2. Organs of a closed circulatory system:
   A. Have valves
   B. Regulate blood flow
   C. Lead to heart
   D. Contains atria and ventricles
   E. Smaller than arteries (next size smaller)
   F. Leads away from the heart
   G. 2, 3 or 4 chambers depending on organism
   H. Larger than capillaries (next size larger)
   I. Exchange gases, food and waste materials
   J. Microscopic blood vessels
   K. Can shut down and send blood to where needed
   L. Usually found more on surface of body

3. List the number and types of chambers in a mammal heart _________________________

4. What is the advantage of the 4 chambered heart in mammals? ______________________
____________________________________________________________________

5. A 4 chambered heart allows _________________ to regulate their body temperature
   because more _______________ is produced during _______________________________.

6. Mammals have a higher ______________ demand because their ________________ is higher.

7. The heart is located under the ______________ and is surrounded by the ______________.

8. The atria _______________ blood; the ventricles ________________ blood.

9. What is the cardiac cycle? _________________________________________________

10. Define systole __________________________________________________________
    Define diastole _________________________________________________________

11. In a blood pressure of 120/80, which number represents the systolic pressure? _________
    Which number represents the diastolic pressure? __________

12. The atrioventricular (A-V) valve(s) is/are located:
    a. between the right atrium and ventricle
    b. between the left atrium and ventricle
    c. where the pulmonary artery leaves right ventricle
    d. where the aorta leaves the left ventricle
    e. both a and b
    f. both c and d
13. The semilunar valve(s) is/are located:
   a. between the right atrium and ventricle
   b. between the left atrium and ventricle
   c. where the pulmonary artery leaves right ventricle
   d. where the aorta leaves the left ventricle
   e. both a and b
   f. both c and d

14. What is the function of a valve? ___________________________________________

15. What happens when someone has a heart murmur? ___________________________

16. Heart rate (beats/min) \times \text{stroke volume (vol/beat)} = __________________(vol/min)

17. The sinoatrial (S-A) node is also called the ________________ of the heart because it
   ____________________________________________________________________________.

18. The S-A node generates electrical impulses and initiates contraction of the __________. 
   The electrical impulse moves to the __________________________ and completes atrial 
   contraction. The electrical impulse moves to the Bundle of His which divides and sends the 
   impulse to the right and left bundle branches and Purkinje fibers causing the __________ 
   to contract.

19. Indicate the location of the S-A and A-V nodes:
   S-A ____________________________  A-V _______________________________

20. What records the electrical activity of the heart? _______________________________

21. The heart rate set by the S-A node can be influenced by ________________________ .

22. Rate change in heart:
   _____ A. Increases heart rate when frightened       a. Body temperature
   _____ B. Nerves that speed up heart rate            b. Epinephrine
   _____ C. Increase of 1°C increases heart rate 10 bpm c. Parasympathetic
   _____ D. Nerves that lower heart rate               d. Sympathetic

Use the following blood vessel choices to answer questions 23 - 29.
   a. artery   b. arteriole   c. capillary   d. venule   e. vein

23. Which has the most surface area and the slowest blood flow?_______

24. Which two vessels lead into and away from capillaries?___________

25. Which has precapillary sphincters?_______

26. Which has a high pressure and rapid blood flow?_______

27. Which has valves?_______

28. Which one is squeezed by muscles to help move the blood?_______

29. A bruise is an injury to a collection of which blood vessels?_______
30. Electrical activity in the heart. (1) Label the nodes and specialized muscle fibers (underlined). (2) Add arrows to indicate the direction the impulse is spreading.

1. Sinoatrial node initiates contraction of both atria.
2. Electrical impulse moves to atrioventricular node and completes atrial contraction.
3. Electrical impulse moves to Bundle of His which divides and
4. sends impulse to right and left bundle branches.
5. Electrical impulse travels to Purkinje fibers and both ventricles contract.

