BOC Study Guide

5th edition

Clinical Laboratory Certification Examinations

ASCP American Society for Clinical Pathology

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Certification Examinations

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Thank you to my family - *Adam*, *Peter* and *Joe*, for their support and understanding during this project.

– Patricia A. Tanabe, MPA, MLS(ASCP)^{CM}

Good luck with your board examination—my best to each of you as you embark on an exciting career in laboratory medicine.

– E. Blair Holladay, PhD, SCT(ASCP)^{CM}

Preface

The 5th edition of the *Board of Certification Study Guide for Clinical Laboratory Certification Examinations* contains over 2000 multiple choice questions. Unique to this study guide is the differentiation of questions appropriate for both the Medical Laboratory Technician and Medical Laboratory Scientist levels from questions that are appropriate for the Medical Laboratory Scientist level ***only*** (clearly marked MLS ONLY). The questions in this edition are arranged in chapters which correspond to the major content areas on the examination. Within each chapter, the questions are further grouped by topic. New to this edition are short answer explanations and references for each practice question. Questions with images will appear as they would on the certification examination. Laboratory results will be presented in both conventional and SI units.

The practice questions are presented in a format and style similar to the questions included on the Board of Certification certification examinations. **Please note: *None* of these questions will appear on any Board of Certification examination.**

These practice questions were compiled from previously published materials and submitted questions from recruited reviewers. (Note: These reviewers do not currently serve on any Examination Committee.)

This book is not a product of the Board of Certification, rather it is a product of the ASCP Press, the independent publishing arm of the American Society for Clinical Pathology. Use of this book does not ensure passing of an examination. The Board of Certification's evaluation and credentialing processes are entirely independent of this study guide; however, this book should significantly help you prepare for your BOC examination.

Our thanks to those who edited/ reviewed questions for this book.

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The Importance of Certification, CMP, Licensure and Qualification

The practice of modern medicine would be impossible without the tests performed in the laboratory. A highly skilled medical team of pathologists, specialists, laboratory scientists, technologists, and technicians works together to determine the presence or absence of disease and provides valuable data needed to determine the course of treatment.

Today's laboratory uses many complex, precision instruments and a variety of automated and electronic equipment. However, the success of the laboratory begins with the laboratorians' dedication to their profession and willingness to help others. Laboratorians must produce accurate and reliable test results, have an interest in science, and be able to recognize their responsibility for affecting human lives.

Role of the ASCP Board of Certification

Founded in 1928 by the American Society of Clinical Pathologists (ASCP—now, the American Society for Clinical Pathology), the Board of Certification is considered the preeminent certification agency in the US and abroad within the field of laboratory medicine. Composed of representatives of professional organizations and the public, the Board's mission is to: "*Provide excellence in certification of laboratory professionals on behalf of patients worldwide.*"

The Board of Certification consists of more than 100 volunteer technologists, technicians, laboratory scientists, physicians, and professional researchers. These volunteers contribute their time and expertise to the Board of Governors and the Examination Committees. They allow the BOC to achieve the goal of excellence in credentialing medical laboratory personnel in the US and abroad.

The Board of Governors is the policy-making governing body for the Board of Certification and is composed of 25 members. These 25 members include technologists, technicians, and pathologists nominated by the ASCP and representatives from the general public as well as from the following societies: the American Association for Clinical Chemistry, the AABB, American College of Microbiology, American Society for Clinical Laboratory Science, the American Society of Cytopathology, the American Society of Hematology, the American Association of Pathologists' Assistants, Association of Genetic Technology, the National Society for Histotechnology, and the Clinical Laboratory Management Association (CLMA).

The Examination Committees are responsible for the planning, development, and review of the examination databases; determining the accuracy and relevancy of the test items; confirming the standards for each examination and performing job or practice analyses.

Certification

http://www.ascp.org/certification

Certification is the process by which a nongovernmental agency or association grants recognition of competency to an individual who has met certain predetermined qualifications, as specified by that agency or association. Certification affirms that an individual has demonstrated that he or she possesses the knowledge and skills to perform essential tasks in the medical laboratory. The ASCP Board of Certification certifies those individuals who meet academic and clinical prerequisites and who achieve acceptable performance levels on examinations.

In 2004, the ASCP Board of Certification implemented the **Certification Maintenance Program** (CMP), which mandates participation every 3 years for newly certified individuals in the US. The goal of this program is to demonstrate to the public that laboratory professionals are performing the appropriate and relevant activities to keep current in their practice. Please follow the steps outlined on the website to apply for CMP and retain your certification. (http://www.ascp.org/CMP)

United States Certification
http://www.ascp.org/certification

To apply for a Certification Examination follow these step-by-step instructions:

1 Identify the examination you are applying for and determine your eligibility.

2 Gather your required education and experience documentation.

3 Apply for the examination. We offer 2 options:

   a. Apply online and pay by credit card.

   b. Or download an application, pay by credit card, check or money order and mail to:

      ASCP Board of Certification
      3335 Eagle Way
      Chicago, IL 60678-1033

4 Schedule your examination at a Pearson Professional Center. Visit the Pearson site (http://www.pearsonvue.com/ascp) to identify a location and time that is convenient for you to take your ASCP examination.

International Certification
http://www.ascp.org/certification/International

ASCP offers its gold standard credentials in the form of international certification (ASCP^{i}) to eligible individuals. The ASCP^{i} credential certifies professional competency among new and practicing laboratory personnel in an effort to contribute globally to the highest standards of patient safety. Graduates of medical laboratory science programs outside the United States are challenged with content that mirrors the standards of excellence established by the US ASCP exams. The ASCP^{i} credential carries the weight of 80 years of expertise in clinical laboratory professional certification. Please visit the website to view the following:

1 Website information translated into a specific language.

2 Current listing of international certifications.

3 Eligibility guidelines.

4 Step-by-step instructions to apply for international certification.

State Licensure
http://www.ascp.org/licensure

State Licensure is the process by which a state grants a license to an individual to practice their profession in the specified state. The individual must meet the state's licensing requirements, which may include examination and/or experience. It is important to identify the state and examination to determine your eligibility and view the steps for licensure and/or certification. For a list of states that require licensure, please go to the website. (http://www.ascp.org/statelicensureagencies)

The ASCP Board of Certification (BOC) examinations have been approved for licensure purposes by the states of California and New York. The BOC examinations also meet the requirements for all other states that require licensure.

Qualification
http://www.ascp.org/qualification

A qualification from the Board of Certification recognizes the competence of individuals in specific technical areas. Qualifications are available in laboratory informatics, immunohistochemistry and flow cytometry. To receive this credential, candidates must meet the eligibility requirements and successfully complete an examination (QCYM, QIHC) or a work sample project (QLI). Candidates who complete the Qualification process will receive a Certificate of Qualification, which is valid for 5 years. The Qualification may be revalidated every 5 years upon receipt of completed application and fee. (Documentation of acceptable continuing education may be requested.)

Preparing for and Taking the BOC Certification Examination

Begin early to prepare for the Certification Examination. Because of the broad range of knowledge and skills tested by the examination, even applicants with college education and those completing formal laboratory education training programs will find that review is necessary, although the exact amount will vary from applicant to applicant. Generally, last-minute cramming is the least effective method for preparing for the examination. The earlier you begin, the more time you will have to prepare; and the more you prepare, the better your chance of successfully passing the examination and scoring well.

Study for the Test

Plan a course of study that allows more time for your weaker areas. Although it is important to study your areas of weakness, be sure to allow enough time to review all areas. It is better to spend a short time studying every day than to spend several hours every week or 2. Setting aside a regular time and a special place to study will help ensure studying becomes a part of your daily routine.

Study Resources

http://www.ascp.org/studymaterials

Competency Statements and Content Guidelines

http://www.ascp.org/contentguidelines

The Board of Certification has developed competency statements and content guidelines to delineate the content and tasks included in its tests. Current Content Guidelines for the Medical Laboratory Scientist (MLS) and Medical Laboratory Technician (MLT) examinations as well as other certification examinations offered by the ASCP BOC are available.

Study Guide

The questions in this study guide are in a format and style similar to the questions on the Board of Certification examinations. The questions are in a multiple choice format with 1 best answer. Work through each chapter and answer all the questions as presented. Next, review your answers against the answer key. Review the answer explanation for those questions, that you answered incorrectly. Lastly, each question is referenced if you require further explanation.

Textbooks

The references cited in this study guide (see pp 481-484) identify many useful textbooks. The most current reading lists for most of the examinations are available on the ASCP's website (http://www.ascp.org/readinglists). Textbooks tend to cover a broad range of knowledge in a given field. An added benefit is that textbooks frequently have questions at the end of the chapters that you can use to test yourself should you need further clarification on specific subject matter.

Online practice tests

http://www.ascp-practice.com

The online practice test is a subscription product. It includes 90-day online access to the practice tests, comprehensive diagnostic scores, and discussion boards. If you are an institutional purchaser that would like to pay by check or purchase order (minimum of 20 tests to use a check or purchase order), please download the order form from the website. Content-specific online practice tests can be purchased online.

Taking the Certification Examination

The ASCP Board of Certification (BOC) uses computer adaptive testing (CAT), which is criterion referenced. With CAT, provided you answer the question correctly, the next examination question has a slightly higher level of difficulty. The difficulty level of the questions presented to the examinee continues to increase until a question is answered incorrectly. At this point, a slightly easier question is presented. The importance of testing in an adaptive format is that each test is individually tailored to your ability level.

Each question in the examination pool is calibrated for difficulty and categorized into a subtest area, which corresponds to the content guideline for a particular examination. The weight (value) given to each question is determined by the level of difficulty. All examinations (with the exception of phlebotomy (PBT) and donor phlebotomy (DPT)) are scheduled for 2 hours and 30 minutes and have 100 questions. The PBT and DPT examinations are scheduled for 2 hours and have 80 questions. Your preliminary test results (pass/fail) will appear on the computer screen immediately upon completion of your examination. Detailed examination scores will be mailed within 10 business days after your examination, provided that the BOC has received all required application documents. Examination results cannot be released by telephone under any circumstances.

Your official detailed examination score report will indicate a "pass" or "fail" status and the specific scaled score on the total examination. A scaled score is statistically derived (in part) from the raw score (number of correctly answered questions) and the difficulty level of the questions. Because each examinee has taken an individualized examination, scaled scores are used so that all examinations may be compared on the same scale. The minimum passing score is 400. The highest attainable score is 999.

If you were unsuccessful in passing the examination, your scaled scores on each of the subtests will be indicated on the report as well. These subtest scores cannot be calculated to obtain your total score. These scores are provided as a means of demonstrating your areas of strengths and weaknesses in comparison to the minimum pass score.

Blood Bank

The following items have been identified generally as appropriate for both entry level medical laboratory scientists and medical laboratory technicians. Items that are appropriate for medical laboratory scientists ***only*** *are marked with an* "MLS ONLY."

Blood Products

1 The minimum hemoglobin concentration in a fingerstick from a male blood donor is:

a 12.0 g/dL (120 g/L)
b 12.5 g/dL (125 g/L)
c 13.5 g/dL (135 g/L)
d 15.0 g/dL (150 g/L)

2 MLS ONLY A cause for permanent deferral of blood donation is:

a diabetes
b residence in an endemic malaria region
c history of jaundice of uncertain cause
d history of therapeutic rabies vaccine

3 MLS ONLY Which of the following prospective donors would be accepted for donation?

a 32-year-old woman who received a transfusion in a complicated delivery 5 months previously
b 19-year-old sailor who has been stateside for 9 months and stopped taking his anti-malarial medication 9 months previously
c 22-year-old college student who has a temperature of 99.2°F (37.3°C) and states that he feels well, but is nervous about donating
d 45-year-old woman who has just recovered from a bladder infection and is still taking antibiotics

4 Which one of the following constitutes permanent rejection status of a donor?

a a tattoo 5 months previously
b recent close contact with a patient with viral hepatitis
c 2 units of blood transfused 4 months previously
d confirmed positive test for HBsAg 10 years previously

5 MLS ONLY According to AABB standards, which of the following donors may be accepted as a blood donor?

a traveled to an area endemic for malaria 9 months previously
b spontaneous abortion at 2 months of pregnancy, 3 months previously
c resides with a known hepatitis patient
d received a blood transfusion 22 weeks previously

6 Below are the results of the history obtained from a prospective female blood donor:

age:	16
temperature:	99.0°F (37.2°C)
Hct:	36%
history:	tetanus toxoid immunization 1 week previously

How many of the above results excludes this donor from giving blood for a routine transfusion?

a none
b 1
c 2
d 3

7 MLS ONLY For apheresis donors who donate platelets more frequently than every 4 weeks, a platelet count must be performed prior to the procedure and be at least:

a $150 \times 10^3/\mu L$ ($150 \times 10^9/L$)
b $200 \times 10^3/\mu L$ ($200 \times 10^9/L$)
c $250 \times 10^3/\mu L$ ($250 \times 10^9/L$)
d $300 \times 10^3/\mu L$ ($300 \times 10^9/L$)

8 Prior to blood donation, the intended venipuncture site must be cleaned with a scrub solution containing:

a hypochlorite
b isopropyl alcohol
c 10% acetone
d PVP iodine complex

9 All donor blood testing must include:

a complete Rh phenotyping
b anti-CMV testing
c direct antiglobulin test
d serological test for syphilis

10 During the preparation of Platelet Concentrates from Whole Blood, the blood should be:

a cooled towards 6°C
b cooled towards 20°-24°C
c warmed to 37°C
d heated to 57°C

11 MLS ONLY The most common cause of posttransfusion hepatitis can be detected in donors by testing for:

a anti-HCV
b HBsAg
c anti-HAV IgM
d anti-HBe

12 The Western blot is a confirmatory test for the presence of:

a CMV antibody
b anti-HIV-1
c HBsAg
d serum protein abnormalities

13 The test that is currently used to detect donors who are infected with the AIDS virus is:

a anti-HBc
b anti-HIV 1,2
c HBsAg
d ALT

14 A commonly used screening method for anti-HIV-1 detection is:

a latex agglutination
b radioimmunoassay (RIA)
c thin-layer-chromatography (TLC)
d enzyme-labeled immunosorbent assay (ELISA)

15 MLS ONLY Rejuvenation of a unit of Red Blood Cells is a method used to:

a remove antibody attached to RBCs
b inactivate viruses and bacteria
c restore 2,3-DPG and ATP to normal levels
d filter blood clots and other debris

16 A unit of packed cells is split into 2 aliquots under closed sterile conditions at 8 AM. The expiration time for each aliquot is now:

a 4 PM on the same day
b 8 PM on the same day
c 8 AM the next morning
d the original date of the unsplit unit

17 A unit of Red Blood Cells expiring in 35 days is split into 5 small aliquots using a sterile pediatric quad set and a sterile connecting device. Each aliquot must be labeled as expiring in:

a 6 hours
b 12 hours
c 5 days
d 35 days

18 When platelets are stored on a rotator set on an open bench top, the ambient air temperature must be recorded:

a once a day
b twice a day
c every 4 hours
d every hour

19 Which of the following is the correct storage temperature for the component listed?

a Cryoprecipitated AHF, 4°C
b Fresh Frozen Plasma (FFP), –20°C
c Red Blood Cells, Frozen, –40°C
d Platelets, 37°C

20 A unit of Red Blood Cells is issued at 9:00 AM. At 9:10 AM the unit is returned to the Blood Bank. The container has **not** been entered, but the unit has **not** been refrigerated during this time span. The best course of action for the technologist is to:

a culture the unit for bacterial contamination
b discard the unit if not used within 24 hours
c store the unit at room temperature
d record the return and place the unit back into inventory

21 MLS ONLY The optimum storage temperature for Red Blood Cells, Frozen is:

a –80°C
b –20°C
c –12°C
d 4°C

22 The optimum storage temperature for Red Blood Cells is:

a -80°C
b -20°C
c -12°C
d 4°C

23 If the seal is entered on a unit of Red Blood Cells stored at 1°C to 6°C, what is the maximum allowable storage period, in hours?

a 6
b 24
c 48
d 72

24 The optimum storage temperature for cryoprecipitated AHF is:

a -20°C
b -12°C
c 4°C
d 22°C

25 Cryoprecipitated AHF must be transfused within what period of time following thawing and pooling?

a 4 hours
b 8 hours
c 12 hours
d 24 hours

26 Platelets prepared in a polyolefin type container, stored at 22°-24°C in 50 mL of plasma, and gently agitated can be used for up to:

a 24 hours
b 48 hours
c 3 days
d 5 days

27 The optimum storage temperature for platelets is:

a -20°C
b -12°C
c 4°C
d 22°C

28 According to AABB standards, Fresh Frozen Plasma must be infused within what period of time following thawing?

a 24 hours
b 36 hours
c 48 hours
d 72 hours

29 Cryoprecipitated AHF, if maintained in the frozen state at -18°C or below, has a shelf life of:

a 42 days
b 6 months
c 12 months
d 36 months

30 Once thawed, Fresh Frozen Plasma must be transfused within:

a 4 hours
b 8 hours
c 12 hours
d 24 hours

31 MLS ONLY An important determinant of platelet viability following storage is:

a plasma potassium concentration
b plasma pH
c prothrombin time
d activated partial thromboplastin time

32 In the liquid state, plasma must be stored at:

a 1°- 6°C
b 22°C
c 37°C
d 56°C

33 MLS ONLY During storage, the concentration of 2,3-diphosphoglycerate (2,3-DPG) decreases in a unit of:

a Platelets
b Fresh Frozen Plasma
c Red Blood Cells
d Cryoprecipitated AHF

34 MLS ONLY Cryoprecipitated AHF:

a is indicated for fibrinogen deficiencies
b should be stored at 4°C prior to administration
c will not transmit hepatitis B virus
d is indicated for the treatment of hemophilia B

35 MLS ONLY Which apheresis platelets product should be irradiated?

a autologous unit collected prior to surgery
b random stock unit going to a patient with DIC
c a directed donation given by a mother for her son
d a directed donation given by an unrelated family friend

36 Irradiation of a unit of Red Blood Cells is done to prevent the replication of donor:

a granulocytes
b lymphocytes
c red cells
d platelets

37 Plastic bag overwraps are recommended when thawing units of FFP in 37°C water baths because they prevent:

a the FFP bag from cracking when it contacts the warm water
b water from slowly dialyzing across the bag membrane
c the entry ports from becoming contaminated with water
d the label from peeling off as the water circulates in the bath

38 Which of the following blood components must be prepared within 8 hours after phlebotomy?

a Red Blood Cells
b Fresh Frozen Plasma
c Red Blood Cells, Frozen
d Cryoprecipitated AHF

39 MLS ONLY Cryoprecipitated AHF contains how many units of Factor VIII?

a 40
b 80
c 130
d 250

40 MLS ONLY Which of the following blood components contains the most Factor VIII concentration relative to volume?

a Single-Donor Plasma
b Cryoprecipitated AHF
c Fresh Frozen Plasma
d Platelets

41 MLS ONLY The most effective component to treat a patient with fibrinogen deficiency is:

a Fresh Frozen Plasma
b Platelets
c Fresh Whole Blood
d Cryoprecipitated AHF

42 A blood component prepared by thawing Fresh Frozen Plasma at refrigerator temperature and removing the fluid portion is:

a Plasma Protein Fraction
b Cryoprecipitated AHF
c Factor IX Complex
d FP24

43 Upon inspection, a unit of platelets is noted to have visible clots, but otherwise appears normal. The technologist should:

a issue without concern
b filter to remove the clots
c centrifuge to express off the clots
d quarantine for Gram stain and culture

44 MLS ONLY According to AABB Standards, at least 90% of all Apheresis Platelets units tested shall contain a minimum of how many platelets?

a 5.5×10^{10}
b 6.5×10^{10}
c 3.0×10^{11}
d 5.0×10^{11}

45 MLS ONLY According to AABB Standards, Platelets prepared from Whole Blood shall have at least:

a 5.5×10^{10} platelets per unit in at least 90% of the units tested
b 6.5×11^{10} platelets per unit in 90% of the units tested
c 7.5×10^{10} platelets per unit in 100% of the units tested
d 8.5×10^{10} platelets per unit in 95% of the units tested

46 Which of the following is proper procedure for preparation of Platelets from Whole Blood?

a light spin followed by a hard spin
b light spin followed by 2 hard spins
c 2 light spins
d hard spin followed by a light spin

47 MLS ONLY According to AABB standards, what is the minimum pH required for Platelets at the end of the storage period?

a 6.0
b 6.2
c 6.8
d 7.0

48 MLS ONLY According to AABB standards, Platelets must be:

a gently agitated if stored at room temperature
b separated within 12 hours of Whole Blood collection
c suspended in sufficient plasma to maintain a pH of 5.0 or lower
d prepared only from Whole Blood units that have been stored at 4°C for 6 hours

49 A unit of Whole Blood-derived (random donor) Platelets should contain at least:

a 1.0×10^{10} platelets
b 5.5×10^{10} platelets
c 5.5×10^{11} platelets
d 90% of the platelets from the original unit of Whole Blood

50 Platelets prepared by apheresis should contain at least:

a 1×10^{10} platelets
b 3×10^{10} platelets
c 3×10^{11} platelets
d 5×10^{11} platelets

51 MLS ONLY Leukocyte-Reduced Red Blood Cells are ordered for a newly diagnosed bone marrow candidate. What is the best way to prepare this product?

a crossmatch only CMV-seronegative units
b irradiate the unit with 1,500 rads
c wash the unit with saline prior to infusion
d transfuse through a Log^3 leukocyte-removing filter

52 MLS ONLY Of the following blood components, which one should be used to prevent HLA alloimmunization of the recipient?

a Red Blood Cells
b Granulocytes
c Irradiated Red Blood Cells
d Leukocyte-Reduced Red Blood Cells

53 A father donating Platelets for his son is connected to a continuous flow machine, which uses the principle of centrifugation to separate Platelets from Whole Blood. As the Platelets are harvested, all other remaining elements are returned to the donor. This method of Platelet collection is known as:

a apheresis
b autologous
c homologous
d fractionation

54 To qualify as a donor for autologous transfusion a patient's hemoglobin should be at least:

a 8 g/dL (80 g/L)
b 11 g/dL (110 g/L)
c 13 g/dL (130 g/L)
d 15 g/dL (150 g/L)

55 What is/are the minimum pretransfusion testing requirement(s) for autologous donations collected and transfused by the same facility?

a ABO and Rh typing only
b ABO/Rh type, antibody screen
c ABO/Rh type, antibody screen, crossmatch
d no pretransfusion testing is required for autologous donations

56 MLS ONLY In a quality assurance program, Cryoprecipitated AHF must contain a minimum of how many international units of Factor VIII?

