**DUE DATE:** August 5  
**Extra Credit Date:** August 1  
(No late exams accepted without a BIG deduction in points!)

Anatomy & Physiology2  
**Takehome Exam**

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**This exam covers Lymphatics and Immunity**

1. Place your name and class section on the cover sheet in the space provided. **You will be handing in both the cover sheet and the exam booklet together,** so do not separate them. You may write on the exam booklet if you wish.

2. Write your name on **BOTH SIDES** of the scantron answer sheet. I do not need for you to fill out the sections on social security number, etc.

3. Use a #2 pencil ONLY!! Make sure your scantron is clean, devoid of bends, tears, staples, creases, etc. Anything you do that causes the scantron machine to mis-grade your scantron is your responsibility.

4. If you make erasures on your scantron, do them cleanly without removing the letter underneath the pencil mark. If you make a lot of erasures, you may want to check your scantron after the instructor has graded them.

5. If you wish, you may make a xerox copy of this exam. The Questions marked with an asterisk (*) cover topics that are likely candidates for the final exam.

6. **Significant Ambiguity Declaration (S.A.D.).** If a student feels that a question is significantly ambiguous, the student may do the following:

   a. On the answer sheet, encircle the number of the question in doubt and write S.A.D. in the margin. **An S.A.D. must be accompanied by an answer.** No answer, no consideration of an S.A.D.

   b. Immediately upon completion of the examination, the student must contact the faculty member and discuss the S.A.D. Merely stating that a question is ambiguous will not gain consideration of an S.A.D. The onus of proof rests with the student. He must convince the professor that an ambiguity exists.

"Science is organized knowledge. Wisdom is organized life.”

Hippocrates (460 BC - 377 BC)
PLEASE NOTE: Those questions marked with an asterix (*) are likely candidates for the final exam.

MULTIPLE CHOICE.  1 Point Each. Choose the one alternative that best completes the statement or answers the question. Do not choose more than one answer for any question, or it will be marked ‘wrong’.

*1) Lacteals are critical for the absorption of dietary _____ which do not move into the bloodstream easily.
A) water  
B) glucose  
C) lipids  
D) vitamins  
E) More than one of the above are correct.

*2) Every single day, about _____ L of fluid is returned to the circulatory system by the lymphatic system.
A) 0.5 to 1.5  
B) 2 to 4  
C) 5 to 7  
D) 7.5 to 9  
E) 10 to 12

*3) Lymph most closely resembles:
A) perilymph.  
B) cerebrospinal fluid.  
C) intracellular fluid.  
D) plasma.  
E) serum.

4) The right lymphatic duct and thoracic duct drain fluids into the:
A) internal jugular veins.  
B) external jugular veins.  
C) subclavian veins.  
D) superior vena cava.  
E) aorta.

*5) Which of these is not found in lymph?
A) water  
B) fats  
C) red blood cells  
D) metastasizing cancer cells  
E) More than one of the above are correct.

*6) How many of these are listed as functions of the lymphatic system?
A) transport of excess tissue fluid to the blood vascular system.  
B) transport of red blood cells to the blood vascular system.  
C) maintenance of blood pressure in the venous circulation.  
D) excretion of excess dietary fat.  
E) More than one of the above are correct.
7) Which is correct about lymphatic tissue and organs?
A) Once a lymphocyte enters the lymphoid tissue, it resides there permanently.
B) “Involution by the thymus” refers to the production of Thymus Factor.
C) The thymus is predominantly reticular connective tissue.
D) T lymphocytes act by ingesting foreign substances.
E) More than one of the above are correct.

*8) Antibodies are what sort of molecules?
A) steroid molecules.  C) polysaccharides.
B) proteins.  D) isomeric molecules.
E) lipids.

9) A patient would exhibit which of the following if their lymphatics are blocked by roundworms?
A) a shrinkage of tissues distal to the blockage due to inadequate delivery of lymph.
B) a large amount of lymph pooling in the tissues distal to the blockage.
C) an increased pressure in the lymphatics proximal to the blockage.
D) abnormally high lymph drainage distal to the blockage.
E) More than one of the above are correct.

10) All classes of antibody molecules consist of ___ polypeptide chains.
A) 1 to 6  C) 2 to 10
B) 2 to 8  D) 4 to 10
E) 4 to 20

*11) During the inflammation response, basophils produce all of the following chemicals except:
A) histamine.  C) serotonin.
B) perforin.  D) bradykinin.
E) heparin.

