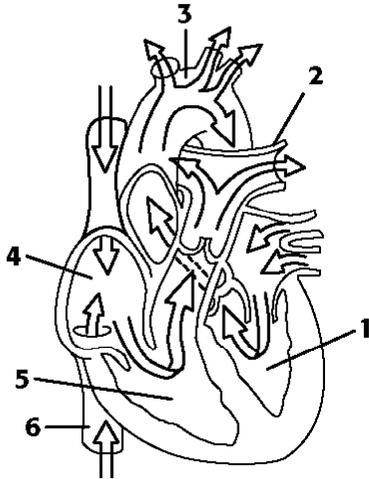


## CHAPTER 46—CIRCULATORY AND RESPIRATORY SYSTEMS

### MULTIPLE CHOICE

- The ventricles are
  - the upper chambers of the heart.
  - the chambers of the heart that pump blood to the lungs and the rest of the body.
  - the chambers of the heart that receive blood from the lungs and the rest of the body.
  - lower chambers of the heart that contract separately.

ANS: B                      DIF: 1                      OBJ: 46-1.1



- Refer to the illustration above. Structure 4 is
  - the right atrium.
  - the left atrium.
  - the right ventricle.
  - the left ventricle.

ANS: A                      DIF: 1                      OBJ: 46-1.1

- Refer to the illustration above. The aorta is structure
  - 2.
  - 3.
  - 5.
  - 6.

ANS: B                      DIF: 1                      OBJ: 46-1.1

- Refer to the illustration above. The vessels labeled “2” carry deoxygenated blood. The vessels are
  - the pulmonary arteries.
  - the pulmonary veins.
  - parts of the aorta.
  - parts of the atria.

ANS: A                      DIF: 1                      OBJ: 46-1.2

- Refer to the illustration above. Blood in chamber 1
  - is full of oxygen.
  - is going toward the lungs.
  - has a low concentration of oxygen.
  - has very little plasma.

ANS: A                      DIF: 1                      OBJ: 46-1.2

6. Vessels that carry blood away from the heart are called
- veins.
  - capillaries.
  - arteries.
  - venules.
- ANS: C                      DIF: 1                      OBJ: 46-1.3
7. The heart chamber that receives blood from the venae cavae is the
- left atrium.
  - right atrium.
  - left ventricle.
  - right ventricle.
- ANS: B                      DIF: 1                      OBJ: 46-1.2
8. Blood entering the right atrium
- is full of oxygen.
  - is returning from the lungs.
  - is deoxygenated.
  - is low in plasma and platelets.
- ANS: C                      DIF: 1                      OBJ: 46-1.2
9. Oxygenated blood from the lungs is received by the
- left ventricle.
  - right atrium.
  - left atrium.
  - right ventricle.
- ANS: C                      DIF: 1                      OBJ: 46-1.2
10. Which type of blood vessel is both strong and elastic?
- capillary
  - artery
  - vein
  - venule
- ANS: B                      DIF: 1                      OBJ: 46-1.3
11. An artery has a much thicker muscle layer than
- a vein.
  - a capillary.
  - a venule.
  - All of the above
- ANS: D                      DIF: 1                      OBJ: 46-1.3
12. The smallest and most numerous blood vessels in the body are the
- venules.
  - veins.
  - arteries.
  - capillaries.
- ANS: D                      DIF: 1                      OBJ: 46-1.3
13. An artery
- usually carries oxygen-rich blood.
  - has thin, slightly elastic walls.
  - has valves that prevent blood from flowing backward.
  - All of the above
- ANS: A                      DIF: 1                      OBJ: 46-1.3
14. If a blood vessel has valves, it is probably
- a vein.
  - an artery.
  - a venule.
  - part of the lymphatic system.
- ANS: A                      DIF: 1                      OBJ: 46-1.3

15. The force exerted against the arterial walls when the heart contracts is called
- hypertension.
  - systolic pressure.
  - diastolic pressure.
  - arterial relaxation.