a 60
b 70
c 80
d 90

57 MLS ONLY An assay of plasma from a bag of Cryoprecipitated AHF yields a concentration of 9 international units (IU) of Factor VIII per mL of Cryoprecipitated AHF. If the volume is 9 mL, what is the Factor VIII content of the bag in IU?

a 9
b 18
c 27
d 81

Blood Group Systems

58 Refer to the following table:

		Antigens					
		1	2	3	4	5	Test results
Panel cells	I	+	0	0	+	+	+
	II	0	0	+	0	+	0
	III	0	+	+	+	0	0
	IV	0	+	+	0	+	+
	V	+	+	+	0	0	+
						auto	0

Given the most probable genotypes of the parents, which of the following statements best describes the most probable Rh genotypes of the 4 children?

a 2 are R_1r, 2 are R_1R_1
b 3 are R_1r, 1 is rr
c 1 is R_0r, 1 is R_1r, 2 are R_1R_1
d 1 is R_0r', 1 is R_1R_1, 2 are R_1r

59 The linked HLA genes on each chromosome constitute a(n):

a allele
b trait
c phenotype
d haplotype

60 An individual's red blood cells give the following reactions with Rh antisera:

anti-D	anti-C	anti-E	anti-c	anti-e	Rh control
4+	3+	0	3+	3+	0

The individual's most probable genotype is:

a DCe/DcE
b DcE/dce
c Dce/dce
d DCe/dce

61 A blood donor has the genotype: *hh*, *AB*. What is his red blood cell phenotype?

a A
b B
c O
d AB

62 An individual has been sensitized to the k antigen and has produced anti-k. What is her most probable Kell system genotype?

a *KK*
b *Kk*
c *kk*
d K_0K_0

63 Given the following typing results, what is this donor's racial ethnicity?

Le(a–b–); Fy(a–b–); Js(a+b+)

a African American
b Asian American
c Native American
d Caucasian

64 A mother has the red cell phenotype D+C+E–c–e+ with anti-c (titer of 32 at AHG) in her serum. The father has the phenotype D+C+E–c+e+. The baby is Rh-negative and not affected with hemolytic disease of the newborn. What is the baby's most probable Rh genotype?

a $r'r'$
b $r'r$
c R_1R_1
d R_1r

65 In an emergency situation, Rh-negative red cells are transfused into an Rh-positive person of the genotype CDe/CDe. The first antibody **most** likely to develop is:

a anti-c
b anti-d
c anti-e
d anti-E

66 Most blood group systems are inherited as:

a sex-linked dominant
b sex-linked recessive
c autosomal recessive
d autosomal codominant

67 The mating of an Xg(a+) man and an Xg(a–) woman will **only** produce:

a Xg(a–) sons and Xg(a–) daughters
b Xg(a+) sons and Xg(a+) daughters
c Xg(a–) sons and Xg(a+) daughters
d Xg(a+) sons and Xg(a–) daughters

68 Refer to the following data:

anti-C	anti-D	anti-E	anti-c	anti-e
+	+	+	+	+

Given the reactions above, which is the most probable genotype?

a R_1R_1
b R_1r'
c R_0r''
d R_1R_2

69 A patient's red cells type as follows:

anti-D	anti-C	anti-E
4+	0	0

Which of the following genotype would be consistent with these results?

a R_0R_0
b R_1r
c R_1R_2
d R_zr

70 The red cells of a nonsecretor (se/se) will most likely type as:

a Le(a–b–)
b Le(a+b+)
c Le(a+b–)
d Le(a–b+)

71 Which of the following phenotypes will react with anti-f?

a *rr*
b R_1R_1
c R_2R_2
d R_1R_2

72 A patient's red blood cells gave the following reactions:

anti-D	anti-C	anti-E	anti-c	anti-e	anti-f
+	+	+	+	+	0

The most probable genotype of this patient is:

a R_1R_2
b R_2r''
c R_zr
d R_zR_z

73 MLS ONLY Anti-N is identified in a patient's serum. If random crossmatches are performed on 10 donor units, how many would be expected to be compatible?

a 0
b 3
c 7
d 10

74 A woman types as Rh-positive. She has an anti-c titer of 32 at AHG. Her baby has a negative DAT and is not affected by hemolytic disease of the newborn. What is the father's most likely Rh phenotype?

a *rr*
b *r''r*
c R_1r
d R_2r

75 Which of the following red cell typings are most commonly found in the African American donor population?

a Lu(a–b–)
b Jk(a–b–)
c Fy(a–b–)
d K–k–

76 Four units of blood are needed for elective surgery. The patient's serum contains anti-C, anti-e, anti-Fy^a and anti-Jk^b. Which of the following would be the best source of donor blood?

a test all units in current stock
b test 100 group O, Rh-negative donors
c test 100 group-compatible donors
d rare donor file

77 A donor is tested with Rh antisera with the following results:

anti-D	anti-C	anti-E	anti-c	anti-e	Rh control
+	+	0	+	+	0

What is his most probable Rh genotype?

a R_1R_1
b R_1r
c R_0r
d R_2r

78 A family has been typed for HLA because 1 of the children needs a stem cell donor. Typing results are listed below:

father:	A1,3;B8,35
mother:	A2,23;B12,18
child #1:	A1,2;B8,12
child #2:	A1,23;B8,18
child #3:	A3,23;B18,?

What is the expected B antigen in child #3?

a A1
b A2
c B12
d B35

79 MLS ONLY Which of the following is the best source of HLA-compatible platelets?

a mother
b father
c siblings
d cousins

80 MLS ONLY A patient is group O, Rh-negative with anti-D and anti-K in her serum. What percentage of the general Caucasian donor population would be compatible with this patient?

a 0.5
b 2.0
c 3.0
d 6.0

81 MLS ONLY The observed phenotypes in a particular population are:

Phenotype	Number of persons
Jk(a+b–)	122
Jk(a+b+)	194
Jk(a–b+)	84

What is the gene frequency of Jk^a in this population?

a 0.31
b 0.45
c 0.55
d 0.60

82 MLS ONLY In a random population, 16% of the people are Rh-negative (*rr*). What percentage of the Rh-positive population is heterozygous for *r*?

a 36%
b 48%
c 57%
d 66%

83 In relationship testing, a "direct exclusion" is established when a genetic marker is:

a absent in the child, but present in the mother and alleged father
b absent in the child, present in the mother and absent in the alleged father
c present in the child, absent in the mother and present in the alleged father
d present in the child, but absent in the mother and alleged father

84 Relationship testing produces the following red cell phenotyping results:

	ABO	Rh
alleged father:	B	D+C–c+E+e–
mother:	O	D+C+E–c–e+
child:	O	D+C+E–c+e+

What conclusions may be made?

a there is no exclusion of paternity
b paternity may be excluded on the basis of ABO typing
c paternity may be excluded on the basis of Rh typing
d paternity may be excluded on the basis of both ABO and Rh typing

85 In a relationship testing case, the child has a genetic marker that is absent in the mother and cannot be demonstrated in the alleged father. What type of paternity exclusion is this known as?

a indirect
b direct
c prior probability
d Hardy-Weinberg

86 A patient is typed with the following results:

Patient's cells with		Patient's serum with	
anti-A	0	A_1 red cells	2+
anti-B	0	B red cells	4+
anti-A,B	2+	Ab screen	0

The most probable reason for these findings is that the patient is group:

a O; confusion due to faulty group O antiserum
b O; with an anti-A_1
c A_x; with an anti-A_1
d A_1; with an anti-A

87 Human blood groups were discovered around 1900 by:

a Jules Bordet
b Louis Pasteur
c Karl Landsteiner
d PL Mollison

88 Cells of the A_3 subgroup will:

a react with *Dolichos biflorus*
b bE– with anti-A
c give a mixed-field reaction with anti-A,B
d bE– with anti-H

89 The enzyme responsible for conferring H activity on the red cell membrane is alpha-:

a galactosyl transferase
b N-acetylgalactosaminyl transferase
c L-fucosyl transferase
d N-acetylglucosaminyl transferase

90 Even in the absence of prior transfusion or pregnancy, individuals with the Bombay phenotype (O_h) will always have naturally occurring:

a anti-Rh
b anti-K_o
c anti-U
d anti-H

91 The antibody in the Lutheran system that is best detected at lower temperatures is:

a anti-Lu^a
b anti-Lu^b
c anti-Lu3
d anti-Lu^{ab}

92 MLS ONLY Which of the following antibodies is neutralizable by pooled human plasma?

a anti-Kn^a
b anti-Ch
c anti-Yk^a
d anti-Cs^a

93 Anti-Sd^a is strongly suspected if:

a the patient has been previously transfused
b the agglutinates are mixed-field and refractile
c the patient is group A or B
d only a small number of panel cells are reactive

94 HLA antibodies are:

a naturally occurring
b induced by multiple transfusions
c directed against granulocyte antigens only
d frequently cause hemolytic transfusion reactions

95 Genes of the major histocompatibility complex (MHC):

a code for HLA-A, HLA-B, and HLA-C antigens only
b are linked to genes in the ABO system
c are the primary genetic sex-determinants
d contribute to the coordination of cellular and humoral immunity

96 MLS ONLY Isoimmunization to platelet antigen HPA-1a and the placental transfer of maternal antibodies would be expected to cause newborn:

a erythroblastosis
b leukocytosis
c leukopenia
d thrombocytopenia

97 Saliva from which of the following individuals would neutralize an auto anti-H in the serum of a group A, Le(a–b+) patient?

a group A, Le(a–b–)
b group A, Le(a+b–)
c group O, Le(a+b–)
d group O, Le(a–b+)

98 Inhibition testing can be used to confirm antibody specificity for which of the following antibodies?

a anti-Lu^a
b anti-M
c anti-Le^a
d anti-Fy^a

99 Which of the following Rh antigens has the highest frequency in Caucasians?

a D
b E
c c
d e

100 MLS ONLY Anti-D and anti-C are identified in the serum of a transfused pregnant woman, gravida 2, para 1. Nine months previously she received Rh immune globulin (RhIG) after delivery. Tests of the patient, her husband, and the child revealed the following:

	anti-D	anti-C	anti-E	anti-c	anti-e
patient	0	0	0	+	+
father	+	0	0	+	+
child	+	0	0	+	+

The most likely explanation for the presence of anti-C is that this antibody is:

a actually anti-C^w
b from the RhIG dose
c actually anti-G
d naturally occurring

101 MLS ONLY The phenomenon of an Rh-positive person whose serum contains anti-D is best explained by:

a gene deletion
b missing antigen epitopes
c trans position effect
d gene inhibition

102 MLS ONLY When the red cells of an individual fail to react with anti-U, they usually fail to react with:

a anti-M
b anti-Le^b
c anti-S
d anti-P_1

103 Which of the following red cell antigens are found on glycophorin-A?

- **a** M, N
- **b** Le^a, Le^b
- **c** S, s
- **d** P, P_1, P^k

104 Paroxysmal cold hemoglobinuria (PCH) is associated with antibody specificity toward which of the following?

- **a** Kell system antigens
- **b** Duffy system antigens
- **c** P antigen
- **d** I antigen

105 Which of the following is a characteristic of anti-i?

- **a** associated with warm autoimmune hemolytic anemia
- **b** found in the serum of patients with infectious mononucleosis
- **c** detected at lower temperatures in the serum of normal individuals
- **d** found only in the serum of group O individuals

106 In a case of cold autoimmune hemolytic anemia, the patient's serum would most likely react 4+ at immediate spin with:

- **a** group A cells, B cells and O cells, but not his own cells
- **b** cord cells but not his own or other adult cells
- **c** all cells of a group O cell panel and his own cells
- **d** only penicillin-treated panel cells, not his own cells

107 Cold agglutinin syndrome is associated with an antibody specificity toward which of the following?

- **a** Fy:3
- **b** P
- **c** I
- **d** Rh:1

108 Which of the following is a characteristic of anti-i?

- **a** often associated with hemolytic disease of the newborn
- **b** reacts best at room temperature or 4°C
- **c** reacts best at 37°C
- **d** is usually IgG

109 The Kell (K1) antigen is:

- **a** absent from the red cells of neonates
- **b** strongly immunogenic
- **c** destroyed by enzymes
- **d** has a frequency of 50% in the random population

110 MLS ONLY In chronic granulomatous disease (CGD), granulocyte function is impaired. An association exists between this clinical condition and a depression of which of the following antigens?

- **a** Rh
- **b** P
- **c** Kell
- **d** Duffy

111 The antibodies of the Kidd blood group system:

a react best by the indirect antiglobulin test
b are predominantly IgM
c often cause allergic transfusion reactions
d do not generally react with antigen-positive, enzyme-treated RBCs

112 Proteolytic enzyme treatment of red cells usually destroys which antigen?

a Jk^a
b E
c Fy^a
d k

113 Anti-Fy^a is:

a usually a cold-reactive agglutinin
b more reactive when tested with enzyme-treated red blood cells
c capable of causing hemolytic transfusion reactions
d often an autoagglutinin

114 Resistance to malaria is best associated with which of the following blood groups?

a Rh
b I/i
c P
d Duffy

115 MLS ONLY What percent of group O donors would be compatible with a serum sample that contained anti-X and anti-Y if X antigen is present on red cells of 5 of 20 donors, and Y antigen is present on red cells of 1 of 10 donors?

a 2.5
b 6.8
c 25.0
d 68.0

116 MLS ONLY How many Caucasians in a population of 100,000 will have the following combination of phenotypes?

System	Phenotype	Frequency (%)
ABO	O	45
Gm	Fb	48
PGM1	2-1	37
EsD	2-1	18

a 1
b 14
c 144
d 1,438

117 MLS ONLY What is the approximate probability of finding compatible blood among random Rh-positive units for a patient who has anti-c and anti-K? (Consider that 20% of Rh-positive donors lack c and 90% lack K)

a 1%
b 10%
c 18%
d 45%

118 A 25-year-old Caucasian woman, gravida 3, para 2, required 2 units of Red Blood Cells. The antibody screen was positive and the results of the antibody panel are shown below:

													EM	
Cell	**D**	**C**	**c**	**E**	**e**	**K**	**Jk^a**	**Jk^b**	**Le^a**	**Le^b**	**M**	**N**	**P$_1$**	**37°C**	**AHG**
1	+	+	0	0	+	+	+	+	0	+	+	+	+	0	0
2	+	+	0	0	+	0	+	0	0	+	+	0	0	0	0
3	+	0	+	+	0	0	+	+	0	+	+	+	+	0	1+
4	+	+	+	0	+	0	0	+	0	+	+	0	+	0	1+
5	0	0	+	0	+	0	+	+	0	+	+	0	0	0	1+
6	0	0	+	+	+	0	+	0	+	0	+	+	0	0	1+
7	0	0	+	0	+	+	+	+	+	0	+	+	+	0	1+
8	0	0	+	0	+	0	0	+	0	+	0	+	+	0	1+
													auto	0	0

EM = enhancement media

What is the most probable genotype of this patient?

a *rr*
b *r′r′*
c R_0r
d R_1R_1

Physiology and Pathophysiology

119 MLS ONLY A man suffering from gastrointestinal bleeding has received 20 units of Red Blood Cells in the last 24 hours and is still oozing post-operatively. The following results were obtained:

PT:	20 seconds (control: 12 seconds)
APTT:	43 seconds (control: 31 seconds)
platelet count:	160 × 10^3/μL (160 × 10^9/L)
Hgb:	10 g/dL (100 g/L)
Factor VIII:	85%

What blood product should be administered?

a Fresh Frozen Plasma
b Red Blood Cells
c Factor VIII Concentrate
d Platelets

120 MLS ONLY Transfusion of which of the following is needed to help correct hypofibrinogenemia due to DIC?

a Whole Blood
b Fresh Frozen Plasma
c Cryoprecipitated AHF
d Platelets

121 A blood component used in the treatment of hemophilia A is:

a Factor VIII Concentrate
b Fresh Frozen Plasma
c Platelets
d Whole Blood

122 MLS ONLY Which of the following blood components is most appropriate to transfuse to an 8-year-old male hemophiliac who is about to undergo minor surgery?

a Cryoprecipitated AHF
b Red Blood Cells
c Platelets
d Factor VIII Concentrate

123 MLS ONLY A unit of Fresh Frozen Plasma was inadvertently thawed and then immediately refrigerated at 4°C on Monday morning. On Tuesday evening this unit may still be transfused as a replacement for:

a all coagulation factors
b Factor V
c Factor VIII
d Factor IX

124 MLS ONLY A newborn demonstrates petechiae, ecchymosis and mucosal bleeding. The preferred blood component for this infant would be:

a Red Blood Cells
b Fresh Frozen Plasma
c Platelets
d Cryoprecipitated AHF

125 MLS ONLY Which of the following would be the best source of Platelets for transfusion in the case of alloimmune neonatal thrombocytopenia?

a father
b mother
c pooled platelet-rich plasma
d polycythemic donor

126 An obstetrical patient has had 3 previous pregnancies. Her first baby was healthy, the second was jaundiced at birth and required an exchange transfusion, while the third was stillborn. Which of the following is the most likely cause?

a ABO incompatibility
b immune deficiency disease
c congenital spherocytic anemia
d Rh incompatibility

127 MLS ONLY A specimen of cord blood is submitted to the transfusion service for routine testing. The following results are obtained:

anti-A:	anti-B:	anti-D:	Rh-control:	direct antiglobulin test:
4+	negative	3+	negative	2+

It is known that the father is group B, with the genotype of *cde/cde*. Of the following 4 antibodies, which 1 is the most likely cause of the positive direct antiglobulin test?

a anti-A
b anti-D
c anti-c
d anti-C

128 ABO-hemolytic disease of the newborn:

a usually requires an exchange transfusion
b most often occurs in first born children
c frequently results in stillbirth
d is usually seen only in the newborn of group O mothers

129 Which of the following antigens is **most** likely to be involved in hemolytic disease of the newborn?

a Le^a
b P_1
c M
d Kell

130 ABO hemolytic disease of the fetus and newborn (HDFN) differs from Rh HDFN in that:

a Rh HDFN is clinically more severe than ABO HDFN
b the direct antiglobulin test is weaker in Rh HDFN than ABO
c Rh HDFN occurs in the first pregnancy
d the mother's antibody screen is positive in ABO HDN

131 MLS ONLY The following results were obtained:

	anti-A	anti-B	anti-D	Weak D	DAT	Ab screen
infant	0	0	0	NT	4+	NT
mother	4+	0	0	0	NT	anti-D

NT = not tested

Which of the following is the most probable explanation for these results?

a ABO hemolytic disease of the fetus and newborn
b Rh hemolytic disease of the fetus and newborn; infant has received intrauterine transfusions
c Rh hemolytic disease of the fetus and newborn, infant has a false-negative Rh typing
d large fetomaternal hemorrhage

132 A group A, Rh-positive infant of a group O, Rh-positive mother has a weakly positive direct antiglobulin test and a moderately elevated bilirubin 12 hours after birth. The most likely cause is:

a ABO incompatibility
b Rh incompatibility
c blood group incompatibility due to an antibody to a low frequency antigen
d neonatal jaundice **not** associated with blood group

133 MLS ONLY In suspected cases of hemolytic disease of the newborn, what significant information can be obtained from the baby's blood smear?

a estimation of WBC, RBC, and platelet counts
b marked increase in immature neutrophils (shift to the left)
c a differential to estimate the absolute number of lymphocytes present
d determination of the presence of spherocytes

134 The Liley method of predicting the severity of hemolytic disease of the newborn is based on the amniotic fluid:

a bilirubin concentration by standard methods
b change in optical density measured at 450 nm
c Rh determination
d ratio of lecithin to sphingomyelin

135 These laboratory results were obtained on maternal and cord blood samples:

mother: A–
baby: AB+, DAT: 3+ cord hemoglobin: 10 g/dL (100 g/L)

Does the baby have HDN?

a no, as indicated by the cord hemoglobin
b yes, although the cord hemoglobin is normal, the DAT indicates HDN
c yes, the DAT and cord hemoglobin level both support HDN
d no, a diagnosis of HDN cannot be established without cord bilirubin levels

136 MLS ONLY The main purpose of performing antibody titers on serum from prenatal immunized women is to:

- **a** determine the identity of the antibody
- **b** identify candidates for amniocentesis or percutaneous umbilical blood sampling
- **c** decide if the baby needs an intrauterine transfusion
- **d** determine if early induction of labor is indicated

137 Which unit should be selected for exchange transfusion if the newborn is group A, Rh-positive and the mother is group A, Rh-positive with anti-c?

- **a** A, CDe/CDe
- **b** A, cDE/cDE
- **c** O, cde/cde
- **d** A, cde/cde

138 MLS ONLY A mother is group A, with anti-D in her serum. What would be the preferred blood product if an intrauterine transfusion is indicated?

- **a** O, Rh-negative Red Blood Cells
- **b** O, Rh-negative Red Blood Cells, Irradiated
- **c** A, Rh-negative Red Blood Cells
- **d** A, Rh-negative Red Blood Cells, Irradiated

139 MLS ONLY Laboratory studies of maternal and cord blood yield the following results:

Maternal blood	Cord blood
O, Rh-negative	B, Rh-positive
anti-E in serum	DAT = 2+
	anti-E in eluate

If exchange transfusion is necessary, the best choice of blood is:

- **a** B, Rh-negative, E+
- **b** B, Rh-positive, E+
- **c** O, Rh-negative, E–
- **d** O, Rh-positive, E–

140 A blood specimen from a pregnant woman is found to be group B, Rh-negative and the serum contains anti-D with a titer of 512. What would be the most appropriate type of blood to have available for a possible exchange transfusion for her infant?

- **a** O, Rh-negative
- **b** O, Rh-positive
- **c** B, Rh-negative
- **d** B, Rh-positive

141 Blood selected for exchange transfusion must:

- **a** lack red blood cell antigens corresponding to maternal antibodies
- **b** be <3 days old
- **c** be the same Rh type as the baby
- **d** be ABO compatible with the father

142 When the main objective of an exchange transfusion is to remove the infant's antibody-sensitized red blood cells and to control hyperbilirubinemia, the blood product of choice is ABO compatible:

- **a** Fresh Whole Blood
- **b** Red Blood Cells (RBC) washed
- **c** RBC suspended in Fresh Frozen Plasma
- **d** heparinized Red Blood Cells

143 To prevent graft-vs-host disease, Red Blood Cells prepared for infants who have received intrauterine transfusions should be:

a saline-washed
b irradiated
c frozen and deglycerolized
d group- and Rh-compatible with the mother

144 MLS ONLY Which of the following is the preferred specimen for the initial compatibility testing in exchange transfusion therapy?

a maternal serum
b eluate prepared from infant's red blood cells
c paternal serum
d infant's postexchange serum

145 Rh-Immune Globulin is requested for an Rh-negative mother who has the following results:

	D	D control	Weak D	Weak D control
mother's postpartum sample:	0	0	$1+^{mf}$	0

mf = mixed field

What is the most likely explanation?

a mother is a genetic weak D
b mother had a fetomaternal hemorrhage of D+ cells
c mother's red cells are coated weakly with IgG
d anti-D reagent is contaminated with an atypical antibody

146 The following results are seen on a maternal postpartum sample:

	D	D control	Weak D	Weak D control
mother's postpartum sample:	0	0	$1+^{mf}$	0

mf = mixed field

The most appropriate course of action is to:

a report the mother as Rh-negative
b report the mother as Rh-positive
c perform an elution on mother's RBCs
d investigate for a fetomaternal hemorrhage

147 What is the most appropriate interpretation for the laboratory data given below when an Rh-negative woman has an Rh-positive child?

