These review questions for the immune system lecture were adapted from our textbook and its website, and also from 1800+ Review Questions for Anatomy and Physiology II (2nd edition) by R. Michael Anson, Ph.D.

You are required to know and understand all the material on the immune system that is covered in the lecture and in the laboratory. Questions marked with an asterisk are from material presented in the laboratory section of the course.

Multiple choice review questions:

1) The major job of the immune system is to protect us from _____, a term that means organisms that cause disease.
- A) Antigens
- B) Pathogens
- C) Antibodies
- D) Trauma

2) Although there are many types of pathogens, the two most common types are (two answers)
- A) Cigarette smoke
- B) Poisons
- C) Viruses
- D) Bacteria
- E) Cholesterol/Heart disease

3) The term _____ means invasion of the body by pathogens
- A) Infection
- B) Illness
- C) Cancer
- D) Trauma

4) Antigen
- A) A medicine given to heart attack victims to restore blood flow
- B) A type of leukocyte
- C) The molecules on the surface of a cell that the immune system interacts with
- D) A medicine given to heart attack victims to counteract blood poisonings (such as snake bites or peanut allergy reactions)

5) The term _____ means all antigens that do **not** occur naturally in the body
- A) Virus
- B) Protein
- C) Antibody
- D) Foreign antigen

6) The term _____ means all the white blood cell types

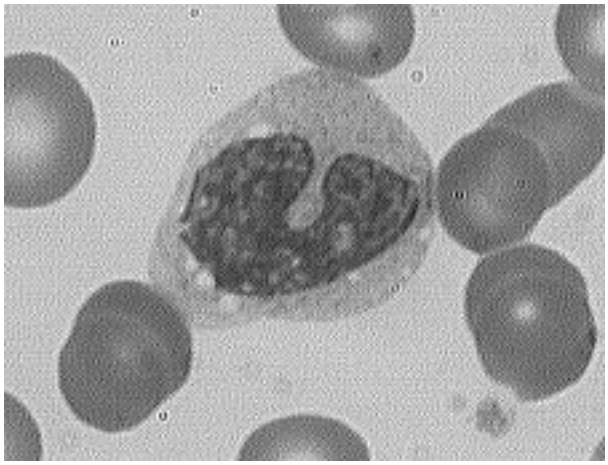
A) Leukocyte
B) Formed elements
C) Lymphocyte
D) Blood
E) Plasma

7) How many major WBC types are there?

A) 3
B) 5
C) 8
D) 10

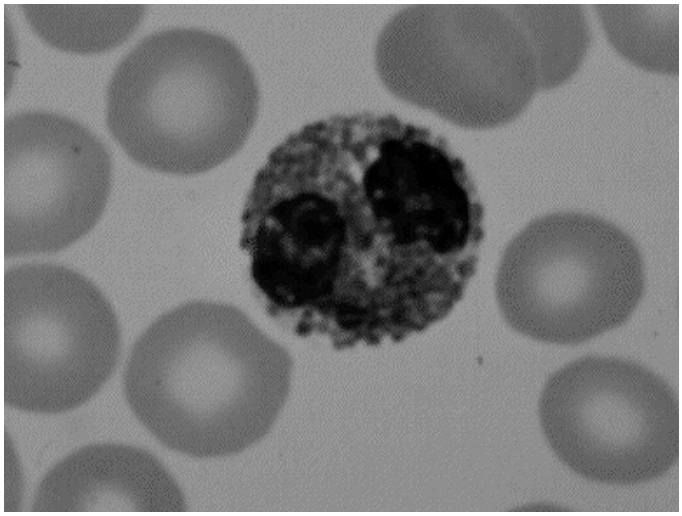
8*) In lab, you identified WBC types under the microscope. What WBC type is shown on the right?

