

### Review Questions for WBC counts topic

Review questions will not be collected and are not worth any points. Doing them will, however, help you prepare for the midterms and quizzes in this course. Furthermore, some of these review questions will appear on the final exam (although the numbers within the questions may be changed).

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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) Viral antigens
- B) Protein antigens
- C) Anti-antibody antigens
- D) Foreign antigens

6) The term \_\_\_\_\_ means all the white blood cell types

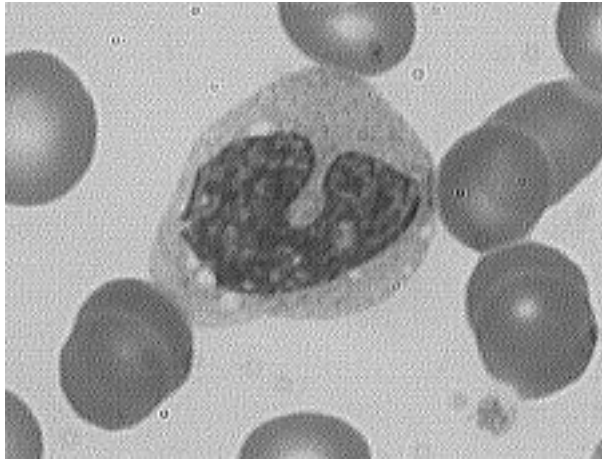
- A) Leukocyte
- B) Formed elements
- C) Lymphocyte
- D) Blood
- E) Plasma

7) How many major WBC types are there?

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

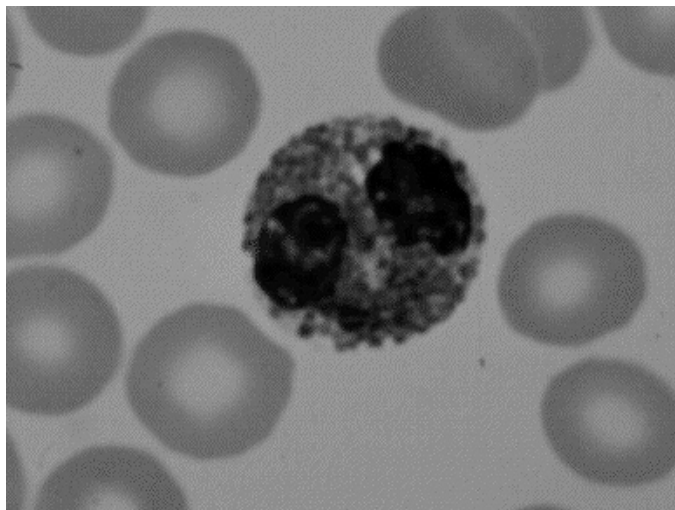
8) In lab, you identified WBC types under the microscope. What WBC type is shown on the right?

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



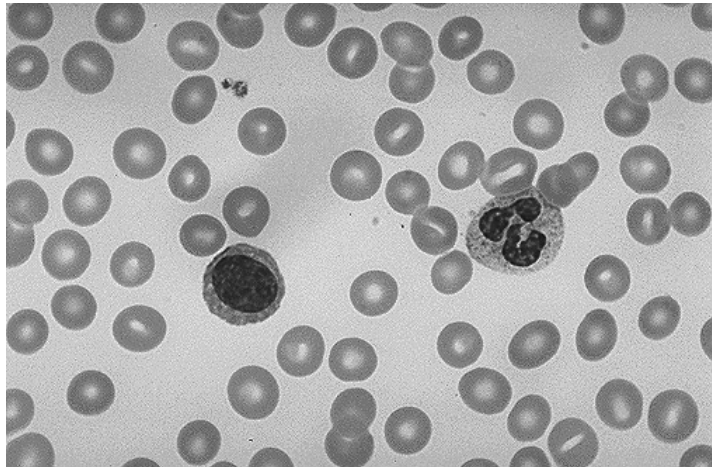
9) In lab, you identified WBC types under the microscope. What WBC type is shown on the right? Hint: It has large red granules.