Rosette fetal screen using enzyme-treated D+ cells

mother's sample:	1 rosette/3 fields
positive control:	5 rosettes/3 fields
negative control:	no rosettes observed

a mother is not a candidate for RhIg
b mother needs 1 vial of RhIg
c mother needs 2 vials of RhIg
d the fetal-maternal hemorrhage needs to be quantitated

148 Refer to the following information:

Postpartum	anti-D	Rh control	Weak D	Weak D control	Rosette fetal screen
mother	0	0	+ micro	0	20 rosettes/5 fields
newborn	4+	0	NT	NT	NT

NT = not tested

What is the best interpretation for the laboratory data given above?

a mother is Rh-positive
b mother is weak D+
c mother has had a fetal-maternal hemorrhage
d mother has a positive DAT

149 MLS ONLY A weakly reactive anti-D is detected in a postpartum specimen from an Rh-negative woman. During her prenatal period, all antibody screening tests were negative. These findings indicate:

a that she is a candidate for Rh immune globulin
b that she is **not** a candidate for Rh immune globulin
c a need for further investigation to determine candidacy for Rh immune globulin
d the presence of Rh-positive cells in her circulation

150 The results of a Kleihauer-Betke stain indicate a fetomaternal hemorrhage of 35 mL of whole blood. How many vials of Rh immune globulin would be required?

a 1
b 2
c 3
d 4

151 A fetomaternal hemorrhage of 35 mL of fetal Rh-positive packed RBCs has been detected in an Rh-negative woman. How many vials of Rh immune globulin should be given?

a 0
b 1
c 2
d 3

152 Criteria determining Rh immune globulin eligibility include:

a mother is Rh-positive
b infant is Rh-negative
c mother has not been previously immunized to the D antigen
d infant has a positive direct antiglobulin test

153 MLS ONLY While performing routine postpartum testing for an Rh immune globulin (RhIG) candidate, a weakly positive antibody screening test was found. Anti-D was identified. This antibody is most likely the result of:

a massive fetomaternal hemorrhage occurring at the time of this delivery
b antenatal administration of Rh immune globulin at 28 weeks gestation
c contamination of the blood sample with Wharton jelly
d mother having a positive direct antiglobulin test

154 Rh immune globulin administration would **not** be indicated in an Rh-negative woman who has a(n):

a first trimester abortion
b husband who is Rh-positive
c anti-D titer of 1:4,096
d positive direct antiglobulin test

155 A Kleihauer-Betke stain of a postpartum blood film revealed 0.3% fetal cells. What is the estimated volume (mL) of the fetomaternal hemorrhage expressed as whole blood?

a 5
b 15
c 25
d 35

156 Based upon Kleihauer-Betke test results, which of the following formulas is used to determine the volume of fetomaternal hemorrhage expressed in mL of whole blood?

a % of fetal cells present × 30
b % of fetal cells present × 50
c % of maternal cells present × 30
d % of maternal cells present × 50

157 An acid elution stain was made using a 1-hour post-delivery maternal blood sample. Out of 2,000 cells that were counted, 30 of them appeared to contain fetal hemoglobin. It is the policy of the medical center to add 1 vial of Rh immune globulin to the calculated dose when the estimated volume of the hemorrhage exceeds 20 mL of whole blood. Calculate the number of vials of Rh immune globulin that would be indicated under these circumstances.

a 2
b 3
c 4
d 5

158 The rosette test will detect a fetomaternal hemorrhage (FMH) as small as:

a 10 mL
b 15 mL
c 20 mL
d 30 mL

159 MLS ONLY A 10 mL fetal maternal hemorrhage in an Rh-negative woman who delivered an Rh-positive baby means that the:

a mother's antibody screen will be positive for anti-D
b rosette test will be positive
c mother is not a candidate for Rh immune globulin
d mother should receive 2 doses of Rh immune globulin

160 MLS ONLY Mixed leukocyte culture (MLC) is a biological assay for detecting which of the following?

a HLA-A antigens
b HLA-B antigens
c HLA-D antigens
d immunoglobulins

161 A 40-year-old man with autoimmune hemolytic anemia due to anti-E has a hemoglobin level of 10.8 g/dL (108 g/L). This patient will most likely be treated with:

a Whole Blood
b Red Blood Cells
c Fresh Frozen Plasma
d no transfusion

162 A patient in the immediate post bone marrow transplant period has a hematocrit of 21%. The red cell product of choice for this patient would be:

a packed
b saline washed
c microaggregate filtered
d irradiated

163 HLA antigen typing is important in screening for:

- **a** ABO incompatibility
- **b** a kidney donor
- **c** Rh incompatibility
- **d** a blood donor

164 MLS ONLY DR antigens in the HLA system are:

- **a** significant in organ transplantation
- **b** not detectable in the lymphocytotoxicity test
- **c** expressed on platelets
- **d** expressed on granulocytes

165 Anti-E is identified in a panel at the antiglobulin phase. When check cells are added to the tubes, no agglutination is seen. The most appropriate course of action would be to:

- **a** quality control the AHG reagent and check cells and repeat the panel
- **b** open a new vial of check cells for subsequent testing that day
- **c** open a new vial of AHG for subsequent testing that day
- **d** record the check cell reactions and report the antibody panel result

Serology

166 MLS ONLY A serological centrifuge is recalibrated for ABO testing after major repairs.

Time in seconds	15	20	25	30
is button delineated?	yes	yes	yes	yes
is supernatant clear?	no	yes	yes	yes
button easy to resuspend?	yes	yes	yes	no
strength of reaction?	+m	1+	1+	1+

Given the data above, the centrifuge time for this machine should be:

- **a** 15 seconds
- **b** 20 seconds
- **c** 25 seconds
- **d** 30 seconds

167 Which of the following represents an acceptably identified patient for sample collection and transfusion?

- **a** a handwritten band with patient's name and hospital identification number is affixed to the patient's leg
- **b** the addressographed hospital band is taped to the patient's bed
- **c** an unbanded patient responds positively when his name is called
- **d** the chart transported with the patient contains his armband not yet attached

168 Samples from the same patient were received on 2 consecutive days. Test results are summarized below:

	Day #1	Day #2
anti-A	4+	0
anti-B	0	4+
anti-D	3+	3+
A_1 cells	0	4+
B cells	4+	0
Ab screen	0	0

How should the request for crossmatch be handled?

a crossmatch A, Rh-positive units with sample from day 1
b crossmatch B, Rh-positive units with sample from day 2
c crossmatch AB, Rh-positive units with both samples
d collect a new sample and repeat the tests

169 The following test results are noted for a unit of blood labeled group A, Rh-negative:

Cells tested with:		
anti-A	anti-B	anti-D
4+	0	3+

What should be done next?

a transfuse as a group A, Rh-negative
b transfuse as a group A, Rh-positive
c notify the collecting facility
d discard the unit

170 What information is essential on patient blood sample labels drawn for compatibility testing?

a biohazard sticker for AIDS patients
b patient's room number
c unique patient medical number
d phlebotomist initials

171 Granulocytes for transfusion should:

a be administered through a microaggregate filter
b be ABO compatible with the recipient's serum
c be infused within 72 hours of collection
d never be transfused to patients with a history of febrile transfusion reactions

172 A neonate will be transfused for the first time with group O Red Blood Cells. Which of the following is appropriate compatibility testing?

a crossmatch with mother's serum
b crossmatch with baby's serum
c no crossmatch is necessary if initial plasma screening is negative
d no screening or crossmatching is necessary for neonates

173 A group B, Rh-negative patient has a positive DAT. Which of the following situations would occur?

a all major crossmatches would be incompatible
b the weak D test and control would be positive
c the antibody screening test would be positive
d the forward and reverse ABO groupings would not agree

174 The following reactions were obtained:

Cells tested with:			Serum tested with:	
anti-A	anti-B	anti-A,B	A_1 cells	B cells
4+	3+	4+	2+	4+

The technologist washed the patient's cells with saline, and repeated the forward typing. A saline replacement technique was used with the reverse typing. The following results were obtained:

Cells tested with:			Serum tested with:	
anti-A	anti-B	anti-A,B	A_1 cells	B cells
4+	0	4+	0	4+

The results are consistent with:

a acquired immunodeficiency disease
b Bruton agammaglobulinemia
c multiple myeloma
d acquired "B" antigen

175 What is the most likely cause of the following ABO discrepancy?

Patient's cells vs:		Patient's serum vs:	
anti-A	anti-B	A_1 cells	B cells
0	0	0	0

a recent transfusion with group O blood
b antigen depression due to leukemia
c false-negative cell typing due to rouleaux
d obtained from a heel stick of a 2-month old baby

176 Which of the following patient data best reflects the discrepancy seen when a person's red cells demonstrate the acquired-B phenotype?

	Forward grouping	Reverse grouping
patient A	B	O
patient B	AB	A
patient C	O	B
patient D	B	AB

a A
b B
c C
d D

177 Which of the following is characteristic of Tn polyagglutinable red cells?

a if group O, they may appear to have acquired a group A antigen
b they show strong reactions when the cells are enzyme-treated
c they react with *Arachis hypogaea* lectin
d the polyagglutination is a transient condition

178 Mixed field agglutination encountered in ABO grouping with no history of transfusion would most likely be due to:

a Bombay phenotype (O_h)
b T activation
c A_3 red cells
d positive indirect antiglobulin test

179 Which of the following is a characteristic of polyagglutinable red cells?

a can be classified by reactivity with *Ulex europaeus*
b are agglutinated by most adult sera
c are always an acquired condition
d autocontrol is always positive

180 Consider the following ABO typing results:

Patient's cells vs:		Patient's serum vs:	
anti-A	anti-B	A_1 cells	B cells
4+	0	1+	4+

Additional testing was performed using patient serum:

	IS	RT
screening cell I	1+	2+
screening cell II	1+	2+
autocontrol	1+	2+

What is the **most likely** cause of this discrepancy?

a A_2 with anti-A_1
b cold alloantibody
c cold autoantibody
d acquired-A phenomenon

181 MLS ONLY Consider the following ABO typing results:

Patient's cells vs:		Patient's serum vs:	
anti-A	anti-B	A_1 cells	B cells
4+	0	1+	4+

Additional testing was performed using patient serum:

	IS	RT
screening cell I	1+	2+
screening cell II	1+	2+
autocontrol	1+	2+

What should be done next?

a test serum against a panel of group O cells
b neutralization
c perform serum type at 37°C
d elution

182 The following results were obtained on a patient's blood sample during routine ABO and Rh testing:

Cell testing:		Serum testing:	
anti-A:	0	A_1 cells:	4+
anti-B:	4+	B cells:	2+
anti-D:	0		
autocontrol:	0		

Select the course of action to resolve this problem:

a draw a new blood sample from the patient and repeat all test procedures
b test the patient's serum with A_2 cells and the patient's red cells with anti-A_1 lectin
c repeat the ABO antigen grouping using 3× washed saline-suspended cells
d perform antibody screening procedure at immediate spin using group O cells

183 MLS ONLY Which of the following explains an ABO discrepancy caused by problems with the patient's red blood cells?

a an unexpected antibody
b rouleaux
c agammaglobulinemia
d Tn activation

184 The test for weak D is performed by incubating patient's red cells with:

a several different dilutions of anti-D serum
b anti-D serum followed by washing and antiglobulin serum
c anti-D^u serum
d antiglobulin serum

185 MLS ONLY Refer to the following data:

Forward group:			Reverse group:		
anti-A	anti-B	anti-A_1 lectin	A_1 cells	A_2 cells	B cells
4+	0	4+	0	2+	4+

Which of the following antibody screen results would you expect with the ABO discrepancy seen above?

a negative
b positive with all screen cells at the 37°C phase
c positive with all screen cells at the RT phase; autocontrol is negative
d positive with all screen cells and the autocontrol cells at the RT phase

186 The following results were obtained when testing a sample from a 20-year-old, first-time blood donor:

Forward group:		Reverse group:	
anti-A	anti-B	A_1 cells	B cells
0	0	0	3+

What is the most likely cause of this ABO discrepancy?

a loss of antigen due to disease
b acquired B
c phenotype O_h "Bombay"
d weak subgroup of A

187 A mother is Rh-negative and the father Rh-positive. Their baby is Rh-negative. It may be concluded that:

a the father is homozygous for D
b the mother is heterozygous for D
c the father is heterozygous for D
d at least 1 of the 3 Rh typings must be incorrect

188 Some blood group antibodies characteristically hemolyze appropriate red cells in the presence of:

a complement
b anticoagulants
c preservatives
d penicillin

189 Review the following schematic diagram:

PATIENT SERUM + REAGENT GROUP "O" CELLS
INCUBATE → READ FOR AGGLUTINATION
WASH → ADD AHG → AGGLUTINATION OBSERVED

The next step would be to:

a add "check cells" as a confirmatory measure
b identify the cause of the agglutination
c perform an elution technique
d perform a direct antiglobulin test

190 The following results were obtained in pretransfusion testing:

	37°C	IAT
screening cell I	0	3+
screening cell II	0	3+
autocontrol	0	3+

The most probable cause of these results is:

a rouleaux
b a warm autoantibody
c a cold autoantibody
d multiple alloantibodies

191 A patient is typed as group O, Rh-positive and crossmatched with 6 units of blood. At the indirect antiglobulin (IAT) phase of testing, both antibody screening cells and 2 crossmatched units are incompatible. What is the most likely cause of the incompatibility?

a recipient alloantibody
b recipient autoantibody
c donors have positive DATs
d rouleaux

192 Refer to the following data:

hemoglobin:	7.4 g/dL (74 g/L)
reticulocyte count:	22%

Direct Antiglobulin Test		Ab Screen – IAT	
polyspecific:	3+	SC I:	3+
IgG:	3+	SC II:	3+
C3:	0	auto:	3+

Which clinical condition is consistent with the lab results shown above?

a cold hemagglutinin disease
b warm autoimmune hemolytic anemia
c penicillin-induced hemolytic anemia
d delayed hemolytic transfusion reaction

193 A patient received 2 units of Red Blood Cells and had a delayed transfusion reaction. Pretransfusion antibody screening records indicate no agglutination except after the addition of IgG sensitized cells. Repeat testing of the pretransfusion specimen detected an antibody at the antiglobulin phase. What is the most likely explanation for the original results?

a red cells were overwashed
b centrifugation time was prolonged
c patient's serum was omitted from the original testing
d antiglobulin reagent was neutralized

194 At the indirect antiglobulin phase of testing, there is no agglutination between patient serum and screening cells. One of 3 donor units was incompatible.

The most probable explanation for these findings is that the:

a patient has an antibody directed against a high incidence antigen
b patient has an antibody directed against a low incidence antigen
c donor has an antibody directed against donor cells
d donor has a positive antibody screen

195 The major crossmatch will detect a(n):

a group A patient mistyped as group O
b unexpected red cell antibody in the donor unit
c Rh-negative donor unit mislabeled as Rh-positive
d recipient antibody directed against antigens on the donor red cells

196 A 42-year-old female is undergoing surgery tomorrow and her physician requests that 4 units of Red Blood Cells be crossmatched. The following results were obtained:

	IS	37°C	IAT
screening cell I	0	0	0
screening cell II	0	0	0
screening cell III	0	0	0

Crossmatch	IS	37°C	IAT
donor 1:	2+	1+	1+
donors 2,3,4:	0	0	0

What is the most likely cause of the incompatibility of donor 1?

a single alloantibody
b multiple alloantibodies
c Rh incompatibilities
d donor 1 has a positive DAT

197 Which of the following would most likely be responsible for an incompatible antiglobulin crossmatch?

a recipient's red cells possess a low frequency antigen
b anti-K antibody in donor serum
c recipient's red cells are polyagglutinable
d donor red cells have a positive direct antiglobulin test

198 A reason why a patient's crossmatch may be incompatible while the antibody screen is negative is:

a the patient has an antibody against a high-incidence antigen
b the incompatible donor unit has a positive direct antiglobulin test
c cold agglutinins are interfering in the crossmatch
d the patient's serum contains warm autoantibody

199 A blood specimen types as A, Rh-positive with a negative antibody screen. 6 units of group A, Rh-positive Red Blood Cells were crossmatched and 1 unit was incompatible in the antiglobulin phase. The same result was obtained when the test was repeated. Which should be done **first**?

a repeat the ABO grouping on the incompatible unit using a more sensitive technique
b test a panel of red cells that possesses low-incidence antigens
c perform a direct antiglobulin test on the donor unit
d obtain a new specimen and repeat the crossmatch

200 During emergency situations when there is no time to determine ABO group and Rh type on a current sample for transfusion, the patient is known to be A, Rh-negative. The technologist should:

a refuse to release any blood until the patient's sample has been typed
b release A Rh-negative Red Blood Cells
c release O Rh-negative Red Blood Cells
d release O Rh-positive Red Blood Cells

201 A 29-year-old male is hemorrhaging severely. He is AB, Rh-negative. 6 units of blood are required STAT. Of the following types available in the blood bank, which would be most preferable for crossmatch?

a AB, Rh-positive
b A, Rh-negative
c A, Rh-positive
d O, Rh-negative

202 A patient is group A_2B, Rh-positive and has an antiglobulin- reacting anti-A_1 in his serum. He is in the operating room bleeding profusely and group A_2B Red Blood Cells are **not** available. Which of the following blood types is first choice for crossmatching?

a B, Rh-positive
b B, Rh-negative
c A_1B, Rh-positive
d O, Rh-negative

203 A 10% red cell suspension in saline is used in a compatibility test. Which of the following would most likely occur?

a a false-positive result due to antigen excess
b a false-positive result due to the prozone phenomenon
c a false-negative result due to the prozone phenomenon
d a false-negative result due to antigen excess

204 MLS ONLY A patient serum reacts with 2 of the 3 antibody screening cells at the AHG phase. 8 of the 10 units crossmatched were incompatible at the AHG phase. All reactions are markedly enhanced by enzymes. These results are most consistent with:

a anti-M
b anti-E
c anti-c
d anti-Fy^a

205 A patient received 4 units of blood 2 years previously and now has multiple antibodies. He has not been transfused since that time. It would be most helpful to:

a phenotype his cells to determine which additional alloantibodies may be produced
b recommend the use of directed donors, which are more likely to be compatible
c use proteolytic enzymes to destroy the "in vitro" activity of some of the antibodies
d freeze the patient's serum to use for antigen typing of compatible units

206 Autoantibodies demonstrating blood group specificity in warm autoimmune hemolytic anemia are associated more often with which blood group system?

a Rh
b I
c P
d Duffy

207 An antibody that causes in vitro hemolysis and reacts with the red cells of 3 out of ten crossmatched donor units is most likely:

a anti-Le^a
b anti-s
c anti-k
d anti-E

208 MLS ONLY A patient's serum reacted weakly positive ($1+^w$) with 16 of 16 group O panel cells at the AHG test phase. The autocontrol was negative. Tests with ficin-treated panel cells demonstrated no reactivity at the AHG phase. Which antibody is most likely responsible for these results?

a anti-Ch
b anti-k
c anti-e
d anti-Js^b

209 An antibody identification study is performed with the 5-cell panel shown below:

		Antigens					
		1	2	3	4	5	Test results
Panel cells	I	+	0	0	+	+	+
	II	0	0	+	0	+	0
	III	0	+	+	+	0	0
	IV	0	+	+	0	+	+
	V	+	+	+	0	0	+
						auto	0

An antibody against which of the following antigens could **not** be excluded?

a 1
b 2
c 3
d 4

210 MLS ONLY A 25-year-old Caucasian woman, gravida 3, para 2, required 2 units of Red Blood Cells. The antibody screen was positive and the results of the antibody panel are shown below:

													EM	
Cell	D	C	c	E	e	K	Jk^a	Jk^b	Le^a	Le^b	M	N	P_1	37°C	AHG
1	+	+	0	0	+	+	+	+	0	+	+	+	+	0	0
2	+	+	0	0	+	0	+	0	0	+	+	0	0	0	0
3	+	0	+	+	0	0	+	+	0	+	+	+	+	0	1+
4	+	+	+	0	+	0	0	+	0	+	+	0	+	0	1+
5	0	0	+	0	+	0	+	+	0	+	+	0	0	0	1+
6	0	0	+	+	+	0	+	0	+	0	+	+	0	0	1+
7	0	0	+	0	+	+	+	+	+	0	+	+	+	0	1+
8	0	0	+	0	+	0	0	+	0	+	0	+	+	0	1+
													auto	0	0

EM = enhancement media

Which of the following antibodies may be the cause of the positive antibody screen?

a anti-M and anti-K
b anti-c and anti-E
c anti-Jk^a and anti-c
d anti-P_1 and anti-c

211 MLS ONLY A 25-year-old Caucasian woman, gravida 3, para 2, required 2 units of Red Blood Cells. The antibody screen was positive and the results of the antibody panel are shown below:

													EM	
Cell	D	C	c	E	e	K	Jk^a	Jk^b	Le^a	Le^b	M	N	P_1	37°C	AHG
1	+	+	0	0	+	+	+	+	0	+	+	+	+	0	0
2	+	+	0	0	+	0	+	0	0	+	+	0	0	0	0
3	+	0	+	+	0	0	+	+	0	+	+	+	+	0	1+
4	+	+	+	0	+	0	0	+	0	+	+	0	+	0	1+
5	0	0	+	0	+	0	+	+	0	+	+	0	0	0	1+
6	0	0	+	+	+	0	+	0	+	0	+	+	0	0	1+
7	0	0	+	0	+	+	+	+	+	0	+	+	+	0	1+
8	0	0	+	0	+	0	0	+	0	+	0	+	+	0	1+
													auto	0	0

EM = enhancement media

Which common antibody has **not** been ruled out by the panel?

a anti-C
b anti-Le^b
c anti-Jk^a
d anti-E

212 In the process of identifying an antibody, the technologist observed 2+ reactions with 3 of the 10 cells in a panel after the immediate spin phase. There was no reactivity after incubation at 37°C and after the anti-human globulin test phase. The antibody most likely is:

a anti-P_1
b anti-Le^a
c anti-C
d anti-Fy^a

213 Transfusion of Ch+ (Chido-positive) red cells to a patient with anti-Ch has been reported to cause:

a no clinically significant red cell destruction
b clinically significant immune red cell destruction
c decreased ^{51}Cr red cell survivals
d febrile transfusion reactions

