1. Which of the following are two hallmarks of the adaptive immune system?

   A. Immediate and Broad  
   B. Specificity and Memory  
   C. Innate and Short  
   D. Non-Specific and Fast  
   E. Immediate and Passive

2. You would want the cells from a potential transplantation donor to have or do all of the following EXCEPT

   A. a match for class II MHC.  
   B. a match for class I MHC.  
   C. stimulate proliferation of your peripheral white blood cells.  
   D. be free of HIV.  
   E. be matched for blood group antigens.

3. All of the following are important functions of the innate immune system EXCEPT that it

   A. promotes early defense against infectious agents.  
   B. has immunoregulatory functions.  
   C. recognizes microbes through receptors for "molecular patterns".  
   D. has specific receptors for antigens.  
   E. has nonclonal distribution of receptors.

4. All of the following are cytokines of the innate immune system EXCEPT

   A. TNF.  
   B. IL-12.  
   C. NK-cell produced IFN-γ.  
   D. type I IFNs.  
   E. IL-2.
5. Acute rheumatic fever is an example of which of the following?

A. an autoimmune disease
B. molecular mimicry with induction of the disease dependent upon an immune response to a Streptococcal cell wall antigen cross-reacting with a myocardial antigen
C. breaking of tolerance to self
D. a disease dependent upon antibody
E. all of the above

6. The Thoracic duct is

A. the lymphocyte port of entry to the blood from the lymphatic system.
B. was a major aqueduct in ancient Rome.
C. the Dendritic cell port of entry for travel from the periphery to the lymph node.
D. part of the air venting system in the BMC.
E. facilitates transfer of maternal antibody to the fetus.

7. Mechanisms for inducing tolerance to self include which of the following?

A. central tolerance resulting from deletion of self-reactive cells in the thymus
B. peripheral tolerance resulting from deletion of self-reactive cells
C. peripheral tolerance resulting from anergy
D. A and B
E. A, B, and C

8. An individual is genetically deficient for the IFN-γ receptor. Which of the following would you expect to be blocked?

A. NK Cell Development.
B. Cell Surface Expression of A Functional T Cell Receptor for Antigen on Mature T Cells
C. IgM Antibody Responses
D. Antimicrobial Defense
E. Immunoglobulin Gene Rearrangement

9. Which of the following can NOT be found in the lymph node?

A. lymphoid follicle
B. red pulp
C. B cells
D. cortex
E. T cells
10. What is receptor editing?
   A. a downstream consequence of exposure to high concentrations of bacterial endotoxin
   B. a mechanism for inducing B cell tolerance by changing the specificity of the antigen receptor
   C. a mechanism for changing the pattern recognition molecules of the innate immune system
   D. what APCs do to present antigen to T cells
   E. responsible for antibody-dependent autoimmunity

11. If you had a tumor but did not know which of its proteins might be an antigen, what might be the best procedure to attempt to induce an immune response against it?
   A. vaccinate with dendritic cells genetically modified to express tumor antigens
   B. vaccinate with dendritic cells pulsed with tumor antigens
   C. vaccinate with tumor cells genetically modified to expression costimulatory molecules
   D. treat with IL-13
   E. deplete endogenous T cells

12. Mechanisms with the potential to contribute to allogeneic graft rejection include all of the following EXCEPT
   A. antibody-mediated hyperacute rejection
   B. CTL-mediated cell destruction
   C. T cell-enhanced acute rejection
   D. chronic rejection with vessel occlusion
   E. passenger lymphocytes

13. Positive and negative selection processes in the thymus generate a T cell repertoire that is both self-tolerant and self-restricted. This means that the mature T cells that develop must have a repertoire of receptors that are specific for:
   A. non-self antigenic peptides bound to non-self MHC molecules
   B. self antigenic peptides bound to self-MHC molecules
   C. self antigenic peptides bound to non-self MHC molecules
   D. non-self antigenic peptides bound to self-MHC molecules
   E. any peptide antigen bound to any MHC molecule

14. A mature naive helper T cell would express which combination of the surface molecules designated TCR (α/β) CD4 and CD8?
   A. TCR-CD4-CD8-
   B. TCR+CD4+CD8+
   C. TCR+CD4-CD8-
   D. TCR-CD4+CD8-
   E. TCR+CD4+CD8-
15. Cytotoxic T cells (CTL) isolated from an individual infected with Virus A will kill virally infected cells in an in vitro assay. What viral antigen/MHC molecule combination do these CTL recognize?