A) Monocyte
B) Eosinophil
C) Lymphocyte
D) Neutrophil
E) Basophil

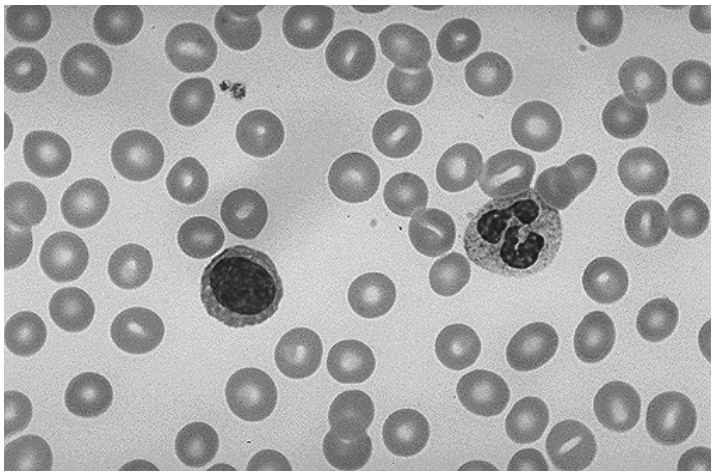


9*) In lab, you identified WBC types under the microscope. What WBC type is shown on the right? Hint: It has large red granules.

A) Monocyte
B) Eosinophil
C) Lymphocyte
D) Neutrophil
E) Basophil



10*) In lab, you identified WBC types under the microscope. What WBC type is shown on the **left** side of this image?



A) Monocyte
B) Eosinophil
C) Lymphocyte
D) Neutrophil
E) Basophil

11*) In lab, you identified WBC types under the microscope. What WBC type is shown on the **right** side of this image?

A) Monocyte
B) Eosinophil
C) Lymphocyte
D) Neutrophil
E) Basophil

12) The term _____ means one cell engulfing (eating) another cell

A) Phagocytosis
B) Consummation
C) Lysis
D) Hemolysis

13) What substance do basophil cells release?

A) Antigens
B) Clotting factors
C) Antibodies
D) Histamine

14) WBCs that do phagocytosis include all of the following except

A) neutrophils
B) basophils
C) macrophages
D) eosinophils

15) Tissue fluid is a watery liquid that surrounds all tissues in the body. Excess tissue fluid is returned to the blood vessels, where it originated. What is the term for excess tissue fluid?

A) Plasma
B) Serum
C) Lymph
D) Aquacyte

16) The ducts and vessels of the lymphatic system return lymph to the blood, but the lymphatic system (especially the lymph nodes) also plays a role in the immune system. What do the lymph nodes do to the lymph that helps your immune system?

A) Filter the lymph
B) Secrete antibiotics into the lymph
C) Heat the lymph to 40 degrees C to sterilize it
D) Secrete antibodies into the lymph

17) The function of the tonsils

A) Mechanical digestion of large food particles
B) Send chyme to the appropriate digestive organs
C) Filter and cleanse respiratory tract fluids
D) Prevent chyme or liquids from entering the nasal cavity

18) Which is **not** a part of the non-specific immune system?

A) B-cells
B) The skin
C) Neutrophils
D) Fever
E) Complement proteins
F) Inflammation

19) The proteins that inhibit viruses from infecting our cells

A) Complement
B) Antibodies
C) Histamines
D) Interferons

20) The proteins that tear apart the membranes of pathogen cells

A) Antibodies
B) T-cells
C) Complement
D) Free radicals

21) The redness, heat, and swelling of injured tissues is known as

A) Tenderness
B) Inflammation
C) Histoitis
D) Infection

22) The thermoregulatory control center or "thermostat" that regulates the body's response to changes in temperature such as during a fever, is located in the

A) hypothalamus.
B) pituitary.
C) cerebral cortex.
D) adrenal gland.

23) The immune system releases a molecule called _____ that causes the redness, heat, and swelling of the inflammatory response (as well as the itching, sneezing, and runny nose of an allergic reaction).

A) histamine.
B) antibodies.
C) adrenaline.
D) antigens.

24) Inflammation is characterized by all of the following except

A) redness.
B) shortness of breath.
C) swelling (edema).
D) pain

25) Which cell type(s) are part of the specific immune system? (More than one correct answer).

A) Basophil cells
B) B cells
C) Lymphocyte cells
D) T cells
E) Neutrophil cells
F) Eosinophil cells
G) Platelets

26) Which of the following are parts of the humoral immune system? (More than one correct answer).