214 MLS ONLY Results of a serum sample tested against a panel of reagent red cells gives presumptive evidence of an alloantibody directed against a high incidence antigen. Further investigation to confirm the specificity should include which of the following?

a serum testing against red cells from random donors
b serum testing against red cells known to lack high incidence antigens
c serum testing against enzyme-treated autologous red cells
d testing of an eluate prepared from the patient's red cells

215 Refer to the following data:

Forward group:			Reverse group:		
anti-A	anti-B	anti-A_1 lectin	A_1 cells	A_2 cells	B cells
4+	0	4+	0	2+	4+

The ABO discrepancy seen above is most likely due to:

a anti-A_1
b rouleaux
c anti-H
d unexpected IgG antibody present

216 Refer to the following panel:

														EM	
Cell	D	C	c	E	e	K	Jk^a	Jk^b	Le^a	Le^b	M	N	P_1	37°C	AHG
1	+	+	0	0	+	+	+	+	0	+	+	+	+	0	2+
2	+	+	0	0	+	0	+	0	0	+	+	0	0	0	3+
3	+	0	+	+	0	0	+	+	0	+	+	+	+	1+	3+
4	+	+	+	0	+	0	0	+	0	+	+	0	+	0	0
5	0	0	+	0	+	0	+	+	0	+	+	0	0	0	2+
6	0	0	+	+	+	0	+	0	+	0	+	+	0	1+	3+
7	0	0	+	0	+	+	+	+	+	0	+	+	+	0	2+
8	0	0	+	0	+	0	0	+	0	+	0	+	+	0	0
													auto	0	0

EM = enhancement media

Based on the results of the above panel, the most likely antibodies are:

a anti-M and anti-K
b anti-E, anti-Jk^a and anti-K
c anti-Jk^a and anti-M
d anti-E and anti-Le^b

217 Which characteristics are true of **all 3** of the following antibodies: anti-Fy^a, anti-Jk^a, and anti-K?

a detected at IAT phase and may cause hemolytic disease of the fetus and newborn (HDFN) and transfusion reactions
b not detected with enzyme treated cells; may cause delayed transfusion reactions
c requires the IAT technique for detection; usually not responsible for causing HDFN
d may show dosage effect; may cause severe hemolytic transfusion reactions

218 MLS ONLY Refer to the following cell panel:

															Enzymes
Cell	D	C	c	E	e	K	Jk^a	Jk^b	Le^a	Le^b	M	N	P_1	AHG	AHG
1	+	+	0	0	+	+	+	+	0	+	+	+	+	3+	4+
2	+	+	0	0	+	0	+	0	0	+	+	0	0	3+	4+
3	+	0	+	+	0	0	+	+	0	+	+	+	+	0	0
4	+	+	+	0	+	0	0	+	0	+	+	0	+	2+	3+
5	0	0	+	0	+	0	+	+	0	+	+	0	0	0	0
6	0	0	+	+	+	0	+	0	+	0	+	+	0	0	0
7	0	0	+	0	+	+	+	+	+	0	+	+	+	0	0
8	0	0	+	0	+	0	0	+	0	+	0	+	+	0	0
													auto	0	0

Based on these results, which of the following antibodies is **most** likely present?

a anti-C
b anti-E
c anti-D
d anti-K

219 MLS ONLY A pregnant woman has a positive antibody screen and the panel results are given below:

															EM		Enzyme
Cell	D	C	c	E	e	K	Jk^a	Jk^b	Fy^a	Fy^b	Le^a	Le^b	M	N	P_1	37°C	AHG	AHG
1	+	+	0	0	+	+	+	+	0	+	0	+	+	+	+	0	0	0
2	+	+	0	0	+	0	+	0	+	0	0	+	+	0	0	1+	2+	0
3	+	0	+	+	0	0	+	+	+	+	0	+	+	+	+	0	1+	0
4	+	+	+	0	+	0	0	+	0	+	0	+	+	0	+	0	0	0
5	0	0	+	0	+	0	+	+	+	+	0	+	+	0	0	0	1+	0
6	0	0	+	+	+	0	+	0	0	0	+	0	+	+	0	0	0	0
7	0	0	+	0	+	+	+	+	0	+	+	0	+	+	+	0	0	0
8	0	0	+	0	+	0	0	+	+	0	0	+	0	+	+	1+	2+	0
															auto	0	0	0

EM = enhancement media

What is the association of the antibody(ies) with hemolytic disease of the newborn (HDN)?

a usually fatal HDFN
b may cause HDFN
c is not associated with HDFN
d HDFN cannot be determined

220 Which of the following tests is most commonly used to detect antibodies attached to a patient's red blood cells in vivo?

a direct antiglobulin
b complement fixation
c indirect antiglobulin
d immunofluorescence

221 Anti-I may cause a positive direct antiglobulin test (DAT) because of:

a anti-I agglutinating the cells
b C3d bound to the red cells
c T-activation
d C3c remaining on the red cells after cleavage of C3b

222 MLS ONLY Which direct antiglobulin test results are associated with an anamnestic antibody response in a recently transfused patient?

Test result	Polyspecific	IgG	C3	Control
result A	$+^{mf}$	$+^{mf}$	0	0
result B	1+	0	1+	0
result C	2+	2+	0	0
result D	4+	4+	4+	0

mf=mixed field

a result A
b result B
c result C
d result D

223 In the direct (DAT) and indirect (IAT) antiglobulin tests, false-negative reactions may result if the:

a patient's blood specimen was contaminated with bacteria
b patient's blood specimen was collected into tubes containing silicon gel
c saline used for washing the serum/cell mixture has been stored in glass or metal containers
d addition of AHG is delayed for 40 minutes or more after washing the serum/cell mixture

224 Polyspecific reagents used in the direct antiglobulin test should have specificity for:

a IgG and IgA
b IgG and C3d
c IgM and IgA
d IgM and C3d

225 In the direct antiglobulin test, the antiglobulin reagent is used to:

a mediate hemolysis of indicator red blood cells by providing complement
b precipitate anti-erythrocyte antibodies
c measure antibodies in a test serum by fixing complement
d detect preexisting antibodies on erythrocytes

226 AHG (Coombs) control cells:

a can be used as a positive control for anti-C3 reagents
b can be used only for the indirect antiglobulin test
c are coated only with IgG antibody
d must be used to confirm all positive antiglobulin reactions

227 A 56-year-old female with cold agglutinin disease has a positive direct antiglobulin test (DAT). When the DAT is repeated using monospecific antiglobulin sera, which of the following is most likely to be detected?

a IgM
b IgG
c C3d
d C4a

228 MLS ONLY The mechanism that best explains hemolytic anemia due to penicillin is:

a drug-dependent antibodies reacting with drug-treated cells
b drug-dependent antibodies reacting in the presence of drug
c drug-independent with autoantibody production
d nonimmunologic protein adsorption with positive DAT

229 Use of EDTA plasma prevents activation of the classical complement pathway by:

a causing rapid decay of complement components
b chelating Mg^{++} ions, which prevents the assembly of C6
c chelating Ca^{++} ions, which prevents assembly of C1
d preventing chemotaxis

230 Which of the following medications is most likely to cause production of autoantibodies?

a penicillin
b cephalothin
c methyldopa
d tetracycline

231 MLS ONLY Serological results on an untransfused patient were:

antibody screen:	negative at AHG
direct antiglobulin test:	3+ with anti-C3d
eluate:	negative

These results are most likely due to:

a warm autoimmune hemolytic anemia
b cold agglutinin syndrome
c paroxysmal cold hemoglobinura
d drug induced hemolytic anemia

232 The drug cephalosporin can cause a positive direct antiglobulin test with hemolysis by which of the following mechanisms?

a drug-dependent antibodies reacting with drug-treated cells
b drug-dependent antibodies reacting in the presence of a drug
c drug-independent with autoantibody production
d nonimmunologic protein adsorption with positive DAT

233 Crossmatch results at the antiglobulin phase were negative. When 1 drop of check cells was added, no agglutination was seen. The **most** likely explanation is that the:

a red cells were overwashed
b centrifuge speed was set too high
c residual patient serum inactivated the AHG reagent
d laboratorian did not add enough check cells

234 Which of the following might cause a false-negative indirect antiglobulin test (IAT)?

a over-reading
b IgG-coated screening cells
c addition of an extra drop of serum
d too heavy a cell suspension

235 The purpose of testing with anti-A,B is to detect:

a anti-A_1
b anti-A_2
c subgroups of A
d subgroups of B

236 What is the most appropriate diluent for preparing a solution of 8% bovine albumin for a red cell control reagent?

a deionized water
b distilled water
c normal saline
d Alsever solution

237 Which of the following antigens gives enhanced reactions with its corresponding antibody following treatment of the red cells with proteolytic enzymes?

a Fy^a
b E
c S
d M

238 In a prenatal workup, the following results were obtained:

Forward Group:				**Reverse Group:**	
anti-A	anti-B	anti-D	Rh control	A_1 cells	B cells
4+	2+	4+	0	0	3+

DAT:	negative
antibody screen:	negative

ABO discrepancy was thought to be due to an antibody directed against a component of the typing sera. Which test would resolve this discrepancy?

a A_1 lectin
b wash patient's RBCs and repeat testing
c anti-A,B and extend incubation of the reverse group
d repeat reverse group using A_2 cells

239 Refer to the following panel:

											EM	
Cell	**D**	**C**	**c**	**E**	**e**	**K**	**Jk^a**	**Jk^b**	**Fy^a**	**Fy^b**	**37°C**	**AHG**
1	+	+	0	0	+	+	+	+	+	+	0	2+
2	+	+	0	0	+	0	+	0	+	+	0	2+
3	+	0	+	+	0	0	0	+	+	+	1+	3+
4	+	+	0	0	+	0	0	+	0	+	0	0
5	0	0	+	0	+	0	+	+	+	+	0	2+
6	0	0	+	+	+	0	+	0	+	0	1+	3+
7	0	0	+	0	+	+	0	+	+	0	0	2+
8	0	0	+	0	+	0	0	+	0	+	**0**	**0**
										auto	0	0

EM = enhancement media

Based on the results of the above panel, which technique would be most helpful in determining antibody specificity?

a proteolytic enzyme treatment
b urine neutralization
c autoadsorption
d saliva inhibition

240 Of the following, the most useful technique(s) in the identification and classification of high-titer, low-avidity (HTLA) antibodies is/are:

a reagent red cell panels
b adsorption and elution
c titration and inhibition
d cold autoadsorption

241 To confirm a serum antibody specificity identified as anti-P_1, a neutralization study was performed and the following results obtained:

	P_1+ RBCs
serum + P_1 substance:	negative
serum + saline:	negative

What conclusion can be made from these results?

a anti-P_1 is confirmed
b anti-P_1 is ruled out
c a second antibody is suspected due to the results of the negative control
d anti-P_1 cannot be confirmed due to the results of the negative control

242 MLS ONLY What happens to an antibody in neutralization study when a soluble antigen is added to the test?

a inhibition
b dilution
c complement fixation
d hemolysis

243 To confirm the specificity of anti-Le^b, an inhibition study using Lewis substance was performed with the following results:

	Le(b+) cells
tubes with patient serum + Lewis substance:	0
tubes with patient serum + saline control:	+

What conclusion can be made from these results?

a a second antibody is suspected due to the positive control
b anti-Le^b is confirmed because the tubes with Lewis substance are negative
c anti-Le^b is not confirmed because the tubes with Lewis substance are negative
d anti-Le^b cannot be confirmed because the saline positive is control

244 MLS ONLY Which of the following is the correct interpretation of this saliva neutralization testing?

	Indicator cells		
Sample	**A**	**B**	**O**
saliva plus anti-A:	+	0	0
saliva plus anti-B:	0	+	0
saliva plus anti-H:	0	0	0

a group A secretor
b group B secretor
c group AB secretor
d group O secretor

245 MLS ONLY A person's saliva incubated with the following antibodies and tested with the appropriate A_2, O, and B indicator cells, gives the following test results:

Antibody specificity	**Test results**
anti-A	reactive
anti-B	inhibited
anti-H	inhibited

The person's red cells ABO phenotype is:

a A
b AB
c B
d O

246 An antibody screen performed using solid phase technology revealed a diffuse layer of red blood cells on the bottom of the well. These results indicate:

a a positive reaction
b a negative reaction
c serum was not added
d red cells have a positive direct antiglobulin test

247 On Monday, a patient's K antigen typing result was positive. Two days later, the patient's K typing was negative. The patient was transfused with 2 units of Fresh Frozen Plasma. The tech might conclude that the:

a transfusion of FFP affected the K typing
b wrong patient was drawn
c results are normal
d anti-K reagent was omitted on Monday

248 Which one of the following is an indicator of polyagglutination?

a RBCs typing as weak D+
b presence of red cell autoantibody
c decreased serum bilirubin
d agglutination with normal adult ABO compatible sera

249 While performing an antibody screen, a test reaction is suspected to be rouleaux. A saline replacement test is performed and the reaction remains. What is the best interpretation?

a original reaction of rouleaux is confirmed
b replacement test is invalid and should be repeated
c original reaction was due to true agglutination
d antibody screen is negative

250 MLS ONLY A 10-year-old girl was hospitalized because her urine had a distinct red color. The patient had recently recovered from an upper respiratory infection and appeared very pale and lethargic. Tests were performed with the following results:

hemoglobin:	5 g/dL (50 g/L)
reticulocyte count:	15%
DAT:	weak reactivity with poly-specific and anti-C3d; anti-IgG was negative
antibody screen:	negative
Donath-Landsteiner test:	positive; P– cells showed no hemolysis

The patient probably has:

a paroxysmal cold hemoglobinuria (PCH)
b paroxysmal nocturnal hemoglobinuria (PNH)
c warm autoimmune hemolytic anemia
d hereditary erythroblastic multinuclearity with a positive acidified serum test (HEMPAS)

251 Which of the following is useful for removing IgG from red blood cells with a positive DAT to perform a phenotype?

a bromelin
b chloroquine
c LISS
d DTT

252 A patient's serum contains a mixture of antibodies. One of the antibodies is identified as anti-D. Anti-Jk^a, anti-Fy^a and possibly another antibody are present. What technique(s) may be helpful to identify the other antibody(ies)?

a enzyme panel; select cell panel
b thiol reagents
c lowering the pH and increasing the incubation time
d using albumin as an enhancement media in combination with selective adsorption

253 A sample gives the following results:

Cells with:		Serum with:	
anti-A	3+	A_1 cells	2+
anti-B	4+	B cells	0

Which lectin should be used first to resolve this discrepancy?

a *Ulex europaeus*
b *Arachis hypogaea*
c *Dolichos biflorus*
d *Vicia graminea*

254 The serum of a group O, Cde/Cde donor contains anti-D. In order to prepare a suitable anti-D reagent from this donor's serum, which of the following cells would be suitable for the adsorption?

a group O, cde/cde cells
b group O, Cde/cde cells
c group A_2B, CDe/cde cells
d group A_1B, cde/cde cells

255 A 26-year-old female is admitted with anemia of undetermined origin. Blood samples are received with a crossmatch request for 6 units of Red Blood Cells. The patient is group A, Rh-negative and has no history of transfusion or pregnancy. The following results were obtained in pretransfusion testing:

	IS	37°C	IAT
screening cell I	0	0	3+
screening cell II	0	0	3+
autocontrol	0	0	3+
all 6 donors	0	0	3+

The best way to find compatible blood is to:

a do an antibody identification panel
b use the saline replacement technique
c use the pre-warm technique
d perform a warm autoadsorption

256 MLS ONLY A patient's serum was reactive 2+ in the antiglobulin phase of testing with all cells on a routine panel including their own. Transfusion was performed 6 months previously. The optimal adsorption method to remove the autoantibody is:

a autoadsorption using the patient's ZZAP-treated red cells
b autoadsorption using the patient's LISS-treated red cells
c adsorption using enzyme-treated red cells from a normal donor
d adsorption using methyldopa-treated red cells

257 MLS ONLY In a cold autoadsorption procedure, pretreatment of the patient's red cells with which of the following reagents is helpful?

a ficin
b phosphate-buffered saline at pH 9.0
c low ionic strength saline (LISS)
d albumin

258 The process of separation of antibody from its antigen is known as:

a diffusion
b adsorption
c neutralization
d elution

259 MLS ONLY Which of the following is most helpful to confirm a weak ABO subgroup?

a adsorption-elution
b neutralization
c testing with A1 lectin
d use of anti-A,B

260 One of the most effective methods for the elution of warm autoantibodies from RBCs utilizes:

a 10% sucrose
b LISS
c change in pH
d distilled water

Transfusion Practice

261 How would the hematocrit of a patient with chronic anemia be affected by the transfusion of a unit of Whole Blood containing 475 mL of blood, vs 2 units of Red Blood Cells each with a total volume of 250 mL?

a patient's hematocrit would be equally affected by the Whole Blood or the Red Blood Cells
b Red Blood Cells would provide twice the increment in hematocrit as the Whole Blood
c Whole Blood would provide twice the increment in hematocrit as the Red Blood Cells
d Whole Blood would provide a change in hematocrit slightly less than the Red Blood Cells

262 After checking the inventory, it was noted that there were no units on the shelf marked "May Issue as Uncrossmatched: For Emergency Only." Which of the following should be placed on this shelf?

a 1 unit of each of the ABO blood groups
b units of group O, Rh-positive Whole Blood
c units of group O, Rh-negative Red Blood Cells
d any units that are expiring at midnight

263 MLS ONLY The primary indication for granulocyte transfusion is:

a prophylactic treatment for infection
b additional supportive therapy in those patients who are responsive to antibiotic therapy
c clinical situations where bone marrow recovery is not anticipated
d severe neutropenia with an infection that is nonresponsive to antibiotic therapy

264 A 42-year-old male of average body mass has a history of chronic anemia requiring transfusion support. Two units of Red Blood Cells are transfused. If the pretransfusion hemoglobin was 7.0 g/dL (70 g/L), the expected posttransfusion hemoglobin concentration should be:

a 8.0 g/dL (80 g/L)
b 9.0 g/dL (90 g/L)
c 10.0 g/dL (100 g/L)
d 11.0 g/dL (110 g/L)

265 How many units of Red Blood Cells are required to raise the hematocrit of a 70 kg nonbleeding man from 24% to 30%?

a 1
b 2
c 3
d 4

266 MLS ONLY For which of the following transfusion candidates would CMV-seronegative blood be **most** likely indicated?

- **a** renal dialysis patients
- **b** sickle cell patient
- **c** bone marrow and hematopoietic cell transplant recipients
- **d** CMV-seropositive patients

267 MLS ONLY Although ABO compatibility is preferred, ABO incompatible product may be administered when transfusing:

- **a** Single-Donor Plasma
- **b** Cryoprecipitated AHF
- **c** Fresh Frozen Plasma
- **d** Granulocytes

268 Transfusion of plateletpheresis products from HLA-compatible donors is the preferred treatment for:

- **a** recently diagnosed cases of TTP with severe thrombocytopenia
- **b** acute leukemia in relapse with neutropenia, thrombocytopenia and sepsis
- **c** immune thrombocytopenic purpura
- **d** severely thrombocytopenic patients, known to be refractory to random donor platelets

269 MLS ONLY Washed Red Blood Cells are indicated in which of the following situations?

- **a** an IgA-deficient patient with a history of transfusion-associated anaphylaxis
- **b** a pregnant woman with a history of hemolytic disease of the newborn
- **c** a patient with a positive DAT and red cell autoantibody
- **d** a newborn with a hematocrit of <30%

270 Which of the following is consistent with standard blood bank procedure governing the infusion of fresh frozen plasma?

- **a** only blood group-specific plasma may be administered
- **b** group O may be administered to recipients of all blood groups
- **c** group AB may be administered to AB recipients only
- **d** group A may be administered to both A and O recipients

271 A patient who is group AB, Rh-negative needs 2 units of Fresh Frozen Plasma. Which of the following units of plasma would be **most** acceptable for transfusion?

- **a** group O, Rh-negative
- **b** group A, Rh-negative
- **c** group B, Rh-positive
- **d** group AB, Rh-positive

272 What increment of platelets/uL (platelets/L), in the typical 70-kg human, is expected to result from each single unit of Platelets transfused to a non-HLA-sensitized recipient?

- **a** 3,000- 5,000
- **b** 5,000-10,000
- **c** 20,000-25,000
- **d** 25,000-30,000

273 MLS ONLY Platelet transfusions are of most value in treating:

- **a** hemolytic transfusion reaction
- **b** posttransfusion purpura
- **c** functional platelet abnormalities
- **d** immune thrombocytopenic purpura

274 MLS ONLY Washed Red Blood Cells would be the product of choice for a patient with:

a multiple red cell alloantibodies
b an increased risk of hepatitis infection
c warm autoimmune hemolytic anemic
d anti-IgA antibodies

275 A patient received about 15 mL of compatible blood and developed severe shock, but no fever. If the patient needs another transfusion, what kind of red blood cell component should be given?

a Red Blood Cells
b Red Blood Cells, Washed
c Red Blood Cells, Irradiated
d Red Blood Cells, Leukocyte-Reduced

276 Fresh Frozen Plasma from a group A, Rh-positive donor may be safely transfused to a patient who is group:

a A, Rh-negative
b B, Rh-negative
c AB, Rh-positive
d AB, Rh-negative

277 A patient admitted to the trauma unit requires emergency release of Fresh Frozen Plasma (FFP). His blood donor card states that he is group AB, Rh-positive. Which of the following blood groups of FFP should be issued?

a A
b B
c AB
d O

278 Fresh Frozen Plasma:

a contains all labile coagulative factors except cryoprecipitated AHF
b has a higher risk of transmitting hepatitis than does Whole Blood
c should be transfused within 24 hours of thawing
d need not be ABO-compatible

279 Ten units of group A platelets were transfused to a group AB patient. The pretransfusion platelet count was $12 \times 10^3/\mu L$ ($12 \times 10^9/L$) and the posttransfusion count was $18 \times 10^3/\mu L$ ($18 \times 10^9/L$). From this information, the laboratorian would most likely conclude that the patient:

a needs group AB platelets to be effective
b clinical data does not suggest a need for platelets
c has developed antibodies to the transfused platelets
d should receive irradiated platelets

280 Hypotension, nausea, flushing, fever and chills are symptoms of which of the following transfusion reactions?

a allergic
b circulatory overload
c hemolytic
d anaphylactic

281 MLS ONLY A patient has become refractory to platelet transfusion. Which of the following are probable causes?

a transfusion of Rh-incompatible platelets
b decreased pH of the platelets
c development of an alloantibody with anti-D specificity
d development of antibodies to HLA antigen

282 MLS ONLY A poor increment in the platelet count 1 hour following platelet transfusion is most commonly caused by:

- **a** splenomegaly
- **b** alloimmunization to HLA antigens
- **c** disseminated intravascular coagulation
- **d** defective platelets

283 MLS ONLY Posttransfusion purpura is usually caused by:

- **a** anti-A
- **b** white cell antibodies
- **c** anti-HPA-1a (PI^{A1})
- **d** platelet wash-out

284 An unexplained fall in hemoglobin and mild jaundice in a patient transfused with Red Blood Cells 1 week previously would most likely indicate:

- **a** paroxysmal nocturnal hemoglobinuria
- **b** posttransfusion hepatitis infection
- **c** presence of HLA antibodies
- **d** delayed hemolytic transfusion reaction

285 In a delayed transfusion reaction, the causative antibody is generally too weak to be detected in routine compatibility testing and antibody screening tests, but is typically detectable at what point after transfusion?