- 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) The proteins that tear apart the membranes of antibody-coated pathogen cells
- A) Antibodies
  - B) T-cells
  - C) Complement
  - D) Free radicals
- 16) Which things below are lymphocytes or made by lymphocytes? (More than one correct answer).
- A) Basophil cells
  - B) B cells
  - C) Toxins
  - D) T cells
  - E) Neutrophil cells
  - F) Eosinophil cells
  - G) Platelets
  - H) Antibodies
- 17) 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) Basophils
  - E) Neutrophils
- 18) Which of the following is part of the cell-mediated immune system?
- A) B cells
  - B) Antibodies
  - C) T cells
  - D) Basophils
  - E) Neutrophils
- 19) True or false: The 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

20) 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

21) Which function is a characteristic of B cells?

- A) Releasing histamine
- B) Formation of antibodies
- C) Generating digestive enzymes for pathogen lysis
- D) Phagocytosis

22) Which is not **true** of antibodies

- A) They are found in the plasma
- B) They are part of cell-mediated immune system
- C) They are proteins
- D) They are Y-shaped

23) Antibodies

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

24) Cells linked together by antibodies are said to be

- A) Agglutinated
- B) Polymerized
- C) Macromolecules
- D) Antigens

25) 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

- 26) The normal total WBC count range for a healthy adult is
- A) 50 WBC/mm<sup>3</sup>
  - B) 80 – 120 WBC/mm<sup>3</sup>
  - C) 4 – 6 million WBC/mm<sup>3</sup>
  - D) 5000 – 10,000 WBC/mm<sup>3</sup>
- 27) Which statement about complement proteins is false?
- A) Complement proteins are present in plasma 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
- 28) Cytotoxic T cells
- A) Make antibodies
  - B) Inject pathogens with toxins
  - C) Engulf pathogens by phagocytosis
  - D) Destroy self-antigens/cause autoimmune disease cells
- 29) 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
- 30) Define these terms as they were defined in class
- a) Pathogen
  - b) Antigen (define the term and also explain the difference between self antigens and foreign antigens)
  - c) Phagocytosis
  - d) Leukocytes
  - e) Histamines
  - f) Antibody
  - g) Humoral immune system

- h) Agglutination
- i) Clonal expansion
- j) Leukocytosis
- k) Leukopenia
- l) Cell mediated immune system

31) The immune system defends the body from \_\_\_\_\_, a term that means living things that cause disease.

32) The term \_\_\_\_\_ means when pathogens have entered the body.

33) The two most common pathogen types are \_\_\_\_\_ and \_\_\_\_\_.

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

35) \_\_\_\_\_ (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.

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

37) 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 \_\_\_\_\_.

38) The cells of the immune system attack all cells that have \_\_\_\_\_ antigens, but the immune cells do not attack any cells that have \_\_\_\_\_ antigens. Rarely, however, the immune system makes a mistake and attacks the body's own cells. This is called a(n) \_\_\_\_\_ disease. List an example autoimmune disease: \_\_\_\_\_.

39) \_\_\_\_\_ are all the blood cells that are part of the immune system. These cells are also called \_\_\_\_\_.

40) There are \_\_\_\_\_ (a number) major types of white blood cells.

41) The five major types of white blood cells are: \_\_\_\_\_, \_\_\_\_\_, \_\_\_\_\_, \_\_\_\_\_, and \_\_\_\_\_.

42) 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 \_\_\_\_\_.

43) There are three types of granulocytes: \_\_\_\_\_, \_\_\_\_\_, and \_\_\_\_\_.

44) There are two types of agranulocytes: \_\_\_\_\_ and \_\_\_\_\_.

45) The two most abundant types of leukocytes are \_\_\_\_\_ are \_\_\_\_\_: the remaining three types account for 10% or less of total number of leukocytes.

46) 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: \_\_\_\_\_

47) Any molecules on cells that the immune system interacts with are called \_\_\_\_\_. They are usually proteins, carbohydrates, or lipids on the surface of a cell.

48) Molecules on cells that the immune system interacts with but does not attack (because the molecules occur naturally as part of the organism) are called \_\_\_\_\_.