ANS: B                      DIF: 1                      OBJ: 46-1.3

16. Normal blood pressure in millimeters of mercury is
- 145/95 for males and 135/85 for females.
  - 130/100 for both males and females.
  - 120/80 for males and 110/70 for females.
  - 100/50 for males and 120/70 for females.

ANS: C                      DIF: 1                      OBJ: 46-1.3

17. The pressure exerted on the inner walls of the arteries when the heart relaxes between beats is the \_\_\_\_\_ pressure.
- systolic.
  - diastolic.
  - barometric.
  - residual.

ANS: B                      DIF: 1                      OBJ: 46-1.3

18. Pulmonary circulation is the flow of blood to and from the
- stomach.
  - liver.
  - intestines.
  - lungs.

ANS: D                      DIF: 1                      OBJ: 46-1.4

19. Atherosclerosis is characterized by
- increased circulation to the heart.
  - larger muscles.
  - a narrowing of the inner walls of coronary arteries due to buildup of fatty materials.
  - a widening of inner walls of blood vessels as a result of a heart attack.

ANS: C                      DIF: 1                      OBJ: 46-1.4

20. cholesterol buildup : atherosclerosis ::
- iron buildup : atherosclerosis
  - arteriosclerosis : the heart to work more easily
  - low intake of saturated fats : heart attacks
  - atherosclerosis : heart attacks

ANS: D                      DIF: 2                      OBJ: 46-1.4

21. The iron-containing molecule in red blood cells is called
- plasma.
  - ferric oxide.
  - hemoglobin.
  - carbonic acid.

ANS: C                      DIF: 1                      OBJ: 46-2.1

22. Mature red blood cells
- can live for about a year.
  - are the largest cells in the blood.
  - promote clotting.
  - do not have a nucleus.

ANS: D                      DIF: 1                      OBJ: 46-2.2

23. Infections generally result in an increase in the number of
- a. leukocytes.
  - b. erythrocytes.
  - c. platelets.
  - d. alveoli.

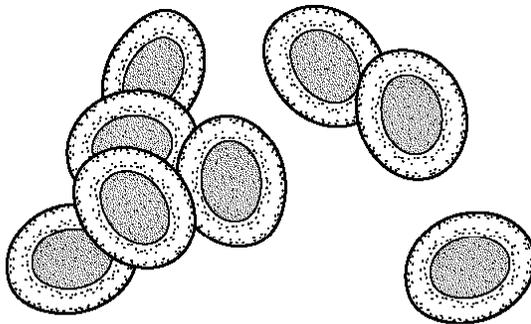
ANS: A                      DIF: 1                      OBJ: 46-2.2

24. Red blood cells
- a. transport respiratory gases.
  - b. combat bacterial infection.
  - c. destroy viruses.
  - d. transport cholesterol.

ANS: A                      DIF: 1                      OBJ: 46-2.2

25. Defending the body against bacterial infection and invasion by foreign substances is a function of
- a. red blood cells.
  - b. plasma.
  - c. platelets.
  - d. white blood cells.

ANS: D                      DIF: 1                      OBJ: 46-2.2



26. Refer to the illustration above. These cells are
- a. filled with plasma.
  - b. platelets.
  - c. red blood cells.
  - d. white blood cells.

ANS: C                      DIF: 1                      OBJ: 46-2.2

27. Refer to the illustration above. These cells
- a. can live for at least a year.
  - b. are the largest cells in the circulatory system.
  - c. promote clotting.
  - d. contain hemoglobin.

ANS: D                      DIF: 1                      OBJ: 46-2.2

28. nutrients, salts, and proteins : plasma solutes ::
- a. arteries and veins : lymphatic vessels
  - b. erythrocytes and leukocytes : blood cells
  - c. platelets and megakaryocytes : leukocytes
  - d. lymphocytes and macrophages : erythrocytes

ANS: B                      DIF: 2                      OBJ: 46-2.2

29. An abnormality involving the platelets would probably affect the process of
- a. breathing.
  - b. locomotion.
  - c. fighting bacterial infections.
  - d. blood clotting.