- **a** 3-6 hours
- **b** 3-7 days
- **c** 60-90 days
- **d** after 120 days

286 The most serious hemolytic transfusion reactions are due to incompatibility in which of the following blood group systems?

- **a** ABO
- **b** Rh
- **c** MN
- **d** Duffy

287 Severe intravascular hemolysis is most likely caused by antibodies of which blood group system?

- **a** ABO
- **b** Rh
- **c** Kell
- **d** Duffy

288 Which of the following blood group systems is most commonly associated with delayed hemolytic transfusion reactions?

- **a** Lewis
- **b** Kidd
- **c** MNS
- **d** I

289 After receiving a unit of Red Blood Cells, a patient immediately developed flushing, nervousness, fever spike of 102°F (38.9°C), shaking, chills and back pain. The plasma hemoglobin was elevated and there was hemoglobinuria. Laboratory investigation of this adverse reaction would most likely show:

- **a** an error in ABO grouping
- **b** an error in Rh typing
- **c** presence of anti-Fy^a antibody in patient's serum
- **d** presence of gram-negative bacteria in blood bag

290 A trauma patient who has just received ten units of blood may develop:

a anemia
b polycythemia
c leukocytosis
d thrombocytopenia

291 MLS ONLY Five days after transfusion, a patient becomes mildly jaundiced and experiences a drop in hemoglobin and hematocrit with no apparent hemorrhage. Below are the results of the transfusion reaction workup:

	anti-A	anti-B	anti-D	A_1 cells	B cells	Ab screen	DAT
patient pretransfusion	neg	4+	3+	4+	neg	neg	neg
patient posttransfusion	neg	4+	3+	4+	neg	1+	1+
donor #1	neg	neg	3+	4+	4+	neg	
donor #2	neg	4+	3+	4+	neg	neg	

In order to reach a conclusion, the technician should first:

a retype the pre- and posttransfusion patient samples and donor #1
b request an EDTA tube be drawn on the patient and repeat the DAT
c repeat the pretransfusion antibody screen on the patient's sample
d identify the antibody in the serum and eluate from the posttransfusion sample

292 The most appropriate laboratory test for early detection of acute posttransfusion hemolysis is:

a a visual inspection for free plasma hemoglobin
b plasma haptoglobin concentration
c examination for hematuria
d serum bilirubin concentration

293 During initial investigation of a suspected hemolytic transfusion reaction, it was observed that the posttransfusion serum was yellow in color and the direct antiglobulin test was negative. Repeat ABO typing on the posttransfusion sample confirmed the pretransfusion results. What is the next step in this investigation?

a repeat compatibility testing on suspected unit(s)
b perform plasma hemoglobin and haptoglobin determinations
c use enhancement media to repeat the antibody screen
d no further serological testing is necessary

294 Which of the following transfusion reactions is characterized by high fever, shock, hemoglobinuria, DIC and renal failure?

a bacterial contamination
b circulatory overload
c febrile
d anaphylactic

295 Hemoglobinuria, hypotension and generalized bleeding are symptoms of which of the following transfusion reactions?

a allergic
b circulatory overload
c hemolytic
d anaphylactic

296 When evaluating a suspected transfusion reaction, which of the following is the ideal sample collection time for a bilirubin determination?

a 6 hours posttransfusion
b 12 hours posttransfusion
c 24 hours posttransfusion
d 48 hours posttransfusion

297 A patient's record shows a previous anti-Jk^b, but the current antibody screen is negative. What further testing should be done before transfusion?

a phenotype the patient's red cells for the Jk^b antigen
b perform a cell panel on the patient's serum
c crossmatch type specific units and release only compatible units for transfusion
d give Jk^b negative crossmatch compatible blood

298 A posttransfusion blood sample from a patient experiencing chills and fever shows distinct hemolysis. The direct antiglobulin test is positive (mixed field). What would be most helpful to determine the cause of the reaction?

a auto control
b elution and antibody identification
c repeat antibody screen on the donor unit
d bacteriologic smear and culture

299 A patient is readmitted to the hospital with a hemoglobin level of 7 g/dL (70 g/L) 3 weeks after receiving 2 units of red cells. The initial serological tests are:

ABO/Rh:	A+
antibody screen:	negative
DAT:	1+ mixed field

Which test should be performed next?

a antibody identification panel on the patient's serum
b repeat the ABO type on the donor units
c perform an elution and identify the antibody in the eluate
d crossmatch the post reaction serum with the 3 donor units

300 In a delayed hemolytic transfusion reaction, the direct antiglobulin test is typically:

a negative
b mixed-field positive
c positive due to complement
d negative when the antibody screen is negative

301 MLS ONLY A patient has had massive trauma involving replacement of 1 blood volume with Red Blood Cells and crystalloid. She is currently experiencing oozing from mucous membranes and surgical incisions. Laboratory values are as follows:

PT:	normal
APTT:	normal
bleeding time:	prolonged
platelet count:	$20 \times 10^3/\mu L$ ($20 \times 10^9/L$)
hemoglobin:	11.4 g/dL (114 g/L)

What is the blood component of choice for this patient?

a Platelets
b Cryoprecipitated AHF
c Fresh Frozen Plasma
d Prothrombin Complex

302 For a patient who has suffered an acute hemolytic transfusion reaction, the primary treatment goal should be to:

a prevent alloimmunization
b diminish chills and fever
c prevent hemoglobinemia
d reverse hypotension and minimize renal damage

303 A patient multiply transfused with Red Blood Cells developed a headache, nausea, fever and chills during his last transfusion. What component is most appropriate to prevent this reaction in the future?

a Red Blood Cells
b Red Blood Cells, Irradiated
c Red Blood Cells, Leukocyte-Reduced
d Red Blood Cells selected as CMV-reduced-risk

304 The use of Leukocyte-Reduced Red Blood Cells and Platelets is indicated for which of the following patient groups?

a CMV-seropositive postpartum mothers
b victims of acute trauma with massive bleeding
c patients with history of febrile transfusion reactions
d burn victims with anemia and low serum protein

305 Leukocyte-Poor Red Blood Cells would most likely be indicated for patients with a history of:

a febrile transfusion reaction
b iron deficiency anemia
c hemophilia A
d von Willebrand disease

306 Posttransfusion anaphylactic reactions occur most often in patients with:

a leukocyte antibodies
b erythrocyte antibodies
c IgA deficiency
d Factor VIII deficiency

307 Which of the following transfusion reactions occurs after infusion of only a few milliliters of blood and gives no history of fever?

a febrile
b circulatory overload
c anaphylactic
d hemolytic

308 Fever and chills are symptoms of which of the following transfusion reactions?

a citrate toxicity
b circulatory overload
c allergic
d febrile

309 Hives and itching are symptoms of which of the following transfusion reactions?

a febrile
b allergic
c circulatory overload
d bacterial

310 A temperature rise of 1°C or more occurring in association with a transfusion, with no abnormal results in the transfusion reaction investigation, usually indicates which of the following reactions?

a febrile
b circulatory overload
c hemolytic
d anaphylactic

311 A 65-year-old woman experienced shaking, chills, and a fever of 102°F (38.9°C) approximately 40 minutes following the transfusion of a second unit of Red Blood Cells. The most likely explanation for the patient's symptoms is:

a transfusion of bacterially contaminated blood
b congestive heart failure
c anaphylactic transfusion reaction
d febrile transfusion reaction

312 A sickle cell patient who has been multiply transfused experiences fever and chills after receiving a unit of Red Blood Cells. Transfusion investigation studies show:

DAT:	negative
plasma hemolysis:	no hemolysis observed

The patient is most likely reacting to:

a IgA
b plasma protein
c red cells
d white cells or cytokines

313 MLS ONLY Use of only male donors as a source of plasma intended for transfusion is advocated to reduce which type of reaction?

a allergic
b TRALI
c hemolytic
d TACO (circulatory overload)

314 MLS ONLY Platelets are ordered for a patient who has a history of febrile reactions following red cell transfusions. What should be done to reduce the risk of another febrile reaction?

a pretransfusion administration of Benadryl®
b transfuse Irradiated Platelets
c give Platelets from IgA-deficient donors
d give Leukocyte-Reduced Platelets

315 Symptoms of dyspnea, cough, hypoxemia, and pulmonary edema within 6 hours of transfusion is most likely which type of reaction?

a anaphylactic
b hemolytic
c febrile
d TRALI

316 A patient with a coagulopathy was transfused with FP24 (plasma frozen within 24 hours of collection). After infusion of 15 mL, the patient experienced hypotension, shock, chest pain and difficulty in breathing. The most likely cause of the reaction is:

a anti-IgA
b bacterial contamination
c intravascular hemolysis
d leukoagglutinins

317 To prevent febrile transfusion reactions, which Red Blood Cell product should be transfused?

a Red Blood Cells, Irradiated
b CMV-negative Red Blood Cells
c Red Blood Cells, Leukocyte-Reduced
d IgA-deficient donor blood

318 During the issue of an autologous unit of Whole Blood, the supernatant plasma is observed to be dark red in color. What would be the best course of action?

a the unit may be issued only for autologous use
b remove the plasma and issue the unit as Red Blood Cells
c issue the unit only as washed Red Blood Cells
d quarantine the unit for further testing

319 Coughing, cyanosis and difficult breathing are symptoms of which of the following transfusion reactions?

a febrile
b allergic
c circulatory overload
d hemolytic

320 Which of the following is a nonimmunologic adverse effect of a transfusion?

a hemolytic reaction
b febrile nonhemolytic reaction
c congestive heart failure
d urticaria

321 Congestive heart failure, severe headache and/or peripheral edema occurring soon after transfusion is indicative of which type of transfusion reaction?

a hemolytic
b febrile
c anaphylactic
d circulatory overload

322 A patient with severe anemia became cyanotic and developed tachycardia, hypertension, and difficulty breathing after receiving 3 units of blood. No fever or other symptoms were evident. This is most likely what type of reaction?

a febrile reaction
b transfusion-associated circulatory overload (TACO)
c anaphylactic reaction
d hemolytic reaction

323 A patient became hypotensive and went into shock after receiving 50 mL of a unit of Red Blood Cells. She had a shaking chill and her temperature rose to 104.8°F (40.4 °C). A transfusion reaction investigation was initiated but no abnormal results were seen. What additional testing should be performed?

a Gram stain and culture of the donor unit
b lymphocytotoxicity tests for leukoagglutinins
c plasma IgA level
d elution and antibody identification

324 The most frequent transfusion-associated disease complication of blood transfusions is:

a cytomegalovirus (CMV)
b syphilis
c hepatitis
d AIDS

325 The purpose of a low-dose irradiation of blood components is to:

a prevent posttransfusion purpura
b prevent graft-vs-host (GVH) disease
c sterilize components
d prevent noncardiogenic pulmonary edema

326 MLS ONLY Which of the following patient groups is at risk of developing graft-vs-host disease?

a full term infants
b patients with history of febrile transfusion reactions
c patients with a positive direct antiglobulin test
d recipients of blood donated by immediate family members

327 Irradiation of donor blood is done to prevent which of the following adverse effects of transfusion?

a febrile transfusion reaction
b cytomegalovirus infection
c transfusion associated graft-vs-host disease
d transfusion related acute lung injury (TRALI)

328 MLS ONLY Therapeutic plasmapheresis is performed in order to:

a harvest granulocytes
b harvest platelets
c treat patients with polycythemia
d treat patients with plasma abnormalities

329 MLS ONLY Plasma exchange is recommended in the treatment of patients with macroglobulinemia in order to remove:

a antigen
b excess IgM
c excess IgG
d abnormal platelets

330 The most important step in the safe administration of blood is to:

a perform compatibility testing accurately
b get an accurate patient history
c exclude disqualified donors
d accurately identify the donor unit and recipient

1 b	59 d	117 c	175 d	233 c	291 d
2 c	60 d	118 d	176 b	234 d	292 a
3 c	61 c	119 a	177 a	235 c	293 d
4 d	62 a	120 c	178 c	236 c	294 a
5 b	63 a	121 a	179 b	237 b	295 c
6 b	64 a	122 d	180 c	238 b	296 a
7 a	65 a	123 d	181 c	239 a	297 d
8 d	66 d	124 c	182 d	240 c	298 b
9 d	67 c	125 b	183 d	241 d	299 c
10 b	68 d	126 d	184 b	242 a	300 b
11 b	69 a	127 c	185 c	243 b	301 a
12 b	70 c	128 d	186 d	244 d	302 d
13 b	71 a	129 d	187 c	245 c	303 c
14 d	72 a	130 a	188 a	246 a	304 c
15 c	73 b	131 c	189 b	247 b	305 a
16 d	74 a	132 a	190 b	248 d	306 c
17 d	75 c	133 d	191 a	249 c	307 c
18 c	76 d	134 b	192 b	250 a	308 d
19 b	77 b	135 c	193 c	251 b	309 b
20 d	78 d	136 b	194 b	252 a	310 a
21 a	79 c	137 a	195 d	253 c	311 d
22 d	80 d	138 b	196 a	254 d	312 d
23 b	81 c	139 d	197 d	255 d	313 b
24 a	82 b	140 a	198 b	256 a	314 d
25 a	83 d	141 a	199 c	257 a	315 d
26 d	84 c	142 c	200 c	258 d	316 a
27 d	85 b	143 b	201 b	259 a	317 c
28 a	86 c	144 a	202 a	260 c	318 d
29 c	87 c	145 b	203 d	261 b	319 c
30 d	88 c	146 d	204 c	262 c	320 c
31 b	89 c	147 a	205 a	263 d	321 d
32 a	90 d	148 c	206 a	264 b	322 b
33 c	91 a	149 c	207 a	265 b	323 a
34 a	92 b	150 b	208 a	266 c	324 c
35 c	93 b	151 d	209 a	267 b	325 b
36 b	94 b	152 c	210 b	268 d	326 d
37 c	95 d	153 b	211 d	269 a	327 c
38 b	96 d	154 c	212 b	270 d	328 d
39 b	97 d	155 b	213 a	271 d	329 b
40 b	98 c	156 b	214 b	272 b	330 d
41 d	99 d	157 c	215 c	273 c	
42 b	100 c	158 a	216 b	274 d	
43 d	101 b	159 b	217 a	275 b	
44 c	102 c	160 c	218 a	276 a	
45 a	103 a	161 d	219 b	277 c	
46 a	104 c	162 d	220 a	278 c	
47 b	105 b	163 b	221 b	279 c	
48 a	106 c	164 a	222 a	280 c	
49 b	107 c	165 a	223 d	281 d	
50 c	108 b	166 b	224 b	282 b	
51 d	109 b	167 a	225 d	283 c	
52 d	110 c	168 d	226 c	284 d	
53 a	111 a	169 c	227 c	285 b	
54 b	112 c	170 c	228 a	286 a	
55 a	113 c	171 b	229 c	287 a	
56 c	114 d	172 c	230 c	288 b	
57 d	115 d	173 b	231 b	289 a	
58 a	116 d	174 c	232 b	290 d	

Blood Products

1 **b** All donors, regardless of sex, require a minimum hemoglobin of 12.5 g/dL (125 g/L). The value must not be performed on an earlobe stick.
[AABB Standards 2008a, p70]

2 **c** Jaundice is a sign of liver impairment, which might be due to HBV or HCV. Infection with HBV and HCV is a cause for indefinite deferral.
[AABB Standards 2008a, p73; Kaplan 2003, pp497-500]

3 MLS ONLY **c** The receipt of blood products is a 6-month deferral, the deferral for travel to areas endemic for malaria is 12 months regardless of antimalarial prophylaxis, and a person taking antibiotics may have bacteremia. The requirement for temperature is not over 37.5°C or 99.5°F.
[AABB Standards 2008a, pp70-74]

4 **d** A positive test for HbsAg at any time is an indefinite deferral.
[AABB Standards 2008a, pp70-74]

5 MLS ONLY **b** A woman who had a spontaneous abortion at 2 months of pregnancy, 3 months previously would be acceptable. A donor is acceptable if she has not been pregnant in the previous 6 weeks.
[AABB Standards 2008a, pp70-74]

6 **b** The Hct must be >38%. A donor may be 16 unless state law differs. Temperature must not exceed 99.5°F/37.5°C, blood pressure must be <180 mm Hg systolic and <100 mm Hg diastolic, pulse 50-100 unless an athlete (which can be lower). Toxoids and vaccines from synthetic or killed sources have no deferral.
[AABB Standards 2008a, pp70-71]

7 MLS ONLY **a** The minimum platelet count required for frequent repeat donors is $150 \times 10^3/\mu L$ ($150 \times 10^9/L$). A platelet count is not required prior to the first donation or if the interval between donations is at least 4 weeks.
[AABB Standards 2008a, p25]

8 **d** The scrub must use iodine, eg, PVP iodine complex. Donors who are sensitive to iodine can have the area cleaned with a preparation of 2% chlorhexidine and 70% isopropyl alcohol.
[AABB Tech Manual 2008b, pp193, 942]

9 **d** Testing for syphilis was the first mandated donor screening test for infectious disease and is still part of donor screening.
[AABB Tech Manual 2008b, ch8]

10 **b** Platelets are prepared and stored at 20°-24°C for optimum function.
[AABB Tech Manual 2008b, p198]

11 MLS ONLY **b** The most common posttransfusion hepatitis is hepatitis B. The estimated risk of transmission is 1:220,000 units transfused. The risk of hepatitis C transmission is 1:1,800,000 units. Hepatitis B surface antigen (HBsAg) is a required donor test for detection of acute or chronic HBV infection.
[AABB Tech Manual 2008b, pp242, 260-73]

12 **b** Western blot uses purified HIV proteins to confirm reactivity in samples whose screening test for anti-HIV is positive.
[AABB Tech Manual 2008b, ch10]

13 **b** The causative agent for AIDS is the human immunodeficiency virus types 1 and 2.
[AABB Tech Manual 2008b, ch8]

14 **d** The enzyme-labeled immunosorbent assay (ELISA) method is a very sensitive method employed to screen donors for markers of transfusion-transmitted viruses.
[AABB Tech Manual 2008b, ch8]

15 MLS ONLY **c** Rejuvenation of RBCs uses additives to restore or enhance 2,3-DPG and ATP levels.
[Harmening 2005, p111]

16 **d** Sterile docking devices allow entry into donor units without affecting the expiration date of the product.
[Harmening 2005, p286]

17 **d** Sterile docking devices allow entry into donor units without affecting the expiration date of the product.
[Harmening 2005, p286]

18 **c** If storage devices do not have automated temperature recording, temperature must be manually monitored every 4 hours.
[AABB Tech Manual 2008b, p284]

19 **b** Fresh Frozen Plasma is stored at –18°C or below for 12 months.
[AABB Standards 2008a, Reference Standard 5.1]

20 **d** Blood may be returned to the blood bank after issue provided that 1) the container has not been entered, 2) at least 1 sealed segment is attached to the container, 3) visual inspection of the unit is satisfactory and documented, and 4) the unit has been maintained at the appropriate storage or transport temperature. Studies have shown that refrigerated components retain an acceptable temperature of <10°C for up to 30 minutes after removal from the refrigerator.
[AABB Tech Manual 2008b]

21 MLS ONLY **a** Red Blood Cells, Frozen with 40% glycerol are stored at –65°C or lower.
[AABB Standards 2008a, Reference Standard 5.1]

22 **d** Red Blood Cells are stored at 1°-6°C.
[AABB Standards 2008a, Reference Standard 5.1]

23 **b** If the seal is broken during processing, components are considered to be prepared in an open system, rather than a closed system. The expiration time for Red Blood Cells in an open system is 24 hours.
[AABB Standards 2008a, Reference Standard 5.1]

24 **a** Cryoprecipitated AHF is stored at –18°C or lower.
[AABB Standards 2008a, Reference Standard 5.1]

25 **a** Cryoprecipitate must be transfused within 4 hours of pooling.
[Harmening 2005, p232]

26 **d** Whole Blood-derived platelets are stored at 20°-24°C with continuous gentle agitation. Platelets prepared by the PRP method may be stored for up to 5 days.
[AABB Standards 2008a, Reference Standard 5.1]

27 **d** The required temperature for storage of platelets is 20°-24°C.
[AABB Standards 2008a, Reference Standard 5.1]

28 **a** Per AABB standards, thawed FFP should be stored at 1°-6°C for no more than 24 hours.
[AABB Standards 2008a, p68]

29 **c** Cryoprecipitate has a shelf life of 12 months in the frozen state.
[Harmening 2005, p232]

30 **d** Once thawed, FFP is stored at 1°-6°C for up to 24 hours.
[Marques 2007, p25]

31 MLS ONLY **b** The pH of platelets should be maintained at 6.2 or above throughout the storage period.
[AABB Standards 2008a, §5.7.5]

32 **a** The required temperature for storage of thawed plasma is 1°-6°C.
[AABB Standards 2008a, Reference Standard 5.1]

33 MLS ONLY **c** 2,3-DPG declines during storage of Red Blood Cells, causing a "shift-to-the-left" in the oxygen dissociation curve and an impaired ability to deliver oxygen to the tissues.
[Harmening 2005, p308]

34 MLS ONLY **a** Cryoprecipitate is used primarily for fibrinogen replacement. It is stored at room temperature (20°-24°C) after thawing and must be infused within 6 hours. If pooled with other cryo units, it must be infused within 4 hours.
[Harmening 2005, p308]

35 MLS ONLY **c** Blood products from blood relatives containing viable lymphocytes must be irradiated to inhibit the proliferation of T cells and subsequent GVHD.
[Harmening 2005, p227]

36 **b** Irradiation inhibits proliferation of T lymphocytes.
[Harmening 2005, p23]

37 **c** FFP thawed in a water bath should be protected so that entry ports are not contaminated with water. One can may use a plastic overwrap or keep ports above the water level.
[AABB Tech Manual 2008b, p191]

38 **b** Fresh Frozen Plasma (FFP) must be separated and frozen within 8 hours of Whole Blood collection.
[Harmening 2005, p231]