*12) Which structure drains lymph from the right upper limb?
A) lumbar trunk  C) right lymphatic duct
B) thoracic duct  D) cisterna chyli

*13) The _______ tonsils which are the ones most commonly removed in childhood?
A) adenoid  C) pharyngeal
B) lingual  D) palatine
E) More than one is correct
14) Lymphocytes that have developed the correct receptors for an antigen are termed:
A) capped  
B) opsonized  
C) self-tolerant  
D) sensitized  
E) immunocompetent

15) When lymphocytes called natural killer (NK) cells are "surveying" for abnormal cells that need to be destroyed, NK cells release _____, which make holes in the cell membranes of the abnormal cells.
A) defensins  
B) perforins  
C) superoxide anions  
D) lysozymes  
E) Hydrogen peroxide

16) Which of these is identified with passive immunity?
A) long-term immune protection  
B) infusion of weakened viruses  
C) passage of IgG antibodies from a pregnant mother to her fetus  
D) booster shot  
E) More than one of the above are correct

17) What stimulates cells to make and secrete antiviral proteins, and activate NK cells and macrophages?
A) defensins  
B) complement system  
C) interferon  
D) perforins  
E) interleukins

18) Where do T cells become immunocompetent? Inside the:
A) spleen.  
B) bone marrow.  
C) thymus.  
D) lymph nodes.  
E) More than one is correct

19) Bacterial infection is especially likely to elevate the ____ count.
A) lymphocyte  
B) basophil  
C) monocyte  
D) neutrophil  
E) hemoglobin

20) What do histamine, bradykinin, and leukotrienes have in common? They all stimulate:
A) hyperemia.  
B) margination.  
C) the complement complex  
D) clotting.  
E) phagocytosis
21) Which of these determines whether or not we have Severe Combined Immunodeficiency (SCID)?
A) The type of antigen
B) Memory cell production
C) Enzymes present at the time of the invasion
D) Our genes

*22) The system that recognizes foreign molecules and acts to immobilize, neutralize, or destroy them is the:
A) integumentary system.  C) immune system.
B) renal system.  D) lymphatic system.

*23) All of these are functions of the inflammatory response except one. Which one is it?
A) prevents the spread of the injurious agent to nearby tissue
B) replaces injured tissues with connective tissue
C) disposes of cellular debris and pathogens
D) sets the stage for repair processes
E) More than one of the above are not a function of the immune response.

24) TRUE about antibodies?
A) IgG is usually found in the bloodstream before IgM
B) Millions of different types of antibodies are produced by the average human body.
C) B cells in the germinal layers of the lymph nodules undergo high rates of mutation.
D) “Somatic Recombination” is the term for how new combinations of genes are formed in gametes.

*25) The redness of an inflamed area is caused by:
A) hyperemia caused by vasodilation.
B) blood pooling caused by vasoconstriction.
C) phagocyte mobilization.
D) production of complement and interferon.
E) More than one of the above are correct.

26) Antibody molecules get their shape by ________ bonds.
A) disulfide  C) amino acid
B) hydrogen  D) sodium
27) At the site of an injury, neutrophils adhere to the endothelium in a process called _____, and then move between endothelial cells into the interstitial fluid, a process called _____.
A) opsonization; cytokinesis  
B) cytokinesis; margination  
C) margination; diapedesis  
D) chemotaxis; diapedesis  
E) diapedesis; chemotaxis

28) Small molecules that bind with self-proteins to produce antibody-attracting substances are called:
A) haptens.  
B) antibodies.  
C) ions.  
D) reagins.  

29) Antibodies attach to pathogens and expose sites to activate this part of the immune system:
A) The release of interferon.  
B) B lymphocytes to plasma cells.  
C) NK cells and T lymphocytes.  
D) The complement system.  
E) The release of interleukins.

30) Cytotoxic T cells can destroy cancer cells using:
A) perforin.  
B) hapten.  
C) pyrogen.  
D) interleukin.  
E) complement.

31) In clonal selection of B cells, which substance is responsible for determining which cells will eventually become cloned?
A) antigen  
B) lymphocyte  
C) antibody  
D) macrophage

32) Cytotoxic T cells are part of _______ immunity:
A) cell-mediated  
B) passive  
C) innate  
D) humoral  
E) diplomatic

33) Which of the following is not a form of nonspecific resistance?
A) a flu shot  
B) fever  
C) the nasal mucosa  
D) stomach acid  
E) inflammation
*34) The second line of defense against microorganisms includes:
A) perforins
B) cilia
C) gastric juice
D) phagocytes
E) More than one of the above are correct.

*35) Which of these cells is most directly responsible for humoral immunity?
A) killer T cells.
B) helper T cells.
C) B lymphocytes.
D) mast cells.
E) neutrophils.