A. Infected with Virus A and expressing the identical MHC Class I molecules as the CTL
B. Infected with Virus B and expressing the identical MHC Class I molecules as the CTL
C. Infected with Virus A and expressing different MHC Class I molecules as the CTL
D. Infected with Virus B and expressing different MHC Class I molecules as the CTL
E. Infected with any virus

16. Which "receptor/ligand" pair supplies the crucial second signal for activation of B lymphocytes by T helper cells?

A. CD4/MHC Class II
B. LFA-1/ICAM-1
C. CD28/CD80 (B7)
D. Antigen/immunoglobulin
E. CD2/CD58

17. The TH2 subset of CD4+ T helper cells is best characterized by the release of which cytokine(s)?

A. IFN-γ, TNF-β
B. IL-12
C. IL-2
D. IL-7
E. IL-4, IL-5

18. Which characteristic best describes the secondary immune response?

A. IgM production predominates
B. Lesser amounts of antigen-specific antibody exist in serum
C. There is a switch to a lower affinity antibody
D. Occurs with a shorter lag period after antigenic stimulation
E. Requires a larger dose of antigen for initiation of a response

19. A baby suffering from recurrent infections is found to have no detectable B or T lymphocytes. This immunodeficiency is most probably the result of a defect in:

A. the spleen
B. the thymus
C. T-B cell cooperation
D. Lymphoid stem cells
E. the Bursa of Fabricius
20. Concerning generation of antigen receptor diversity:
   A. Both the light and heavy immunoglobulin chain variable regions are encoded by V, D and J gene segments.
   B. Diversity can only be generated before encountering antigen.
   C. In T cells, N-nucleotide addition occurs only in heavy chains.
   D. Somatic hypermutation occurs in both B and T cells.
   E. Antibodies produced late in an immune response have increased affinity for antigen.

21. IgA:
   A. Is important in cell-mediated immunity.
   B. Is found in breast milk.
   C. Is the most abundant immunoglobulin in the blood.
   D. Cannot fix complement.
   E. Is the only mucosal antibody that does not undergo class switching.

22. The class of immunoglobulin present in highest concentration in the blood of a newborn infant is?
   B. IgA
   C. IgA and IgE
   D. IgM
   E. IgD

23. Antigen-presenting cells that activate helper T cells must express which one of the following on their surfaces?
   A. IgE
   B. Gamma interferon
   C. Class I MHC
   D. Class II MHC

24. Which one of the following is NOT true regarding the alternative complement pathway?
   A. It can be triggered by infectious agents in the absence of antibody.
   B. It does not require C1, C2, or C4.
   C. It cannot be initiated unless C3b fragments are already present.
   E. It has the same terminal sequence of events as the classical pathway.
25. C3 is cleaved to form C3a and C3b by C3 convertase. C3b is involved in all of the
following EXCEPT:
A. altering vascular permeability
B. promoting phagocytosis
C. forming alternative-pathway C3 convertase
D. forming C5 convertase

26. Which one of the following is NOT released by activated helper T cells?
A. Gamma interferon
B. Interleukin-4
C. Interleukin-2
D. Alpha interferon

27. During the maturation of a B lymphocyte, the first immunoglobulin heavy chain
synthesized is the:
A. gamma chain
B. mu chain
C. epsilon chain
D. alpha chain

28. Which of the following is NOT true of class I MHC antigens?
A. They are found mainly on B cells, macrophages, and activated T cells
B. They are controlled by at least three gene loci in the MHC
C. They are important in human transplantation
D. They are predominantly expressed

29. The antibody-binding site is formed primarily by:
A. the constant regions of H and L chains
B. the hypervariable regions of H chains
C. the hypervariable regions of H and L chains
D. the variable regions of L chains
E. the variable regions of H constant chains

30. Antigen-presenting cells that activate cytotoxic T cells must express which one of the
following on their surfaces?
A. Te
B. Gamma interferon
C. Class II MHC antigens
D. Class I antigens
31. Which one of the following properties of antibodies is NOT dependent on the structure of the heavy-chain constant region?