ANS: D                      DIF: 1                      OBJ: 46-2.3

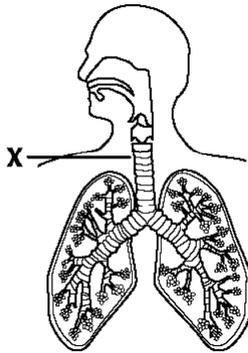
30. Which of the following is *not* involved in the formation of blood clots?
- a. platelet congregation at the site of rupture of a blood vessel
  - b. release of clotting factors from platelets
  - c. production of fibrin, a protein
  - d. formation of fibrin–red blood cell complexes that circulate in the blood and are too large to move through ruptured blood-vessel walls

ANS: D                      DIF: 1                      OBJ: 46-2.3

31. A person with antigen A on their red blood cells can give blood to someone with blood type(s)
- a. A and AB.
  - b. B and AB.
  - c. only AB.
  - d. only O.

ANS: A                      DIF: 1                      OBJ: 46-2.4

32.



Refer to the illustration above. The structure labeled “X” is the

- a. epiglottis.
- b. pharynx.
- c. trachea.
- d. larynx.

ANS: C                      DIF: 1                      OBJ: 46-3.2

33. During swallowing, the air passageway of the pharynx is covered by the
- a. larynx.
  - b. epiglottis.
  - c. trachea.
  - d. bronchi.

ANS: B                      DIF: 1                      OBJ: 46-3.2

34. Alveoli in the lungs are connected to the bronchi by a network of tiny tubes called
- a. arterioles.
  - b. venules.
  - c. capillaries.
  - d. bronchioles.

ANS: D                      DIF: 1                      OBJ: 46-3.2

35. bronchiole : alveoli ::  
 a. alveoli : bronchi  
 b. bronchi : larynx  
 c. larynx : pharynx  
 d. bronchi : bronchioles  
 ANS: D                    DIF: 2                    OBJ: 46-3.2
36. The actual exchange of gases occurs at the site of the  
 a. trachea.  
 b. nasal passageway.  
 c. larynx.  
 d. alveoli.  
 ANS: D                    DIF: 1                    OBJ: 46-3.3
37. Each alveolus  
 a. contains many air sacs.  
 b. attaches directly to the larynx.  
 c. is surrounded by capillaries.  
 d. is a large air sac.  
 ANS: C                    DIF: 1                    OBJ: 46-3.3
38. Gas exchange occurs when  
 a. oxygen in the alveoli diffuses into the blood in the capillaries.  
 b. oxygen binds with hemoglobin in the red blood cells.  
 c. the red blood cells give up oxygen to the cells of the body tissues.  
 d. All of the above  
 ANS: D                    DIF: 1                    OBJ: 46-3.3
39. carbon dioxide : lungs ::  
 a. nutrients : kidneys  
 b. nutrients : lungs  
 c. nitrogenous waste : kidneys  
 d. nitrogenous waste : lungs  
 ANS: C                    DIF: 2                    OBJ: 46-3.3
40. Carbon dioxide is transported in the blood in all of the following ways *except*  
 a. dissolved in plasma.  
 b. combined with hemoglobin.  
 c. as bicarbonate ions.  
 d. by white blood cells.  
 ANS: D                    DIF: 1                    OBJ: 46-3.3
41. When the diaphragm and rib cage muscles relax,  
 a. the chest cavity enlarges.  
 b. inspiration occurs.  
 c. expiration occurs.  
 d. it is impossible to breathe.  
 ANS: C                    DIF: 1                    OBJ: 46-3.4
42. The dome-shaped muscle below the chest cavity is called the  
 a. soleus.  
 b. biceps.  
 c. diaphragm.  
 d. popliteus.  
 ANS: C                    DIF: 1                    OBJ: 46-3.4