36) What is used to prevent infectious agents from spreading?
A) plasmin.
B) the complement system.
C) histamine.
D) fibrin.
E) heparin.

37) Which of these statements is/are true regarding how the immune system prevents attack on host tissues.
A) The development of tolerance is specific to B cells only.
B) Neutrophils capable of binding to self-antigens through a process called negative selection.
C) Tolerance to self is due to the action of foreign antigens that inactivate the immune response to one's own tissues.
D) Tolerance is developed very early in life.
E) More than one of the above are correct.

38) Temporarily swollen lymph nodes that are painful to the touch most likely indicate:
A) inflammation or infection localized in that area.
B) widespread inflammation or infection.
C) chronic infection or cancer.
D) clogging of the efferent lymphatic vessels.
E) More than one of the above are correct.

*39) Which of these is the main antibody-mediated mechanism used against foreign cells in the body?
A) Interferon production.
B) Complement fixation.
C) Neutralization.
D) Agglutination.

40) When neutrophils and macrophages phagocytize bacteria, they secrete interleukin-1, which:
A) causes hyperemia.
B) acts as a pyrogen.
C) stimulates fever.
D) causes inflammation.
E) More than one of the above are correct.
41) Which of the following is not characteristic of the specific immune system?
A) It will normally only attack a specific antigen.
B) It covers the entire body, using the bloodstream as the main transport system.
C) It has memory.
D) It is specific for a given organ.
E) More than one of the above are correct.

42) Antibody functions include all of the following except:
A) binding and inactivating chemical toxins released by bacteria or other microorganisms.
B) attaching to cell-bound antigens on red blood cells when blood types are properly matched.
C) linking soluble antigens together so that they fall out of solution.
D) targeting foreign cells so that complement proteins can cause cellular lysis.
E) More than one of the above are correct.

43) Capping and antigen endocytosis are early steps in the action of:
A) antigen-presenting cells.
B) NK cells.
C) cytotoxic T cells.
D) helper T cells.
E) immunoglobulins.

44) Before a B lymphocyte can secrete antibodies it must transform into:
A) a stem cell.
B) a plasma cell.
C) an antigen-presenting cell.
D) a T cell.
E) a macrophage.

45) These cells recognize an Ag-MHCP complex, secrete interleukins, attract macrophages, and stimulate T and B cell mitosis and maturation.
A) memory T cells
B) suppressor T cells
C) helper T cells
D) cytotoxic T cells
E) natural killer cells

46) Seral antibodies might be used to diagnose all of the following except:
A) mushroom poisoning.
B) hepatitis.
C) rabies.
D) septicaemia.
E) HIV.

47) One mechanism of antibody action is ____, which makes bacteria easier to phagocytize.
A) margination
B) cytolysis
C) opsonization
D) complement fixation
E) pyrexia
48) Select the correct statement about phagocytic cells.
A) Neutrophils may destroy themselves when they phagocytize large quantities of a foreign substance.
B) Macrophages release defensins during killing.
C) The respiratory burst characterizes eosinophil phagocytosis.
D) Kupffer cells are a type of neutrophil.
E) More than one of the above are correct.

49) Which of the following is not an autoimmune disease?
A) multiple sclerosis  
B) type II diabetes  
C) systemic lupus erythematosus  
D) glomerulonephritis

50) Which of the following would be classified as a delayed hypersensitivity reaction?
A) immune complex hypersensitivity  
B) anaphylaxis  
C) cytotoxic hypersensitivity  
D) allergic contact dermatitis  
E) More than one of the above are correct.

51) The function of an antigen-presenting cell depends on the presence of ___ on its plasma membrane.
A) IgG  
B) interleukin-2  
C) helper factors  
D) MHC proteins  
E) complement proteins

52) Which of the following is not a mechanism for the development of autoimmune disorders?
A) exposure of previously "hidden" self-antigens to the adaptive immune system
B) a second exposure to an allergen
C) mutation followed by the appearance of membrane proteins not previously present
D) cross-reaction of antibodies formed against foreign antigens with self-antigens

53) Which is a correct statement regarding immunodeficiency?
A) Severe combined immunodeficiency (SCID) disease is an acquired condition.
B) The causative agent in acquired immune deficiency syndrome (AIDS) is a virus that recognizes CD4 proteins.
C) Hodgkin's disease is a hereditary immunodeficiency found in children.
D) The most common form of immunodeficiency is graft versus host (GVH) disease.
E) More than one of the above are correct.
*54) Immunocompetence:
A) occurs mainly in one specific organ of cellular immunity.
B) is the ability of individual cells to recognize a specific antigen by binding to it.
C) prevents intercellular communication so that only specific cell types respond to the invader.
D) requires exposure to an antigen.

