisocytosis
  - d. normal RBC morphology
34. The CBC data below would most likely be caused by:
- WBC:  $4.5 \times 10^9/L$
  - RBC:  $3.65 \times 10^{12}/L$
  - Hgb: 10.9 g/dL
  - Hct: 33.5%
  - MCV: 88 fL
  - MCHC: 34%
- a. folate deficiency or liver disease
  - b. numerous pregnancies or vitamin B12 deficiency
  - c. chronic blood loss or inadequate iron intake
  - \*d. acute blood loss or a hemolytic anemia

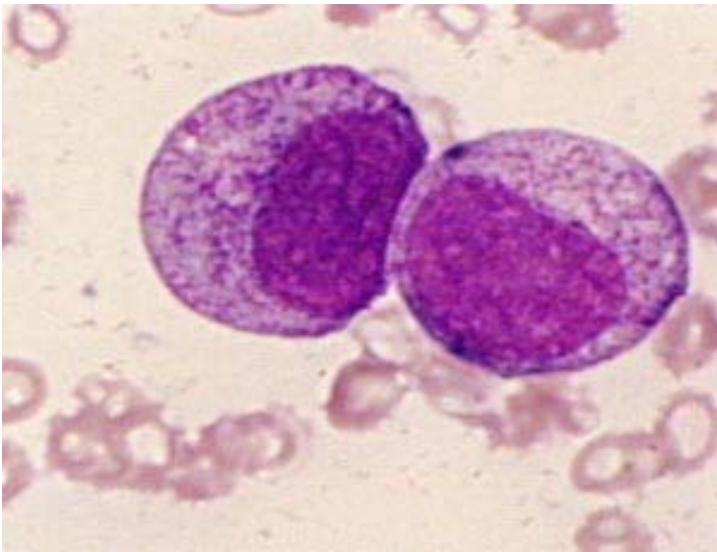
35. What disorder is characterized by the following lab results?

Hemoglobin = 6.2 g/dL  
MCV = 68 fL  
Serum iron – decreased  
TIBC – increased  
Ferritin – decreased  
Hgb A2 = 2%  
Hgb A = 98%



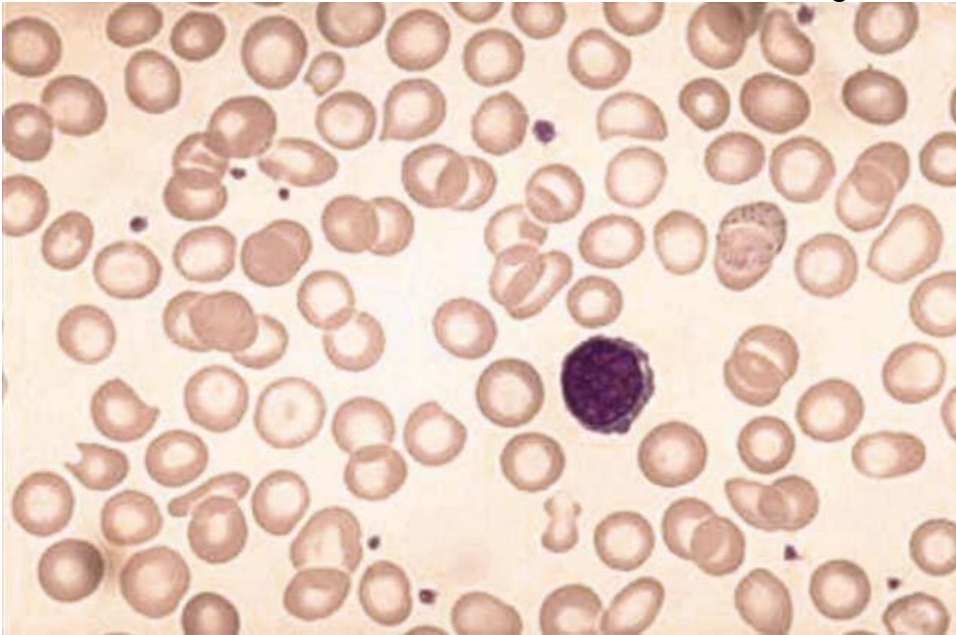
- \*a. iron deficiency anemia
- b. beta thalassemia major
- c. megaloblastic anemia
- d. alpha thalassemia

36. Identify the nucleated cells.



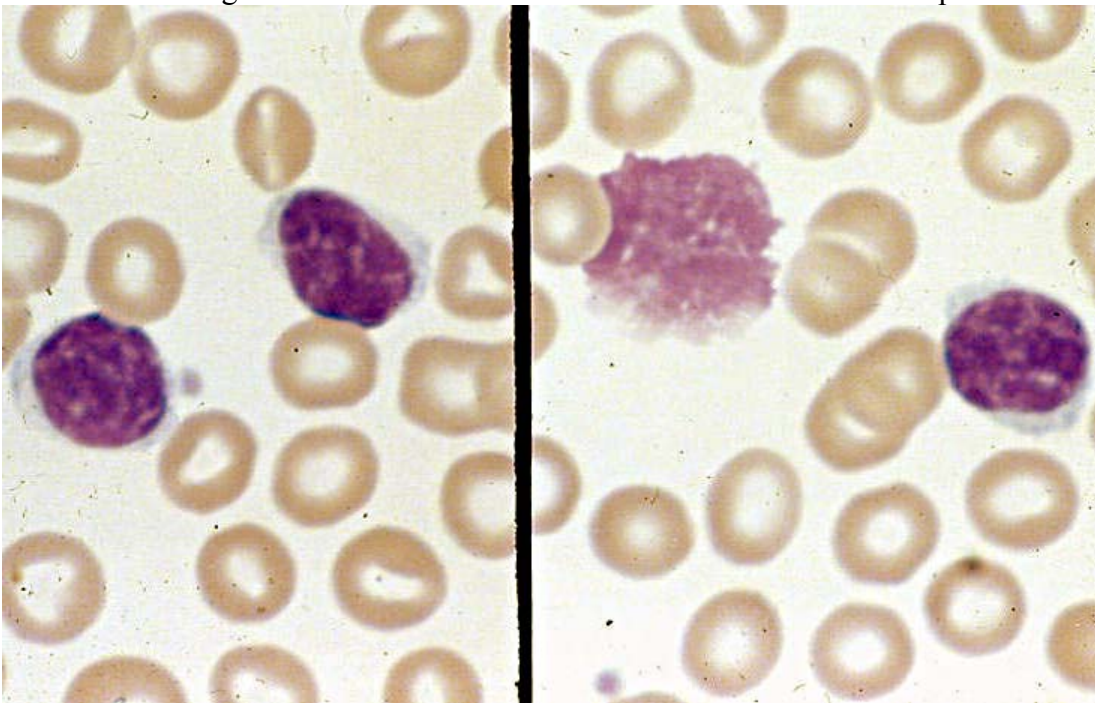
- a. myeloblasts
- \*b. promyelocytes
- c. myelocytes
- d. metamyelocytes

37. Which disorder below is consistent with the RBCs in the image?



- a. hemolytic anemia
- b. megaloblastic anemia
- \*c. anemia of chronic disease
- d. hereditary membrane defect

38. Based on the cells in this photomicrograph, what is the most likely type of leukemia?  
Further testing indicates that most of these cells are CD 19 and CD 5 positive.

