Using Figure 10.1, identify the following:

1) The neutrophil is indicated by letter _______.
   Answer: A
   Difficulty: 1  Page Reference: 345-347

2) The eosinophil is indicated by letter _______.
   Answer: C
   Difficulty: 1  Page Reference: 345-347

3) The monocyte is indicated by letter _______.
   Answer: B
   Difficulty: 1  Page Reference: 345-347

4) The lymphocyte is indicated by letter _______.
   Answer: D
   Difficulty: 1  Page Reference: 345-347
5) The granulocytes are indicated by letters ________ and ________.
   Answer: A; C
   Diff: 2       Page Ref: 345-347

6) The most common type of leukocyte is indicated by letter ________.
   Answer: A
   Diff: 2       Page Ref: 345-347

7) The type of leukocyte that fights allergies and parasitic worms is indicated by letter
   ________.
   Answer: C
   Diff: 2       Page Ref: 345-347

Fill in the blank or provide a short answer:

8) The volume of erythrocytes within a given volume of whole blood, expressed as a
   percentage, is ________.
   Answer: hematocrit
   Diff: 1       Page Ref: 340

9) The plasma protein that contributes to the osmotic pressure of blood is ________.
   Answer: albumin
   Diff: 2       Page Ref: 342

10) The iron-containing protein found in RBCs that transports the majority of oxygen carried in
    the blood is ________.
    Answer: hemoglobin
    Diff: 2       Page Ref: 342

11) The anucleate cells that function to transport oxygen to the body’s cells are called
    ________.
    Answer: erythrocytes (RBCs)
    Diff: 1       Page Ref: 342

12) A decrease in the blood’s ability to transport oxygen is called ________.
    Answer: anemia
    Diff: 1       Page Ref: 343

13) The red blood cell disorder caused by life at a high altitude is called ________.
    Answer: polycythemia
    Diff: 2       Page Ref: 344

14) White blood cells are also called ________.
    Answer: leukocytes
    Diff: 1       Page Ref: 344

15) The movement of WBCs to areas of inflammation in response to chemical mediators is called
    ________.
    Answer: positive chemotaxis
    Diff: 2       Page Ref: 345
16) An abnormal elevation of WBCs above the normal count of 11,000 cells/mm³ is called ________.
   Answer: leukocytosis
   Diff: 2     Page Ref: 345

17) The process by which WBCs are able to easily slip in and out of blood vessels is called ________.
   Answer: diapedesis
   Diff: 2     Page Ref: 344

18) The process of blood cell formation within the red marrow of bones is called ________.
   Answer: hematopoiesis
   Diff: 3     Page Ref: 347

19) The process by which bleeding is stopped is called ________.
   Answer: hemostasis
   Diff: 1     Page Ref: 349

20) A thrombus that has broken away from a vessel wall and is freely floating in the bloodstream is called an ________.
   Answer: embolus
   Diff: 2     Page Ref: 350

21) An insufficiency of circulating platelets is called ________.
   Answer: thrombocytopenia
   Diff: 2     Page Ref: 351

22) Hereditary bleeding disorders that result from lack of clotting factors are referred to as ________.
   Answer: hemophilia
   Diff: 1     Page Ref: 351

23) Substances that the body recognizes as foreign are called ________.
   Answer: antigens
   Diff: 2     Page Ref: 351

24) The rarest blood type in the United States is type ________.
   Answer: AB
   Diff: 2     Page Ref: 353

25) Blood type A carries the ________ antigen.
   Answer: A
   Diff: 1     Page Ref: 353

26) The blood type referred to as the universal donor is called type ________.
   Answer: O
   Diff: 2     Page Ref: 353

27) A person with type B blood can receive blood from blood type(s) ________.
   Answer: B; O
   Diff: 3     Page Ref: 353
28) If you carry the Rh antigen, you are referred to as Rh _________.
Answer: positive  
Diff: 2  Page Ref: 353