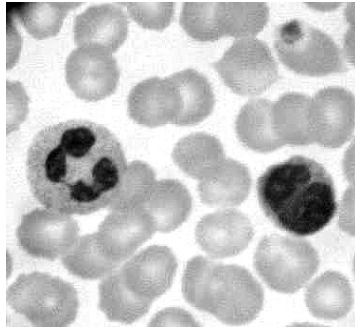
49) Molecules on cells that the immune system interacts with and attacks (because the molecules do not occur naturally as part of the organism) are called \_\_\_\_\_.



- 50) Pathogens that enter the body can be engulfed (“eaten”) by white blood cells, a process known as \_\_\_\_\_.
- 51) The three phagocytes of the immune system are \_\_\_\_\_, \_\_\_\_\_, and \_\_\_\_\_. Circle the one that does the least phagocytosis of the three.
- 52) The main function of neutrophils is \_\_\_\_\_.
- 53) Neutrophils can be recognized by their nuclei, which generally have \_\_\_\_\_ (a number range) of lobes.
- 54) Basophils can be recognized by their nuclei, which generally have \_\_\_\_\_ (a number) of lobes.
- 55) Lymphocytes can be recognized by their nuclei which are usually \_\_\_\_\_ or \_\_\_\_\_ shaped.
- 56) \_\_\_\_\_ cells, which develop from monocytes, are the most voracious of the phagocytes.
- 57) 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.
- 58) 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.
- 59) In addition to albumin protein, the blood contains large amounts of \_\_\_\_\_ which are proteins needed to protect the body from invaders, and \_\_\_\_\_ proteins which are needed for blood clotting.
- 60) Antibodies are also known as \_\_\_\_\_.
- 61) Any overabundance of white blood cells is known as \_\_\_\_\_.

62) The most common cause of leukocytosis is \_\_\_\_\_.

63) The photo below shows a blood sample when viewed through a microscope. What blood cell type are the small gray circles with nothing visible inside? \_\_\_\_\_ What cell type is the large cell on the left with the black lobed nucleus? \_\_\_\_\_ What cell type is the large cell on the right with the black round nucleus? \_\_\_\_\_ Be as specific as possible in all answers.



64) \_\_\_\_\_ refers to bone cancer that results in abnormally high levels of white blood cells. If untreated, these cancers are always fatal.

65) The \_\_\_\_\_ is a set of proteins present in the blood that, when activated, lyse pathogen cell membranes.

66) Of the five major types of white blood cells, only one type, the \_\_\_\_\_, have cells that are individually programmed to defend the body against specific pathogens.

67) The two major types of lymphocytes are \_\_\_\_\_ cells and \_\_\_\_\_ cells.

68) 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.

69) Thanks to clonal expansion of 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.

70) For the lymphocytes 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 \_\_\_\_\_.

71) Re-exposure, even years later, to a foreign 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 many B and T cells against the antigen made by clonal expansion during the first encounter with the pathogen.

72) \_\_\_\_\_ are Y-shaped molecules in the blood that bind antigens.

73) Antibodies are \_\_\_\_\_ (one of the four types of macromolecules).

74) \_\_\_\_\_ are the lymphocytes that make and secrete antibodies.

75) 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.

76) When a B-cell encounters the foreign antigen that it is programmed to fight, it begins to secrete antibodies against that antigen. The B cell that is secreting antibodies is sometimes called a \_\_\_\_\_ cell.

77) 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.

78) 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

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

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

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

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

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

84) 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 \_\_\_\_\_.

85) Some T cells are \_\_\_\_\_ T cells, which are necessary for B and T lymphocytes to undergo clonal expansion.

86) 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.