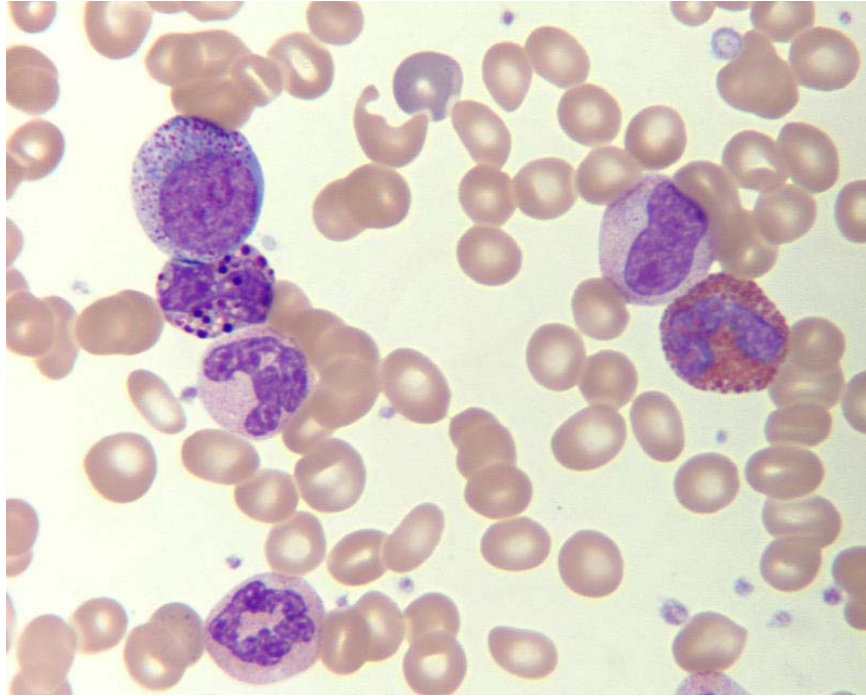


- a. ALL
- b. CML
- c. AML

\*d. CLL

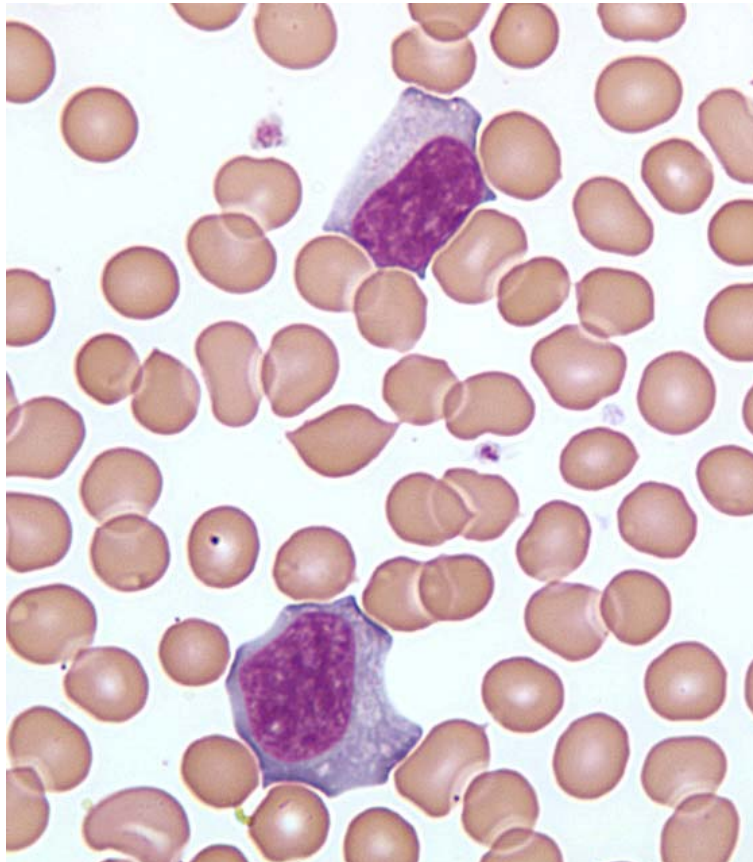
39. The WBC count on a patient is  $143 \times 10^9/L$ . Based on the cells in this peripheral smear, what is the most likely type of leukemia?

- a. ALL
- \*b. CML
- c. AML
- d. CLL

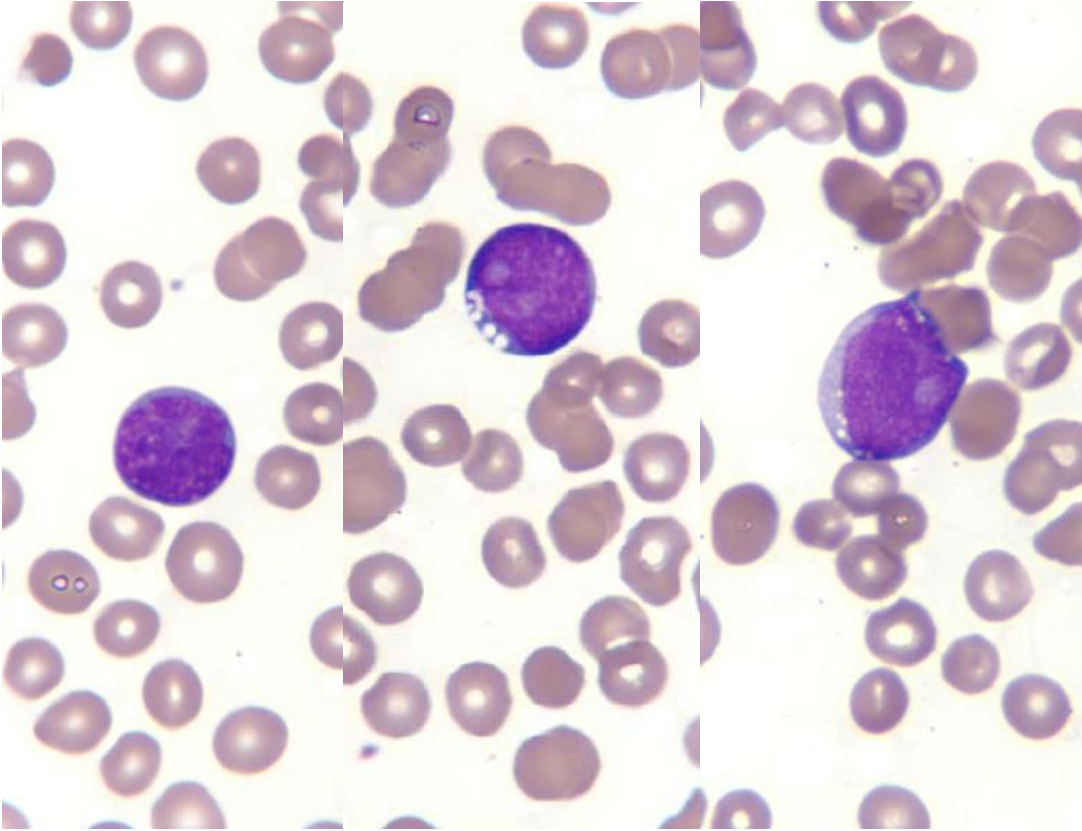


40. These nucleated cells were seen in the peripheral blood of a patient with a relative and absolute lymphocytosis. What would you name them?

- \*a. variant lymphs
- b lymphoblasts
- c. prolymphocytes
- d. plasma cells



41. Which of the following is the most likely identification of the nucleated cells in this case. This is a 6 year old with a WBC count of  $13.0 \times 10^9/L$  and a platelet count of  $57 \times 10^9/L$ . A CD panel revealed they are positive for CD34, CD19 and CD10, but negative for CD33 and CD13.

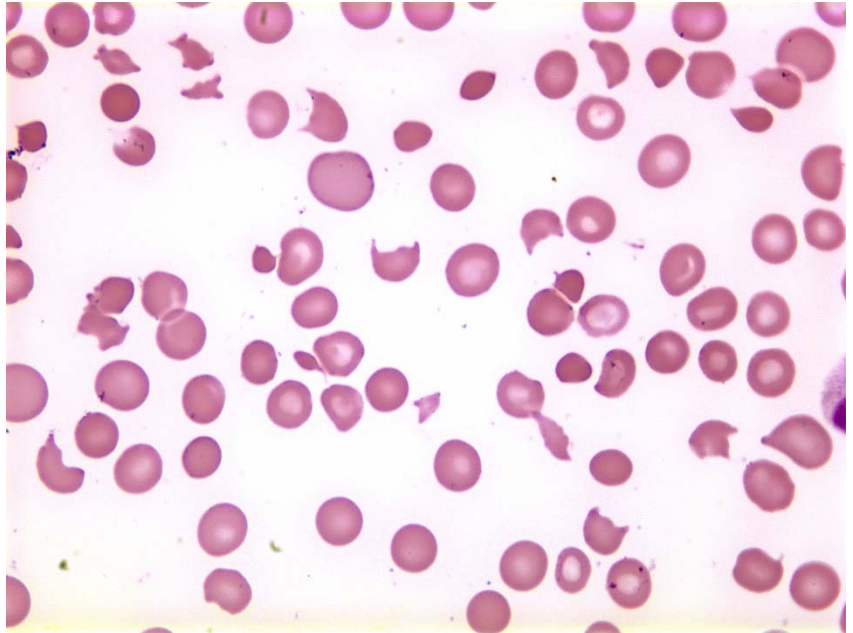


- a. Variant lymphocytes
- \*b. Lymphoblasts
- c. Myeloblasts
- d. Monoblasts



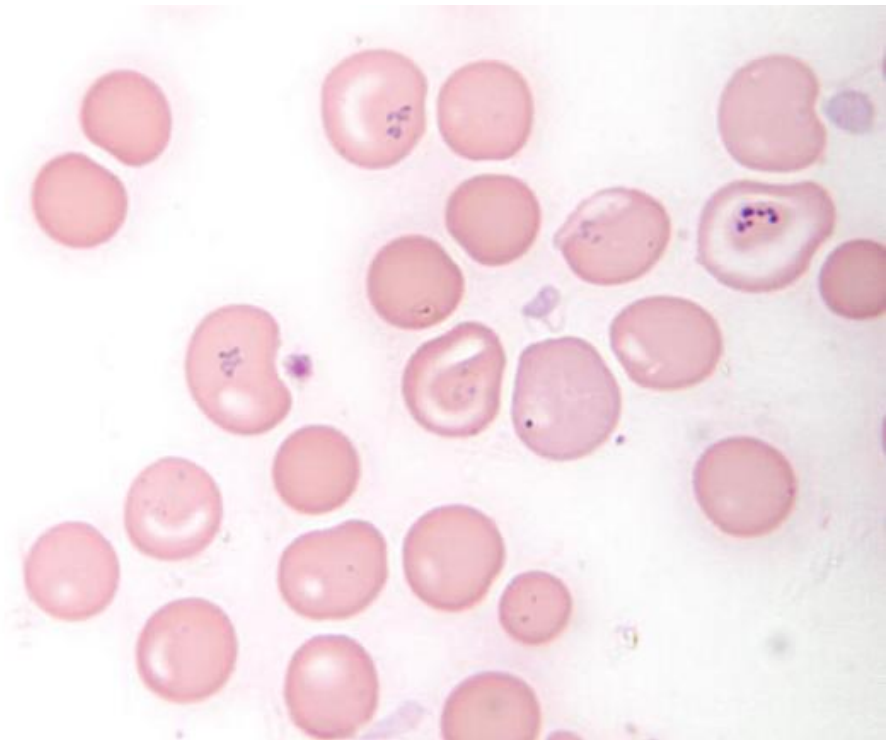
42. Observe for the most prevalent and significant RBC abnormality in this Wright's stained smear. Which of the following conditions is most likely?