29) The condition in which maternal antibodies cross the placenta and destroy the baby’s RBCs is called _________.
Answer: hemolytic disease of the newborn  
Diff: 3  Page Ref: 354

30) The condition in which fetal RBCs are destroyed faster than the infant liver can rid the body of the breakdown products of hemoglobin is called _________.
Answer: physiologic jaundice  
Diff: 2  Page Ref: 356

Multiple Choice

1) The matrix of blood is called:
   A) buffy coat  
   B) plasma  
   C) erythrocytes  
   D) lymphocytes  
   E) formed elements
Answer: B  
Diff: 1  Page Ref: 340

2) In a centrifuged blood sample, the buffy coat between the formed elements and the plasma contains:
   A) leukocytes and erythrocytes  
   B) platelets and erythrocytes  
   C) leukocytes and platelets  
   D) erythrocytes only  
   E) leukocytes only
Answer: C  
Diff: 3  Page Ref: 340

3) Which one of the following is NOT a physical characteristic of blood:
   A) sticky  
   B) opaque  
   C) sweet tasting  
   D) heavier than water  
   E) alkaline
Answer: C  
Diff: 2  Page Ref: 340
4) Which one of the following does NOT describe blood plasma:
   A) it contains plasma proteins
   B) it contains metal ions (salts)
   C) its pH is 7.35 to 7.45
   D) it contains hormones
   E) it is the color of red wine
Answer: E

5) Which one of the following formed elements is the most abundant:
   A) erythrocytes
   B) eosinophils
   C) platelets
   D) basophils
   E) lymphocytes
Answer: A

6) Erythrocytes:
   A) have lobed nuclei and cytoplasmic granules
   B) are anucleate
   C) number 4000 to 11,000 per cubic millimeter of blood
   D) can travel by diapedesis
   E) clot blood
Answer: B

7) Normal whole blood contains _________ g of hemoglobin per 100 mL.
   A) 4–8
   B) 12–18
   C) 15–20
   D) 30–35
   E) 42–48
Answer: B

8) Which of the following is not a type of red blood cell disorder?
   A) aplastic anemia
   B) sickle cell anemia
   C) pernicious anemia
   D) polycythemia
   E) leukemia
Answer: E
9) Excessive erythrocytes result in:
   A) sickle cell anemia
   B) leukocytosis
   C) polycythemia
   D) leukopenia
   E) pernicious anemia

   Answer: C
   Diff: 2    Page Ref: 344

10) There are an average of ________ WBCs per cubic millimeter of whole blood.
    A) 100-1000
    B) 4000-11,000
    C) 10,000-20,000
    D) 50,000-100,000
    E) 1 million–3 million

   Answer: B
   Diff: 3    Page Ref: 344

11) Which one of the following is NOT true of WBCs:
    A) they use diapedesis to move in and out of blood vessels
    B) they locate areas of tissue damage through chemotaxis
    C) they move by ameboid motion
    D) they account for less than 1 percent of total blood volume
    E) they initiate the clotting process

   Answer: E
   Diff: 1    Page Ref: 344–345

12) Which one of the following groups consist of granulocytes:
    A) neutrophils, eosinophils, and basophils
    B) lymphocytes and monocytes
    C) eosinophils and monocytes
    D) basophils and eosinophils
    E) neutrophils, lymphocytes, and eosinophils

   Answer: A
   Diff: 2    Page Ref: 345

13) The type of leukocytes that would increase rapidly during allergy attacks and infections of parasitic worms are:
    A) eosinophils
    B) basophils
    C) neutrophils
    D) lymphocytes
    E) monocytes

   Answer: A
   Diff: 3    Page Ref: 345
14) The most numerous white blood cells are the:
   A) lymphocytes
   B) neutrophils
   C) eosinophils
   D) monocytes
   E) basophils
   Answer: B  
   Diff: 2  Page Ref: 345

15) Which type of leukocyte contains heparin, an anticoagulant:
   A) neutrophil
   B) monocyte
   C) lymphocyte
   D) basophil
   E) eosinophil
   Answer: D  
   Diff: 3  Page Ref: 346