A) B cells
B) Antibodies
C) T cells
D) Bone marrow
E) Neutrophils

27) Which of the following is part of the cell-mediated immune system?

A) B cells
B) Antibodies
C) T cells
D) Bone marrow
E) Neutrophils

28) True or false: B cells and T cells that attack the flu virus would also be able to attack the virus that causes the common cold.

A) True
B) False

29) True or false: B cells and T cells that attack this year's flu virus would also be able to attack last year's flu virus.

A) True
B) False

30) Which function is a characteristic of B cells?
A) Releasing histamine
B) Formation of antibodies
C) Generating digestive enzymes for pathogen lysis
D) Phagocytosis

31) Which is not **true** of antibodies
A) They are found in the blood
B) They are part of cell-mediated immune system
C) They are proteins
D) They are Y-shaped

32) Antibodies
A) Are present on all cells (cells of the body and pathogen cells)
B) Are only present on pathogen cells, inside or outside the body
C) Bind to foreign pathogens
D) Are released by basophils

33) Cells linked together by antibodies are said to be
A) Agglutinated
B) Polymerized
C) Macromolecules
D) Antigens

34) When a B cell or T cell encounters the foreign antigen that it is against, the B or T cell will divide repeatedly to make copies of itself. This process is called
A) Metastasis
B) Mitosis
C) Binary fission
D) Clonal expansion
E) Cancer

35) B cells and T cells that do not immediately attack pathogens, but that instead remain inactive until a future encounter with the pathogen, are called
A) Leukocyte reservoir cells
B) Memory B and T cells
C) Stem B and T cells
D) Residual lymphocytes

36) Which statement about complement proteins is false?
A) Complement proteins are present in body fluids even during times of no infection
B) They are activated by T cells
C) They attack cells covered by antibodies
D) They lyse (break open) pathogen cells

37) The cells that do “clonal expansion” are
A) B and T lymphocytes
B) Bacteria that enter the body before the immune system controls their growth
C) All immune cells
D) Cancer cells

38) Which event does **not** represent an action of the nonspecific immune system?
A) T cells attacking a pathogen
B) histamine increasing vasodilation and increased capillary permeability
C) phagocytosis by neutrophils and macrophages
D) WBCs attracted to a site of injury

39) The cell types that present foreign antigens to T cells are
A) B lymphocytes.
B) cancerous cells
C) platelets.
D) macrophages

40) Killer T cells
A) Make antibodies
B) Inject pathogens with digestive enzymes
C) Engulf pathogens by phagocytosis
D) Destroy self-antigens/cause autoimmune disease cells

41) Helper T cells
A) Find pathogens hidden within cells
B) Lyse (break open) the cell wall of pathogens to allow other WBCs to enter
C) Allow B cells and T cells to do clonal expansion
D) Make capillaries leaky to assist other WBCs to exit the blood

42) The term _____ disease means any disease where the immune system attacks the self antigens of the body (in other words, the immune system attacks the body instead of pathogens).
A) Self-directed
B) Autoimmune
C) Malignant
D) Immunodeficiency

43) Which is **not** an autoimmune disease?
A) Alzheimer’s disease
B) Lupus
C) Rheumatoid arthritis
D) Multiple sclerosis

44) The term _____ means any excessive response by the immune system to a harmless antigen in the environment.

A) Phagocytosis
B) Autoimmune disease
C) Acquired immunodeficiency
D) Allergy

45) An allergic response that is so extreme that it is life threatening is called

A) Hemolysis
B) Vasoconstriction
C) Anaphylactic shock
D) Cardiovascular embolism

46) The major symptom of AIDS disease is

A) Loss of the immune system
B) Development of multiple autoimmune diseases
C) Irrational behavior/dementia
D) Weakness due to destruction of red blood cells

47) The _____ virus causes the disease AIDS

A) HIV
B) Autoimmunity
C) H1N1
D) Hepatitis

48) The HIV virus is passed from person to person…

A) By skin contact (handshakes, touching, etc.)
B) Through the air (being within 20 feet or less of an infected person)
C) By exchange of body fluids (sexual contact, shared needles, etc.)
D) Touching the same object (such as a telephone or a computer keyboard)

49) The time from HIV infection to loss of the immune system is

A) Hours
B) Days
C) Weeks
D) Years

50) The type of T cells that is attacked by the human immunodeficiency virus (HIV) in AIDS victims, is the

A) helper T cells.
B) memory T cells.
C) accountant T cells.
D) killer T cells.