39 MLS ONLY **b** Cryoprecipitate contains at least 80 units of AHF.
[Harmening 2005, p232]

40 MLS ONLY **b** Cryoprecipitated AHF contains at least 80 IU of Factor VIII concentrated in about 10 mL of plasma.
[Harmening 2005, p237]

41 MLS ONLY **d** Cryoprecipitate is indicated as a source of fibrinogen for hypofibrinogenemia. It contains a minimum of 150 mg of fibrinogen concentrated in a small volume of plasma.
[Harmening 2005, p308]

42 **b** Cryoprecipitate is the fraction of plasma proteins that precipitate when FFP is slowly thawed at 1°-6°C.
[Harmening 2005, p232]

43 **d** Clots in the unit may indicate contamination.
[Harmening 2005, p372]

44 MLS ONLY **c** Per AABB standards, at least 90% of platelet pheresis units sampled must contain at least 3.0×10^{11} platelets.
[AABB Standards 2008a, p36]

45 MLS ONLY **a** Per AABB standards, at least 90% of the platelet units prepared from Whole Blood that are sampled must contain at least 5.5×10^{10} platelets.
[AABB Standards 2008a, pp35-36]

46 **a** Whole blood-derived Platelets are prepared by a light spin to separate the Red Blood Cells from the platelet-rich plasma (PRP), followed by a heavy spin of the PRP to concentrate the platelets.
[Harmening 2005, p230]

47 MLS ONLY **b** Per AABB standards, at least 90% of platelet units sampled must have a pH of at least 6.2 at the end of the allowable storage.
[AABB Standards 2008a, pp35-36]

48 MLS ONLY **a** Per AABB standards, store Platelets at 20°-24°C with continuous agitation. Platelets must be separated from Whole Blood units and maintained at a temperature of at least 20°C. The pH must be at least 6.2 at the end of the storage time.
[AABB Standards 2008a, p65]

49 **b** Whole blood-derived (random donor) Platelets should contain at least 5.5×10^{10} platelets, be stored with continuous agitation at 20°-24°C, and have a pH of 6.2 or higher when tested at the end of the storage period.
[Harmening 2005, p230]

50 **c** Apheresis (single donor) Platelets should contain at least 3.0×10^{11} platelets, be stored with continuous agitation at 20°-24°C, and have a pH of 6.2 or higher when tested at the end of the storage period.
[Harmening 2005, p230]

51 MLS ONLY **d** Newly diagnosed bone marrow candidates are at great risk for severe sequelae of CMV infections. Infection can best be reduced by using leukocyte-reduction filters. CMV-seronegative units are rarely used since leukocyte reducing via filtration is so effective. Washing does not remove as many leukocytes as filtering.
[Harmening 2005, p310]

52 MLS ONLY **d** Leukoreduction of blood products reduces donor leukocytes to less than 5×10^6 and decreases the risk of HLA alloimmunization.
[Marques 2007, p20]

53 **a** The apheresis process is to remove whole blood, the desired component removed, and the remaining portion of blood returned to the donor/patient.
[AABB Practical Guide 2007, ch14]

54 **b** Autologous donors have less stringent criteria than allogeneic donors. Donations must be collected at least 72 hours prior to surgery.
[AABB Standards 2008a, p22]

55 **a** Only ABO and Rh is required with the patient's sample. Each autologous unit must be confirmed for ABO and Rh from an integrally attached segment.
[AABB Standards 2008a, p44]

56 MLS ONLY **c** FDA requires that 4 representative units be tested each month for Factor VIII levels of 80 IU or higher. If the average value is less than 80 IU of Factor VIII, corrective action must be taken.
[AABB Tech Manual 2008b, p224]

57 MLS ONLY **d** To determine the total IU of Factor VIII per bag of cryoprecipitate, multiple the assayed value/mL by the number of mL in the container.
[Harmening 2005, p32]

Blood Group Systems

58 **a** The mother has a 50% chance of passing on R_1 and 50% chance of passing on r. The father will always pass on R_1. Statistically, 50% of the children will be R_1r and 50% of the them will be R_1R_1.
[Harmening 2005, p139]

59 **d** The entire set of HLA antigens located on one chromosome is a haplotype.
[Harmening 2005, p485]

60 **d** The patient lacks *E*. Since *C* and *c* are alleles, *C* is inherited from one parent and *c* from the other. Since the person is homozygous for *e*, one of the genes needs to code for ce (RHce) and the other Ce (RHCe). The *RHD* gene is more likely inherited with *Ce* than *ce*, so the person's most probable genotype is *DCe/dce*. This genotype is found in 31% of the white and 15% of the black populations.
[AABB Tech Manual 2008b, pp387-392]

61 **c** The A and B structures can not be developed since there is no H precursor substance due to the lack of the *H* gene in the blood donor.
[AABB Tech Manual 2008b, p362]

62 **a** This individual cannot have the k antigen on their cells. K_0K_0 is rare and no Kell system antigens are detected on the red blood cells. Those individuals usually produce antibodies that are reactive with all normal cells. *KK* is the most probable genotype.
[Harmening 2005, p176]

63 **a** Fy(a–b–) individuals are very rare with all populations other than the individual of African descent. 68% of African Americans are Fy(a–b–).
[AABB Tech Manual 2008b, p422]

64 **a** The baby is Rh-negative and lacks c, since there is no evidence of HDFN. Inheritance of no D and no c is denoted as *r′*. The baby must have inherited this gene from both parents, and is homozygous *r′r′*.
[AABB Tech Manual 2008b, pp387-396]

65 **a** The most common genotype in Rh-negative individuals is *rr*. Anti-e would not be formed because the recipient's red cells contain the e antigen. The first antibody most likely to develop would be anti-c.
[Harmening 2005, p137]

66 **d** Blood group genes are autosomal, they are not carried on the sex gene. Whenever the gene is inherited, the antigen is expressed on the red blood cells, which is known as codominant.
[Harmening 2005, p110]

67 **c** The Xg blood group system is unique in that the gene encodes on the X chromosome. A negative mother would not have the Xg(a) to pass on. A positive father would, however, transmit the Xg(a) to all his daughters.
[Harmening 2005, p198]

68 **d** All common Rh antigens are present on the red blood cells. R_1 (*DCe*) and R_2 (*DcE*) are frequent genotypes.
[Harmening 2005, p139]

69 **a** R_0R_0 is the only correct choice here. R_0 = D+C–E–c+e+.
[AABB Tech Manual 2008b, pp387-396]

70 **c** The Lewis antigens are developed by gene interaction. Both the *Lewis* and *Secretor* gene are required for red cells to type as Le(a–b+). If a person has a *Lewis* gene, but not *Secretor* gene, then the cells type as Le(a+b–). The Le(a–b–) phenotype is derived when the *Lewis* gene is absent and the *Secretor* gene may or may not be present. The Le(a+b–) phenotype occurs in 22% or the population, and Le(a–b–) occurs in 6%, so the most likely phenotype of a nonsecretor (se/se) is Le(a+b–).
[AABB Tech Manual 2008b, p374]

71 **a** Anti-f will react with react with cells that carry c and e on the same Rh polypeptide. No other listed genotypes produce an Rh polypeptide that carries both c and e.
[AABB Tech Manual 2008b, pp387-396]

72 **a** Nonreactivity with anti-f indicates the cells do not have an Rh polypeptide that possesses both c and e, which is necessary to type as f+. R_1R_2 is the most likely genotype.
[AABB Tech Manual 2008b, pp387-396]

73 MLS ONLY **b** The N antigen is lacking in 30% of the Caucasian population.
[AABB Tech Manual 2008b, p415]

74 **a** The baby appears to lack c since no HDFN was evident. The mom is most likely R_1R_1, so had to pass R_1 onto the baby. The father must have passed on an Rh gene that also did not produce c. Given the choices, the father has to be R_1r.
[AABB Tech Manual 2008b, pp387-396]

75 **c** The Fy(a–b–) phenotype occurs in 68% of the population of African descent, but is extremely rare in the other ethnic backgrounds. Lu(a–b–), Jk(a–b–) and K–k– are very rare in all ethnic backgrounds.
[AABB Tech Manual 2008b, ch14]

76 **d** The frequency of compatible donors for this patient can be calculated by multiplying the percentage of the population that is e–C– × Fy(a–) × Jk(b–). The blood supplier's immunohematology reference laboratory may have units in stock or can request blood from other IRLs through the American Rare Donor w.
[Harmening 2005, p217, 257]

77 **b** The most likely haplotype is DCe/dce.
[AABB Tech Manual 2008b, p391]

78 **d** From the first 2 children it can be determined the mom has the haplotypes A2B12 and A23F18. The dad has the haplotypes A1B3 and A3B35. The expected B antigen in child #3 is B35.
[Harmening 2005, p435]

79 MLS ONLY **c** If an exact match of HLA-A and HLA-B antigens is necessary, siblings would be the most likely match, since siblings may have received the same haplotypes from the parents.
[AABB Tech Manual 2008b, p550]

80 MLS ONLY **d** Determination of compatibility can be determined by multiplying the percentage of compatibility of each antigen. 46% of the population is group O, 15% are D–, and 91% are K–. 0.46 × 0.15 × 0.91 = 0.
[AABB Tech Manual 2008b, p348]

81 MLS ONLY **c** Use the Hardy-Weinberg equation: $p^2 + 2pq + q^2 = 1.0$ In this example, p^2 is the homozygous population, Jk(a+b–). The square root of $p^2 = p$, which is the gene frequency of Jk^a in this population. Out of 400 people, 122, or 30% are homozygous. The square root of 0.30 = is 0.55.
[AABB Tech Manual 2008b, pp349-351]

82 MLS ONLY **b** The Hardy-Weinberg equation states $p + q = 1.0$. When the equation is expanded, it is $p^2 + 2pq + q^2 = 1.0$.
[AABB Tech Manual 2008b, pp349-351]

83 **d** When a marker is in a child that the mother and alleged father do not have, the alleged father can not be the biological father of the child. This is a direct exclusion.
[AABB Tech Manual 2008b, p352]

84 **c** The child's genotype does not include E. The alleged father is homozygous for E. If he was the father the child would also have E. The father can be excluded from paternity.
[Harmening 2005, p139]

85 **b** Direct exclusion of paternity is established when a genetic marker is present in the child but is absent from the mother and the alleged father.
[AABB Tech Manual 2008b, p352]

86 **c** A_x cells are more strongly reactive with anti-A,B than with anti-A and the plasma frequently has anti-A_1 present.
[AABB Tech Manual 2008b, p366]

87 **c** The ABO blood group system was discovered by Karl Landsteiner.
[Harmening 2005, p109]

88 **c** Mixed-field reactivity with anti-A and anti-A,B is a typical finding for A_3 subgroups.
[AABB Tech Manual 2008b, p366]

89 **c** Fucose is the immunodominant sugar for H.
[AABB Tech Manual 2008b, p372]

90 **d** Bombay phenotypes (O_h) lack H antigen on their red cells, and produce naturally occurring anti-H in their serum.
[Harmening 2005, p121]

91 **a** Most examples of anti-Lu^a agglutinate saline suspended cells. Most examples of anti-Lu^b are IgG and reacts at 37°C. Anti-Lu3 usually reacts at the AHG phase as does anti-Lu^{ab}.
[Harmening 2005, p185]

92 MLS ONLY **b** Anti-Ch and anti-Rg react at IAT with trace amounts of C4 (a component of complement) present on normal RBCs. The Ch and Rg substance is found soluble in plasma. Neutralization studies with pooled plasma can help confirm the antibody reactivity in a patient's sample. If test procedures are used to coat cells with C4, a patient with anti-Ch or anti-Rg may agglutinate the cells directly.
[AABB Tech Manual 2008b, p429]

93 **b** Anti-Sd^a is an antibody to a high-prevalence antigen, which varies in strength from person to person. Most examples of anti-Sd^a characteristically present as small, mixed-field, refractile agglutinates that may have a shiny appearance when observed microscopically after the antiglobulin test.
[Harmening 2005, p197]

94 **b** HLA antibodies are formed in response to pregnancy, transfusion or transplantation and are therefore not naturally occurring. They are associated with febrile nonhemolytic transfusion reactions and TRALI. They are directed against antigens found on granulocytes and other cells such as platelets.
[AABB Tech Manual 2008b, p397]

95 **d** MHC consists of both class I and class II HLA antigens. Discrimination of self from nonself is the primary function of the HLA system and involves many immune responses.
[AABB Tech Manual 2008b, p555]

96 MLS ONLY **d** HPA-1a is a platelet specific antigen, which is the most common cause of neonatal alloimmune thrombocytopenia. Treatment consists of IVIG.
[AABB Tech Manual 2008b, p534]

97 **d** Group O have the most H substance in their saliva. The person must also be a secretor of ABH substances. Due to gene interaction between the secretor gene and Lewis gene, people who are Le(a–b+) assures H in their saliva.
[Harmening 2005, p112]

98 **c** Lewis antigens are found soluble in saliva. If saliva containing Lewis substance is added to a sample with anti-Le^a, then neutralization occurs. Le(a+) indicator cells added to the test system would be nonreactive. A proper control system is required whenever neutralization studies are performed.
[Harmening 2005, p155]

99 **d** The overall incidence of the e antigen is 98%. The overall incidence of c is 80%, D is 85% and E is 30%.
[Harmening 2005, p136]

100 MLS ONLY **c** The G antigen is normally present on red cells possessing either C or D. Anti-G reacts with panel cells that are D+ or C+ and the antibodies appear to be anti-C and anti-D. The G antigen is expressed on the child's D+ red blood cells.
[Harmening 2005, p144]

101 MLS ONLY **b** Individuals who are partial D are missing epitopes of the D antigen and can develop antibodies toward the epitopes they lack. Since all normal D antigens have all epitopes, the specificity of the person's antibody is anti-D.
[AABB Tech Manual 2008b, p395]

102 MLS ONLY **c** The U antigen is a high incidence antigen found on the RBCs of all individuals except 1% of African-Americans, who lack glycoprotein B and usually type S–s–U–.
[Harmening 2005, p168]

103 **a** The M and N antigens are found on glycophorin A.
[Harmening 2005, p167]

104 **c** Autoanti-P, a cold-reactive IgG autoantibody described as a biphasic hemolysin, is associated with paroxysmal cold hemoglobinuria.
[Harmening 2005, p172]

105 **b** Patients with infectious monucleosis often demonstrate potent examples of anti-i that are transient in nature.
[Harmening 2005, p174]

106 **c** Anti-I is commonly found in all individuals, but when it causes hemolysis, the titer may be high and react at all temperatures. Cold agglutinin syndrome is mainly found in lymphoproliferative diseases.
[Harmening 2005, p173]

107 **c** Anti-I is associated with cold agglutinin syndrome.
[Harmening 2005, p174]

108 **b** Anti-i is an IgM antibody that reacts with cord cells and i adult cells. It is not associated with hemolytic disease of the newborn since IgM antibodies do not cross the placenta.
[Harmening 2005, p174]

109 **b** The Kell antigen is highly immunogenic. It is present on the red cells of up to 9% of adults and neonates, and is not affected by enzymes.
[Harmening 2005, p176]

110 MLS ONLY **c** Red blood cells of individuals with the McLeod phenotype lack Kx and Km and have significant depression of other Kell antigens. The McLeod phenotype has been found in patients with chronic granulomatous disease (CGD).
[Harmening 2005, p179]

111 **a** Antibodies in the Kidd blood group system are IgG and react best at the antiglobulin phase. These antibodies are associated with delayed hemolytic transfusion reactions and reactivity can be enhanced by testing with enzyme pretreated cells.
[Harmening 2005, p183]

112 **c** The Fy^a and Fy^b antigens are sensitive to denaturation by proteolytic enzymes. Serum containing anti-Fy^a reacts with untreated Fy(a+) cells, but not with enzyme treated Fy(a+) cells.
[Harmening 2005, p180]

113 **c** Anti-Fy^a is an IgG antibody that reacts best at the AHG phase, does not react with enzyme-treated red cells, is capable of causing hemolytic disease of the newborn, and is not known to be an autoagglutinin.
[Harmening 2005, pp180-181]

114 **d** The Duffy glycoprotein on red cells is a receptor for the malarial parasite *Plasmodium vivax*. Red cells with the phenotype Fy(a–b–) are resistant to invasion by *P vivax*.
[Harmening 2005, p182]

115 MLS ONLY **d** 75% of donors would be compatible with anti-X and 90% with anti-Y. The frequency of compatibility for both antigens is determined by multiplying the 2 compatibility percentages: $0.75 \times 0.90 = 0.675$.
[AABB Tech Manual 2008b, p348]

116 MLS ONLY **d** When the percentages of each phenotype are multiplied together, the incidence of the phenotype occurs in 1.438% of the population, so in a population of 100,000, there would be 1,438 with the phenotype.
[AABB Tech Manual 2008b, p348]

117 MLS ONLY **c** Multiplication of the individual compatibility frequencies results in the percentage of compatible donors that would lack both antigens. $0.20 \times 0.90 = 0.18$, or 18%.
[AABB Tech Manual 2008b, p348]

118 **d** After performing rule outs, the most likely antibody is anti-c. To form anti-c, the patient would need to inherit a gene from both parents that does not produce the c antigen. The most common gene that codes for no c antigen is denoted as R_1.
[Harmening 2005, p136]

Physiology and Pathophysiology

119 MLS ONLY **a** Massive transfusion patients (2 or more blood volumes) usually require platelets and FFP but since his platelet count is adequate, only FFP should be given at this time.
[Harmening 2005, p314]

120 MLS ONLY **c** Cryoprecipitate is used primarily for fibrinogen replacement. Fibrinogen level is decreased in patients with DIC, due to uncontrolled thrombin generation.
[Harmening 2005, pp232, 237, 308]

121 **a** Patients with severe hemophilia A may have spontaneous hemorrhages that are treated with Factor VIII concentrate.
[Harmening 2005, p308]

122 MLS ONLY **d** Factor VIII concentrate is the product of choice in the treatment of classic hemophilia.
[Harmening 2005, p223]

123 MLS ONLY **d** Factors V and VIII would be decreased but IX would not be decreased.
[Harmening 2005, p307]

124 MLS ONLY **c** These are symptoms of a low platelet count. If the mother's platelet count is normal, the newborn likely has neonatal alloimmune thrombocytopenia (NAIT), caused by maternal antibody to the infant's platelet antigens.
[Harmening 2005, p306]

125 MLS ONLY **b** When platelets are needed, maternal platelets are often prepared for use at cordocentesis or delivery. Platelets should be washed to remove maternal antibody.
[AABB Tech Manual 2008b, p534]

126 **d** HDFN is caused by maternal antibody crossing the placenta and destroying fetal antigen-positive red cells. Unlike ABO antibodies, which are naturally-occurring and can affect the first pregnancy, Rh antibodies are not produced until the mother has been exposed to Rh-positive red cells, usually during delivery of the first Rh-positive child. Once immunized, subsequent pregnancies with Rh-positive infants are affected, usually with increasing severity.
[Harmening 2005, pp384, 392]

127 MLS ONLY **c** HDFN is caused by maternal antibodies against antigens on fetal red cells inherited from the father. Since the father is homozygous for c, the baby's red cells have to be c+, and could react with maternal anti-c if present. The father is A–, D–, and C–, and cannot pass these antigens to the child.
[Harmening 2005, p384]

128 **d** ABO HDFN is a mild disease, not usually requiring transfusion. It may occur in any pregnancy in which there is ABO incompatibility. High-titered IgG antibodies are more frequently seen in group O mothers than in A or B mothers.
[Harmening 2005, pp391-392]

129 **d** HDFN is caused by maternal IgG antibodies. Outside the Rh system, the most clinically significant antibody for HDFN is anti-K. IgM antibodies do not cross the placenta.
[Harmening 2005, p385]

130 **a** ABO HDFN is a mild disease that may occur in any ABO-incompatible pregnancy, including the first, since the antibodies are naturally occurring. Rh HDFN does not occur until the mother has become immunized. Once this happens, subsequent pregnancies may be quite severely affected. The DAT is typically weak or even negative in ABO HDFN, and strongly positive in Rh HDFN.
[Harmening 2005, pp384, 391-392]

131 MLS ONLY **c** The mother has anti-D; the baby has a positive DAT; yet the baby appears to be Rh-negative. Textbooks state that, if a baby has a strongly positive DAT, the baby's red cells may be so heavily coated with maternal antibody that the D antigen sites are blocked and cannot react with anti-D reagent, causing a false-negative Rh type. Since the infant is type O, ABO hemolytic disease of the fetus and newborn (HDFN) does not fit this example. If the fetus had received enough D– intrauterine transfusions to cause the red cells to type as D–, they would not demonstrate a 4+ positive DAT, as shown in this example. There is no indication of a fetomaternal hemorrhage.
[Harmening 2005, p289]

132 **a** ABO HDFN occurs most commonly in group A babies born to group O mothers and usually has a mild course. The DAT is typically weak or negative and jaundice develops 12-48 hours after birth. The mother and baby are both Rh-positive.
[Harmening 2005, pp391-392]

133 MLS ONLY **d** Spherocytosis is characteristic of ABO HDFN but not Rh HDFN.
[Harmening 2005, p392]

134 **b** The change in optical density (absorbance) of amniotic fluid measured spectrophotometrically at 450 nm is calculated and plotted on the Liley graph according to the weeks gestation. The graph is divided into 3 zones, which predict the severity of HDFN and the need for intervention and treatment.
[Harmening 2005, p388]

135 **c** A positive DAT on cord blood demonstrates the presence of maternal antibody coating the baby's red cells and indicates hemolytic disease of the newborn. Normal cord hemoglobin in newborns ranges from 14-20 g/L. A cord hemoglobin value of 10 g/L indicates anemia and supports the diagnosis of HDFN.
[Harmening 2005, pp389-390]

136 MLS ONLY **b** Antibody titers do not themselves predict the severity of HDFN or the treatment needed. Instead, titers above a critical level, usually 16-32, identify candidates for amniocentesis or PUBS to monitor the fetus and determine the course of treatment.
[Harmening 2005, pp387-388]

137 **a** Blood for an exchange transfusion should lack the antigen to any maternal antibodies that have entered the infant's circulation and are reactive at 37°C or AHG.
[Harmening 2005, p274]

138 MLS ONLY **b** Fetuses undergoing intrauterine transfusion must receive irradiated blood products. The unit must lack the antigen that the mother has produced antibody against. Most centers treating HDN use group O Rh-negative RBCs for intrauterine transfusions.
[Harmening 2005, pp227, 390]

139 MLS ONLY **d** Blood selected for exchange transfusion is usually crossmatched with the mother's blood, and should be ABO-compatible. It should be negative for the antigen that she has produced antibody against. Unless the HDFN is caused by anti-D, the baby's Rh type is selected. In this case, group O, baby's Rh type, E–, is the best choice for the exchange transfusion.
[Harmening 2005, p390]