55) Which of these are types of macrophages?
A) dendritic cells and microglia.  
B) NK cells.  
C) Cytotoxic cells.  
D) t-lymphocytes  
E) More than one of the above are correct.

*56) Delayed hypersensitivities:
A) are mediated by B cells.  
B) include allergic contact dermatitis.  
C) include anaphylactic shock, a systemic vasodilation that results in inadequate blood delivery to all tissues.  
D) do not involve T cells.  
E) More than one of the above are correct.

*57) These molecules identify cells of your body as “host cells”:
A) antigens  
B) epitopes  
C) major histocompatibility complex proteins  
D) antigen-presenting cells  
E) antibodies

58) The HIV virus contains the enzyme _____ that stimulates host cells to produce DNA from viral _____.
A) reverse transcriptive; RNA  
B) reverse transcriptive; DNA  
C) DNA polymerase; DNA  
D) RNA polymerase; RNA  
E) RNA polymerase; DNA

*59) Where might you find MALT lymphatic tissue?
A) The spleen.  
B) the thymus.  
C) the bone marrow.  
D) the digestive mucosa.  
E) More than one of the above are correct
60) Upon detecting a new antigen, _____ antibodies are produced by the plasma cells.
A) IgA  C) IgM
B) IgD  D) IgG
E) IgE

61) The only antibody class that can cross the placenta:
A) IgD.  C) IgG.
B) IgM.  D) IgA.
E) IgE.

62) Which cell is the main antigen-presenting cell?
A) Neutrophils.  C) B cells.
B) Fibroblasts.  D) Plasma cells.
E) Macrophages.

63. Autoantibodies might be used to diagnose which of the following?
A) Rheumatoid arthritis.
B) Hepatitis caused by alcoholism.
C) Pregnancy.
D) Lyme disease.
E) More than one is correct.

64. The AIDS virus attacks which cells?
A) Plasma cells  C) Helper T cells
B) B cells  D) Cytotoxic T cells
E) Natural killer cells

65. What is released into tissues by activated macrophages and T cells _____, which promotes the production of more leukocytes.
A) colony-stimulating factors
B) erythropoietin
C) leukotrienes
D) complement proteins
E) interferons
SHORT ANSWER On a separate sheet of paper, answer the following questions to the best of your ability. Here are the rules:

1. The answer sheet can have up to 3 names on it (hand them in as a group if you’d like). The group must answer all the questions on this page for full credit.

2. Each question can be answered in a short, succinct paragraph. I will take off points for long, drawn-out answers that do not answer the question directly.

3. Type your answers. On the top of the page, type any names of group members. Clearly type the question number in front of the answer.

PLEASE NOTE: Those questions marked with an asterix (*) contain information that may be contained within the final exam.

**Short Answer #1** (1 points). A nurse palpated enlarged lymph nodes. Describe signs and symptoms that help to distinguish cancerous lymph nodes from infected lymph nodes

**Short Answer #2** (2 points). Even though the adaptive immune system has two “routes”, cell-mediated and humoral, we have a saying in medicine: "Patient with no T cells, patient with no immunity". Explain why. HINT: this might be best answered after you do the outline on the next page!

**Short Answer #3** (2 points). We might treat chronic bronchitis with antibodies, but most hepatitis with interferon. Why? Explain the difference between interferons and antibodies in 1 short sentence. Which cells secrete them?
OUTLINE PROJECT (30 points).

A novel (“brand new”) bacterium enters the body and begins to reproduce. Outline the steps you expect in both cell-mediated and humoral immunity.

To answer this, follow these rules:

1. Limit yourself to 8 steps for each type of immunity. Each step should be short, 2 or 3 sentences long at THE MOST.

Label each step clearly:

Cell-mediated Immunity
STEP #1:
STEP #2:
etc....

Humoral Immunity
STEP #1:
STEP #2:
etc....

2. Cell-Mediated Immune Response starts with APC cells and interleukin.

Be sure to include the role of interleukins, Tc, Th, Tm cells, and “becoming immunocompetent”.

3. For Humoral immunity, break down “Recognition” into 4 or 5 individual steps.

Do not go into detail on the different kinds of attacks, but do mention them in your answer.

Be sure to include the following concepts: Ag, cytokines, titer.
EXTRA CREDIT (2 points). How might a 'monoclonal antibody' provide immunity to multiple pathogens?