87) 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: \_\_\_\_\_

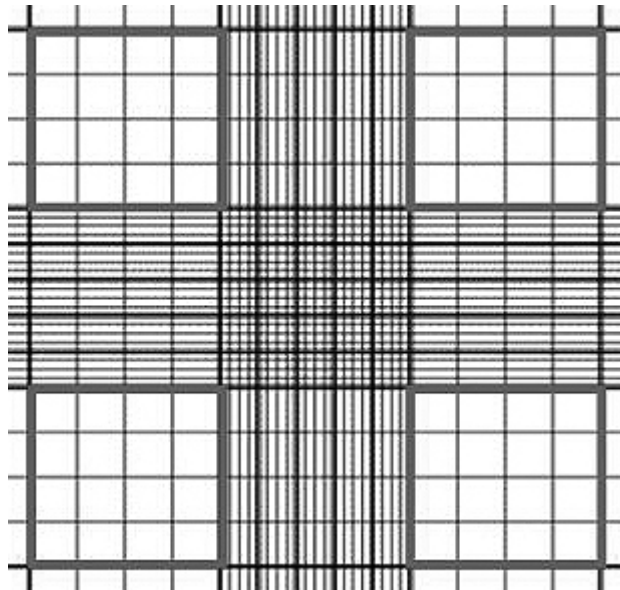
88) One way that we medically enhance the immune response against a specific pathogen is to inject a person with non-living antigens from the pathogen (or in some cases, a weakened but living form of the pathogen). This procedure is called a(n) \_\_\_\_\_. The person will not become sick if they encounter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

89) 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. Why do you have to get the flu shot again next year? Be as specific as possible in your answer.

90) Name the possible causes of leukocytosis that were mentioned in class.

91) Name the possible causes of leukopenia that were mentioned in class.

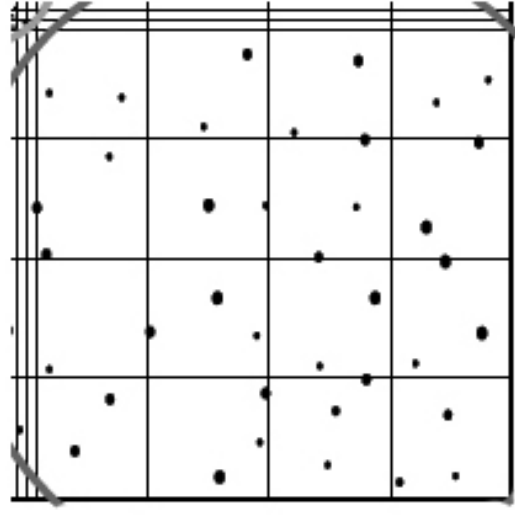
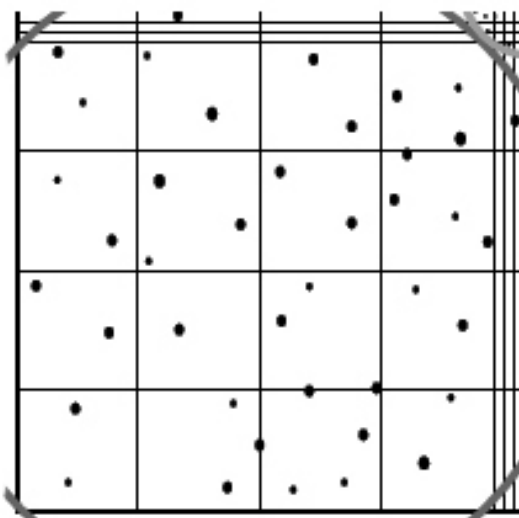
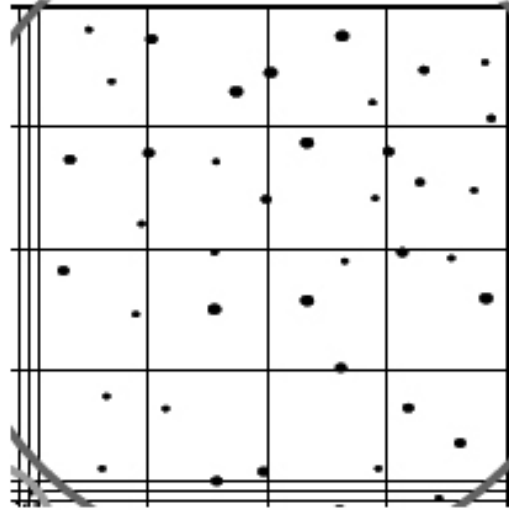
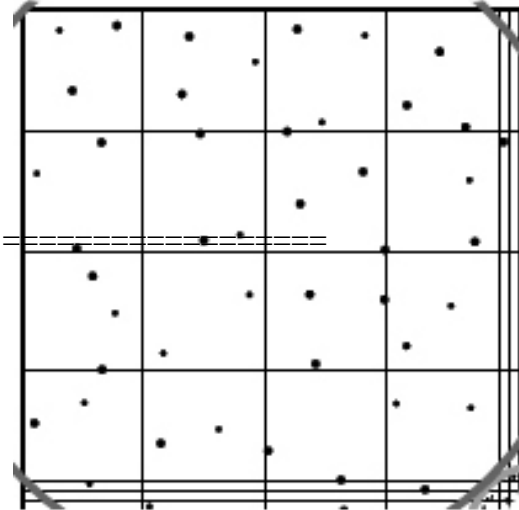
92) The figure on the right shows the entire grid on the hemocytometer. Draw an X on all square regions of the figure that you count to do a total WBC count.