16) The type of leukocytes that become macrophages in the tissues are:
   A) neutrophils
   B) eosinophils
   C) basophils
   D) lymphocytes
   E) monocytes
   Answer: E  
   Diff: 3  Page Ref: 345~346

17) Platelets are fragments of multinucleate cells called:
   A) erythrocytes
   B) eosinophils
   C) basophils
   D) megakaryocytes
   E) macrophages
   Answer: D  
   Diff: 1  Page Ref: 347

18) Blood cell formation in adults occurs in all of the following EXCEPT the:
   A) flat bones of the skull
   B) flat bones of the pelvis
   C) shaft of the femur
   D) proximal epiphyses of the humerus and femur
   E) the epiphyseal plates
   Answer: C  
   Diff: 2  Page Ref: 347
19) Blood cell formation is called ________ and occurs in red bone marrow.
   A) hematopoiesis
   B) hemostasis
   C) agglutination
   D) coagulation
   E) hemolysis
   Answer: A
   Diff: 2       Page Ref: 347

20) The average functional lifespan of an RBC is:
   A) 20–30 days
   B) 50–75 days
   C) 100–120 days
   D) one year
   E) the body’s lifetime
   Answer: C
   Diff: 1       Page Ref: 347

21) An immature RBC is called a:
   A) megakaryocyte
   B) hemocytoblast
   C) reticulocyte
   D) agranulocyte
   E) granulocyte
   Answer: C
   Diff: 3       Page Ref: 347

22) The hormone that regulates the rate of erythrocyte production is called:
   A) renin
   B) leukopoietin
   C) vasopressin
   D) erythropoietin
   E) thrombopoietin
   Answer: D
   Diff: 3       Page Ref: 348

23) Megakaryocytes pinch off anucleate fragments called:
   A) granulocytes
   B) platelets
   C) agranulocytes
   D) erythrocytes
   E) neutrophils
   Answer: B
   Diff: 3       Page Ref: 347
24) The series of reactions that stop blood flow following a cut is called:
   A) homeostasis
   B) coagulation
   C) hemostasis
   D) erythropoiesis
   E) agglutination
   Answer: C
   Diff: 1     Page Ref: 349

25) Which one of the following represents the proper sequence of hemostasis:
   A) platelet plug formation, coagulation, vascular spasm
   B) vascular spasm, coagulation, platelet plug formation
   C) coagulation, vascular spasm, platelet plug formation
   D) vascular spasm, platelet plug formation, coagulation
   E) coagulation, platelet plug formation, vascular spasm
   Answer: D
   Diff: 3     Page Ref: 349

26) Which chemical is released to bring about vasoconstriction during the vascular spasm phase of hemostasis:
   A) renin
   B) erythropoietin
   C) serotonin
   D) thrombopoietin
   E) interleukin
   Answer: C
   Diff: 3     Page Ref: 349

27) Blood normally clots in approximately:
   A) 1 minute
   B) 3 to 6 minutes
   C) 5 to 10 minutes
   D) 15 minutes
   E) 30 minutes
   Answer: B
   Diff: 1     Page Ref: 350

28) Prothrombin activator converts prothrombin to:
   A) prothrombin activator
   B) thrombin
   C) fibrinogen
   D) fibrin activator
   E) serotonin
   Answer: B
   Diff: 3     Page Ref: 350
29) A _________ clot is formed during the process of hemostasis.
   A) fibrinogen  
   B) fibrin  
   C) prothrombin  
   D) thrombin  
   E) thromboplastin  
   Answer: B  
   Diff: 3  Page Ref: 350

30) A clot that breaks away from a vessel wall and circulates freely within the bloodstream is called a(n):
   A) embolus  
   B) fibrin  
   C) thromboplastin  
   D) thrombus  
   E) clotting cascade  
   Answer: A  
   Diff: 2  Page Ref: 350