140 **a** Blood selected for exchange transfusion should be ABO-compatible with the mother and baby, and antigen-negative. Prenatal antibody titers above 16 or 32 are considered significant, and the condition of the fetus should be monitored.
[Harmening 2005, pp387-390]

141 **a** Blood selected for exchange transfusion should be antigen-negative and ABO-compatible with the mother and baby. Red Blood Cells are usually less than 7 days old, CMV–, hemoglobin S–, and irradiated.
[AABB Tech Manual 2008b, pp647-648]

142 **c** For exchange transfusion, antigen-negative Red Blood Cells are typically resuspended in ABO-compatible thawed Fresh Frozen Plasma.
[AABB Tech Manual 2008b, p647]

143 **b** Blood selected for intrauterine transfusion and transfusion to premature infants should be irradiated to prevent graft-vs-host disease.
[Harmening 2005, p390]

144 MLS ONLY **a** If the initial antibody screen, using either the mother's or baby's serum is positive, either antigen-negative or AHG-crossmatch-compatible units are selected until the antibody is no longer demonstrable in the baby's serum.
[AABB Standards 2008, §5.16.1]

145 **b** Care must be taken so that fetal Rh-positive RBCs in the maternal circulation are not interpreted as maternal, because the mother would be assumed erroneously to be weak D+.
[Harmening 2005, p391]

146 **d** The presence of D+ infant's red cells in the mother's circulation can cause the weak D test to show mixed-field agglutination. Care must be taken so that fetal Rh-positive RBCs in the maternal circulation are not interpreted as maternal, because the mother would be assumed erroneously to be weak D+.
[Harmening 2005, p391]

147 **a** The rosette test is a qualitative test. When enzyme-treated cells are used as indicator cells, a negative test (indicating there was not an excessive bleed) can have up to 1 rosette per 3 fields. The mother needs to receive 1 vial of RhIg for a normal bleed.
[AABB Tech Manual 2008b, pp935-936]

148 **c** The weak D result is most likely due to excessive bleed of fetal cells. Rosette results indicate a quantitative test for approximate volume of fetal-maternal bleed should be performed.
[AABB Tech Manual 2008b, pp631-632]

149 MLS ONLY **c** About half of the antenatal dose of RhIG may still be present at delivery so the antibody screen may detect weak anti-D, which should not be interpreted erroneously as active rather than passive immunization.
[Harmening 2005, p390]

150 **b** One dose of RhIg will protect the mother from a bleed of 30 mL. The bleed was 35 mL, 2 vials of RhIg will be needed.
[AABB Tech Manual 2008b, pp631-632]

151 **d** One vial of Rh immune globulin protects against a fetomaternal hemorrhage of 15 mL of red cells, or 30 mL of Whole Blood. Divide the volume of fetomaternal hemorrhage (35 mL) by 15; round down to 2, then add 1 extra vial = 3 vials total.
[AABB Tech Manual 2008b, p632]

152 **c** RhIG should be given to nonimmunized D– females who are pregnant or have delivered a D+ infant.
[Harmening 2005, p234]

153 MLS ONLY **b** About half of the antenatal dose of RhIG may still be present at delivery so the antibody screen may detect weak anti-D, which should not be interpreted erroneously as active rather than passive immunization.
[Harmening 2005, p390]

154 **c** RhIG is of no benefit once a person has been actively immunized and has formed anti-D.
[Harmening 2005, p391]

155 **b** The formula to calculate the percentage assumes the mother's blood volume as 5,000 mL. 0.003 × 5,000 mL=15mL.
[AABB Tech Manual 2008b, p632]

156 **b** The percentage is cells/100, the mother's volume is assumed to be 5,000 mL. The percentage must be multiplied by 50 to determine total volume.
[AABB Tech Manual 2008b, p632]

157 **c** Use the formula: (fetal cells counted/cells counted) × (maternal blood volume). Assume the mother's blood volume is 5,000 mL. In this example, 30 fetal cells/2,000 cells counted × 5,000 mL = 75 mL. RhIg protects against 30 mL. So 2.5 vials are needed, rounded up to 3 full vials. Add 1 vial for hospital policy and 4 vials are needed.
[AABB Tech Manual 2008b, p632]

158 **a** The rosette test is a sensitive method to detect FMH of 10 mL or more.
[AABB Tech Manual 2008b, pp387-388]

159 MLS ONLY **b** The rosette screen will be positive if there is a FMH of 10 mL or more. A Kleihauer-Betke or flow cytometry should be performed to quantitate the FMH and determine if additional doses of Rh immune globulin are needed to prevent immunization from occurring.
[AABB Tech Manual 2008b, pp631-632]

160 MLS ONLY **c** The mixed lymphocyte culture (MLC) is used to detect genetic differences in the HLA D region antigens.
[AABB Tech Manual 2008b, p559]

161 **d** Transfusion should generally be avoided except in cases of life-threatening anemia. A hemoglobin of 10.8 g/dL (108 g/L) is not life-threatening, especially if the patient is not actively bleeding.
[Harmening 2005, p411]

162 **d** Bone marrow transplant patients are at risk for transfusion-associated graft-vs-host disease (TA-GVHD) and therefore should receive irradiated blood products.
[Harmening 2005, p227]

163 **b** HLA antigen typing is important to consider before organ transplantation.
[Harmening 2005, p435]

164 MLS ONLY **a** DR antigens, also known as Class II antigens, are significant in organ transplantation. These antigens are expressed on B lymphocytes, macrophages, monocytes and endothelial cells and are detected in the lymphocytotoxicity test.
[Harmening 2005, pp436, 444]

165 **a** Negative check cells means the results of tubes with the negative reactions are invalid. The reactivity of the check cells should be verified with anti-IgG since anti-E was detected, indicating the anti-IgG was reactive. All tests that were nonreactive with the check cells requires repeat test performance.
[Harmening 2005, p102]

Serology

166 MLS ONLY **b** The listed criteria are typical for serological calibration of a centrifuge. Optimum spin time is the least amount of time when all criteria are satisfied.
[AABB Tech Manual 2008b, pp980-981]

167 **a** Samples must be labeled with 2 independent patient identifiers and the date of collection. This information should be identical to that on the patient's identification band and request.
[AABB Tech Manual 2008b, p439]

168 **d** Results of ABO and Rh testing on a current specimen must always be compared to that of a previous transfusion record. Errors in typing or patient identification may be detected when discrepancies are found. Collection of a new sample allows determination of which sample was incorrectly collected.
[AABB Tech Manual 2008b, p451]

169 **c** A serological test to confirm the ABO on all RBC units and Rh on units labeled as Rh-negative must be performed prior to transfusion. Any errors in labeling must be reported to the collection facility.
[AABB Tech Manual 2008b, p451]

170 **c** Samples must be labeled with 2 independent patient identifiers and the date of collection. This information should be identical to that on the patients identification band and request. There must be a mechanism to identify the phlebotomist, but initialing the sample tubes is not required.
[AABB Standards 2008a, §5.11; [AABB Tech Manual 2008b, p441]

171 **b** Granulocytes must be compatible with recipient's plasma. Granulocyte products have an expiration of 24 hours.
[AABB Standards 2008a, pp45-46, 55]

172 **c** Because neonates are immunologically immature, alloimmunization to red cell antigens is very rare during the neonatal period. No crossmatching is required if the initial antibody screen performed with either the baby's or mother's plasma is negative.
[AABB Standards 2008a, §5.16; [AABB Tech Manual 2008b, pp459-460]

173 **b** A positive DAT will interfere with weak D testing causing both the patient and control to demonstrate positive results. Any positive result in the control tube invalidates any results.
[AABB Tech Manual 2008b, p404]

174 **c** Patients with multiple myeloma demonstrate rouleaux formation, which can cause the appearance of agglutination. If the cells are washed to remove residual plasma, and tests repeated, an accurate red cell typing is obtained. By performing a saline replacement with the reverse typing, true agglutination will remain when the cell buttons of the reverse cells are resuspended in saline.
[AABB Tech Manual 2008b, pp370-371]

175 **d** ABO immunoglobulins develop at approximately 3 months of age, attain adult levels by age 10, and may, but not always, decline in titer in the elderly.
[AABB Tech Manual 2008b, p363]

176 **b** Acquired B occurs in group A individuals and is due to deacetylation of the A antigen by bacterial enzymes. Detection of acquired B is dependent upon the source of anti-B used.
[AABB Tech Manual 2008b, p367]

177 **a** Tn is caused from a somatic mutation and the phenomenon is persistent. Resolution of the red cell typing can be performed with enzyme-treated patient cells, since Tn is denatured by enzymes. Although the reactivity with anti-A may be weak, testing with anti-A_1 lectin gives strong reactivity, unlike subgroups of A, which are weakly reacting with anti-A and nonreactive with A_1 lectin.
[Harmening 2005, pp508-515]

178 **c** Mixed-field reactivity is a characteristic of the A_3 subgroup. Transfusion history would be important to be sure it is not 2 cell populations.
[AABB Tech Manual 2008b, p366]

179 **b** Polyagglutination is a property of the cells. Most adult plasma agglutinate the cells due to naturally occurring antibodies directed towards the crypt antigens.
[AABB Tech Manual 2008b, p370]

180 **c** Presence of agglutination with A_1 cells, screening cells and autocontrol at IS and RT is indicative of a cold autoantibody.
[Harmening 2005, 128]

181 MLS ONLY **c** Warming serum and reagent red cells to 37°C before repeating ABO typing will decrease/eliminate reactivity of cold autoantibody.
[Harmening 2005, p128]

182 **d** Unexpected reactivity with reverse cells should include a test with screen cells at immediate spin to determine if alloantibodies are present. Resolution of the ABO discrepancy can be performed with group B cells that lack the corresponding antigen for the identified alloantibody.
[AABB Tech Manual 2008b, pp371-372]

183 MLS ONLY **d** Most ABO discrepancies are due to problems in the reverse typing. Discrepancies stemming from the forward type or the patient's cells are usually due to Tn activation from a somatic mutation.
[Harmening 2005, p510]

184 **b** Although monoclonal anti-D react with most D+ red blood cells, cells with fewer antigen sites requires testing after the antiglobulin test. The test is referred to as a test for weak D.
[AABB Tech Manual 2008b, p394]

185 MLS ONLY **c** The ABO discrepancy is most likely due to anti-H in an A_1 individual. Anti-H reacts most strongly at room temperature with group O screening cells and weaker or negative at room temperature with autologous or donor group A_1 cells. As the branched H structures are converted to A, some group A_1 individuals may develop a clinically-insignificant anti-H recognizing H structures on group O and A_2 blood groups.
[Harmening 2005, pp116, 126]

186 **d** Some subgroups of A are only recognized because of their lack of anti-A in the reverse typing. Often, the donors are confirmed as subgroups of A by an adsorption-elution technique.
[AABB Tech Manual 2008b, p366]

187 **c** The mom does not have the *D* gene. The father would have to have inherited one gene that produces D and another gene that does not produce D. The mom and dad both passed on genes that do not produce D.
[AABB Tech Manual 2008b, pp387-936]

188 **a** Some blood group antibodies, in the presence of their corresponding antigen and complement, activate the complement cascade and demonstrate in-vitro hemolysis.
[Harmening 2005, p58]

189 **b** Agglutination at AHG phase indicates the presence of clinically significant antibody, indicating the need for antibody identification.
[Harmening 2005, p246]

190 **b** Presence of agglutination at AHG phase with both screening cells and autocontrol is indicative of warm autoantibody.
[Harmening 2005, p407]

191 **a** Presence of agglutination at AHG phase with screening cells and 2 out of 6 donor units indicates antibody in patient serum to antigen(s) on screening cells and donor cells. The presence of an autoantibody would most likely react with all cells, including the autologous control or DAT.
[Harmening 2005, p60..

192 **b** Reaction with anti-IgG in the DAT and with both screening cells and autocontrol at the AHG phase is indicative of a warm autoantibody.
[Harmening 2005, p407]

193 **c** Initial result was most likely a false-negative result due to the omission of patient serum. This would explain the initial negative result followed by the subsequent positive result.
[Harmening 2005, p102]

194 **b** The absence of agglutination at the AHG phase with screening cells and agglutination with one of 3 donor units is most likely due to an antibody to a low-incidence antigen.
[Harmening 2005, p271]

195 **d** The major crossmatch tests the recipient's plasma with donor's cells. This would detect any antibody in the recipient that would react with antigens on the donor's RBCs. If a patient were mistyped as a group O rather than group A, then group O cells would be selected for crossmatch and no incompatibility would be found.
[AABB Tech Manual 2008b, pp452-456]

196 **a** The patient has a negative antibody screen, but one unit is found to be incompatible. The antibody is most likely directed towards a low-incidence antigen.
[AABB Tech Manual 2008b, p455]

197 **d** Since crossmatching is a test between the patient's plasma and donor's cells, any incompatibility is due to the donor's red cells. If a patient is negative for clinically significant antibodies to common antigens, an incompatible unit by the antiglobulin test is due to either a positive DAT on the donors red cells or the patient has an antibody to a low-incidence antigen that the donor's cells possess.
[AABB Tech Manual 2008b, p455]

198 **b** If a patient is negative for clinically significant antibodies, and a single crossmatch is incompatible, the incompatibility is either due to donor cells with a positive DAT or the patient has an antibody to a low-incidence antigen that the donor's cells possess.
[AABB Tech Manual 2008b, p455]

199 **c** If a patient is negative for clinically significant antibodies, and a single crossmatch is incompatible, the incompatibility is either due to donor cells with a positive DAT or the patient has an antibody to a low-incidence antigen that the donor's cells possess.
[AABB Tech Manual 2008b, p455]

200 **c** Emergent release of blood can not use previous records. Blood typing must be performed on the current sample. In this case, group O Rh-negative is the best choice since there is evidence the patient is Rh-negative.
[AABB Tech Manual 2008b, p455]

201 **b** When group specific units of Red Blood Cells are not available, group compatible units are selected. Since the patient is AB, group A would be selected to conserve group O units for group O patients. Rh-negative patients should receive Rh-negative units of red blood cells.
[Harmening 2005, p269]

202 **a** This patient has an anti-A_1, which eliminates A_1B cells immediately. Rh-negative units should be conserved for Rh-negative patients when Rh-positive units are available. Selection of group B units provides compatible units quickly.
[AABB Tech Manual 2008b, p368]

203 **d** The strength of agglutination is dependent upon optimal antigen to antibody ratio. Excessive amount of antigen does not allow maximal uptake of antibody per red cell and therefore agglutination is negatively affected leading to weaker or negative results.
[Harmening 2005, p63]

204 MLS ONLY **c** Rh antibodies show enhanced reactivity with enzyme pretreated cells. The M and Fy^a antigens are cleaved from enzyme pretreated cells and therefore there would be no reaction between enzyme pretreated cells and serum containing anti-M or anti-Fy^a. The incidence of the c antigen is 80% in whites and 96% of blacks. The incidence of the E antigen is 29% in whites and 22% in blacks. Increased reactivity with enzyme pretreated cells and incompatible results with 8 of 10 donor units is most likely due to anti-c.
[Harmening 2005, pp166-167, 180-181]

205 **a** Determining the patient's phenotype allows focusing identification procedures toward antibodies the patient can develop.
[AABB Tech Manual 2008b, p441]

206 **a** Warm autoantibodies often exhibit Rh specificity.
[Harmening 2005, p406]

207 **a** Lewis antibodies may bind complement and fresh serum that contains anti-Le^a may hemolyze Le(a+) red cells in vitro. Approximately 22% of the population is Le(a+).
[Harmening 2005, p153]

208 MLS ONLY **a** The reactivity of anti-k and anti-Js^b with enzyme pretreated cells is unchanged and anti-e would show enhanced reactivity with enzyme treated cells. Chido antigens are sensitive to treatment with most enzymes and anti-Ch would therefore not react with enzyme pretreated cells. The Chido antigen is a high incidence antigen.
[Harmening 2005, pp142, 177, 200]

209 **a** Antibodies to antigens on cells 2, 3, 4, and 5 can be ruled out in tubes II and III, in which there was no reaction between patient serum and cells.
[Harmening 2005, pp250-252]

210 MLS ONLY **b** Anti-K and anti-P_1 can be ruled out on cell 1 since there is no agglutination of cell 1 with the patient's sample. Anti-M and anti-Jk^a can be eliminated on cell 2, which has a double-dose antigen expression of both M and Jk^a.
[Harmening 2005, pp250-252]

211 MLS ONLY **d** Antibodies to C, Le^b and Jk^a can be eliminated due to the lack of agglutination with panel cells 1 and 2. Panel cells 1 and 2 possessed the C, Le^b and Jk^a antigens. Only anti-E remains.
[Harmening 2005, pp250-252]

212 **b** Lewis antibodies are usually IgM and agglutinate saline suspended cells. Approximately 22% of the population is Le(a+), which would account for 3 out of 10 donor units being incompatible. Anti-P_1 is also an antibody that may react at immediate spin, but 79% of the white population and 94% of the black population are P_1+. Anti-C and anti-Fy^a are IgG antibodies that react at the antiglobulin phase.
[Harmening 2005, pp153, 171, 180-181]

213 **a** Chido antibodies are considered clinically insignificant.
[Harmening 2005, p200]

214 MLS ONLY **b** Lack of agglutination between patient serum and with cells that lack one of the high incidence antigens would confirm the specificity of the antibody.
[Harmening 2005, p258]

215 **c** An ABO discrepancy in an A_1 individual, manifested by agglutination in the serum grouping with A_2 cells, is most likely due to anti-H. The greatest concentration of H substance is found on O cells, followed by A_2 cells. The least amount of H substance is found on A_1 and A_1B cells.
[Harmening 2005, p116]

216 **b** Reactivity at 37°C and AHG indicate the presence of an IgG antibody. Anti-M, although usually IgM, may be partly or wholly IgG. Anti-M is ruled out on cell 4. Anti-Le^b is usually IgM and can be ruled out on cells 4 and 8. This leaves anti-E, anti-Fy^a and anti-K.
[Harmening 2005, pp250-252]

217 **a** All 3 antibodies can cause HDFN and delayed transfusion reactions. Anti-Jk^a is associated with showing dosage.
[Harmening 2005, p177, 180-181, 183]

218 MLS ONLY **a** Rh antibodies demonstrate enhanced reactivity with enzyme-pretreated cells. Antibodies in the Kell system do not have enhanced reactivity with enzyme-pretreated cells. Anti-E and -D are ruled out on cell 3, and anti-K is ruled out on cell 7.
[Harmening 2005, pp250-252]

219 MLS ONLY **b** Anti-Fy^a may cause mild to rarely severe hemolytic disease of the fetus and newborn.
[Harmening 2005, pp250-252]

220 **a** The direct antiglobulin test (DAT) is used to identify red blood cells that have been coated with antibody in vivo.
[AABB Tech Manual 2008b, p278]

221 **b** In cold agglutinin syndrome, anti-I acts as a complement binding antibody with a high titer and high thermal amplitude. The complement cascade is activated and C3d remains on the red cell membrane of circulating cells.
[Harmening 2005, p172]

222 MLS ONLY **a** An anamnestic response is a secondary response from memory cells. There will be an increase in antibody titer upon exposure; the antibody sensitizes incompatible cells circulating in the patient. The DAT appears mixed-field since the patient's own cells are not sensitized.
[AABB Tech Manual 2008b, p446]

223 **d** After washing cells for the DAT or IAT procedure, the AHG should be added immediately and read. Delay can cause a weakened or negative result due to dissociation of the bound IgG in the prolonged time before reagent is added.
[AABB Tech Manual 2008b, p446]

224 **b** Polyspecific AHG contains anti-IgG and anti-C3d.
[AABB Tech Manual 2008b, p471]

225 **d** Antiglobulin reagent is used to detect the presence of red cells, coated in vivo with IgG and/or C3d. Antiglobulin reagent may be polyspecific (contains an anti-IgG and anti-C3d) or monospecific (anti-IgG or anti-C3d).
[Harmening 2005, p98]

226 **c** AHG control cells are IgG-sensitized cells that react with the anti-IgG in the AHG reagent to demonstrate AHG was added and not neutralized by insufficient washing of the tests prior to its addition.
[AABB Tech Manual 2008b, p449]

227 **c** Cold agglutinin disease is associated with cold reactive antibodies that typically activate complement. Cells that do not undergo lysis due to complement activation have C3d attached to the red blood cells.
[AABB Tech Manual 2008b, p511]

228 MLS ONLY **a** Detection of antibodies to penicillin requires treatment of test cells with penicillin and the subsequent testing of the patient's plasma and eluate. Test cells that have not been treated with penicillin do not react.
[AABB Tech Manual 2008b, pp515-518]

229 **c** EDTA chelates calcium preventing blood to clot. This chelation of calcium also will stop the complement cascade. Calcium ions are necessary for C1 to attach to IgG on the red blood cells.
[AABB Tech Manual 2008b, p500]

230 **c** Methyldopa is frequently listed as the prototype for drug-independent antibody mechanism where autoantibody is present on the red cells and may also be present in the plasma.
[AABB Tech Manual 2008b, pp515-518]

231 MLS ONLY **b** Auto-antibody specificity in cold agglutinin syndrome is most often anti-I. This auto-antibody reacts optimally at 4°C, but also reacts between 25°C and 31°C. Auto anti-I can activate complement so C3d can be attached to patient cells. The eluate will be negative as C3d cannot be eluted from cells.
[Harmening 2005, pp398-400]

232 **b** Second and third generation cephalosporins react when the drug is present in vitro. When serum, drug, and red cells are present, direct or indirect agglutination or lysis may be observed.
[AABB Tech Manual 2008b, pp515-518]

233 **c** A negative reaction after the addition of check cells indicates AHG serum was not present. Inadequate washing of red cells may leave residual patient serum behind, which can neutralize AHG serum.
[Harmening 2005, p101]

234 **d** Weak antibodies may be missed if there are excess RBC antigens as there may be too few antibodies to bind to red cell antigens.
[Harmening 2005, p102]

235 **c** A_x cells react more strongly with anti-A,B than with anti-A. If anti-A is nonreactive, A_x cells may be detected with anti-A,B.
[AABB Tech Manual 2008b, p366]

236 **c** A solution of 8% bovine albumin can be prepared by diluting the more concentrated solution with normal saline. The formula to be used is: (volume1 × concentration1) = (volume2 × concentration2). A solution of 6%-8% albumin is used with some anti-D reagents as a control for spontaneous agglutination.
[AABB Tech Manual 2008b, pp726-727]

237 **b** Rh antibodies show enhanced reactivity with enzyme pretreated cells. Treatment of red cells with enzymes weakens reactivity with antibodies in the MNS and Duffy systems.
[Harmening 2005, pp166-167, 180-181]