43. Which of the following occurs as air rushes into the lungs from the environment to equalize air pressure?
- a. inspiration
  - b. contraction
  - c. expiration
  - d. None of the above

ANS: A                      DIF: 1                      OBJ: 46-3.4

44. The breathing center in the brain is most sensitive to the
- a. concentration of oxygen.
  - b. concentration of carbon dioxide in the lungs.
  - c. concentration of carbon dioxide in the blood.
  - d. amount of oxygen in the cells.

ANS: C                      DIF: 2                      OBJ: 46-3.5

### COMPLETION

1. The \_\_\_\_\_ system transports oxygen, carbon dioxide, food molecules, hormones, and other material to and from the cells of the body.

ANS: circulatory

DIF: 1                      OBJ: 46-1.5

2. The \_\_\_\_\_ valve prevents blood from going from the left ventricle to the left atrium.

ANS:  
mitral  
bicuspid

DIF: 1                      OBJ: 46-1.1

3. Electrical impulses in the heart are relayed to the ventricles by the \_\_\_\_\_.

ANS: atrioventricular node

DIF: 1                      OBJ: 46-1.2

4. Blood flows from the right atrium to the right ventricle through the \_\_\_\_\_.

ANS: tricuspid valve

DIF: 1                      OBJ: 46-1.1

5. \_\_\_\_\_ are the blood vessels that connect the arteries to the veins.

ANS: Capillaries

DIF: 1                      OBJ: 46-1.3

6. Systolic pressure is caused by contraction of the heart's \_\_\_\_\_.

ANS: ventricles

DIF: 1                    OBJ: 46-1.3

7. The condition that results when blood pressure is consistently higher than normal is called high blood pressure or \_\_\_\_\_.

ANS: hypertension

DIF: 1                    OBJ: 46-1.3

8. The flow of blood from the heart to all parts of the body except the lungs is called \_\_\_\_\_ circulation.

ANS: systemic

DIF: 1                    OBJ: 46-1.4

9. Excess fluid in the body's tissues is returned to the blood by a system of vessels called the \_\_\_\_\_ system.

ANS: lymphatic

DIF: 1                    OBJ: 46-1.5

10. The major function of \_\_\_\_\_ is to assist in the blood clotting process.

ANS: platelets

DIF: 1                    OBJ: 46-2.1

11. The primary role of hemoglobin in the blood is to carry \_\_\_\_\_.

ANS: oxygen

DIF: 1                    OBJ: 46-2.1

12. Red blood cells are called \_\_\_\_\_.

ANS: erythrocytes

DIF: 1                    OBJ: 46-2.2

13. Defending the body against bacterial infection and invasion by other foreign substances is the function of \_\_\_\_\_ blood cells.