31) Which of the following is a blood clotting disorder:
   A) polycythemia  
   B) hemophilia  
   C) leukocytosis  
   D) leukopenia  
   E) anemia  
   Answer: B  
   Diff: 2  Page Ref: 351

32) Bleeding disorders often result from a lack of which one of the following vitamins:
   A) vitamin B12  
   B) vitamin A  
   C) vitamin C  
   D) vitamin D  
   E) vitamin K  
   Answer: E  
   Diff: 2  Page Ref: 351

33) The ion essential for blood clotting is:
   A) sodium  
   B) calcium  
   C) iodine  
   D) potassium  
   E) hydrogen  
   Answer: B  
   Diff: 2  Page Ref: 349-350
34) The organ largely responsible for the synthesis of clotting factors is the:
   A) pancreas
   B) thyroid
   C) liver
   D) spleen
   E) kidneys
   Answer: C  
   Diff: 2  Page Ref: 351

35) Treatment of hemophilia often involves:
   A) transfusion of plasma and vitamin K supplements
   B) injections of missing clotting factors and B12 injections
   C) vitamin K supplements only
   D) transfusion of plasma or injections of missing clotting factor
   E) vitamin K supplements and B12 injections
   Answer: D  
   Diff: 3  Page Ref: 351

36) Severe shock occurs with blood loss of:
   A) over 5 percent
   B) over 10 percent
   C) over 20 percent
   D) over 30 percent
   E) over 50 percent
   Answer: D  
   Diff: 3  Page Ref: 351

37) A substance that stimulates the immune system to release antibodies:
   A) antigen
   B) antibody
   C) interleukin
   D) fibrinogen
   E) prothrombin activator
   Answer: A  
   Diff: 1  Page Ref: 351

38) The process whereby the binding of antibodies to antigens causes RBCs to clump is called:
   A) hemostasis
   B) coagulation
   C) agglutination
   D) clotting cascade
   E) hemolysis
   Answer: C  
   Diff: 2  Page Ref: 351
39) Which antigen(s) does type AB blood contain:
   A) A antigen
   B) B antigen
   C) A and B antigens
   D) sometimes A antigens, other times B antigens
   E) no antigens
Answer: C
Diff: 3 Page Ref: 353

40) The most common type of blood in the U.S. population is:
   A) A
   B) B
   C) AB
   D) O
   E) AO
Answer: D
Diff: 1 Page Ref: 353

41) The universal recipient has blood type:
   A) A
   B) B
   C) AB
   D) O
   E) ABO
Answer: C
Diff: 2 Page Ref: 353

42) ABO blood groups are based on the presence of:
   A) A antigens
   B) B antigens
   C) O antigens
   D) A and B antigens
   E) A, B, and O antigens
Answer: D
Diff: 2 Page Ref: 353

43) Which blood type(s) can a person with blood type O receive:
   A) blood type A
   B) blood type B
   C) blood type AB
   D) blood type O
   E) blood types A, B, AB, or O
Answer: D
Diff: 2 Page Ref: 353
44) The immune serum used to prevent maternal sensitization to Rh antigens is:
   A) serotonin
   B) interleukin
   C) agglutinin
   D) RhoGAM
   E) HepBlg
   Answer: D
   Diff: 2    Page Ref: 354

45) Which of these blood types carries no antigens:
   A) blood type A
   B) blood type B
   C) blood type AB
   D) blood types A, B, and AB
   E) blood type O
   Answer: E
   Diff: 3    Page Ref: 353

46) Compatibility testing for agglutination of donor RBCs by the recipients' serum is called:
   A) blood typing
   B) transfusion reaction
   C) cross matching
   D) hemolysis
   E) hemodialysis
   Answer: C
   Diff: 3    Page Ref: 354

47) Anemias appearing in old age result from all of the following EXCEPT:
   A) nutritional deficiencies
   B) drug therapy
   C) leukemia
   D) erythrocyte mutations
   E) vitamin deficiencies
   Answer: D
   Diff: 3    Page Ref: 343-344

