PRACTICE EXAM DISCLAIMER:

- Practice quizzes and exams are made before we cover all the material that will be covered on the exam. You may see some questions on here that address content we have not yet gone over in class.
- There may be some material on this practice exam that we will not get to in class by the time of the exam; you will NOT be responsible for this material.
- Any material that is discussed in class is “fair game” for the exam unless specified otherwise. This practice exam is NOT all-encompassing for the material you are responsible for knowing.

1. Antibody binding to antigenic epitopes occurs via the amino terminal domains of the heavy and light chains. How can you describe the amino acids of these antibody chains and the way they determine the complementary surface that specifically interacts with the epitope?
   a. These interactions occur at the Fc regions of the antibody
   b. The hypervariable regions of both the H and L chains determine epitope binding
   c. The isotype of the antibody, which is determined by the Constant regions determines epitope binding.
   d. All of the above are true
   e. None of the above are correct

2. Surgical removal of a chicken’s Bursa of Fabricius would result in
   a. The absence of erythrocytes
   b. Other mesodermal embryonic tissue taking over the role as the site of lymphopoiesis
   c. The absence of one or more early leukocyte stem cells lineages
   d. Immunity from viral infections
   e. Secretion of hormones

3. Kohler and Milstein used a modified radial immunoprecipitation assay. What two kinds of antibody-specific functions were critical to the way that this assay worked?
   a. Complement fixation and immunoprecipitation
   b. Placental transfer and bacterial lysis
   c. Immune complex formation and viral neutralization
   d. B cell signaling and ABO blood typing
   e. Mast cell activation and apoptosis

4. What is the product of recombination that represents the deleted portion of the immunoglobulin gene that is produced during B cell development?
   a. Combinatorial, associational and junctional fragments
   b. Allotypic, isotypic and idiotypic antigenic products
   c. Okazaki fragments
   d. All of the above
   e. None of the above

5. Which of the following statement(s) is true?
   a. Due to inbreeding there is possibility of shortened lifespan of the mice.
   b. It is possible to get 100% homozygosity after successive inbreeding generations.
   c. Congenic mice only differ by a single differential locus.
   d. Both a and b
   e. Both a and c

6. A pleuripotent hematopoietic stem cell has the potential to differentiate into all but which of the following cells?
   a. Erythrocyte
b. Monocyte  
c. Lymphocyte  
d. Hepatocyte  
e. Mast cell

7. A graft from a mother to her child would be a(n)
   a. Xenograft  
b. Autograft  
c. Allograft  
d. Syngeneic graft  
e. Heterograph

8. In an immunoglobulin molecule, the light chains and heavy chains are covalently connected by
   a. Disulfide bonds  
b. Ionic bonds  
c. Hydrogen bonds  
d. b and c  
e. a, b and c

9. Which of the cells were resistant to aminopterin when used in the Kohler and Milstein experiment to produce hybridomas?
   a. Splenocytes (spleen cells)  
b. Myeloma cells  
c. Hybridomas  
d. Both a and b  
e. Both a and c

10. An ELISA is a liquid phase immunoassay that uses what kind of reaction as a surrogate indicator of the antibody-antigen interaction?
    a. The presence of radioactivity in the precipitate  
b. The lysis of target cells  
c. Agglutination of the erythrocytes  
d. Conversion of a chromogenic substrate to a colored product  
e. The release of hemoglobin from the red blood cells

11. The production of an anti-hapten antibody requires covalently coupling the hapten (H) to a carrier protein (CP1) before immunization with the hapten-carrier protein conjugate (H-CP1). Why is the carrier protein replaced with another protein (CP2) when antiserum is tested for its ability to produce a precipitate with H-CP2 in experiments to define the chemical nature of antigens?
    a. There would be no precipitation in the presence of the immunizing carrier protein.  
b. By replacing the carrier protein used for immunization with another carrier protein, whatever precipitation forms is due to crosslinking of hapten on the CP2 carrier protein.  
c. This prevents non-specific precipitation reactions.  
d. This ensures that precipitations that do develop are the result of antibody interaction with free hapten.  
e. None of the above

12. Previous exposure to cowpox provides protection against smallpox because
    a. The smallpox antigen can be bound by most antibodies  
b. The similarity between the cowpox and smallpox antigens allows for cross-reactive immunity  
c. The cowpox acts as an emulsifying agent for the smallpox virus  
d. All of the above  
e. None of the above.
Questions 13 and 14 relate to the results of the precipitation reactions described in the table below. The number of +s indicate the size of the immunoprecipitate. “0” indicates no precipitation.