ANS: white

DIF: 1                    OBJ: 46-2.2

14. Antigens determining blood type are carried on the surface of \_\_\_\_\_.

ANS:  
erythrocytes  
red blood cells

DIF: 1                    OBJ: 46-2.4

15. The \_\_\_\_\_ is a long, straight tube that carries air from the back of the throat to the lungs.

ANS: trachea

DIF: 1                    OBJ: 46-3.2

16. When you swallow, the \_\_\_\_\_ prevents food from entering the trachea.

ANS: epiglottis

DIF: 1                    OBJ: 46-3.2

17. Hemoglobin in red blood cells binds to both oxygen and \_\_\_\_\_.

ANS: carbon dioxide

DIF: 1                    OBJ: 46-3.3

18. When the diaphragm and the rib muscles contract, enlarging the chest cavity, \_\_\_\_\_ occurs.

ANS: inspiration

DIF: 1                    OBJ: 46-3.4

19. Breathing is regulated mainly by response to the level of \_\_\_\_\_ detected in the blood.

ANS: carbon dioxide

DIF: 1                    OBJ: 46-3.5

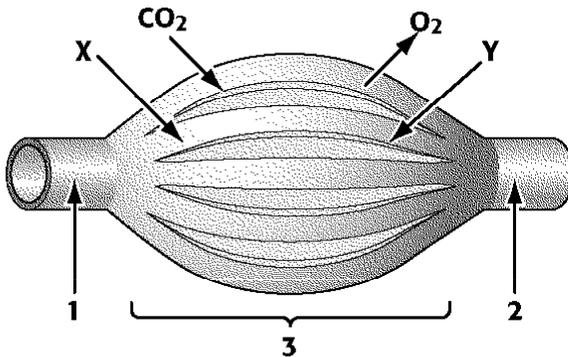
20. \_\_\_\_\_ respiration is the exchange of gases between the atmosphere and the blood, while \_\_\_\_\_ respiration is the exchange of gases between the blood and the cells of the body.

ANS: External, internal

DIF: 1                    OBJ: 46-3.1

## PROBLEM

1.



The diagram above shows two human blood vessels, 1 and 2, connected by a capillary bed, 3. Blood pressure is higher in vessel 2 than in vessel 1. The arrows indicate the direction of diffusion of  $\text{O}_2$  and  $\text{CO}_2$ . Write your answers to the following in the spaces below.

- What type of blood vessel is vessel 1?
- What type of blood vessel is vessel 2?
- Does this diagram show part of the systemic circuit or part of the pulmonary circuit of the human circulatory system?
- In which location, X or Y, will the concentration of  $\text{O}_2$  in the blood be higher?
- Name one other substance typically found in blood that would move out of a capillary bed into body tissues along with the  $\text{O}_2$  shown in the diagram.
- Name one other substance typically found in blood that would move into a capillary bed from body tissues along with the  $\text{CO}_2$  shown in the diagram.

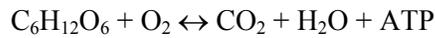
ANS:

- vein
- artery
- systemic circuit
- Y
- possible answers: food molecule, water, vitamin, ion, hormone, or white blood cell
- possible answers: wastes or ammonia

DIF: 3

OBJ: 46-1.3

2. Every living cell in the human body must have an energy supply. Cells take up glucose or a related chemical and break it down inside the mitochondria to get ATP. ATP is the form of energy that cells use for their various activities. The breakdown of glucose occurs in the process of aerobic respiration. A summary of this process is shown in the following equation (note that this is not a balanced equation):



O<sub>2</sub>, which is a gas, is consumed in this process, and CO<sub>2</sub>, also a gas, is produced. Trace the pathway of a molecule of O<sub>2</sub> from the location where it enters the human body, across any cell membranes it must pass, until it reaches a muscle cell in the right leg. Then, trace the pathway of a molecule of CO<sub>2</sub> from inside that muscle cell, where it is produced in aerobic respiration, until it leaves the body. Write your answer in the space below or on a separate sheet of paper.

ANS:

The O<sub>2</sub> molecule would enter the body through one of the nostrils, pass through the pharynx, the trachea, and one of the two bronchi, and then enter a bronchiole in the lung. It would then move into an alveolus and then move across a cell membrane of the alveolus and enter the blood. Once in the blood, the O<sub>2</sub> would move across the cell membrane into a red blood cell. It would then be transported through the pulmonary vein, which takes blood from the lungs to the heart. The O<sub>2</sub> in the blood would enter the heart in the left atrium, move to the left ventricle, and then be forced out of the heart into the aorta. The O<sub>2</sub> in the blood would then be transported into smaller arteries, still smaller arterioles, and finally a capillary bed in the muscle in the right leg. The O<sub>2</sub> would then move out of the red blood cell across its cell membrane, and would enter a muscle cell across that cell's membrane. A CO<sub>2</sub> molecule produced by aerobic respiration in this muscle cell would leave the cell by moving across the cell membrane and would enter the blood. In the blood, it might move across the cell membrane of a red blood cell and remain in its cytoplasm. (Alternately, the CO<sub>2</sub> might dissolve in the plasma or combine with water to form bicarbonate ions.) The CO<sub>2</sub> in blood would then be transported into venules, and then into veins, until it returned to the vena cava. From the vena cava, it would reenter the heart. The CO<sub>2</sub> in blood would enter the right atrium of the heart, move to the right ventricle, and then be forced out of the heart into the pulmonary artery. From there, it would be transported to one of the lungs. In a lung, the CO<sub>2</sub> would move out of the red blood cell by moving across its cell membrane. It would then move across a cell membrane of an alveolus. From the alveolus, the CO<sub>2</sub> would pass through a bronchiole, a bronchus, the trachea, and the pharynx, and would then leave the body through one of the nostrils.