True/False

1) Normal pH of blood is between 7.35 and 7.45.
   Answer: TRUE
   Diff: 2    Page Ref: 340

2) Blood plasma is largely water.
   Answer: TRUE
   Diff: 1    Page Ref: 340

3) The temperature of blood is slightly lower than body temperature.
   Answer: FALSE
   Diff: 1    Page Ref: 340
4) Leukocytes are more numerous in blood than erythrocytes.
   Answer: FALSE
   Diff: 2  Page Ref: 340

5) The process by which white blood cells move in and out of blood vessels is called phagocytosis.
   Answer: FALSE
   Diff: 3  Page Ref: 344

6) An abnormally low WBC count is called leukopenia.
   Answer: TRUE
   Diff: 2  Page Ref: 345

7) Basophils are the most numerous type of leukocyte.
   Answer: FALSE
   Diff: 2  Page Ref: 345

8) All formed elements arise from a common type of stem cell called a hemocytoblast.
   Answer: TRUE
   Diff: 3  Page Ref: 347

9) Normal blood volume in healthy males is 5–6 liters.
   Answer: TRUE
   Diff: 1  Page Ref: 340

10) Erythropoietin is released to stimulate platelet production in response to inadequate amounts of oxygen in the blood.
    Answer: FALSE
    Diff: 3  Page Ref: 348

11) Hemophilia is commonly called "bleeder's disease."
    Answer: TRUE
    Diff: 1  Page Ref: 351

12) A phlebotomist collects and processes blood samples for laboratory analysis.
    Answer: TRUE
    Diff: 1  Page Ref: 352

13) Blood type A will respond to a blood transfusion of blood type B with anti-B antibodies.
    Answer: TRUE
    Diff: 3  Page Ref: 353

14) Rh-related problems occur in pregnant Rh- women carrying an Rh+ baby.
    Answer: TRUE
    Diff: 2  Page Ref: 354

15) Universal donors can receive blood groups A, B, AB, and O.
    Answer: FALSE
    Diff: 1  Page Ref: 353
Matching

Match the following function with its blood cell:

1) Transports oxygen bound to hemoglobin  
   Diff: 1  Page Ref. 342
   A) eosinophils
   B) lymphocytes

2) Active phagocytes that increase rapidly during acute infection  
   Diff: 2  Page Ref. 345
   C) erythrocytes
   D) monocytes
   E) neutrophils

3) Kill parasitic worms  
   Diff: 2  Page Ref. 345
   F) basophils

4) Transport carbon dioxide  
   Diff: 1  Page Ref. 342
   G) leukocytes

5) Active phagocytes that become macrophages  
   Diff: 2  Page Ref. 345

6) Form B and T lymphocytes  
   Diff: 2  Page Ref. 345

7) Contain histamine  
   Diff: 2  Page Ref. 345

8) Increase during allergy attacks  
   Diff: 2  Page Ref. 345

9) Produce antibodies  
   Diff: 2  Page Ref. 345

10) Long-term "clean-up team"  
    Diff: 2  Page Ref. 345

1) C  2) E  3) A  4) C  5) D  6) B
7) F  8) A  9) B  10) D
Match the following blood types:

11) The blood type that has no antigens
   A) Blood type B
   B) Blood type A
   Diff: 2   Page Ref: 353

12) The blood type that possesses the A antigen only
   C) Blood type O
   D) Blood type AB
   Diff: 2   Page Ref: 353

13) The blood type that can receive blood types B and O only
   Diff: 2   Page Ref: 353

14) The blood type that forms anti-A and anti-B antibodies
   Diff: 2   Page Ref: 353

15) The blood type known as the universal donor
   Diff: 1   Page Ref: 353

16) The blood type known as the universal recipient
   Diff: 1   Page Ref: 353


Essay

1) Scott’s blood test shows that he has excess red blood cells. Identify and describe two causes of this disorder.
   Answer: Scott’s disorder is polycythemia, which results from excess numbers of erythrocytes in the blood.
   This disorder may result from:
   1. Bone marrow cancer (called polycythemia vera)
   2. Life at a high altitude where the air is thinner and less oxygen is available (called secondary polycythemia)
   Increased sluggishness of the blood results from polycythemia.
   Diff: 2   Page Ref: 344