- a. Iron deficiency anemia
- b. Sickle cell anemia
- c. Beta/Gamma thalassemia
- \*d. Hemolytic uremic syndrome

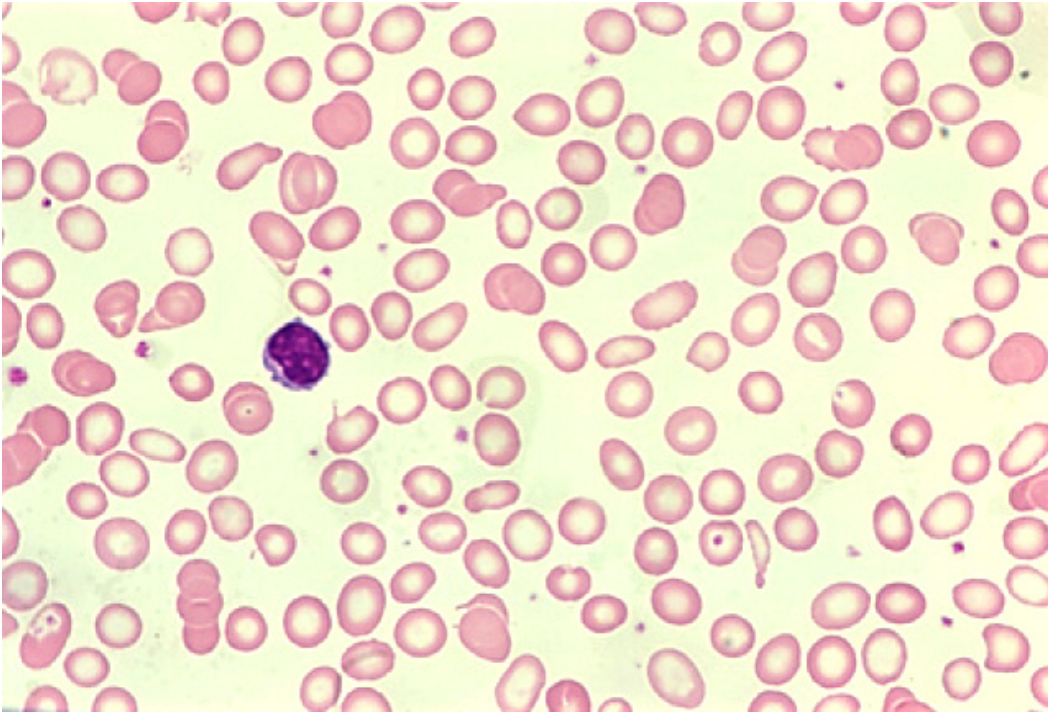


43. Identify the RBC inclusions in this Wright's stained smear.

- a. Heinz bodies
- \*b. Siderotic granules
- c. Howell Jolly bodies
- d. Basophilic stippling



44. Predict the MCV of the RBCs in this photomicrograph.



- a. increased
- b. normal
- \*c. decreased
- d. impossible to predict

45. In an adult female with no apparent nor any history of a bleeding problem, the prothrombin time is 14 sec and the APTT is 49 sec. The platelet count is normal. The patient is known to have an autoimmune disease. Which test should be ordered to rule out a lupus anticoagulant?

- a. Factor VIII assay
- b. platelet aggregation profile
- \*c. Dilute Russell Viper Venom Time
- d. Substitution assay using adsorbed plasma

46. In order to obtain a normal APTT, which list of clotting factors is needed in normal concentration and with normal activity in the patient's plasma?

- a. II, Protein C, X, XI
- b. II, V, VII, X
- \*c. VIII, IX, XI, XII
- d. I, VIII, XIII

47. A child has a platelet count of  $68 \times 10^9/L$  and many bruises. The RBC values are all normal. He has a history of a recent viral infection causing symptoms of a common cold, but no history of abnormal bleeding. Which of the following is most likely?
- a. vonWillebrand's Disease
  - \*b. immune thrombocytopenic purpura
  - c. hemolytic uremic syndrome
  - d. thrombotic thrombocytopenic purpura
48. A patient with a bleeding problem has the following laboratory results:
- Protome = 11.5 sec
  - APTT = 35 sec
  - Bleeding Time = 13 min.
  - Fibrinogen Assay = 278 mg/dL
  - FDP assay = normal
  - Platelet count =  $350 \times 10^9/L$
- Of the following what is the most likely diagnosis and best follow-up test:
- a. Hemophilia A; factor VIII assay
  - \*b. vonWillebrand's disease; platelet aggregation studies
  - c. DIC; D-D Dimer assay
  - d. Lupus anticoagulant; platelet neutralization assay
49. In a patient on Coumadin therapy, what is an expected therapeutic INR value?
- a. 1.1
  - b. 1.5
  - \*c. 2.1
  - d. 5.2
50. A negative result for a D-Dimer assay would indicate which of the following:
- a. a bleeding problem is present
  - \*b. a deep vein thrombosis is unlikely
  - c. the antithrombin levels are decreased
  - d. diagnosis of hemolytic uremic syndrome
51. If a patient with diabetes mellitus has excessive fat catabolism, which test will usually be positive on a routine urine exam?
- a. cholesterol
  - \*b. ketones
  - c. urobilinogen
  - d. protein

52. If a fasting plasma glucose level of 80 mg/dL is obtained on an individual, the expected range of the fasting cerebrospinal fluid (CSF) glucose in mg/dL would be:
- a. 15-25
  - \*b. 40-50
  - c. 60-80
  - d. 100-120
53. Finding a hazy appearing urine with positive blood, RBCs and RBC casts in the sediment is typical when the diagnosis is:
- a. nephrotic syndrome
  - b. pyelonephritis
  - \*c. acute glomerulonephritis
  - d. multiple myeloma
54. A 62-year-old patient with hyperlipoproteinemia and decreased serum albumin has moderate to many waxy, granular, and possible fatty casts. Possible oval fat bodies are also noted. What else should always be found in the urine in this condition?
- a. glucose
  - \*b. albumin
  - c. bilirubin
  - d. Bence Jones protein
55. Significant numbers of bacteria in urine would most likely interfere with which two tests?
- a. Proteins and ketones
  - b. Glucose and ketones
  - c. Proteins and pH
  - \*d. Glucose and pH
56. A urine is diluted by adding 1 mL urine to 2 mL of water and has a specific gravity of 1.008. The specific gravity to be reported would be:
- a. 1.008
  - \*b. 1.024
  - c. 1.032
  - d. 1.040

57. Identify the large objects seen in this urine sediment with a pH of 8.

- a. triple phosphate
- b. uric acid
- c. calcium phosphate
- \*d. ammonium biurate



58. Identify the majority of the cells seen in this urine sediment microscopic?

- \*a. transitional epithelial cells
- b. squamous epithelial cells
- c. leukocytes
- d. renal epithelial cells



59. Amniotic fluid and urine should be protected from light:

- a. because the proteins are unstable
- b. to prevent hemolysis
- \*c. to prevent breakdown of bilirubin
- d. because the antibodies may be light sensitive

60. A patient had his annual athletic physical checkup one hour after completing three hours of weight-lifting. The chem strip results were negative except for a 1+ blood. No RBCs were seen in the microscopic. The probable explanation for these results is:

- a. the specimen was collected between 2 and 4 p.m.
- \*b. myoglobin was excreted during and after exercise.
- c. contamination from another specimen containing blood.
- d. injury to the kidneys during the exercise.

61. A 25-year old woman complains of painful urination and is suspected of having a urinary tract infection. Which of the following specimens should be collected for a routine urinalysis and urine culture?

- a. catheterized collection
- b. timed collection
- \*c. midstream "clean catch"
- d. random specimen

62. Pleural fluid from a patient with congestive heart failure has a low protein and LD content. It contains few nucleated cells. What type of fluid is this considered to be?

- \*a. transudate
- b. exudate
- c. chylous effusion
- d. plasma

63. In an undiluted spinal fluid, 100 RBCs and 40 WBCs were counted in  $4 \text{ mm}^2$  on a hemocytometer with a depth of 0.1mm. The CSF WBC count would be reported as:

- a.  $50/\mu\text{L}$
- \*b.  $100/\mu\text{L}$
- c.  $125/\mu\text{L}$
- d.  $250/\mu\text{L}$

64. The microscopic examination of urine sediment was reported as 10 to 25 RBCs/hpf, whereas the test for blood by reagent strip was negative. Which of the following statements best accounts for this discrepancy?

- a. The urine is contaminated with vaginal fluid
- b. Many RBCs are lysed and their peroxidase activity is reduced
- \*c. Ascorbic acid is interfering with the reaction on the pad
- d. The amount of peroxidase present is below the sensitivity of the pad

65. A manual patient bilirubin test was performed along with a control sample and a bilirubin standard of 5.0 mg/dl. The acceptable range for the control is 3.1-3.9 mg/dl.  
The normal expected total bilirubin in this lab is <1.2 mg/dL

The following absorbances were obtained:

Standard: 0.425  
Patient: 0.101  
Control: 0.385

Which of the following best describes the correct interpretation of this data?

- a. Patient value is normal; control value is within range; patient result can be reported
- \*b. Patient value is normal; control is outside acceptable range; patient result cannot be reported
- c. Patient value is abnormal; control within range; patient result can be reported
- d. Patient value is abnormal; control outside acceptable range; patient result cannot be reported

66. Which percentage of results will fall within  $\pm 2$  standard deviations of the mean in a frequency histogram?

- a. 99%
- \*b. 95%
- c. 68%
- d. 50%

67. Which of the following standards, require that MSDSs (Material Safety Data Sheets) be accessible to all employees who come into contact with potentially hazardous substances?