DIF: 3

OBJ: 46-3.3

## ESSAY

1. Do arteries carry oxygenated blood or deoxygenated blood? Explain. Write your answer in the space below.

ANS:

An artery is a blood vessel that carries blood away from the heart. Most arteries carry oxygenated blood from the heart to the rest of the body, but some arteries—the pulmonary arteries, which carry blood from the heart to the lungs—carry deoxygenated blood that has been returned to the heart from the rest of the body.

DIF: 2

OBJ: 46-1.2

2. Describe the antibody-antigen interactions that take place when an Rh<sup>-</sup> person who has blood type B receives blood from an Rh<sup>+</sup> person who has blood type AB. Write your answer in the space below.

ANS:

An Rh<sup>-</sup> person who has blood type B has only blood antigen B. A person having this antigen would produce antibodies to antigens A and Rh. An Rh<sup>+</sup> person who has blood type AB has blood antigens Rh, A, and B. When these antigens enter the recipient's blood, antibodies to the A and Rh will produce agglutination. The B antigen of the donor's blood will not cause agglutination because the recipient does not produce antibodies to this antigen.

DIF: 2                      OBJ: 46-2.4

3. Describe how oxygen is transported in the blood. Write your answer in the space below.

ANS:

Red blood cells are filled with hemoglobin, which is an iron-containing protein that gives blood its red color. Oxygen easily binds to the hemoglobin, making red blood cells efficient oxygen carriers that circulate throughout the body as they flow with the plasma.

DIF: 1                      OBJ: 46-3.3

4. Carbon dioxide (CO<sub>2</sub>) dissolves poorly in plasma. Although it can bind to hemoglobin, the ability of red blood cells to transport it on hemoglobin is limited. Thus, 70 percent of the CO<sub>2</sub> that leaves the body is carried out in a third way. Explain what happens. Write your answer in the space below.

ANS:

The remaining 70 percent combines with water in the blood to form carbonic acid (H<sub>2</sub>CO<sub>3</sub>) inside red blood cells. Because carbonic acid is unstable, hydrogen (H<sup>+</sup>) and bicarbonate (HCO<sub>3</sub><sup>-</sup>) ions quickly form, and the CO<sub>2</sub> is transported through the blood in the form of bicarbonate ions. When the blood reaches the lungs, chemical reactions that reverse the process occur, releasing carbon dioxide. The carbon dioxide diffuses from the blood into the alveoli in the lungs. It is then exhaled with water vapor.

DIF: 2                      OBJ: 46-3.3

5. How is air moved in and out of the lungs? Write your answer in the space below.

ANS:

When the diaphragm and rib muscles contract, the diaphragm moves downward and the rib cage moves up and outward. This expands the chest cavity, lowering the air pressure in the lungs and causing air to flow in. When the diaphragm and the rib muscles relax, the diaphragm moves upward and the rib cage moves down and inward. This reduces the size of the chest cavity, increasing the pressure of the air in the lungs and causing air to flow out.

DIF: 1                      OBJ: 46-3.4