Answers to multiple choice review questions:

1 = B
2 = C and D
3 = A
4 = C
5 = D
6 = A
7 = 5
8* = A
9* = B
10* = C
11* = D
12 = A
13 = D
14 = B
15 = C
16 = A
17 = C
18 = A
19 = D
20 = C
21 = B
22 = A
23 = A
24 = B
25 = B and D
26 = A and B
27 = C
28 = B
29 = B
30 = B
31 = B
32 = C
33 = A
34 = D
35 = B
36 = B
37 = A
38 = A
39 = D
40 = B
41 = C
42 = B
43 = A
44 = D
45 = C
46 = A
47 = A
48 = C
49 = D
50 = A

Fill-in-the-blank review questions:

1) The immune system defends the body from _____, a term that means living things that cause disease.

2) The term _____ means when pathogens have entered the body.

3) The two most common pathogen types are _____ and _____.

4) _____ (a pathogen type) are small cells. They have a metabolism, a chromosome, and they reproduce by dividing themselves into two new cells.

5) _____ (a pathogen type) are the smallest pathogen type. They are not cells. They have no metabolism or cell membrane. They can only reproduce by entering the inside of the body's cells, and then tricking the cell into make copies of themselves.

6) A(n) _____ is any molecule that the immune system interacts with; usually these molecules are proteins, carbohydrates, and lipids on the surface of cells.

7) The antigens that are made naturally as part of the body are called _____, whereas the antigens that are **not** made naturally as part of the body (such as the antigens on pathogens) are called _____.

8) The cells of the immune system attack all cells that have _____ antigens, but the immune cells do not attack any cells that have _____ antigens.

9) Any disease where the immune system makes a mistake and attacks the body's own cells (cells with self antigens) is called a(n) _____ disease. List an example autoimmune disease: _____.

10) _____ are the blood cells that are part of the immune system. These cells are also called _____.

11) There are _____ (a number) major types of white blood cells.

12) The five major types of white blood cells are: _____, _____, _____, _____, and _____.

13*) White blood cells are sometimes divided into two groups, depending on whether they have granules in their cytoplasm or not. Those WBCs that have granules are called _____ and those WBCs that do not have granules are called _____.

14*) There are three types of granulocyte: _____, _____, and _____.

15*) There are two types of agranulocyte: _____ and _____.

16*) The two most abundant types of leukocytes are _____ are _____: the remaining three types account for 10% or less of total number of leukocytes.

17*) Name the WBC cell type(s) that…(some blanks may require more than one answer)

a) Can have a nucleus with two lobes: _____
b) Can have a nucleus with three lobes: _____
c) Can have a kidney-bean shaped nucleus: _____
d) Can have a large round nucleus: _____
e) Has large red granules: _____

18) Pathogens that enter the body can be engulfed ("eaten") by white blood cells, a process known as _____.

19) The three phagocytes of the immune system are _____, _____, and _____. Circle the one that does the least phagocytosis of the three.

20) The main function of neutrophils is to _____.

21*) Neutrophils can be recognized by their nuclei, which generally have _____ (a number range) lobes.

22*) Basophils can be recognized by their nuclei, which generally have _____ (a number) of lobes.

23*) Lymphocytes can be recognized by their nuclei which are usually _____ or _____ shaped.

24) _____cells, which develop from monocytes, are the most voracious of the phagocytes.

25*) Monocytes can be recognized by their size (they are usually smaller/larger (circle one) compared to other blood cells) and by the _____ shape of their nucleus.

26) Basophils release _____, which is a molecule that dilates blood vessels and makes the blood vessel leaky so that the immune system cells can exit the blood vessel and attack pathogens outside the blood.

27) All tissues of the body are bathed in a watery fluid called the _____. The source of this fluid is _____.

28) The capillaries provide more tissue fluid to the tissues than is required. The excess amounts of tissue fluid are called _____.