- a. Bloodborne Pathogen Standard
- \*b. Hazardous Communication Standards
- c. Centers for Disease Control (CDC) Regulations
- d. Personal Protection Equipment Standard

68. A test kit requires that you dilute 1 mL of patient serum with 3 mL of buffer. One mL of that dilution are then added to 9 mL of test reagent. What is the final dilution of patient serum?

- a. 1:10
- b. 1:20
- c. 1:30
- \*d. 1:40

69. Which of the following serum results are consistent with primary hyperparathyroidism?

- \*a. increased calcium, decreased phosphorus, increased parathyroid hormone (PTH)
- b. increased calcium, increased phosphorus, increased parathyroid hormone (PTH)
- c. decreased calcium, increased phosphorus, increased parathyroid hormone (PTH)
- d. decreased calcium, decreased phosphorus, decreased parathyroid hormone (PTH)

70. What is the most likely problem with a patient who has the following laboratory results?

- Serum gamma glutamyltransferase: normal
- Serum alanine aminotransferase: normal
- Serum indirect and total bilirubin: increased
- Serum direct bilirubin: normal
- Urine bilirubin: normal
- Urine urobilinogen: increased

- a. infectious hepatitis
- b. bone disease
- c. biliary obstruction
- \*d. severe hemolytic anemia

71. Which of the following is true of creatinine?

- a. synthesized in the kidney
- \*b. product of creatine phosphate metabolism
- c. elevated in gout
- d. considered a liver function test

72. What is the creatinine clearance in mL/min of a 45-year-old male of average height and weight if his serum creatinine = 1.8 mg/dl, urine creatinine = 129.5 mg/dl. and total urine volume collected in a 24 hour period is 500 ml?

- a. 10
- \*b. 25
- c. 125
- d. 155

73. What is the acid-base abnormality of a patient who has a pH of 7.30, pCO<sub>2</sub> of 45 mm Hg, and a total CO<sub>2</sub> value of 23 mEq/L?

- a. metabolic acidosis
- b. metabolic alkalosis
- \*c. respiratory acidosis
- d. respiratory alkalosis

74. Isoenzymes:

- \*a. Differ in structure, but catalyze the same reaction.
- b. Differ in structure and catalyze different reactions
- c. Have the same structure, but catalyze different reactions.
- d. Have the same structure and catalyze the same reaction.

75. To compensate for an increased blood pH, the kidneys will:



- a. decrease the excretion of ADH
- b. decrease excretion of bicarbonate ion
- \*c. decrease secretion of hydrogen ion
- d. increase secretion of hydrogen ion

76. Which of the following analytes is the earliest indicator of myocardial infarction and the first analyte to return to normal post-infarction?

- a. Total CK
- b. LD
- \*c. Myoglobin
- d. AST

77. Which statement about glycated hemoglobin (Hb A 1c) is correct?

- a. formation of Hb A 1c occurs when the RBC is senescent
- \*b. diabetics typically have higher Hb A 1c values than non-diabetics
- c. glycation of red blood cells is reversible
- d. Hb A 1c values indicate average blood glucose levels for the previous 2 weeks

78. Which of the following is true regarding the response of a person with Type I diabetes mellitus to a glucose tolerance test?

- a. glucose will be removed from the blood at a faster rate than normal
- \*b. the peak glucose level will be higher than normal, and a return to the fasting level is delayed
- c. the person will overproduce insulin due to the glucose load
- d. 2 hours after administration of glucose the diabetics blood sugar level will be near the normal fasting level

79. The pituitary hormone responsible for water reabsorption by the kidney is:

- a. aldosterone
- b. renin
- c. cortisol
- \*d. antidiuretic hormone

80. A serum thyroid stimulating hormone level that is 5 times the upper limit of normal in the presence of an increased T4:

- a. is diagnostic of primary hypothyroidism
- b. is diagnostic for secondary hypothyroidism
- \*c. is typical in hyperthyroidism
- d. establishes the pituitary gland as the cause for hypothyroidism

81. What is the purpose for polymerase chain reaction (PCR) technology?

- \*a. Temperature management technique that amplifies DNA copies to produce enough for analysis
- b. Method for separating molecules of various size and charge by passage through a medium
- c. Enzyme system that selectively nicks a nucleic acid at the phosphodiester bond to produce nucleotides
- d. Method to produce hybridization probes

82. The plasma protein that is most indicative of iron storage levels is:

- a. haptoglobin
- b. transferrin
- \*c. ferritin
- d. erythropoietin

83. A patient breathing room air has the following arterial blood gas and electrolyte results:

pH = 7.54  
pCO<sub>2</sub> = 18.5 mmHg  
pO<sub>2</sub> = 145 mmHg  
HCO<sub>3</sub><sup>-</sup> = 18 mmol/L  
Na = 135 mmol/L  
K = 4.6 mmol/L  
Cl = 98 mmol/L  
TCO<sub>2</sub> = 26 mmHg

The best explanation for these results is:

- a. Blood for electrolytes was drawn above an IV
- b. Serum sample was hemolyzed
- c. Venous blood was sampled for the arterial blood gases
- \*d. Blood gas sample was exposed to air

84. Calculate the LDL Cholesterol value using the following data:

Total cholesterol = 300 mg/dL  
HDL Cholesterol = 30 mg/dL  
Triglycerides = 240 mg/dL  
Glucose = 100 mg/dL

- a. 178 mg/dL
- \*b. 222 mg/dL
- c. 230 mg/dL
- d. 270 mg/dL

85. Low risk of coronary heart disease is associated with:

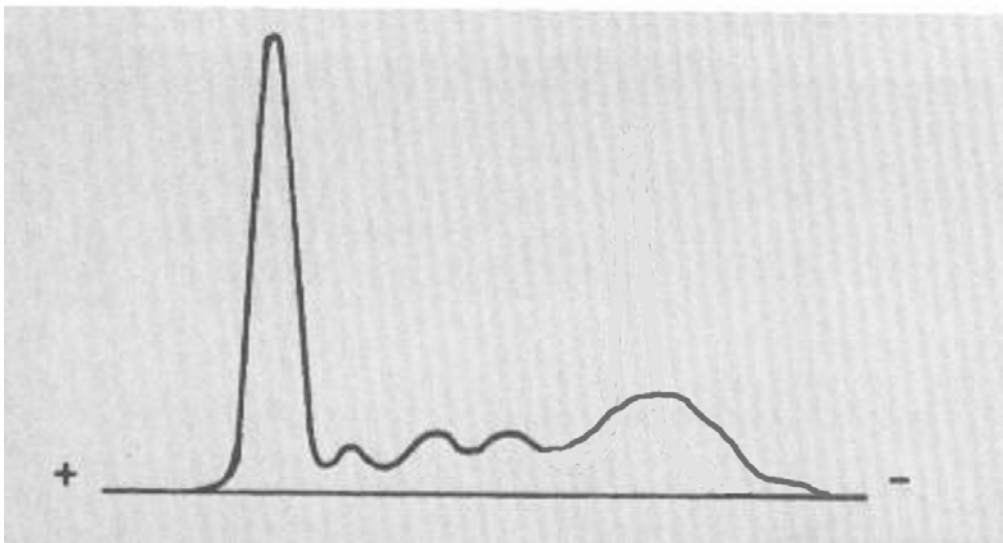
- a. increased LDL- cholesterol
- \*b. increased HDL - cholesterol
- c. increased VLDL - cholesterol
- d. increased lipase

86. Four serum specimens were analyzed for electrolytes. Which set of results is most likely in error? (results are in mEq/L)

Sodium; Chloride; Bicarbonate

- \*a. 130; 105; 27
- b. 135; 103; 18
- c. 138; 98; 27
- d. 140; 100; 25

87. A serum protein electrophoresis pattern shows a moderate generalized elevation in all gamma globulins. Other protein fractions are normal. This pattern supports a diagnosis of:



- a. nephrotic syndrome
- b. monoclonal gammopathy
- c. acute inflammation
- \*d. polyclonal gammopathy

88. One of two controls within a run is above +2 standard deviations and the other control is below -2 standard deviations from the mean. What do these results indicate?

- \*a. Poor precision has led to random error (RE)
- b. A systematic error (SE) is present
- c. Proportional error is present
- d. QC material is contaminated

89. Which electrolyte concentration and which disorder is indicated by increases in this electrolyte?

- a. potassium, muscular dystrophy
- b. potassium, cystic fibrosis
- c. chloride, muscular dystrophy
- \*d. chloride, cystic fibrosis

90. Which of the following situations is most likely to cause a falsely high creatinine clearance result?

- a. The patient uses the midstream void procedure when collecting his or her urine
- b. The patient adds tap water to the urine container because he or she forgets to save on of the urine samples
- c. The patient does not empty his or her bladder at the conclusion of the test
- \*d. The patient empties his or her bladder at the start of the test and adds the urine to the collection

91. An anion gap was found to be 3 mmol/L. Which of the following is the most likely cause of this result?

- a. Increased unmeasured cations
- b. Decreased unmeasured cations
- \*c. Falsely decreased sodium value
- d. Falsely decreased chloride value

92. Determine the anion gap given the serum electrolyte data:

Na – 148 mmol/L  
Cl – 88 mmol/L  
HCO<sub>3</sub><sup>-</sup> – 30 mmol/L  
pCO<sub>2</sub> – 33 mm/Hg

- a. 10 mmol/L
- b. 20 mmol/L
- \*c. 30 mmol/L
- d. cannot be determined

93. Which condition gives rise to the highest serum level of transaminases?

- \*a. Acute hepatitis
- b. Alcoholic cirrhosis
- c. Obstructive biliary disease
- d. Myocardial infarction

94. A technologist is asked to use the serum from a clot tube left over from a chemistry profile run at 8 am for a STAT ionized calcium at 11 am. The technologist should

- a. Perform the assay on the 8 am sample
- b. Perform the test only if the serum container was tightly capped
- c. Perform the assay on the 8 am sample only if it was refrigerated
- \*d. Request a new specimen

95. How many grams of sulfosalicylic acid (MW=254) are required to prepare 500 mL

of a 2 M solution?