238 **b** Patients may have antibodies to components of reagents. Washing the patient's cells prior to testing to remove their plasma from the cell suspension will resolve the reactivity with anti-B.
[AABB Tech Manual 2008b, p370]

239 **a** Enzyme treatment would allow for differentiation of the remaining antibodies after rule outs. The Fy^a antigen would be denatured, allowing determination of whether anti-Jk^a and -K are present, and to confirm anti-E.
[Harmening 2005, p252]

240 **c** Soluble forms of some blood group antigens can be prepared from other sources and used to inhibit reactivity of the corresponding antibody, such as the HTLA antibodies anti-Ch and anti-Rg. Most HTLA antibodies, although weakly reactive in undiluted serum, will continue to react weakly at higher dilutions.
[AABB Tech Manual 2008b, pp444-445]

241 **d** For neutralization studies to be valid, the saline dilutional control must be reactive. Since neutralization studies involve adding a substance to the patient's plasma, nonreactivity in test tubes may be due to simple dilution. The saline control acts as the dilutional control and must be reactive. When the saline control is reactive, then if the tube with the substance is nonreactive, the interpretation that neutralization has occurred is made. If it is reactive, neutralization did not occur.
[AABB Tech Manual 2008b, p480]

242 MLS ONLY **a** In neutralization, a known source of a blood group soluble substance (for example, saliva, urine, or plasma) is incubated with a plasma antibody. During the incubation, the antibody combines with the soluble substance. The antibody is neutralized and inhibited from combining with the same blood group substance found on red blood cells when the blood cells are added to the system.
[Harmening 2005, p252]

243 **b** Anti-Le^b is confirmed because the tubes with Lewis substance are negative. Nonreactivity of the serum with Le(b+) cells indicates the anti-Le^b in the serum was neutralized by the Lewis substance. The test is valid since the patient's serum with saline rather than substance added is still able to react with the Le(b+) cells.
[Harmening 2005, p155]

244 MLS ONLY **d** Reactivity with anti-H is no longer demonstrable, which indicates H substance is present. There is no A or B substance in the saliva as evidenced by the ability of anti-A and anti-B reacting with respective cells. People with H substance and no A or B substance are group O secretors.
[AABB Tech Manual 2008b, p883]

245 MLS ONLY **c** Secretor studies demonstrates the presence of a substance by the observation of neutralization of the corresponding antibody. Nonreactivity with B and O cells indicates B and H substances are present in the saliva so the red cells from this person are group B.
[AABB Tech Manual 2008b, p883]

246 **a** In the solid phase technology, the antibody screening cells are bound to the surface of the well. Antibody specific for antigen on the red blood cells attaches, resulting in a diffuse pattern of red blood cells in the well. A negative reaction would have manifested as a pellet of red blood cells in the bottom of the well.
[Harmening 2005, pp246-247]

247 **b** The K antigen is integral to the red cell membrane and would not change in a patient. Errors in typing or patient identification may be detected when discrepancies are found when comparing historical records.
[AABB Tech Manual 2008b, pp418-419]

248 **d** Polyagglutination is a property of the red blood cells. Structures on the red cells are altered due to bacterial enzymes or a somatic mutation, so crypt antigens not normally exposed on cells are now present. Antibodies to the exposed structures are naturally occurring in adult plasma.
[Harmening 2005, p528]

249 **c** Rouleaux will readily disperse in saline whereas true agglutination will remain after saline replacement.
[AABB Tech Manual 2008b, pp903-904]

250 MLS ONLY **a** The Donath-Landsteiner test is diagnostic for PCH. The antibody is IgG and is biphasic: hemolysis occurs when the antibody is incubated with cells and cold temperatures and then incubated at 37°C. Often the antibody demonstrates specificity towards the high-incidence antigen P (not to be confused with P_1). The antibody screen is usually negative and the patient's red cells are coated with complement.
[AABB Tech Manual 2008b, pp383, 514]

251 **b** Two reagents used for removing IgG from red blood cells are chloroquine diphosphate (CDP) and EDTA glycine acid (EGA). Using either of these procedures is useful to reduce a patient's DAT and allow phenotyping with IAT reactive antisera.
[AABB Tech Manual 2008b, p894]

252 **a** Anti-Fy^a would not react with enzyme pretreated cells; a select cell panel would allow for individual reactivity of the remaining 2 antibodies. Thiol reagents would be used to disperse agglutination of IgM antibodies; the antibodies in question are IgG.
[Harmening 2005, p252]

253 **c** *Dolichos biflorus* plant seed extract forms complexes with N-acetylgalactosamine. When properly diluted, it can distinguish between A_1 donor cells and all other subgroups of A.
[AABB Tech Manual 2008b, p365]

254 **d** The serum of a group O individual contains anti-A, anti-B and anti-A,B. To prepare a suitable reagent, the ABO antibodies must be removed and anti-D left in the serum. The serum would need to be adsorbed with cells of the A_1B, cde/cde phenotype.
[Harmening 2005, p110]

255 **d** Since the auto control is positive after the AHG phase and no reactivity was detected at immediate spin, the serology is most consistent with a warm autoantibody. An adsorption with autologous cells to remove the antibody to used the adsorbed plasma for alloantibody detection is the next step.
[AABB Tech Manual 2008b, pp506-507]

256 MLS ONLY **a** ZZAP is a reagent to remove IgG from the patient's own cells to allow better adsorption of IgG autoantibody from the patient's plasma onto the cells. The intent of the autoadsorption is to remove autoantibody to look for alloantibodies prior to transfusion.
[AABB Tech Manual 2008b, pp507-508]

257 MLS ONLY **a** Treating autologous cells with a proteolytic enzyme such as ficin enhances the adsorption of the cold reactive antibody.
[AABB Tech Manual 2008b, pp512-513]

258 **d** An elution is the process of removal of antibody from red blood cells. The product of the elution method is an eluate. The eluate contains the antibody and can be used in antibody identification methods.
[Harmening 2005, p523]

259 MLS ONLY **a** Adsorption and elution techniques are used to detect ABO antigens that are not detectable by direct agglutination. The cells are incubated with the antibody (anti-A or anti-B) to the antigen expected on the red blood cells. An elution method is performed and the antibody in the eluate is tested for recovering anti-A (or anti-B depending on the specificity that was used in the adsorption).
[AABB Tech Manual 2008b, p366]

260 **c** Antibody-antigen complexes are dependent upon a neutral pH. Extremes in pH causes dissociation. Both auto and alloantibodies are recovered in elutes prepared by reagent kits that alter the pH.
[AABB Tech Manual 2008b, pp919-922]

Transfusion Practice

261 **b** Each unit of Whole Blood or RBCs will increase the hematocrit by 3%-5%, so 2 units of RBCs will increase the hematocrit by twice as much as 1 unit of Whole Blood.
[Harmening 2005, p305]

262 **c** For emergency transfusions, group O– RBC units should be used.
[Harmening 2005, p314]

263 MLS ONLY **d** Granulocyte transfusions may be indicated for severely neutropenic patients with infections not controlled by antibiotic therapy, who are expected to recover bone marrow production of white cells.
[AABB Tech Manual 2008b, pp596-597]

264 **b** Each unit of RBCs is expected to increase the hemoglobin level by 1-1.5 g/dL (10-15 g/L).
[Harmening 2005, p305]

265 **b** Each unit of RBCs is expected to increase the hematocrit level by 3%-5%, so it would take 2 units to raise the level 6%.
[Harmening 2005, p305]

266 MLS ONLY **c** CMV-seronegative or leukoreduced blood products should be administered to immunocompromised patients, including bone marrow and hematopoietic cell transplant recipients.
[Harmening 2005, p310]

267 MLS ONLY **b** Cryoprecipitate contains ABO antibodies so one should consider giving ABO compatible, especially when infusing large volumes.
[AABB Tech Manual 2008b, p467]

268 **d** Class I HLA antigens on platelets are a known cause for platelet refractoriness. Leukoreduction of blood products is used as a mechanism to reduce or prevent patients from developing antibodies.
[AABB Practical Guide 2007, ch11]

269 MLS ONLY **a** Patients with IgA deficiency who have had anaphylactic transfusion reactions should receive washed RBCs. Anaphylactic reactions are typically caused by anti-IgA in the recipient. Washing removes plasma IgA from the donor unit. cells.
[Harmening 2005, p305]

270 **d** FFP should be ABO compatible with the recipient's RBCs. Avoid FFP with antibodies to A or B antigens the patient may have. Group A plasma has anti-B, and should only be transfused to A or O recipients.
[Harmening 2005, p307]

271 **d** FFP should be ABO compatible with the recipient's RBCs. Avoid FFP with ABO antibodies to A or B antigens the patient may have.
[Harmening 2005, p307]

272 **b** Each unit of platelets should increase the count 5,000-10,000/μL (5,000-10,000/L).
[Harmening 2005, p306]

273 MLS ONLY **c** Functional abnormalities are frequent in hypoproliferative thrombocytopenia. Decreased platelets is not an outcome of a hemolytic transfusion reaction, posttransfusion purpura is usually self-limiting and is due to an antibody to a specific platelet antigen, immune thrombocytopenia purpura patients have low platelet counts but rarely have hemorrhage.
[AABB Tech Manual 2008b, p579]

274 MLS ONLY **d** Washing red blood cells with saline removes donor plasma and IgA, and prevents anaphylactic reactions due to anti-IgA in the recipient.
[Harmening 2005, p305]

275 **b** Anaphylactic transfusion reactions are distinguished from other types of reactions by 1) the absence of fever, and 2) the reactions are sudden in onset after infusion of only a few mL of blood. Since the reaction is due to anti-IgA, washing the donor red blood cells to remove all plasma protein is indicated. Alternatively, blood products from IgA-deficient donors may be used.
[Harmening 2005, p342]

276 **a** FFP should be ABO compatible with the recipient's RBCs. Avoid FFP with ABO antibodies to A or B antigens the patient may have. Rh type is not significant.
[Harmening 2005, p307]

277 **c** FFP should be ABO compatible with the recipient's RBCs. If patient's type has not been determined (currently), plasma lacking anti-A and anti-B should be given.
[Harmening 2005, p307]

278 **c** FFP contains all factors, including cryoprecipitate. It does not have a higher risk of transmitting hepatitis than Whole Blood. It must be transfused within 24 hours of thawing and must be ABO compatible.
[Harmening 2005, p307]

279 **c** Each unit of platelets should increase the count 5,000-10,000 platelets/μL (5,000-10,000/L). Platelet antibodies can diminish this expected increment.
[Harmening 2005, p306]

280 **c** Symptoms of hemolytic transfusion reactions are fever, chills, flushing, chest and back pain, hypotension, nausea, dyspnea, shock, renal failure, and DIC. Circulatory overload, allergic, and anaphylactic reactions are not characterized by fever.
[Harmening 2005, p339]

281 MLS ONLY **d** Alloimmunization to the HLA results in refractoriness to random donor platelet transfusions.
[Harmening 2005, p339]

282 MLS ONLY **b** Alloimmunization to the HLA results in refractoriness to random donor platelet transfusions.
[Harmening 2005, p443]

283 MLS ONLY **c** Posttransfusion purpura (PTP) is caused by platelet-specific alloantibody in a previously immunized recipient. Transfused donor platelets in blood products are destroyed, with concomitant destruction of the recipient's own platelets, through unknown mechanisms. The usual antibody specificity is HPA-1a.
[Harmening 2005, pp345-346]

284 **d** Previously immunized patients may have an undetectable level of antibody. Transfusion of antigen-positive donor red cells may cause an anamnestic response and result in a delayed hemolytic transfusion reaction. Symptoms may be mild, and present only as jaundice and unexplained anemia.
[Harmening 2005, pp345-346]

285 **b** Delayed hemolytic transfusion reactions are caused by a secondary anamnestic response in a previously alloimmunized recipient. Unlike a primary response, a secondary response is rapid. Antibody may be detectable 3-7 days from the time of transfusion.
[Harmening 2005, p340]

286 **a** Antibodies in the ABO system may activate complement and cause immediate intravascular hemolysis if incompatible blood is transfused. Antibodies in the Rh, Duffy, and MN systems typically cause extravascular hemolysis, which is usually less severe.
[Harmening 2005, p338]

287 **a** ABO antibodies activate complement and may cause intravascular hemolysis. Rh, Kell, and Duffy antibodies are primarily associated with extravascular hemolysis.
[Harmening 2005, pp109-110, 143, 177]

288 **b** Antibodies in the Kidd system activate complement and may cause intravascular hemolysis. The antibodies often decline in vivo, are weak, show dosage, and are difficult to detect in vitro, making them prime candidates for causing anamnestic delayed hemolytic transfusion reactions.
[Harmening 2005, p183]

289 **a** ABO antibodies activate complement and may cause intravascular hemolysis. The antibodies are naturally occurring against A and B antigens that the recipient lacks. Rh and Duffy antibodies may also cause hemolytic transfusion reactions, but the antibodies are the results of alloimmunization and not naturally present in recipients who lack the antigen. The incidence of septic transfusion reactions from bacterial contamination of Red Blood Cells is rare, about 1:500,000.
[Harmening 2005, pp109, 339, 344]

290 **d** Patients receiving >1 blood volume replacement often develop thrombocytopenia and require platelet transfusion.
[Harmening 2005, p314]

291 MLS ONLY **d** A positive DAT in a posttransfusion blood sample usually indicates that the patient is producing alloantibody against an antigen present on the transfused donor red cells. An elution should be performed to remove the antibody from the red cells and identify it. Free antibody may also be present in the serum. If the antibody screen is positive, the antibody should be identified.
[Harmening 2005, p350]

292 **a** Free hemoglobin released from destruction of transfused donor red cells will impart a distinct pink or red color in the posttransfusion sample plasma.
[Harmening 2005, p349]

293 **d** The immediate steps required to investigate a transfusion reaction include a clerical check of records and labels, visual inspection of postreaction plasma for hemolysis, and direct antiglobulin test and repeat ABO typing on the postreaction sample. Additional investigation is performed when there is evidence of hemolysis, bacterial contamination, TRALI, or other serious adverse event.
[AABB Standards 2008a, §7·4·2]

294 **a** In septic transfusion reactions, patients experience fever >101°F (38.3° C), shaking chills, and hypotension. In severe reactions, patients develop shock, renal failure, hemoglobinuria, and DIC.
[AABB Tech Manual 2008b, p729]

295 **c** Clinical signs of a hemolytic transfusion reaction include fever and chills, and, in severe cases, DIC. Circulatory overload, allergic and anaphylactic reactions are not characterized by fever and DIC.
[Harmening 2005, pp338-343]

296 **a** Bilirubin is a marker for red cell hemolysis. Bilirubin peaks at 5-7 hours after transfusion and is back to pretransfusion levels at 24 hours if liver function is normal.
[AABB Tech Manual 2008b, p723]

297 **d** Delayed hemolytic transfusion reactions may occur in recipients who are previously immunized but who do not have detectable antibody, if they receive blood with the corresponding antigen. When there is a history of clinically significant antibodies, donor red cells should be phenotyped and antigen-negative blood selected. A complete antiglobulin crossmatch must be performed.
[Marques 2007, pp51-52, 77]

298 **b** If the direct antiglobulin test is positive in a transfusion reaction investigation, the antibody should be eluted from the red cells and identified.
[Marques 2007, pp72-74]

299 **c** Lack of expected rise in hemoglobin after transfusion may be a sign of a delayed hemolytic transfusion reaction. If the DAT is positive, an elution should be performed to remove and identify the antibody coating the transfused donor red cells. In this case, the antibody is not detectable in the antibody screen, so a routine cell panel on the serum would not be helpful. Since the transfusion occurred 3 weeks previously, donor samples are not available for testing.
[Harmening 2005, pp340, 349-350]

300 **b** Delayed hemolytic transfusion reactions are associated with extravascular hemolysis, rather than intravascular. Alloantibody coats the transfused antigen-positive donor cells in the recipient's circulation, producing a mixed-field positive reaction in the DAT.
[Harmening 2005, pp340, 349-350]

301 MLS ONLY **a** In massive transfusions, Platelets are indicated if the platelet count is less than 50,000/μL (50,000/L).
[Harmening 2005, p314]

302 **d** Treatment of acute hemolytic transfusion reactions focuses on supportive measures and control of DIC, hypotension, and acute renal failure.
[Harmening 2005, p339]

303 **c** Red Blood Cells, Leukocyte-Reduced should be chosen, because febrile nonhemolytic transfusion reactions are either due to chemokines released from leukocytes in nonleukoreduced blood components or to patient antibodies directed towards donor HLA antigens on the leukocytes.
[Harmening 2005, p341]

304 **c** Leukocyte-Reduced RBCs and Platelets can be used to prevent further nonhemolytic transfusion reactions.
[Harmening 2005, p310]

305 **a** Leukocyte antibodies are a primary cause of febrile transfusion reactions. Leukocyte-reduced blood components reduce the risk of febrile nonhemolytic reactions.
[Harmening 2005, p341]

306 **c** Anaphylactic transfusion reactions are attributed to anti-IgA in IgA-deficient recipients.
[Harmening 2005, p342]

307 **c** Two distinguishing features of anaphylactic transfusion reactions are that symptoms occur with transfusion of only small amounts of blood, and the patient has no fever.
[Harmening 2005, p342]

308 **d** Febrile nonhemolytic transfusion reactions are defined as fever of 1°C or greater (over baseline temperature) during or after transfusion, with no other reason for the elevation than transfusion, and no evidence of hemolysis in the transfusion reaction investigation. Allergic reactions, citrate toxicity, and circulatory overload are not characterized by fever.
[Harmening 2005, p341]

309 **b** Allergic reactions are a type 1 immediate hypersensitivity reaction to an allergen in plasma. Most are mild reactions shown by urticaria (hives, swollen red wheals) which may cause itching.
[Harmening 2005, pp341-342]

310 **a** Febrile nonhemolytic transfusion reactions are defined as fever of 1°C or greater (over baseline temperature) during or after transfusion, with no other reason for the elevation than transfusion, and no evidence of hemolysis in the transfusion reaction investigation.
[Harmening 2005, p341]

311 **d** Febrile nonhemolytic transfusion reactions occur in about 1% of transfusions, making it one of the most common types of reaction. Neither transfusion-associated circulatory overload (TACO) or anaphylactic transfusion reactions are characterized by fever. Bacterially contaminated Red Blood Cells are rare, and rapidly produce severe symptoms upon transfusion.
[Harmening 2005, pp341-344]

312 **d** Febrile nonhemolytic transfusion reactions are caused by leukoagglutinins in the patient or cytokines released from donor leukocytes during storage. Since these reactions are not caused by red cell antibodies, transfusion investigation studies show no hemolysis or abnormal test results.
[Marques 2007, pp72-74]

313 MLS ONLY **b** TRALI is most commonly caused by donor HLA or granulocyte-specific antibodies that react with recipient antigens, causing damage to the lung basement membrane and bilateral pulmonary edema within 6 hours of transfusion. Multiparous females are more likely to have antibodies than males. Using male donors as the sole source of plasma products is a strategy for reducing the risk of TRALI.
[AABB Tech Manual 2008b, pp733-735]

314 MLS ONLY **d** Prestorage leukoreduction reduces the number of white cells in Apheresis Platelets and RBCs, and significantly decreases the risk of febrile reactions.
[AABB Tech Manual 2008b, p730]

315 **d** Noncardiogenic pulmonary edema, dyspnea, hypotension, and hypoxemia occurring within 6 hours of transfusion are clinical symptoms of TRALI.
[Marques 2007, p76]

316 **a** Anaphylactic transfusion reactions are severe reactions that occur after infusion of a small amount of donor blood. Symptoms are hypotension, shock, respiratory distress, dyspnea, and substernal pain. Anaphylactic reactions are usually caused by anti-IgA.
[Marques 2007, p75]

317 **c** Leukoreduction of blood products reduces the risk of febrile nonhemolytic transfusion reactions, which are caused by leukoagglutinins or cytokines from white cells.
[Marques 2007, p20]

318 **d** One reason to quarantine blood components before transfusion is hemolysis of the red cells. Hemolysis of red cells is an indication of contamination or improper storage.
[Harmening 2005, p289]

319 **c** Transfusion-associated circulatory overload (TACO) is hypervolemia manifested by coughing, cyanosis, and pulmonary edema.
[Harmening 2005, p343]

320 **c** Transfusion-associated circulatory overload (TACO) is hypervolemia caused by blood transfusion in susceptible patients. Hemolytic (antibody to red cell antigen), febrile NHTR (leukoagglutinins or cytokines), and allergic (reaction to allergens in plasma) are immunologic reactions.
[AABB Tech Manual 2008b, pp725-731]

321 **d** Transfusion-induced hypervolemia causing edema and congestive heart failure is a feature of transfusion-associated circulatory overload (TACO). Hypervolemia is not a complication of a hemolytic, febrile, or anaphylactic transfusion reaction.
[Harmening 2005, pp338-343]

322 **b** Hypervolemia due to transfusion in susceptible patients, such as cardiac, elderly, infants, or severely anemic, causes circulatory overload (TACO) and associated respiratory and cardiac problems.
[Harmening 2005, p343]

323 **a** Septic transfusion reactions due to contaminated blood products are manifested by high fever, chills, hypotension, shock, nausea, diarrhea, renal failure, and DIC. Symptoms usually appear rapidly. Transfusion reaction investigation shows no evidence of unexpected blood group antibodies. A Gram stain and blood culture of the donor unit may detect the presence of aerobic or anaerobic organisms.
[Harmening 2005, p344]

324 **c** Hepatitis transmission is unlikely, but has a higher risk of transmission through blood transfusion than CMV (rare), syphilis (no transfusion-transmitted cases reported in >30 years), or HIV (1:2,300,000 units).
[AABB Tech Manual 2008b, pp242-251]

325 **b** Irradiation inhibits proliferation of T cells and subsequent GVHD.
[Harmening 2005, p227]

326 MLS ONLY **d** Blood from a family member may be homozygous for a shared HLA haplotype, allowing donor lymphocytes to engraft in the recipient and cause transfusion-associated GVHD.
[Harmening 2005, p347]

327 **c** Gamma irradiation of blood products prevents donor lymphocytes from replicating after transfusion and causing transfusion associated graft-vs-host disease in susceptible patients.
[Harmening 2005, p347]

328 MLS ONLY **d** The most common use of therapeutic plasmapheresis is to remove plasma abnormalities, such as pathological antibodies, immune complexes, or cryoglobulins.
[AABB Practical Guide 2007, ch14]

329 MLS ONLY **b** Macroglobulinemia, also known as Waldenström, is a syndrome with IgM monoclonal paraprotein. Since IgM protein is intravascular, plasma exchange provides symptomatic relief.
[AABB Practical Guide 2007, ch14]

330 **d** The major cause of transfusion-associated fatalities is transfusion of blood to the wrong patient.
[Harmening 2005, p264]