29) Excess tissue fluid is eventually returned to the bloodstream after it flows through the vessels, ducts, and nodesof the _____ system.

30) The hollow structures of the lymphatic system where lymph vessels merge are called _____. It is there that the lymph is _____. Because pathogen cells tend to get trapped there, many WBCs are stationed inside these structures.

31) In addition to trapping pathogen cells (which come from outside the body), the lymph nodes can often trap dangerous cells that come from within the body. These rapidly multiplying cells are _____ cells.

32) All the lymphatic vessels in the body merge into two major lymph vessels: The _____ duct and the _____ duct. From these two ducts, the lymph drains back into the subclavean veins.

33) Water molecules are part of many fluids in the body, including lymph, tissue fluid, and blood. In the blank spaces below, use the numbers 1 – 6 to indicate the order a molecule of water would encounter the following fluids and body parts, as it moves from the blood to the end of the lymphatic system.

The thoracic duct _____
A lymph node _____
A lymph vessel _____
The plasma _____
Tissue fluid _____
Capillary wall _____

Circle the answer above where the water would re-enter the blood.

Draw a box around the answer above where the water would findlarge numbers of stationary immune cells

Draw a star over the answer above that swells when we are fighting an infection.

34) The lymphoid organs that help cleanse the upper respiratory tract of pathogens are the _____.

35) The _____ is the lymphoid organ that helps rid the blood of pathogens and filters out _____.

36) _____ are the lymphoid organs that cleanse the fluids in the digestive system of pathogens.

37) The body has two immune systems: (1) The _____ (or innate) immune system, which makes the body less accessible and less hospitable to all pathogens, and (2) the _____ (or adaptive) immune system, which has cells that attack specific pathogens.

38) The _____ is the most important organ of the non-specific immune system, because it simply blocks most pathogens from ever entering the body.

39) During infection, certain immune cells secrete molecules that travel to the body's "thermostat" in the _____ (a region of the body) and reset the body temperature upward, resulting in a. _____

40) The elevated temperature of a fever assists the immune system in two ways: _____ and _____.

41) The _____ is a set of proteins present in the blood that, when activated, destroy pathogen cell membranes.

42) Many cells, after being infected by a virus, manage to secrete _____ proteins, which inhibit viruses from entering neighboring cells.

43) One action of the non-specific is called inflammation. The four signs of inflammation are _____, _____, _____, and _____.

44) The inflammatory response is initiated when _____ (a type of WBC) releases _____, which makes capillaries _____. This causes the redness and swelling of the inflammation, and allows _____ to pass from the blood into the injured tissue.

45) During inflammation, molecules released by damaged tissue do two things: _____ and _____.

46) The branch of the immune system that is able to recognize specific pathogens and launch powerful attacks against them is the _____ immune system.

47) The cells of specific immune system are the white blood cells that defend the body against specific pathogens. Of the five major types of white blood cells, only one type, the _____, are part of the specific immune system.

48) The two major types of lymphocytes are _____ cells and _____ cells.

49) Each individual lymphocyte cell can recognize and attack one/many (circle one) type(s) of foreign antigens. Since there are thousands of different pathogens that could potentially infect the body, there are one /many (circle one) different lymphocytes.

50) Thanks to the memory B cells and T cells, we have a much stronger and faster immune response against a pathogen we have encountered before. This phenomena is called the _____ of the immune system.

51) For the specific immune system to mount a specific defense against a newly encountered pathogen takes _____ (how long?). This response is slow because at the beginning of the infection there may be only a single lymphocyte in the body that happens to bind to that particular pathogen. To effectively fight the pathogen, that single cell has to make millions of copies of itself. This process is called _____.

52) Re-exposure, even years later, to an antigen that has been responded to before results in a specific defense that takes _____ (how long?) to mount. This is due to the presence of _____ B and T cells made during the first encounter with the pathogen.

53) _____ are Y-shaped molecules in the blood that bind antigens.

54) Antibodies are _____ (a type of macromolecule molecule).

55) _____ are the lymphocytes that make and secrete antibodies.

56) When a B lymphocyte has encountered its foreign antigen (the specific foreign antigen that the B cell is programmed to respond to) the B cell begins to reproduce itself, a process that is called _____ of the lymphocyte.