- a. 127
- \*b. 254
- c. 508
- d. 2

96. A peak blood level for orally administered theophylline (therapeutic range 8-20 mg/L) measured at 8 am is 5.0 mg/L. The preceding trough level was 4.6 mg/L. What is the most likely explanation of these results?

- a. laboratory error made on peak measurement
- b. Specimen for peak level was collected from wrong patient
- \*c. blood for peak level was drawn too soon
- d. elimination rate has reached maximum

97. Which of the following conditions is associated with a high serum Troponin I?

- a. viral hepatitis
- b. bone disease
- \*c. acute myocardial infarction
- d. pancreatitis

98. Decreased serum total protein, increased alpha and gamma globulin level and increased urine protein and lipid is usually seen in:

- a. pyelonephritis
- b. hepatic cirrhosis
- c. glomerulonephritis
- \*d. nephrotic syndrome

99. The term R 4s means that:

- a. Four consecutive controls are greater than  $\pm 1$  standard deviation from the mean
- \*b. One control in a group is plus 2s above the mean and a second control is minus 2s
- c. Two consecutive controls in the same run are each greater than  $\pm 4$  s from the mean
- d. There is a shift above the mean for four consecutive controls

100. An anion gap was found to be 28 mmol/L. Which of the following is a possible cause of this result?

- a. Liver disease with a high bilirubin
- b. Increased unmeasured cations
- \*c. Increased unmeasured anions
- d. Decreased potassium

101. Which immunoglobulin class would be most important in the study of immune-mediated transfusion reactions due to the presence of alloantibodies?
- \*a. IgG
  - b. IgM
  - c. IgA
  - d. IgD
102. The composition of which of the following PCR reagents is most critical in insuring that amplification of only the target DNA occurs?
- a. PCR reaction buffer
  - b. DNA polymerase
  - \*c. Oligonucleotide primers
  - d. dNTPs
103. A man opens up an old loaf of bread and inhales *Penicillium* spores from the organism growing inside. Phagocytes in the man's lungs engulf and digest the spores. The man never gets sick. This is an example of:
- a. passive immunity
  - b. adaptive immunity
  - c. acquired immunity
  - \*d. innate immunity
104. Which of the following statements are true concerning B lymphocytes?
- a. when mature B lymphocytes are released from the bone marrow, they immediately begin secreting antibody
  - b. B cell antibody response is generally very effective against viruses contained within host cells
  - c. B cells are taught to discriminate "self" antigens from "non-self" antigens in the thymus
  - \*d. B memory cells can live for years and reactivate quickly if they encounter the same antigen
105. The detection of the following markers suggests an acute infection of hepatitis B virus:
- a. anti-HBe, anti-HBc
  - \*b. HBs Ag, anti-HBc IgM
  - c. HBs Ag, anti-HBe
  - d. HBe Ag, anti-HBe IgM
106. An antigen found in a high proportion of patients with progressive carcinoma of the colon is:
- a. viral antigen
  - \*b. carcinoembryonic antigen
  - c. alpha-fetoprotein
  - d. heterophil

107. Hemolytic Disease of the Newborn and transfusion reactions caused by antibodies to red cell antigens are examples of \_\_\_\_\_ reactions.

- a. Type I
- \*b. Type II
- c. Type III
- d. Type IV

108. Which immunoglobulins can activate the classic pathway of the complement system?

- a. IgA and IgM
- b. IgG (all subgroups) and IgA
- \*c. IgG1, IgG2, IgG3, and IgM
- d. IgE and IgG1, IgG2, IgG4

109. Which statement best describes how heterogeneous immunoassays differ from homogeneous immunoassays?

- \*a. Heterogeneous assays require a washing step while homogeneous assays do not require a washing step
- b. Heterogeneous assays are easier to automate than homogenous assays
- c. The concentration of patient analyte is always directly proportional to bound label in homogeneous assays but indirectly proportional in heterogeneous assays
- d. Homogeneous assays can have a competitive and non-competitive format while heterogeneous assays can only have a competitive format

110. Blood was drawn from a 25-year-old woman with suspected SLE. A FANA screen was performed, and a speckled pattern resulted. Which of the following actions should be taken next?

- a. report out as diagnostic for SLE
- b. report out as drug-induced lupus
- \*c. test for antibodies to ds-DNA and Sm antigens
- d. repeat the ANA test using a different methodology

111. The role of properdin in the alternate complement pathway is:

- a. binding to a foreign antigen
- b. conversion of B to Bb
- \*c. activation of C3
- d. inhibition of the formation of C3 convertase

112. A 3-year-old boy is hospitalized because of recurrent bouts of pneumonia. Lab tests are run, and the following findings were noted: prolonged bleeding time, decreased platelet count, increased level of serum alpha-fetoprotein, and a deficiency of naturally occurring isohemagglutinins. Based on these results, which is the most likely diagnosis?

- a. purine-nucleoside phosphorylase deficiency
- b. selective IgA deficiency
- c. severe combined immunodeficiency
- \*d. Wiskott-Aldrich syndrome

113. A 25-year-old female was evaluated for episodes of numbness and difficulty moving her extremities. Laboratory results were as follows:

CBC, Urinalysis, Renal function tests, Electrolytes and Glucose: all within reference limits  
ANA: negative  
Antiachetylcholine receptor antibody: negative  
Total Protein, IgG and myelin basic protein in the CSF: elevated  
High resolution protein electrophoresis: serum – polyclonal gamma region  
High resolution protein electrophoresis: CSF – oligoclonal gamma region

What is the most likely diagnosis?

- \*a. Multiple Sclerosis (MS)
- b. Multiple Myeloma
- c. Systemic Lupus Erythematosus (SLE)
- d. Myasthenia Gravis (MG)

114. What is the role of class II MHC proteins on donor cells in acute graft rejection?

- a. They produce interleukin-2, which attacks the donor cells
- \*b. They are recognized by helper T cells, which then activate cytotoxic T cells to kill the donor cells
- c. They induce the production of blocking antibodies that protect the graft
- d. They induce IgE which mediates graft rejection

115. Which of the following descriptions is not true of IgM?

- a. it has the highest molecular weight of all the immunoglobulins
- b. it fixes complement
- c. it is produced in the primary antibody response
- \*d. it crosses the placenta to impart passive immunity

116. In which of the following tests is a lack of agglutination considered a positive reaction?

- a. hemagglutination
- b. passive hemagglutination
- c. reverse passive hemagglutination
- \*d. hemagglutination inhibition



117. Which of the following is the immunodominant sugar for Blood group A specificity?

- \*a. N-acetyl galactosamine
- b. D-galactose
- c. L-fucose
- d. N-acetyl glucosamine

118. If a pedi-pack of red blood cells is prepared from the original single-bag unit of red blood cells, the expiration date of the unit must be changed to:

- a. 8 hours
- \*b. 24 hours
- c. 48 hours
- d. 72 hours

119. Which of the following is true of additive solutions for red blood cells?

- a. 5% dextrose is the only compound added to the original preservative
- \*b. they extend the outdate of the red cell unit to 42 days from collection
- c. they can be prepared up to 3 days after outdate of the original unit
- d. units with the additive have a higher hematocrit than the original unit

120. Which of the following would make a specimen unacceptable for routine antibody screening and compatibility testing?

- a. an anticoagulated tube was drawn
- b. the specimen was stored at 4°C for 24 hours
- \*c. the specimen was hemolyzed
- d. the specimen was labeled with only the patient's name, hospital number and date of collection

121. Directed donor units from family members should be processed to avoid graft-vs-host disease by:

- a. filtration to remove leukocytes
- \*b. irradiation
- c. washing with saline
- d. freezing and deglycerolization

122. The temperature that must be maintained in all areas of the blood bank refrigerator at all times is:

- a. 3-5 degrees C
- b. 6-9 degrees C
- c. 1-10 degrees C
- \*d. 1-6 degrees C

123. The following results are obtained in a paternity case:

	<u>Alleged Father</u>	<u>Mother</u>	<u>Child</u>
ABO	A	A	A
Rh	Pos	Pos	Pos
MN phenotype	MN	MM	MN
HLA type	A3,A9,B7,B9	A1,A2,B5,B7	A1,A6,B5,B12

On the basis of these results, the alleged father is:

- a. possibly the father
- \*b. excluded as the father
- c. definitely proven to be the father
- d. more testing is needed

124. Which of the following blood components contains the most factor VIII concentration relative to volume?

- a. plasma
- \*b. cryoprecipitate
- c. fresh frozen plasma
- d. platelet concentrate

125. A 45 year-old man was admitted to the hospital for with gastrointestinal bleeding from recurrent peptic ulcers. The patient had received a transfusion 4 months earlier for the same symptoms. Three units were crossmatched, found to be compatible and transfused. Five days after the transfusion, the patient appeared pale and mildly jaundiced, had a fever of 39°C and his hemoglobin had dropped to 5g/dL. Upon testing the antibody screen was positive. Five days ago it had been negative. What type of transfusion reaction has occurred in this patient?