A. Isotype
B. Ability to fix complement
C. Ability to cross the placenta
D. Affinity for antigen

32. Regarding Th-1 and Th-2 cells, which one of the following is the LEAST accurate?

A. Th-2 cells produce interleukin-4 and -5 and promote antibody-mediated immunity
B. Both Th-1 and Th-2 cells express CD3 and CD4 cell surface proteins
C. Before naïve Th cells differentiate into Th-1 or Th-2 cells, they are capable of producing both gamma interferon and interleukin-4 or interleukin-5
D. Th-1 cells produce gamma interferon and promote cell-mediated immunity
1. A needle that had been in a patient accidentally stabbed a healthcare worker. How would you determine if the worker was infected with HBV as a result of the incident?

   I'd run a series of serological tests to determine the level of HBV Ag, HBeAg, Anti-HBV Ag, Anti-HBV Ab, and level of ALT etc. Moreover, I'd look for HBV DNA (this is the standard testing for HBV currently). If HBV DNA is present and HBeAg is present, ALT levels are highly elevated, then the worker should be infected with HBV.

2. An individual appears in your office with a tumor for which there is an exciting new treatment based on stimulating the immune response to the cancer cells. This person also has a liver transplant and is on Cyclosporine as an immunosuppressive therapy. What would you do? Why?

   I would not recommend the patient to undergo the new treatment based on stimulating the immune response to the cancer cells. It'd be too risky and dangerous to do so because it might well most likely lead to rejection of his liver transplant. It's also essential not to be at odds with his immunosuppressive therapy treatment, whose purpose is to avoid stimulation of his immune system.

3. What is the evidence supporting the effectiveness of vaccination for some common infectious diseases? Give one example of a disease dramatically reduced by vaccination.

   The introduction of polio vaccines (Salk & Sabin) have dramatically lowered the incidence of almost eradicate polio.

4. An individual has a mutation severely inhibiting the natural function of the CD40 ligand. What would be the consequences? Why?

   CD40 ligand is expressed on T cells and acts to activate CD4+ helper T cells. Its major function is to activate APCs/DCs to amplify their cytokine production and activation signals (e.g., T cell activation). The inhibition of CD40L would weaken the interaction and the ability of T cells to activate APC/DC cells. For example, Th1 cells activate macrophages mainly via CD40L-CD40 interactions.

5. An individual presents with overwhelming opportunistic infections and a CD4 T cell count of less than 200 cells/mm³. What might you expect is happening? How would you prove this?

   The individual has progressed from his HIV+ status to AIDS. The CD4 T cell count at the early stage of AIDS is due to his CD4 T cell count < 200 cells/mm³. I'd prove this by running tests (e.g., RT-PCR & DNA tests) to quantitate his viral load to prove that his viral load has increased to a dangerous level which is indicative of AIDS.
6. Name two major components of all viruses.
   - **Genome (DNA/RNA)**
   - **capsid**

7. List 3 major functions of a viral capsid.
   - (1) **Protection**
   - (2) **Structural** (to form an entity capable of infecting others)
   - (3) **Transport** (structural protein, recognition purposes)

8. T/F Viruses encode both capsids and envelopes.  **F**

9. Name two major types of virus symmetry.
   - **icosahedral**
   - **helical**

10. What steps and enzymes are involved in the following virus families ability to produce mRNA. Distinguish which enzymes are virus encoded and which are host cell encoded.

   **Picornaviridae**
   - ss + RNA (acts like host mRNA)
   - however, ss + RNA → viral RNA polymerase → ss-RNA for viral replication!