<table>
<thead>
<tr>
<th>Antigen used in the immunoprecipitation</th>
<th>Antiserum used in the immunoprecipitation reaction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hapten A-protein conjugate</td>
<td>Anti-Hapten A: +++ (1)</td>
</tr>
<tr>
<td>Hapten B-protein conjugate</td>
<td>Anti-Hapten A: 0 (5)</td>
</tr>
</tbody>
</table>

13. Identify the cells in the table above (identified by the number in parentheses in the cell) that represents a cross reaction.
   a. 1 and 6
   b. 1 and 3
   c. 6 and 3
   d. 3 and 7
   e. 7 and 4

14. Based on the data in the table above, haptens B and D are probably structurally unrelated because
   a. Anti-A antiserum will not bind either B nor D
   b. Anti-D antiserum will not precipitate B
   c. Anti C will precipitate both A and B conjugated protein
   d. All of the above
   e. None of the above

15. Which one of the following statements is incorrect?
   a. B cells have antibodies as their cell surface antigen-specific receptor
   b. There are five isotypes of antibody in mammals
   c. IgM can assemble into pentamers
   d. B cells can differentiate into antibody-secreting plasma cells
   e. B cells differentiate in the thymus

16. Which of the following are examples of myeloid cells?
   a. Neutrophils
   b. Basophils
   c. T lymphocytes
   d. All of the above
   e. Only a and b

17. How would you calculate the number of possible light chain V region permutations in an animal from the following information?
   a. Multiply the number of LV segments by the number of D segments by the number of J segments by the number of C regions in the light chain
   b. Calculate the enzymatic activity of the recombinase activating gene
   c. Determine the number of Bence Jones proteins produced
   d. Multiply the number of LV segments by the number of J segments for the kappa light chain and for the lambda light chain and then add those two numbers together
18. What kinds of differences were found when Kabat and Wu sequenced Bence-Jones proteins?
   a. They found the specific sequences that linked heavy chains together via disulfide bridges
   b. They found that there were allotypic differences in light chains
   c. They found three hypervariable regions that distinguished multiple protein V regions sequences
   d. They found all of the above
   e. None of the above

19. If an antibody that can bind a surface antigen is digested with Papain, it will retain the ability to
   a. Cross link that antigen
   b. Activate the complement cascade
   c. Bind Fc receptors
   d. All of the above
   e. None of the above

20. How can the weak non-covalent bonds (e.g. ionic bonds, hydrophobic bonds, hydrogen bonds and van der waals forces) produce an antibody antigen complex that has a high affinity constant?
   a. The bonds work differently in salt solution
   b. The bonds form a permanent interaction between the two molecular component of the immune complex
   c. The bonds are present in large numbers
   d. The bonds operate over long distances
   e. All of the above.

21. What characteristics does the carrier protein contribute to the hapten that are essential to the production of an immune response to antigen?
   a. Size and granularity
   b. Fluorescence and complement activation
   c. Molecular complexity and large size
   d. The ability to precipitate
   e. The ability to aggregate

22. Rearrangement of the Ig heavy chain locus V region is done in B cells
   a. That are responding to antigenic stimulation
   b. Once the cells have entered the thymus
   c. Before the B cell begins to engulf bacteria by phagocytosis
   d. As the B cell develops in primary lymphoid tissue
   e. None of the above

23. A host organism rejects a transplant from a donor organism of the same species. This means that the host organism can:
   a. Reject xenografts.
   b. Reject allografts.
   c. Reject xenografts but not allografts.
   d. Has poor immunological memory.
   e. Both A and B are correct.

24. The ______________ of an antibody is determined by the Fc portion of its heavy chain.
   a. Idiotype
   b. Isotype
25. In flow cytometry, what does the light emitted as a side scatter measure?
   c. Affinity to antigen  
   d. Antigen-binding pocket  
   e. Complementarity determining region

26. If an anti-albumin antibody is purified and digested with pepsin, and then mixed with albumin, it will produce a precipitate. What will happen if more of the same antibody, digested with papain, is added to the pepsin-digested antibody/albumin mixture?
   a. Nothing  
   b. An exothermic reaction  
   c. The total amount of precipitate will increase  
   d. The total amount of precipitate will decrease  
   e. The total amount of precipitate will stay the same

27. Which of the following is always true about an antigen?
   a. An antigen is a foreign molecule  
   b. An antigen can cause the production of antibodies  
   c. An antigen is small  
   d. Antigens are always proteins or polysaccharides  
   e. Antigens are capable of being bound by immunologic receptors