57) When a B-cell encounters an antigen, it proliferates into two types of cells: One type releases antibodies to the antigen, and the other type are _____ cells that will become active if the pathogen is encountered again in the future.

58) When a lymphocyte (such as a B cell) does clonal expansion, the all the new cells it produces do/do not (circle one) have the same specificity for the same antigen as the original cell that clonally expanded.

59) The antibodies attached to a pathogen slow the spread of the infection in many ways: The antibodies attached to the pathogen simply "get in the way," so to speak, interfering with the functioning of the pathogen cell. Another way that the antibodies fight the pathogen is by linking several pathogens together. The term _____ means when cells are linked together by antibodies

60) Each antibody can simultaneously bind to _____ (how many?) identical antigens. This is what allows antibodies to agglutinate pathogens containing foreign antigens.

61) Antibodies bound to a pathogen trigger attacks on that pathogen by _____ proteins, which are proteins in the blood that can lyse (tear open) cells.

62) The complement proteins only destroy cells that have antibodies attached to their antigens. This prevents the complement proteins from attacking _____.

63) B cell lymphocytes and the antibodies they make are together called the _____ (or antibody-mediated) immune system.

64) _____ are the lymphocytes that attack pathogen cells by direct cell-to-cell contact (unlike B cells, which attack pathogens indirectly by releasing antibody proteins).

65) Unlike B cells, T cells are **not** activated simply by encountering the foreign antigen they are specific for. For a T cell to become activated, it first must encounter a _____ cell which has digested and displayed the specific foreign antigen that the T cell is programmed to respond to.

66) When a T lymphocyte has encountered its foreign antigen (the specific foreign antigen that the T cell is programmed to respond to) displayed by a macrophage cell, the T cell begins to reproduce itself, a process that is called _____ of the lymphocyte.

67) When an activated T lymphocyte proliferates, are three subpopulations of T lymphocytes that are formed: _____, _____, and _____.

68) Killer T-cells attack pathogen cells by direct cell-to-cell contact. The killer T cell contacts the pathogen cell then injects the pathogen cell with _____.

69) Some T cells are _____ T cells, which remain inactive until the pathogen is encountered again.

70) Some T cells are _____ T cells, which are necessary for B and T lymphocytes to undergo clonal expansion.

71) The branch of the specific immune system that is carried out by T cell lymphocytes is called the _____ immune system because living cells (T cells, macrophages, and pathogen cells) are all required for its functioning.

72) After each description, write B if it describes a B cell, write T if it describes a T cell. Some blanks may require more than one answer.

a) Lymphocytes: _____

b) Makes antibodies: _____

c) Part of the humoral immune system: _____

d) Part of the cell-mediated immune system: _____

e) It works with the complement proteins to destroy pathogen cells: _____

f) Has memory cells: _____

g) It requires the help of a macrophage cell to become activated to fight pathogens: _____

73) One way that we medically enhance the immune response against a specific pathogen is to inject a person with non-living antigens from the pathogen (or in some cases, a weakened but living form of the pathogen). This procedure is called a _____. The person will not become sick if they encounter the true pathogen because their immune system has already _____ (done what?).

74) Multiple sclerosis (MS) is a disease where the immune system attacks the body's own tissues. Diseases of this type are called _____ diseases. In MS, the immune system attacks the _____, which causes the speed of nerve signals to decrease.

75) List two other examples (other than multiple sclerosis) of autoimmune diseases: _____ and _____.

76) Transplanting an organ from one person to another is complicated by the fact that the recipient's immune system may "reject the organ" (mount an immune response against it). For this reason, _____ are often given to the organ recipient.

77) A(n) _____ is a excessive (tissue damaging) response by the immune system to a harmless antigen. Examples of such harmless antigens are pollen, cat hair, and dust.

78) An allergic reaction to a substance that is so severe that it becomes life threatening is called _____.

79) Anaphylactic shock occurs because so much _____ (a molecule that makes capillaries leaky) is released by _____ cells that the blood volume decreases to dangerous levels.

80) _____ is a genetic disease that produces a deficit of the immune system.