93) A differential WBC count was done on a patient's blood sample. The results are shown below. Use the table of normal differential WBC count percentage values and the Clinical Applications box (both of which are in your lab manual, in exercises 6.1 and 6.2) diagnose all possible diseases that the patient might have.

Neutrophils = 56%	Eosinophils = 4%	Basophils = 1%
Monocytes = 12%	Lymphocytes = 26%	

94) Each of the four figures below shows one of the squares that were counted in a total WBC count. Using the same methods of counting and calculation that you used in lab, calculate the total WBC count for the blood sample. Be sure to include the correct units in your answer \_\_\_\_\_. Would this WBC count be within the normal range for a patient? \_\_\_\_\_. If not, does the patient have leukocytosis or leukopenia? \_\_\_\_\_.



**Answers for Review Questions for WBC Counts topic:**

1) B

2) C and D

3) A

4) C

5) D

6) A

7) B

8) A

9) B

10) C

11) D

12) A

13) D

14) B

15) C

16) B, C, D, and H

17) A and B

18) C

19) B

20) B

21) B

22) B

23) C

24) A

25) D

26) D

27) B

28) B

29) A

30) a) Any living thing that can cause disease.

b) Molecules that the immune system interacts with. Usually, these are the proteins, carbohydrates, and lipids on the surface of cells. Self antigens are the antigens that occur naturally in the body. Foreign antigens are antigens that do not occur naturally in the body.

c) One cell engulfing (eating) another cell

d) The blood cells that are part of the immune system. They are also known as white blood cells (WBCs).

e) Molecules that are released from basophil WBCs. Histamines cause the walls of capillaries to become leaky.

f) A Y-shaped protein made by B cells that binds to foreign antigens on pathogens.

g) The B cells and the antibodies they secrete.

h) Antibodies linking cells together.

i) Lymphocyte cells reproducing only when they have been exposed to the exact antigen that they are against.

j) Total WBC count above the normal range of 5000 – 10000 WBCs/mm<sup>3</sup>.

k) Total WBC count below the normal range of 5000 – 10000 WBCs/mm<sup>3</sup>.

l) The Cytotoxic T cells (also known as killer T cells)



31) Pathogens

32) Infection

33) Viruses  
Bacteria

34) Bacteria

35) Viruses

36) Antigens

37) Self antigens  
Foreign antigens

38) Foreign antigens  
Self antigens  
Autoimmune disease  
Multiple sclerosis, Lupus, or Rheumatoid arthritis

39) Leukocytes  
White blood cells (WBCs)

40) Five

41) Neutrophils  
Eosinophils  
Basophils  
Monocytes  
Lymphocytes

42) Granulocytes  
Agranulocytes

43) Neutrophils

Eosinophils

Basophils

44) Monocytes

Lymphocytes

45) Neutrophils

Lymphocytes

46) a) Neutrophils, eosinophils, and basophils

b) Neutrophils

c) Monocytes and lymphocytes

d) Lymphocytes

e) Eosinophils

47) Antigens

48) Self antigens

49) Foreign antigens

50) Phagocytosis

51) Neutrophils

Eosinophils

Macrophages (which come from monocytes)