   **Reoviridae**
   - ds RNA → viral RNA polymerase → +mRNA

   **Herpesviridae**
   - dsDNA → host RNA polymerase → +mRNA

   **Retroviridae**
   - dimerized ss + RNA → ssDNA → dsDNA → host RNA polymerase → +mRNA

   **Orthomyxoviridae**
   - ss-RNA → viral RNA polymerase → Cap switching → viral RNA → +mRNA

11. What virus is the causative agent of ATL?
    - **HTLV-I**

12. What virus is associated with the development of nasopharyngeal carcinoma?
    - **Hepadnaviridae**
    - **Adenovirus**
13. What virus is associated with the development of Kaposi's Sarcoma?  
   Herpes virus (HIV-8) 

14. What picornavirus is the causative agent of common colds?  
   Rhinovirus 

15. What picornavirus is the causative agent of poliomyelitis?  
   Polio virus (of the Enteroviruses) 

16. What group of viruses are the most common cause of aseptic meningitis?  
   Enteroviruses 

17. What virus causes Colorado Tick Fever?  
   Rhipithovirus (from reoviridae) 

18. What virus is associated with acute hepatitis?  
   Hepatitis A virus 

19. What's the treatment for acute hepatitis caused by the above virus?  
   Pooled immunoglobulin lessenn (if <2 weeks) 

20. Name the genus and family to which rabies virus belongs?  
   (family) Rhabdoviridae, Lyssavirus (genre) 

21. Describe the symmetry of the rabies virion.  
   Bullet-shaped 

22. What are the two clinical types of the disease rabies?  
   - Dumb rabies (Flaccid paralysis) 
   - Fruous rabies 

23. What treatment should be given to someone who may have contracted rabies?  
   (1) Cleanse the wound 
   (2) Immerse antirabies AV in wound multiple times 
   (3) Vaccinate individual with rabies vaccine intramuscularly 

24. How is rabies transmitted? Two scenarios!  
   (1) Bats' feces 
   (2) Dogs' bites 

25. Which of the following rabies mRNAs is the most abundant, N or L?  
   N
26. If a patient exhibits Koplik's spots what is your diagnosis?
   Measles ✓

27. Where do these spots appear?
   In the mouth ✓

28. What family does the measles virus belong to?
   Morbillivirus of the Paramyxoviridae subfamily of Paramyxoviridae

29. What 3 viruses are components of the MMR vaccine?
   Mumps, Measles, Rubella

30. What age group is most at risk for developing RSV disease?
   Infants (four months old - 6 months - 2 years)

31. What are the risk factors that predispose someone to more severe RSV disease?
   - Exposed to tobacco smoke ✓
   - Male gender ✓
   - Immunocompromised individuals

32. Is there a treatment and if so how effective is it?
   Ribavirin, not that effective though.

33. What is meant by antigenic drift? Antigenic shift? What virus are we talking about?
   Influenza. Antigenic drift is caused by gradual and subtle mutation of within virus genome of influenza virus that may lead to annual epidemics. (Orthomyxoviridae) Antigenic shift is caused by "drastic" mutation arises by the merging of 2 different species (eg: swine & human) to recombine and goes into a completely new form of influenza virus (different genotypes). What drug is used to treat the above disease and how does it work?
   Amantadine - block M2 channel so H+ ion cannot go through. (Inhibition of viral uncoating with host cell membrane, release of viral genome into host)

34. What drug is used to treat the above disease and how does it work?
   Amantadine - block M2 channel so H+ ion cannot go through. (Inhibition of viral uncoating with host cell membrane, release of viral genome into host)

35. What is meant if a virus is said to be H1N1?
   H1N1. The influenza virus has a H1 subtype (hemagglutinin H1) & a N1 subtype (neuraminidase N1)
   (Usually subtyping flu virus)
36. Where in the cell do influenza viruses replicate? Is this unusual? Why?
Host's Nucleus. It is unusual because RNA viruses usually replicate in cytoplasm with their own viral replication machinery. However, influenza viruses are not encoded with H3 and thus need to "snatch" caps from host in the nucleus using viral cap endonuclease.

37. Who is at risk for severe and life threatening cases of influenza?
Immunocompromised individuals, elderly.

38. Other than amantadine what drugs are used to treat flu, how do they work?
Neuraminidase inhibitor (eg, Tamiflu) inhibits NA function to create neuraminic acid, which bonds with cells. Thus, it disrupts neuraminic acid from cells.