2) Joanna has learned that she has leukocytosis. Explain this disorder to her.
   Answer: Leukocytosis is a white blood cell disorder. It results when the total WBC count is above 11,000 cells per cubic millimeter of blood. Leukocytosis generally indicates a bacterial or viral infection in the body.
   Diff: 2   Page Ref: 345
3) List and describe the structure of the two major classifications of leukocytes.
   Answer: The two major groups are the granulocytes and the agranulocytes.
   1. The granulocytes have lobed nuclei and granules in the cytoplasm.
   2. The agranulocytes lack cytoplasmic granules. Their nuclei are more normal in shape (either spherical, oval, or kidney-shaped).
   
   Diff: 1  Page Ref: 345

4) Describe the three phases of the normal blood-clotting process.
   Answer: Hemostasis involves three major phases. The first phase is platelet plug formation, in which platelets become "sticky" and cling to the site of injury. The second phase is the vascular spasm phase, in which serotonin released by the platelets causes the blood vessels to spasm and constrict, thus decreasing blood loss. The third phase is coagulation wherein thromboplastin interacts with PF3 and calcium, as well as other blood proteins, to form prothrombin activator. Prothrombin activator converts prothrombin to thrombin, which then joins with fibrinogen to form fibrin, the basis of the clot.
   
   Diff: 3  Page Ref: 349-350

5) Explain the cause, effect, and treatment of hemophilia.
   Answer: Hemophilia refers to several different hereditary bleeding disorders that can result from a lack of any of the factors needed for clotting. Hemophilia causes uncontrolled bleeding. Treatment involves transfusion of either fresh blood plasma or the specific purified clotting factor that the individual is missing.
   
   Diff: 3  Page Ref: 351

6) Describe ABO and Rh blood groups.
   Answer: The blood groups are based on the presence or absence of specific surface antigens. Blood group A has type A antigens on their RBCs, blood group B has type B antigens on their RBCs, blood group AB has both type A and type B antigens on their RBCs, and blood group O lacks either type A or type B antigens. The Rh+ blood group indicates the presence of the Rh antigens on their RBCs. Individuals belong to blood groups A, B, AB, or O, and they are also classified as either Rh+ or Rh-.
   
   Diff: 2  Page Ref: 351; 353-354

7) Explain the antigen–antibody response as it relates to blood groups.
   Answer: Antigens are surface proteins found on all cells including blood cells. In the case of blood groups, an individual’s blood type reflects the presence or absence of specific antigens. An antigen–antibody response is initiated if the individual receives a transfusion of blood containing antigens that it identifies as being "foreign." Antibodies found in a person’s blood bind to the foreign antigen, causing agglutination, or clumping. The antigen–antibody complexes clog the small blood vessels, and the foreign RBCs are lysed, releasing hemoglobin into the bloodstream. The most serious complication of a transfusion reaction is kidney failure due to blockage of the kidney tubules by the hemoglobin molecules.
   
   Diff: 3  Page Ref: 351; 353
8) Discuss hemolytic disease of the newborn (erythroblastosis fetalis).

Answer: Erythroblastosis fetalis results from Rh incompatibility between an Rh− woman and her Rh+ baby. With delivery of the first such infant, the mother’s blood becomes sensitized by the Rh+ antigens of the infant and she begins forming anti-Rh+ antibodies. With the second and subsequent pregnancies, in which the woman carries Rh+ infants, the mother’s antibodies cross the placenta and destroy the baby’s RBCs. The baby becomes anemic and hypoxic, and brain damage and death may result unless fetal transfusions are performed. Prevention of problems in future pregnancies involves treatment of the Rh− woman with RhoGAM upon the birth of her first child to prevent sensitization and anti-Rh antibody formation.