28. The Fc regions is responsible for numerous immunoglobulin activities. Which is NOT a function of the Fc region?
   a. Crosslinking antigen  
   b. Binding complement  
   c. Mediating placental barrier crossing  
   d. Determining the antibody half-life (catabolism index)  
   e. Binding Fc receptors

29. IgM is different from IgA in several ways. Which of these is a difference between the two isotypes?
   a. Only IgM has the ability to crosslink antigens  
   b. IgM can form pentamers, while IgA can only form dimers  
   c. IgA is the only antibody found in serum  
   d. IgM is the only antibody made as a consequence of VDJ rearrangements  
   e. IgA is always the first antibody made upon antigen stimulation

30. The associational diversity of the immunoglobulin’s antigen combining site is derived from
   a. Its rearrangement of the V,D, and J segments into a single chain  
   b. The activation of B cells in the Bursa of Fabricius  
   c. The stimulation of T cell differentiation  
   d. The rearrangement of the light chain V and J regions  
   e. The simultaneous and random synthesis of a single light chain sequence and single heavy chain sequences in each B cell

31. The ability to eliminate unfused myeloma cells from a hybridoma fusion
32. The term “xenograft” refers to
   a. A transfusion between individuals of different ethnicities
   b. A graft between males and females of the same species
   c. A graft between individuals of different species
   d. A graft of tissue from its normal site to a different site in the body
   e. None of the above

33. What role does somatic hypermutation play in immunoglobulin sequence diversity?
   a. None
   b. It is the only contributor to the diversity of these sequences
   c. At rates 100,000 times higher than background mutation rates, it is a major factor in creating new sequences of H and L chains
   d. This event only alters J chain sequences and thus only defines the interaction of IgM and IgA multimers
   e. None of the above are true

34. The surgical removal of a primary lymphoid tissue:
   a. Has no affect on the immune response, as the secondary tissues can make up for the lack of primary tissue.
   b. Is always fatal.
   c. Marks cells for apoptosis.
   d. Will eliminate an entire lineage of cells.
   e. Both C and D are correct.

35. Lymphocytes traffic through all tissue
   a. Except the spleen
   b. As a way of surveying for random interactions with foreign antigens
   c. At specific times of the day
   d. Only when antigen stimulation occurs
   e. Never: they are fixed in specific tissues for the duration of their lifespan

36. Kohler and Milstein were able to identify the isotype of the anti-sheep erythrocyte antibody produced by the fused hybridoma cell by
   a. Radioimmunoassay
   b. Isoelectric focusing of radiolabeled culture supernatant from the hybridoma cultures
   c. Counting the numbers of chromosomes in the fused cells
   d. Determination of the specific anti-isotype antibodies that would inhibit anti-sheep erythrocyte antibody lysis
   e. All of the above

37. Because the myeloma cell used by Kohler and Milstein had functional heavy and light chain loci,
   a. The hybridoma made multiple permutations of antibodies with heavy chains from the spleen cell fusion partner and heavy chains from the myeloma fusion partner
   b. The hybridoma could produce many different isotypes of anti-sheep erythrocyte antibody
38. After twenty generations of brother x sister inbreeding, what characteristics will be associated with the strain produced
   a. Genetically homozygous at most (>98.5%) loci
   b. The presence of balanced lethal alleles
   c. Residual heterozygosity at some loci as a consequence of random segregation
   d. Reduced vigor, litter size, shortened lifespan
   e. All of the above

39. The basic antibody molecule structure is composed of
   a. Four heavy chains and two light chains that are each different from the rest
   b. Two identical heavy chains and two identical light chains
   c. One heavy chain and one J chain
   d. Five heavy chains, five light chains, and several J chain
   e. None of the above

40. Neonatal splenectomy (surgical removal of the spleen at birth) will cause
   a. An absence of B cells
   b. An absence of NK cells
   c. An absence of T cells
   d. A reduction of the total B cell pool
   e. A reduction of the total leukocyte pool

41. The Bursa of Fabricius is a tissue not found in mammals. What is its equivalent in mammals, and what does this bursal equivalent do?
   a. It is the thymus and is responsible for all cytokine production
   b. It is the mesenteric lymph node and it is responsible for developmental maturation of all B cells
   c. It is the fetal liver and the bone marrow, and is responsible for antigen-independent developmental maturation of B cells
   d. It is the thyroid and it creates the hormonal environment necessary for immune activity under stressful conditions
   e. It is the ovary, and produces the early pluripotent hematopoietic stem cells

42. IgA is found in both the monomeric form as an immunoglobulin with two heavy chains and two light chains, and also as
   a. A pentamer with associated J chain
   b. A dimer with associated J chain
   c. A hexamer
   d. A monomer with J chain
   e. All of the above