Diagram modified from:
http://www.southalabama.edu/biology/shardo/oly152/cardiovascular/heart_electric_nonav.html
31. In which arteries can a pulse be detected? __________________________________________________________________________
   What is measured by a pulse? __________________________________________________________________________
32. Contraction of smooth muscles in which blood vessel increases blood pressure in the arteries? ______________
33. Blood pressure is higher in ________________ and lower in ____________________ .
34. Blood pressure is the ________________ force that blood puts on vessel walls and is greatest at the ________________ end of capillaries. It forces ____________ and ____________ through clefts in capillaries to interstitial fluid.
35. About ________ of the fluid reenters by ________________ near the ________________.
36. The remaining fluid goes to the ________________ system which drains into the ________________ system at the ________________ vein.
37. Flow of blood. Label the vessels and heart structures (underlined words) involved in flow of blood. Draw blue arrows to show flow of deoxygenated blood. Draw red arrows to show flow of oxygenated blood. *(If you don’t have these colors, provide the key to your color scheme.)*

1. Blood comes from the upper and lower body tissues via capillaries. (Blood has ↓O₂, ↑CO₂)
2. Blood goes to venules.
3. Blood from the upper body goes to the superior vena cava and from the lower body to the inferior vena cava.
4. Blood enters the right atrium.
5. Blood enters the right ventricle through the right atrioventricular valve.
6. Blood enters the right and left pulmonary arteries through the semilunar valve.
7. Blood goes to the lungs and capillary beds. It gets oxygenated and CO₂ is released.
8. Blood returns to the heart via right and left pulmonary veins.
10. Blood enters left ventricle through the left atrioventricular valve.
11. Blood enters the aorta through the semilunar valve.
12. Blood goes to the arteries.
13. Blood goes to the arterioles.
14. Blood enters capillary beds in the upper and lower body tissues. (Blood has ↑O₂, ↓CO₂) Oxygen is diffused into the tissues and CO₂ is removed from the tissues.
38. Which sequence most accurately describes a sequence of blood flow?______
   a. right atrium → right ventricle → pulmonary artery
   b. right atrium → left atrium → left ventricle → aorta
   c. left atrium → left ventricle → pulmonary artery
   d. left ventricle → left atrium → aorta
   e. right atrium → right ventricle → aorta

39. Which sequence most accurately describes a sequence of blood flow?______
   a. pulmonary vein → pulmonary artery → right atrium
   b. pulmonary artery → left atrium → left ventricle
   c. pulmonary artery → pulmonary capillaries → pulmonary vein → left atrium
   d. left ventricle → aorta → pulmonary artery
   e. pulmonary artery → pulmonary capillaries → pulmonary vein → right atrium

40. Blood Clotting Mechanism
   ___________________________ (from injury) release ___________________________
   (enzyme; activator) which combines with ___________________________
   (produced by liver; inactive) + ___________________________ + vitamin K
   (normal plasma constituent; inactive)
   forming ___________________________ (enzyme; active) which reacts with
   ___________________________ (blood protein produced by liver; inactive) forming
   ___________________________ (thread-like material that catches RBCs and forms clot; active).

41. Cardiovascular Disease

   |   | A. Clot in blood vessel in brain              | a. Myocardial infarction |
   |   | B. Plaque deposits on inner walls of arteries | b. Fibrillation          |
   |   | C. Blockage in heart artery                   | c. Stroke                |
   |   | D. Silent killer; promotes atherosclerosis    | d. Hemorrhagic stroke    |
   |   | E. Ruptured blood vessel in brain             | e. Atherosclerosis       |
   |   | F. Hardened plaque deposits in artery walls   | f. Arteriosclerosis      |
   |   | G. Heart quivers during MI; no blood pumped  | g. Angina pectoris       |
   |   | H. Symptom of atherosclerosis and arteriosclerosis | h. Hypertension |
42. Whole Blood

**COMPONENTS OF WHOLE BLOOD**

**PLASMA**
- Pos. Ions
  - Potassium
  - Sodium
  - Magnesium
- Neg. Ions
  - Chloride
  - Bicarbonate
  - Phosphate
- Buffering
- Viscosity
- Osmotic potential
- Antibody production
- Escorts for lipids
- Blood clotting
- Antibody production
- Osmotic potential
- Urea

**CELLULAR ELEMENTS**
- Biconcave
  - No nucleus
  - Life span 3-4 mos
  - No mitochondria
- Produced in bone marrow at ends of long bones
- Oxygen transport (in hemoglobin - iron containing protein)
- Amoeboid movement
  - Often outside of circ. system
- Phagocytosis of bacteria and debris
- Allergic reactions
- Immune response