- a. acute hemolytic transfusion reaction
- \*b. delayed hemolytic transfusion reaction
- c. febrile nonhemolytic transfusion reaction
- d. TRALI

126. A serum containing anti-k is not frequently encountered. This is because:

- \*a. individuals who lack the k antigen are rare
- b. individuals who possess the k antigen are rare
- c. the k antigen is not a good immunogen
- d. Kell<sub>null</sub> individuals are rare

127. Select the most likely cause for the ABO forward and reverse reactions given below:

anti-A	anti-B	anti-A,B	A <sub>1</sub> cells	B cells	O cells	Autocontrol
4+	0	4+	0	0	0	0

- a. polyagglutinable cells
- \*b. elderly patient
- c. acquired A-like antigen
- d. subgroup of A

128. Which of the following would be a cause for deferral of a blood donor?

- a. temperature of 98.9 degrees F
- b. pulse of 90 beats per minute
- c. blood pressure of 110/70 mm Hg
- \*d. hematocrit of 36%

129. It is estimated that a fetomaternal hemorrhage of 60 mL whole blood occurred at delivery. The mother is eligible for RhIg. How much should she be given?

- a. 1 vial microgram RhIg
- b. 1 vial RhIg
- \*c. 3 vials RhIg
- d. 4 vials RhIg

130. Which characteristics are true of all three of the following antibodies: anti-Fy<sup>a</sup>, anti-Jk<sup>a</sup>, and anti-K?

- \*a. detected at the IAT phase; may cause hemolytic disease of the newborn (HDN) and transfusion reactions
- b. not detected with enzyme-treated cells; may cause delayed transfusion reactions
- c. does not show dosage effect; may cause severe hemolytic transfusion reactions
- d. does not bind complement; usually not responsible for causing HDN

131. Neutralization tests:

- a. remove antibody from the serum using antigen positive red cells
- b. determine the highest dilution at which an antibody can produce agglutination with its corresponding antigen
- \*c. eliminate antibody reactivity by combining the antibody with soluble antigen
- d. remove antibody bound to the red cell and recover it in testable form

132. A person of the genotype R<sub>2</sub>R could potentially produce antibodies of the following Rh specificity:

- a. anti-c
- b. anti-e
- c. anti-D
- \*d. anti-C

133. The fact that many individuals who are natives of Western Africa are resistant to malaria appears to be associated with the absence of:

- a. Duffy antibodies on their serum
- b. Kidd antigens on their red cells
- \*c. Duffy antigens on their red cells
- d. Kell antigens on their red cells

134. Which of the following reactions would you expect with a specimen that is from a Bombay phenotype individual?

- \*a. patient's cells + *Ulex europaeus* = no agglutination
- b. patient's cells + *Ulex europaeus* = agglutination
- c. patient's serum + group O donor RBCs = no agglutination
- d. patient's serum + A<sub>1</sub> and B cells = no agglutination

135. Anti-M was detected in a 27-year-old man before surgery. Units negative for M antigen were not available; however the units were approved for transfusion when the major crossmatch using M+N+ donor cells and patient serum resulted in:

- \*a. IS = 2+; 37°C = 0; AHG = 0
- b. IS = 1+; 37°C = 1+; AHG = 0
- c. IS = 2+; 37°C = 1+; AHG = 0
- d. IS = 1+; 37°C = 2+; AHG = 1+

136. Why is testing for Rh antigens and antibodies different from ABO testing?

- a. ABO antigens are attached to specific receptors on the outside of the red cell and do not require any special enhancement for testing; Rh antigens are loosely attached to the red cell membrane and require complement enhancement for detection
- \*b. ABO reactions are primarily due to IgM antibodies and usually occur at room temperature; Rh antibodies are IgG, and agglutination usually requires incubation and enhancement media
- c. There is no difference in ABO and Rh testing; both may be conducted at room temperature with no special enhancement needed for reaction
- d. Both ABO and Rh antigens and antibodies have similar structures, but Rh antibodies are configured so that special techniques are needed to facilitate binding to Rh antigen

137. A patient who is ABO group A and types Le(a+b-) is most probably:

- a. a secretor
- b. homozygous for the Lewis gene
- \*c. a nonsecretor
- d. heterozygous for the Lewis gene

138. Anti-I is the most common specificity found in:

- a. infectious mononucleosis
- \*b. cold agglutinin disease
- c. alcoholic cirrhosis
- d. myeloid leukemia

139. An individual has formed an anti-P<sub>1</sub>. What is their phenotype?

- a. P<sub>1</sub>k
- b. p
- c. P<sub>1</sub>
- \*d. P<sub>2</sub>

140. An Rh negative mother with a high titer of anti-D in her serum delivers a severely jaundiced infant. Testing of the cord blood shows a strongly positive DAT although the cord cells appear Rh negative when tested with anti-D antisera. The most probable explanation is:

- a. Wharton's jelly is reacting with the AHG antisera
- b. the mother's antibody has specificity to rh' in addition to Rho
- c. the jaundice is purely physiological, having no immune basis
- \*d. the infant's cells are truly Rh positive, but the Rh antigen sites have been blocked by the mother's potent anti-D

141. Which of the following is acceptable to be given intravenously with a blood transfusion?

- a. Dextran
- b. 5% dextrose in water
- c. Ringer's solution
- \*d. Physiologic saline

142. If a patient's red blood cells are DAT+ due to penicillin antibody, the

- a. serum will react if penicillin is added to the test system
- b. serum will react with all cells
- \*c. eluate will react with penicillin coated red cells
- d. eluate will react with all cells

143. A patient has an antibody that reacts with 1 in 10 cells. The reactions are seen only at the AHG phase and the use of enzymes has no effect on the results. The crossmatch is compatible for both units requested using non-phenotyped units. Which of the following is the most probable antibody?

- \*a. anti-K
- b. anti-k
- c. anti-Fy<sup>a</sup>
- d. anti-c

144. Which of the following is acceptable for autologous donation?

- a. uncontrolled hypertension
- b. hemoglobin level of 10.5 g/dL
- \*c. weight of 40 kg
- d. surgery scheduled in 2 days

145. Direct antiglobulin testing is useful for which of the following?

- \*a. investigation of Hemolytic Disease of the Newborn
- b. compatibility testing (crossmatching)
- c. antibody screening
- d. antigen typing

146. Which of the following antigens is the most immunogenic (has the greatest ability to stimulate production of antibody in antigen negative individuals)?

- a. K
- \*b. D
- c. Fya
- d. Jka

147. Sulfhydryl reagents such as DTT are used in antibody identification to:

- a. decrease the ionic strength of the test system
- b. increase the reactivity of Kell system antibodies
- \*c. distinguish IgM from IgG antibodies
- d. destroy Duffy and Kidd system antibodies

148. Approximately how many random ABO compatible donors would need to be screened to find 2 units of compatible blood for a patient with anti-S and anti-Jk<sup>b</sup>?

Antigen **Frequency**: S+ 55%; Jk<sup>b</sup>+ 73%

- a. 5
- b. 11
- \*c. 17
- d. 34

149. Which of the following is characteristic of the Xg<sup>a</sup> blood group system?

- \*a. The Xg<sup>a</sup> antigen has a higher frequency in women than in men
- b. The Xg<sup>a</sup> antigen has a higher frequency in men than in women
- c. The Xg<sup>a</sup> antigen is enhanced by enzymes
- d. Anti-Xg<sup>a</sup> is usually a saline reacting antibody

150. Which of the following describes the etiology of graft-versus-host disease (GVHD)?

- a. Anti PLA1 attaches to platelet surfaces permitting extravascular destruction by RES
- b. B lymphocytes from donor blood react with major and minor histocompatibility antigens in patient
- \*c. T lymphocytes from donor blood react with major and minor histocompatibility antigens in patient
- d. Alloantibody in patient serum react with donor red cells

151. The specimen of choice for detecting respiratory syncytial virus is a:

- a. throat swab
- \*b. nasopharyngeal aspirate
- c. bronchoalveolar wash
- d. lung biopsy

152. A flat colony is isolated on MacConkey/EMB from a stool specimen. The isolate has an Alkaline/ Acid reaction on TSI with gas and an abundant H<sub>2</sub>S production. The citrate utilization test, ornithine and lysine decarboxylation tests, and methyl red tests are all positive. No indole is produced and there is motility. The laboratory scientist should report:

- a. normal flora
- \*b. *Salmonella* spp. isolated, confirmation and serotyping to follow
- c. *Shigella* spp, isolated, confirmation and serotyping to follow
- d. possible mixed culture, re-streak for purity

153. The toga virus known to produce fetal defects is:

- a. Influenza
- b. Rotavirus
- \*c. Rubella
- d. Varicella

154. Which of the following organisms would not have *in vitro* susceptibility testing routinely performed even when they are isolated in pure culture from clinically important body sites?

- \*a. *Streptococcus pyogenes*
- b. *Escherichia coli*
- c. *Proteus mirabilis*
- d. *Staphylococcus aureus*

155. An oxidase negative bacillus produces purple colonies on EMB and dark pink, dry-looking colonies on MacConkey agars. Based on the sugars that the organism ferments, what reactions should you see in a TSI slant?

- a. acid over alkaline
- \*b. acid over acid
- c. alkaline over acid
- d. alkaline over alkaline

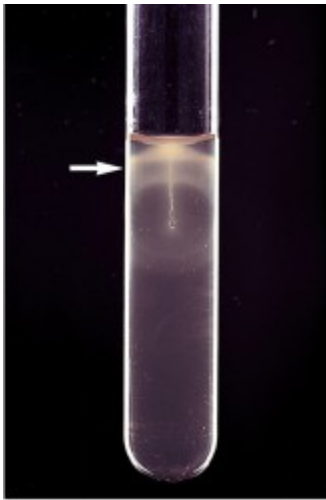
156. Which of the following protozoans is known only in the trophic stage?