52) Phagocytosis

53) 2 – 5 lobes

54) 2 lobes

55) Round or kidney bean shaped

56) Macrophages

57) Larger  
Kidney bean

58) Histamine

59) Antibodies  
Clotting proteins

60) Immunoglobulins

61) Leukocytosis

62) Infection

63) RBCs  
Neutrophil  
Lymphocyte

64) Leukemia

65) Complement proteins

66) Lymphocytes

67) B cells  
T cells

68) One  
Many

69) Memory

70) About two weeks  
Clonal expansion

71) A day or two

72) Antibodies

73) Proteins

74) B cells

75) Clonal expansion

76) Plasma cell

77) Do

78) Agglutination

79) Two

80) Complement

81) The body's own cells

82) Humoral immune system

83) Cytotoxic T cells

84) Toxins

85) Helper

86) Cell mediated immune system

87) a) B and T

b) B

c) B

d) T

e) B

88) Vaccination

Immunization

Clonally expanded

89) A flu shot causes clonal expansion only of the lymphocytes against the exact strain of the influenza virus that was in the vaccination. The flu that comes next year is usually a different strain of the influenza virus than the one that appeared the previous year, and therefore a new shot is needed to cause clonal expansion of the lymphocytes against the new strain of the virus.

90) Fighting an infection

Surgery/Injuries

Allergies

Leukemia

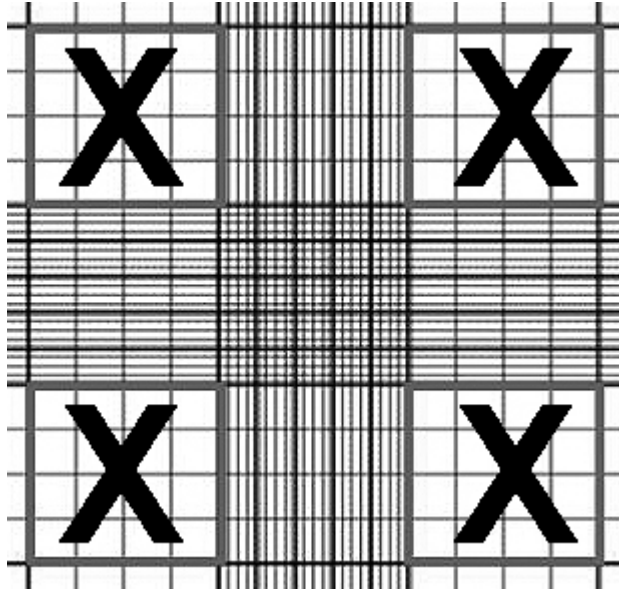
91) Certain viral infections

Autoimmune diseases

Stress

Chemotherapy

92)



93) The percentages that are given in the problem for the five major WBC types are all within their normal ranges, with the exception of the monocytes. The problem lists the patient's monocyte percentage as 12% of the WBCs, but the normal range for monocytes (according to the table in the lab manual) is 3% - 8% of the WBCs. Since the patient has a monocyte count that is above the normal percentage, the patient is said to have monocyte leukocytosis. Referring to the Clinical Applications box in the lab manual, monocyte leukocytosis can be a symptom of malaria, Rocky Mountain spotted fever, bacterial endocarditis, or typhoid fever.

94) These are the approximate counts for each of the four counting squares shown. Your counts may differ slightly from the counts given below, but they should agree within  $\pm 3$  WBCs in each square. (Remember to not count WBCs that are touching the right or bottom of each counting square).

- (a) 40      (b) 37      (c) 39      (d) 38

The WBC count is calculated by adding the four counting squares then multiplying by a factor of 50:

$$40 + 37 + 39 + 38 = 154$$

$$154 \times 50 = 7700 \text{ WBCs/mm}^3$$

A total WBC count of 7700 WBCs/mm<sup>3</sup> is within the normal range. The patient does not have leukocytosis or leucopenia.