39. What two major human pathogens belong to the family retroviridae?
HTLV I, HIV 1, 2

40. What disease are each associated with?
HTLV = Adult T Cell Leukemia
HIV 1, 2 = AIDS

41. Describe the life cycle of a retrovirus from beginning to end.
Take HIV-1 for example. It is a single stranded RNA with 2 copies.
- It first fuses with host's cell membrane and enters host's cell while shedding its envelope. The virus recognizes CD4+ cells via gp120 protein and then binds to CXCR4 and CCR5, respectively.
- After it enters the cell, it uses its own virally encoded reverse transcriptase and RNAse H to transcribe into ss DNA to ds DNA. The dsDNA is then integrated into host's DNA to provirus. When activated (by immune system), NF-kappa B binds to 5' UTR and activates HIV to transcribe and make viral proteins...thin the rest of the cell.
- Once HIV viral progeny is made, it is delivered out of the host cell (this is further facilitated by proteases).
42. What specific steps are targeted by what drugs and how do they work?
   - Reverse transcriptase inhibitors: NRTIs → inhibit reverse transcriptase directly
   - Protease inhibitors: disrupt protease function, which aids viral assembly
   - Integrate into DNA: viral mRNA transcribed by RNA-dependent DNA polymerase

43. Name 2 regulatory proteins of HIV. Describe the function of one.
   - tat: bind TAR located in 5'UTR to activate RNA transcription
   - Rev: regulates RNA transcripts processing & translation

44. Name 3 “accessory” proteins of HIV.
   - Vpu
   - nef
   - Vif

45. Describe the initial tests to be performed on someone who is suspected of having HIV infection.
   1. ELISA - HIV antigen (P) is prepared & patient's serum will be tested. The presence of antibodies indicates infection.
   2. Western blot - confirmed by HIV antigen. If positive, HIV RNA is screened.

46. What 2 assays are used to measure viral load in an HIV infected person?
   - RT-PCR
   - qPCR test

47. What is the current strategy for treatment of HCV infected patients?
   - IFN-α: but not really that effective

48. HCV virus is inherently unstable, giving rise to multiple types and subtypes, what is the MAIN cause for this inherent instability?

49. You suspect a patient to be infected with the HCV virus, however you are uncertain for the following reasons: (1) the concentration of HCV antibodies appears within normal range and (2) his/her liver transaminase concentrations are normal. What ONE assay could you run to determine whether your patient is HCV positive?

50. What is the fundamental reason for the “persistence” of HBV virus?
   - It is not lytic & it tends to hide away from immune system
     - The immune system is not able to completely get rid of the virus from the body
51. Which virus is associated with oral herpes?

\[ HSV - 1 \]

52. Which virus is associated with genital herpes?

\[ HSV - 2 \]

53. Combivir (AZT & 3TC) and indinavir are both examples of nucleoside analog reverse transcriptase inhibitors. True or false?

False

54. Fluids with a high enough HIV concentration to transmit the virus from one body to another include blood, semen, menstrual blood, and breast milk; fluids without enough virus in them to transmit HIV from one body to another include sweat, saliva, and tears. True or false?

True

55. The TAT gene is one of the first genes to be transcribed. It produces a transactivator protein that binds to:
   a. the protein products of the rev gene
   b. short nucleotide sequence called TAR located within the 3’ LTR region of HIV messenger RNA transcripts.
   c. short nucleotide sequence called TAR located within the 5’ LTR region of HIV messenger RNA transcripts.
   d. the reverse transcriptase enzyme

56. The VPU protein is the negative regulator protein which localizes in the cell cytoplasm next to the nuclear membrane and appears to make the cell more capable of producing HIV. True or false?

False

57. Common presenting features of HIV infection in children under one year of age include oral candidiasis, Pneumocystis carinii infection, failure to thrive and developmental delay. True or false?

True

58. True/False Treating cerviche (a delicious raw scallop dish) with lime juice kills hepatitis A virus. Explain why this is true or false?

False. There’s no proof yet. Lime juice isn’t shown to be able to kill virus.