- a. *Balantidium*
- b. *Chilomastix*
- c. *Giardia*
- \*d. *Trichomonas*

157. Of the following species of mycobacterium, which causes a chronic disease of the skin, mucous membranes, and nerve tissue and has not yet been cultivated *in vitro*?

- a. *M. paratuberculosis*
- \*b. *M. leprae*
- c. *M. fortuitum*
- d. *M. goodii*

158. A cloudy CSF sample grew short gram-positive rods and exhibited a narrow zone of beta hemolysis on sheep blood agar. The results of a motility test after 24 hours at room temperature are shown below. The organism is most likely which of the following?



- a. *Salmonella*
- b. *Erysipelothrix*
- c. *Corynebacterium*
- \*d. *Listeria*

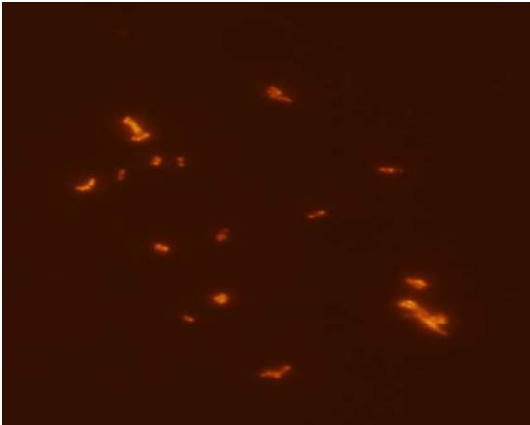
159. Increased CO<sub>2</sub> (8% to 10%) and reduced O<sub>2</sub> (5% to 10%) is the environmental condition that best suits which type of organism?

- a. Aerobes
- b. Anaerobes
- c. Facultative anaerobes
- \*d. Microaerophiles

160. The picture shown below is an auramine-rhodamine stain of an organism recovered from an infected finger wound that was slowly progressive in spite of topical antibiotic treatment. The infection developed several days



after the patient cut his finger cleaning his home aquarium. The organism grew optimally at 30°C on Middlebrook 7H11 medium and formed deep yellow pigment when exposed to light. The organism was negative for nitrates and heat stable catalase, but hydrolyzed Tween and produced urease and pryazinamidase. What is the most probable identification of this organism?



- a. *Mycobacterium ulcerans*
- b. *Mycobacterium gordonae*
- c. *Mycobacterium kansasii*
- \*d. *Mycobacterium marinum*

161. A liquid fecal specimen from a 3-month-old infant is submitted for microbiological examination. In addition to culture on routine media for Salmonella and Shigella this specimen routinely should be:

- \*a. examined for the presence of *Campylobacter spp.*
- b. examined for the presence of *Staphylococcus aureus*
- c. placed in thioglycollate broth to detect botulism
- d. plated on CCFA

162. Humans acquire infections of *Taenia saginata* by:

- \*a. ingestion of the cysticercus in undercooked meat
- b. ingestion of the embryonated egg from contaminated soil
- c. penetration of skin by the filariform larva
- d. injection of rhabditiform larva through insect bites

163. The Vi (K) antigens of the family Enterobacteriaceae are:

- a. the somatic antigens
- \*b. capsular, heat labile antigens
- c. the antigens used to serologically group *Shigella*
- d. located on the flagellum

164. All of the following are true concerning Rickettsiae EXCEPT:

- a. they are small pleomorphic bacilli which are difficult to stain
- b. most are obligate intracellular parasites
- \* c. the specimen of choice for diagnosis is sputum
- d. they are usually transmitted by arthropod vectors

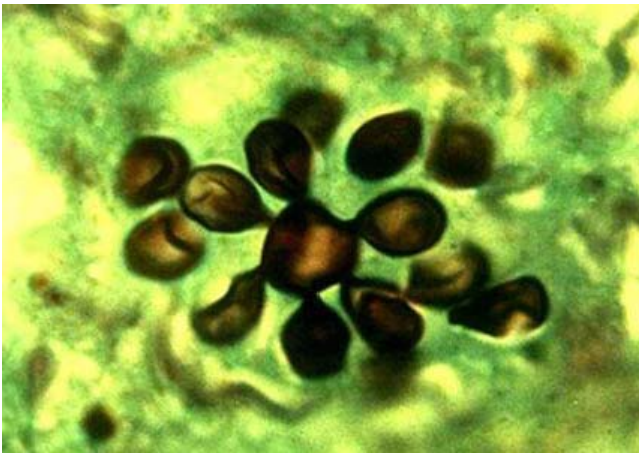
165. The protein coat that surrounds the nucleic acids of a virion is called a:

- a. capsomere
- \*b. capsid
- c. genome
- d. envelope

166. Colonies of *Neisseria* sp. turn color when a redox dye is applied. The color change is indicative of the activity of the bacterial enzyme:

- \*a. Cytochrome oxidase
- b.  $\beta$ -galactosidase
- c. Phenylalanine deaminase
- d. Urease

167. The dimorphic fungus that typically has a tissue phase in which the large mother cells have one to two dozen narrow-necked buds as pictured below and a slow growing mycelial form is:

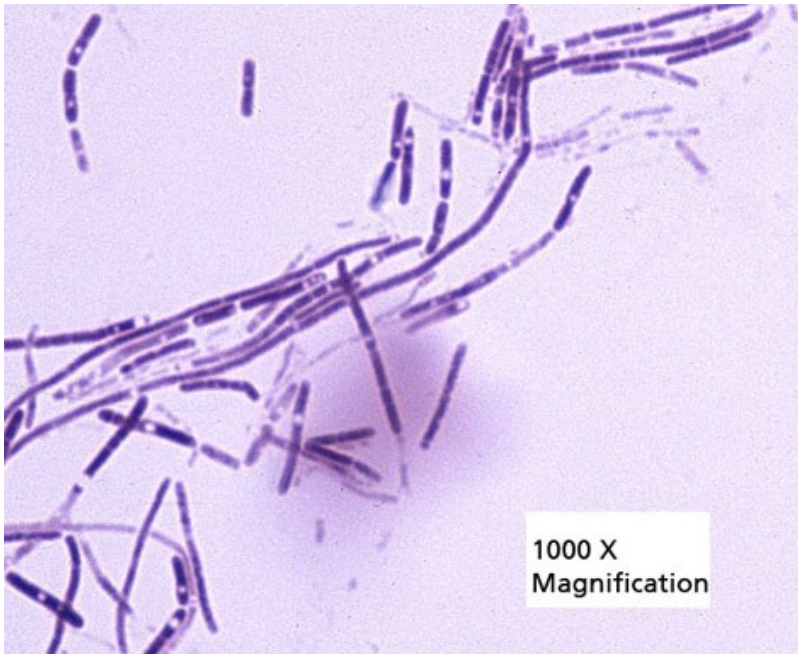


- \*a. *Paracoccidioides brasiliensis*
- b. *Histoplasma capsulatum*
- c. *Coccidioides immitis*
- d. *Blastomyces dermatitidis*

168. Which media is the best choice to selectively isolate *Clostridium difficile*?

- a. Laked Kanamycin- Vancomycin blood agar (LKV)
- b. Egg yolk agar (EYA)
- \*c. Cycloserine cefoxitin fructose agar (CCFA)
- d. Anaerobic blood agar (ANA)

169. The Gram-stained smear of a colony growing aerobically on sheep blood agar appears as shown below. The genus of the organism is most likely which of the following?



- a. *Clostridium*
- \*b. *Bacillus*
- c. *Listeria*
- d. *Pseudomonas*

170. Epiglottitis in children is a common manifestation of an infection with:

- a. *Streptococcus pyogenes*
- \*b. *Haemophilus influenzae*
- c. *Stomatococcus mucilaginosus*
- d. *Streptococcus mutans*

171. A 79-year-old man had surgery to replace an arthritic joint with a prosthetic joint. After several weeks, he complained of low-grade fevers and pain in the joint. Fluid was aspirated from the knee and inoculated into both aerobic and anaerobic blood culture bottles. The anaerobic blood culture bottle turned positive at 48 hours with a gram-positive cocci. The aerobic bottle remained negative. The most likely identification of this isolate is:

- a. *Veillonella* spp.
- b. *Fusobacterium nucleatum*
- \*c. *Peptostreptococcus* spp.
- d. *Enterococcus* spp.

172. Microscopic examination of a fungus cultured from a patient with athlete's foot showed large smooth-walled, club-shaped macroconidia appearing singly or in clusters of two or three from the tips of short

conidiophores as shown below. However, the colonies did not produce microconidia. What is the most likely identification?



- a. *Trichophyton* spp.
- b. *Alternaria* spp.
- \*c. *Epidermophyton* spp.
- d. *Microsporum* spp.

173. Both *Acinetobacter baumannii* and *Pseudomonas aeruginosa* have been implicated in nosocomial infections. Which group of tests best differentiates these two organisms?

- \*a. oxidase, motility, nitrate reduction
- b. growth on MacConkey agar, catalase, glucose oxidation
- c. growth on blood agar, oxidase, catalase
- d. TSI, urea, lysine decarboxylation

174. An organism that many women carry as part of their normal genital microbial flora that may be transmitted to the neonate during childbirth is:

- a. *Staphylococcus aureus*
- b. *Escherichia coli*
- \*c. *Streptococcus agalactiae*
- d. *Gardnerella vaginalis*

175. Evaluation of the acceptability of a sputum specimen sent to the laboratory for bacterial culture is best done by which of the following?