**Other Substances**
- Sugars
- Amino acids
- Fatty acids
- Glycerol
- Cholesterol
- Homocysteine
- CO₂
- N

**Selected Substances**
- Urea
- Amino acids
- Fatty acids
- Glycerol
- Cholesterol
- Homocysteine
- CO₂
- N
Answer Key

2. (A) e;  (B) a;  (C) e;  (D) d;  (E) a;  (F) b;  (G) d;  (H) f;  (I) c;  (J) c;  (K) a;  (L) e

3. 2 atria, 2 ventricles

4. no mixing of oxygenated and unoxygenated blood; more efficient in sending oxygenated blood to body tissues

5. endotherms; heat; cellular respiration

6. oxygen; metabolism

7. sternum; pericardium

8. collect; pump

9. alternating sequence - filling atria with blood and pumping blood from ventricles

10. systole - contraction of heart; diastole - relaxation of heart

11. 120 - systolic pressure; 80 - diastolic pressure

12. e

13. f

14. prevents back flow of blood

15. valves are not closing properly; blood is flowing back

16. cardiac output

17. pacemaker; sets contraction rate

18. atria; atrioventricular node; ventricles

19. S-A - wall of right atrium; A-V - wall between right atrium and right ventricle

20. electrocardiogram

21. nerves, hormones, body temperature

22. (A) b;  (B) d;  (C) a;  (D) c

23. c

24. b, d

25. b

26. a

27. e

28. e

29. c

30. see next page

31. carotid arteries in neck and radial arteries in wrists; heart rate

32. arterioles

33. arteries; veins

34. hydrostatic; arteriole; water; solutes

35. 85%; osmosis; venule

36. lymphatic; circulatory; subclavian

37. see next page

38. a

39. c
40. **Platelets and damaged cells** (from injury) release **thromboplastin** (enzyme; activator) Which combines with **prothrombin** (produced by liver; inactive) + **calcium** + **vitamin K** (normal plasma constituent; inactive) forming **thrombin** (enzyme; active) which reacts with **fibrinogen** (blood protein produced by liver; inactive) forming **fibrin** (thread-like material that catches RBCs and forms clot; active).

41. (A) c; (B) e; (C) a; (D) h; (E) d; (F) f; (G) b; (H) g

30. Heart electrical activity

![Diagram of heart electrical activity](http://www.southalabama.edu/biology/sharedby152/cardiovascularheart_electric_normal.png)

37. Heart and blood circulation

![Diagram of heart and blood circulation](http://www.sci.etsu.edu/Faculty/Paul_Paolin/physlecture20/3d/005.htm)

**NOTE:** Questions 38-39 are taken from *Biology*, 5th ed., Solomon, Berg and Martin, 1999, pg. 927
COMPONENTS OF WHOLE BLOOD

PLASMA

Electrolytes
- POS. IONS
  - Potassium
  - Sodium
  - Magnesium
- NEG. IONS
  - Chloride
  - Bicarbonate
  - Phosphate

Buffering
- Viscosity
- Osmotic potential

Other Substances
- Plasma Proteins
  - Albumin
  - Immunoglobulins
  - Lipoproteins
  - Prothrombin
  - Fibrinogen

- Organic Nutrients
  - Sugars
  - Amino acids
  - Fatty acids
  - Glycerol

- Nitrogenous waste
  - Urea

- Gases
  - CO₂

CELLULAR ELEMENTS

Erythrocytes
- (Red blood cells)
  - Biconcave
  - No nucleus
  - Life span 3-4 mos
  - No mitochondria

Produced in bone marrow at ends of long bones

Oxygen transport
- (in hemoglobin - iron containing protein)

Leukocytes
- (white blood cells)
  - Amoeboid movement
  - Often outside of circ. system

Monocytes
  - Neutrophils
  - Basophils
  - Eosinophils

Phagocytosis of bacteria and debris

Lymphocytes
- B-cells
  - Mature in bone
- T-cells
  - Mature in thymus

Blood clotting

Platelets
- Cell fragments

Blood clotting