81) Acquired immune deficiency syndrome (AIDS) is a disease caused by the _____ virus. It is passed from person to person by _____, such as can occur during unprotected sex, exchanging needles, or blood transfusions.

82) AIDS disease is caused by the HIV virus killing _____ (a specific type of lymphocyte).

83) Without helper T cells, the specific immune system cannot function because B cells and killer T cells cannot _____ without the assistance of helper T cells.

84) After a person is infected with the HIV virus, they will feel healthy and still have a functioning immune system for _____ (a time period). But during this time they are still infectious and their immune system is slowly deteriorating.

Answers to fill-in-the-blank review questions:

1) Pathogens
2) Infection
3) Bacteria
   Viruses
4) Bacteria
5) Viruses
6) Antigen
7) Self antigens
   Foreign antigens
8) Foreign antigens
   Self antigens
9) Autoimmune disease
   Multiple sclerosis (for example)
10) White blood cells
   Leukocytes
11) Five
12) Neutrophils
   Eosinophils
   Basophils
   Monocytes
   Lymphocytes
13*) Granulocytes
   Agranulocytes
14*) Neutrophils
   Eosinophils
   Basophils
15*) Monocytes
   Lymphocytes
16*) Neutrophils
   Lymphocytes
17*) (a) Neutrophils, Eosinophils, Basohils
   (b) Neutrophils
   (c) Monocytes, Lymphocytes
   (d) Lymphocytes
   (e) Eosinophils
18) Phagocytosis
19) Neutrophils
   Eosinophils (circled)
   Monocytes/Macrophages
20) Do phagocytosis on pathogens
21*) 2 – 5 lobes
22*) 2 lobes
23*) Round
   kidney bean
24) Macrophages
25*) Larger
   Kidney bean
26) Histamine
27) Tissue fluid
   Blood water that leaks from capillaries
28) Lymph
29) Lymphatic system
30) Lymph nodes
   Filtered
31) Cancer
32) Thoracic duct
   Right lymphatic duct
33) 6
   5
   4
   1
   3
   2
34) Tonsils
35) Spleen
   Old RBCs
36) Peyer's patches
37) Non-specific
   Specific
38) Skin
39) Hypothalamus
   Fever
40) Inhibits bacterial growth
   Speeds the immune system actions
41) Complement proteins
42) Interferon
43) Heat
   Redness
   Swelling
   Pain
44) Basophils
   Histamine
   Leaky and dilated
   WBCs
45) Activate pain receptors
   Attract WBCs
46) Specific (or Innate) immune system
47) Lymphocytes

48) B cells
T cells
49) One
Many
50) Memory
51) A few weeks
Clonal expansion
52) Days
Memory
53) Antibodies
54) Proteins
55) B cells
56) Clonal expansion
57) Memory
58) Do
59) Agglutination
60) Two
61) Complement
62) The body's own cells
63) Humoral immune system
64) T cells
65) Macrophage
66) Clonal expansion
67) Killer T cells
Memory T cells
Helper T cells
68) Digestive enzymes
69) Memory
70) Helper T cells
71) Cell-mediated immune system
72) a) B and T
b) B
c) B
d) T
e) B
f) B and T
g) T
73) Immunization/vaccination
Done clonal expansion
74) Autoimmune diseases
Myelin sheath of neurons
75) Lupus
Rheumatoid arthritis
76) immunosuppressants
77) Allergy
78) Anaphylactic shock
79) Histamine
B cells
80) SCID
(Severe Combined
ImmunoDeficiency Disease)
81) HIV
Exchange of body fluids
82) Helper T cells
83) Clonally expand
84) Years

Short answer review questions:

1) Fill in the following table about the lymphoid organs.

Lymphoid organ:	Location in body:	Fluid it cleanses and filters:
Peyer's patches		
The spleen		
The tonsils		

2) One of the non-specific body defenses is called the inflammatory response. The inflammatory response, which occurs in an injured tissue, includes (a) making the capillaries leaky, and (b) activating pain receptors. Explain briefly how each of these two functions protects the body.

3) What is the defining difference between the specific and the non-specific immune systems?