- a. measuring the amount of mucous found
- b. checking for mucous or blood
- c. examining microscopically via Gram-stained smear for leukocytes
- \*d. examining microscopically via Gram-stained smear for squamous epithelial cells

176. Infection with which of the following parasites can manifest in symptoms resembling infectious mononucleosis and is acquired by eating contaminated undercooked lamb or pork or by ingestion of the oocyst from cat feces?

- \*a. *Toxoplasma gondii*
- b. *Babesia microti*
- c. *Balantidium coli*
- d. *Blastocystis hominis*

177. Which of the following describes conidia?

- a. functions in the sexual reproduction of fungi
- b. can form ascospores
- \*c. asexual reproductive structures
- d. always are small, unicellular and round in shape

178. The discharge from an infected ear grows colorless colonies on MacConkey agar that swarm on sheep blood. This oxidase negative, Gram-negative bacillus gives the following biochemical reactions:

Citrate: positive	Indole: negative	Urease: positive
Lysine: negative	Ornithine: positive	H <sub>2</sub> S: positive

What is the identification of the organism?

- \*a. *Proteus mirabilis*
- b. *Citrobacter freundii*
- c. *Morganella morganii*
- d. *Escherichia coli*

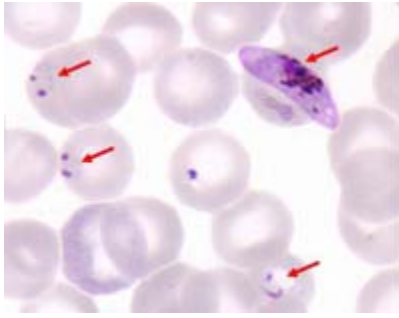
179. A 43-year old female patient complains of a very sore throat. The throat swab that was submitted for routine throat culture grew a variety of diphtheroids; alpha, beta and non-hemolytic streptococci; staphylococci and *Neisseriae*. The next step is to:

- a. report it as normal throat flora
- b. ask for a repeat collection to get a better specimen
- \*c. identify the beta-hemolytic streptococcus species
- d. identify the *Neisseriae* species

180. In antimicrobial susceptibility testing, the minimal bactericidal concentration:

- \*a. is the lowest concentration of antimicrobial agent needed to yield a 99.9% reduction in viable CFU/mL compared with the organism concentration in the original inoculum
- b. is the lowest concentration of antimicrobial agent needed to prevent visible growth of a bacterial suspension
- c. is the maximum concentration of antimicrobial agent that should be used for optimal therapy
- d. should be performed to evaluate antimicrobial agents usually considered to be bacteriostatic

181. After returning from an assignment in Brazil, a missionary was hospitalized with body aches, nausea and recurring cycles of headaches, fever and chills. The Giemsa- stained peripheral blood smear shown below revealed which of the following parasites?



- \*a. *Plasmodium falciparum*
- b. *Babesia microti*
- c. *Plasmodium malariae*
- d. *Plasmodium vivax*

182. A culture from a cervical abscess specimen grew an anaerobic, gram-negative bacillus that was inhibited by bile, negative for indole production, positive for glucose, sucrose and lactose fermentation. The colonies produced a brownish-black pigment. This isolate would most likely be identified as:

- a. *Actinomyces israelii*
- b. *Bacteroides ureolyticus*
- \*c. *Prevotella melaninogenica*
- d. *Porphyromonas gingivalis*

183. When grown on corn meal agar with Tween 80 which of the following organisms show blastoconidia only, without hyphae, pseudohyphae, or chlamydoconidia?

- a. *Trichosporon*
- b. *Candida tropicalis*
- \*c. *Cryptococcus neoformans*
- d. *Candida albicans*

184. Two siblings arrive at the ER. Both had sore throats about 2-3 weeks earlier that grew beta-hemolytic streptococci; now they present with different clinical symptoms. One displays edema and hypertension, and RBC casts are seen in the urine. The other complains of fever and joint pains and has carditis. The diseases that these siblings have are most likely:

- a. erysipelas and glomerulonephritis
- \*b. glomerulonephritis and rheumatic fever
- c. rheumatic fever and scarlet fever
- d. scarlet fever and erysipelas

185. Which property listed below is NOT consistent with the following characteristics?

Gram positive cocci in clusters,  $\beta$ -hemolytic, smooth, opaque and circular colonies with a golden yellow pigment

- a. growth on MSA
- \*b. catalase negative
- c. coagulase positive
- d. produces heat stable exo-toxins

186. *Streptococcus pneumoniae* and *Streptococcus agalactiae* can be used as the positive and negative control respectively for which of the following tests?

- a. PYR
- \*b. Optochin sensitivity
- c. Catalase
- d. Bacitracin sensitivity

187. A gram-negative, pleomorphic rod (coccobacilli) was recovered from a throat culture obtained from a 40-year old male patient undergoing chemotherapy. The organism required hemin (X) and NAD (V) for growth. This species also hemolyzed horse erythrocytes on blood agar. What is the most likely organism?

- a. *Haemophilus ducreyi*
- b. *Haemophilus parahaemolyticus*
- \*c. *Haemophilus haemolyticus*
- d. *Haemophilus aegyptius*

188. A previously normal, full-term infant developed bilateral conjunctivitis at 2 weeks of age. The conjunctivitis was followed by severe coughing, but the infant remained afebrile. When the infant was 4 weeks old, a chest X-ray showed bilateral interstitial infiltrates. Which of the following is the most probable infectious agent?

- a. *Escherichia coli*
- \*b. *Chlamydia trachomatis*
- c. *Listeria monocytogenes*
- d. Adenovirus

189. Most *Neisseria* species grow well on agar containing which of the following ingredients?

- a. Egg base
- b. Peptone yeast
- c. Sorbitol
- \*d. Blood or blood products

190. Which of the following stains greatly enhances the visibility of fungi by binding to the cell walls, causing the fungal structures to fluoresce?

- a. Auramine-rhodamine
- b. Acridine orange

- \*c. Calcofluor white
- d. Periodic Acid-Schiff

191. A veterinary assistant who was responsible for cleaning the animal cages developed a fever. He complained of severe headaches and muscle aches. After these conditions persisted for two weeks he went to his local physician. Dark-field examination of blood and urine specimens from the patient showed long, slender, helically curved organisms with hooked ends that exhibited corkscrew-like motility. The most-likely cause of the infection was:

- \*a. *Leptospira interrogans*
- b. *Treponema pertenu*
- c. *Pasteurella multocida*
- d. *Borellia recurrentis*

192. Production of exotoxin A, which kills host cells by inhibiting protein synthesis, and production of several proteolytic enzymes and hemolysins that destroy cells and tissue are factors that contribute to pathogenicity of:

- \*a. *Pseudomonas aeruginosa*
- b. *Burkholderia cepacia*
- c. *Ralstonia pickettii*
- d. *Alcaligenes faecalis*

193. Which of the following is true of blood cultures for the recovery of bacteria?

- a. For optimum recovery one blood culture should be drawn per day for four days
- \*b. The recommended optimal amount of blood per culture is 10-20 mL
- c. Blood should be allowed to clot
- d. Contamination from skin flora is generally not an issue

194. Which growth medium can be described as suppressing the growth of most gram-negative organisms while allowing gram-positive bacteria to grow?

- a. Chocolate
- \*b. CNA (colistin, nalidixic acid) blood
- c. BHI (brain heart infusion)
- d. Thioglycollate

195. Which of the following is an important virulence factor that allows bacteria to avoid phagocytosis?

- a. Flagella
- b. Exotoxin
- c. Surface membrane pili
- \*d. Capsule

196. Of the asaccharolytic, oxidase-positive bacilli, which bacterial species can be recognized in culture by its bleachlike odor?

- \*a. *Eikenella corrodens*
- b. *Alcaligenes faecalis*



- c. *Pseudomonas aerogenes*
- d. *Sphingomonas paucimobilis*

197. Organisms belonging to the genus *Campylobacter* are:

- a. gram-positive diplococci
- b. gram-positive diphtheroid bacilli
- \*c. gram-negative curved bacilli
- d. gram-negative straight-sided bacilli

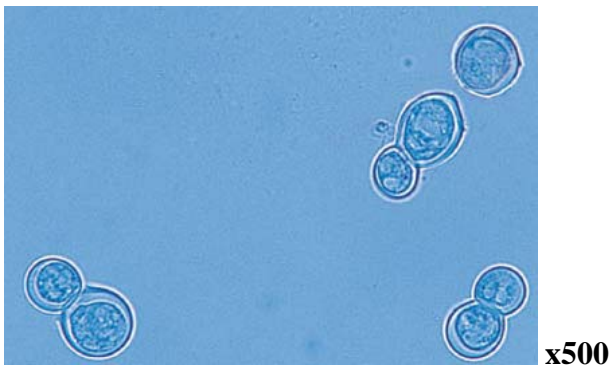
198. Which of the following tests determine slow or late lactose fermentation?

- a. Gelatin hydrolysis
- \*b. ONPG
- c. Vogues-Proskauer
- d. Indole

199. Which of the following adult trematodes live in the small intestine?

- a. *Clonorchis sinensis*
- b. *Schistosoma haematobium*
- c. *Paragonimus westermani*
- \*d. *Fasciolopsis buski*

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



- a. *Coccidioides immitis*
- \*b. *Blastomyces dermatitidis*
- c. *Histoplasma capsulatum*
- d. *Paracoccidioides brasiliensis*