4) You receive a flu shot (a vaccination against that year's flu virus). A few months later, you are exposed to a person with the flu. Thanks to the flu shot, your body is able to fight off the virus so quickly that you never feel ill. Explain (a) What was in the flu shot? (b) What did the flu shot change in your body that allowed you to fight off the flu virus? (c) Why do you have to get the flu shot again next year? Be as specific as possible in your answers.

5) If you are exposed to a pathogen that your body has never encountered before, the immune system makes new B and T cells. Most of the new B and T cells fight the pathogen, but some B and T cells (called memory B cells and memory T cells) do not. Explain why your body makes memory B cells and memory T cells.

6) Multiple sclerosis (MS) is an example of an autoimmune disease. In MS, the immune system attacks the myelin sheath that surrounds neurons, decreasing the efficiency of the nervous system. In lecture, we discussed other examples of autoimmune diseases. Name an autoimmune disease (other than MS) and describe what part of the body is being attacked by the immune system.

7) Patients with autoimmune diseases often treated by giving them hormones that decrease the activity of the immune system. Name the hormones that decrease the immune system's activity: _____ (You may need to review your notes on the endocrine system to answer this question). What is an unintended and dangerous side effect of lowering a patient's immune system activity to treat an autoimmune disease?

8) What is the difference between HIV and AIDS?

9) The HIV virus only destroys helper T cells, which are only a small part of all your immune cells. Explain how HIV can totally destroy the activity of the immune system by infecting only helper T cells.

10) People who die of AIDS are not killed by the HIV virus directly. What actually causes their death?

Answers to short answer review questions:

1)

Lymphoid organ:	Location in body:	Fluid it cleanses and filters:
Peyer's patches	Digestive organs	Digestive fluids
The spleen	Upper abdominal cavity	Blood
The tonsils	Upper esophagus	Saliva

2) Making the capillaries leaky allows WBCs in the blood to exit the capillary and move into the injured tissue. Activating pain receptors discourages us from using the injured organ until it has repaired itself.

3) The specific immune system mounts attacks against specific pathogen types (for example, an attack on an infection of the influenza virus). The non-specific immune system makes the body less accessible and less hospitable to pathogens in general, but it does not mount attacks against specific pathogen types.

4) (a) The flu shot contained antigens from the flu virus (or perhaps a weakened form of the virus).
(b) The flu shot caused clonal expansion of the B and T cells that are against that particular flu virus.
(c) The flu virus mutates rapidly, so the flu virus of one year is not the same as the flu virus of another year. Because the specific immune system mounts extremely specific attacks, the B and T cells that clonally expanded against this year's flu virus will not be able to attack next year's flu virus. That is why, each year, a new flu vaccination (containing antigens from the latest flu virus) must be obtained.

5) Memory B and memory T cells are made so that the immune system's response time will be much quicker if the same pathogen is ever encountered again. The immune system does not have to begin clonal expansion against the pathogen from just a few B and T cells. Large numbers of memory B and T cells against the pathogen are already present if the same pathogen invades again.

6) Rheumatoid arthritis is an autoimmune disease where the immune system attacks the articular cartilage of the joints. This eventually leads to reduced mobility of the joint and joint pain.

Another example of an autoimmune disease is lupus. The immune system attacks a wide range of connective tissue types in the body which results in a variety of symptoms, although muscle and joint pain are common among lupus victims.

7) Glucocorticoids (such as cortisone, cortisol, and prednisone) are immunosuppressant steroids. Although these drugs treat the autoimmune disease by suppressing the immune system, an unintended side effect is increased susceptibility to infection because of lowered immune system activity.

8) AIDS is a disease and HIV is the virus that causes AIDS.

9) Helper T cells are necessary for all B cells and T cells to clonally expand when activated by their foreign antigens. The destruction of helper T cells by the HIV virus therefore leaves the immune system unable to produce the large numbers of B and T cells needed to repel pathogens.

10) AIDS victims often die of infection by weak pathogens (such as the fungus *Pneumocystis jirovecii*). Weak pathogens of this sort are widespread in the environment, but people with healthy immune systems fight them off so easily that no illness occurs. AIDS victims, on the other hand, are not able to fight off pathogens and eventually succumb to the infection.