

# Anatomy and Physiology 2019 Key

90 points (50 minutes)

## Cardiovascular System (30 points)

### Multiple Choice (5 questions; 1 point each)

1. How does fetal hemoglobin differ from adult hemoglobin A?
  - a. It has a lower affinity for oxygen
  - b. It is produced in red bone marrow
  - c. It has 2 alpha and 2 gamma chains
  - d. It is adversely affected in individuals with sickle cell disease
2. Intercalated discs between myocytes are held together by...
  - a. Cadherins
  - b. Desmosomes
  - c. Proteoglycans
  - d. Fibronectins
3. This type of capillary is primarily found in the kidney and small intestines, which are sites of active filtration and absorption, respectively.
  - a. Continuous capillary
  - b. Fenestrated capillary
  - c. Sinusoid capillary
  - d. Porous capillary
4. Contractile stem cells that generate new vessels or scar tissue, stabilize wall, and control permeability are called...
  - a. Pericytes
  - b. Podocytes
  - c. Endothelial germ cells
  - d. Mesenchymal stem cells
5. You observe a patient's ECG and conclude that she has normal ventricular depolarization. What part of the ECG did you likely observe to be normal?
  - a. P wave
  - b. AV delay
  - c. QRS complex
  - d. T wave

### Short Answer (10 questions; 2 points each)

1. The right AV valve is also known as this valve. **Tricuspid**
2. This node delays the electrical signal for 0.1 seconds to allow the atria to finish contracting. **AV node**
3. In an ECG, this wave indicates ventricular repolarization. **T wave**
4. The degree of cardiac muscle stretch before contraction is known as this. **Preload**
5. This law characterizes the observation that higher preload means higher stroke volume. **Frank-Starling law of the heart**
6. Name the two heart structures in a fetus that allow blood to bypass fetal nonfunctional pulmonary circulation. **Foramen ovale and ductus arteriosus**
7. What type of artery has the thickest tunica media? **Muscular artery**
8. What type of capillary would you expect to find in the liver? **Sinusoid capillary**
9. Blood remaining in chambers after ventricle contraction is called... **end systolic volume (ESV)**
10. In the image below, identify the open structure in the bottom left? **Artery**



**Free Response** (1 question; 5 points)

1. You observe the venous end of a capillary, noting that the capillary hydrostatic pressure (HP<sub>c</sub>) is 18 mmHg, the capillary colloid osmotic pressure (OP<sub>if</sub>) is 25 mmHg, the interstitial fluid pressure (HP<sub>if</sub>) is 0 mmHg, and the interstitial colloid osmotic pressure (OP<sub>if</sub>) is 1 mmHg. Calculate the net filtration pressure (NFP) in the venous end of this capillary, indicating the direction (negative for inward, positive for outward). Show all calculations.

$$\text{NFP} = (\text{HP}_c + \text{OP}_{if}) - (\text{HP}_{if} + \text{OP}_c)$$

$$\text{NFP} = (18 + 1) - (0 + 25) = -6 \text{ mmHg (net inward pressure)}$$

**Excretory System** (30 points)

**Multiple Choice** (5 questions; 1 point each)

1. In the nephron, proximal tubule cells have these structures to greatly increase surface area.
  - a. Fenestrated epithelium
  - b. Apical microvilli
  - c. Foot processes
  - d. Infolded apical membrane
2. Which hormone is released by the granular cells of the juxtaglomerular apparatus?
  - a. Renin
  - b. Angiotensin II
  - c. Antidiuretic hormone
  - d. Aldosterone
3. Which cells in the nephron detect low blood pressure or vasoconstriction of afferent arterioles causing low NaCl concentration in filtrate?
  - a. Proximal tubule cells
  - b. Distal tubule cells
  - c. Macula densa cells
  - d. Podocytes
4. How are glucose, amino acids, ions, and vitamins mainly reabsorbed in the kidneys?
  - a. Active transport
  - b. Facilitated diffusion
  - c. Passive diffusion
  - d. Cotransport
5. What are the highly branched epithelial cells that cling to glomerular capillaries and regulate filtration?
  - a. Podocytes
  - b. Pericytes
  - c. Macula densa cells
  - d. Glomerulus cells

**Short Answer** (10 questions; 2 points each)

1. Proximal and distal tubule cells are both made up of this type of epithelium. Columnar
2. Podocytes have these structures that function in adhering to the basement membrane. The name of these cells is derived from these structures. Foot processes
3. This ion is primarily used for cotransport of glucose and other nutrients into tubule cells. Na<sup>+</sup>
4. Antidiuretic hormone primarily targets this part of the nephron. Distal convoluted tubule
5. This hormone inhibits Na<sup>+</sup> resorption and is antagonistic to aldosterone. Atrial natriuretic peptide

6. This vessel utilizes a countercurrent exchanger to preserve the medullary gradient. **Vasa recta**
7. Each  $H^+$  secreted into filtrate coupled to the transport of this ion into peritubular capillaries.  **$HCO_3^-$**
8. In pregnant women, this hormone is responsible for  $NaCl$  and water reabsorption, often resulting in edema. **Estrogen**
9. This is created by interaction of filtrate flow through ascending and descending limbs of juxtamedullary nephrons that increases the medullary gradient. **Countercurrent multiplier**
10. This hormone causes synthesis and retention of more apical  $Na^+$  and  $K^+$  channels and more basolateral  $Na^+ - K^+$  ATPases. **Aldosterone**

**Free Response** (1 question; 5 points)

1. Give a brief overview of the renin-angiotensin-aldosterone system (RAAS) in the kidney, starting from the initial stimulus to the sequential responses.

Granular cells of JGA release renin in response to sympathetic stimulation, activated macula densa cells (detect low BP or vasoconstriction of afferent arterioles causing low  $NaCl$  concentration in filtrate). Renin release increase angiotensin II, which stimulates adrenal cortex to release aldosterone. Angiotensin II and aldosterone both increase BP through their mechanisms.

**Lymphatic System** (30 points)

**Multiple Choice** (5 questions; 1 point each)

1. The special lymphatic capillaries that transport absorbed fat from the small intestine to the bloodstream are called...
  - a. **Lacteals**
  - b. Chylomicrons
  - c. Lymph vessels
  - d. Chyle
2. What is an example of an adaptation that lymphatic system uses to transport fluid?
  - a. Pumps that generate pressure gradients
  - b. **Milking action of skeletal muscles**
  - c. Pressure changes in the extremities during breathing
  - d. Lack of valves to increase transport efficiency
3. This type of lymphoid connective tissue dominates all lymphoid organs except the thymus.
  - a. Diffuse lymphoid tissue
  - b. Areolar connective tissue

- c. Reticular connective tissue
  - d. Elastic connective tissue
4. Where do B and T cells originate?
- a. B cells originate in red bone marrow, T cells originate in the thymus
  - b. B cells originate in the thymus, T cells originate in red bone marrow
  - c. Both B cells and T cells originate in red bone marrow
  - d. Both B cells and T cells originate in the thymus
5. In the lymph node, the connective tissue strands that extend inward and divide the node into compartments are called...
- a. Medullary cords
  - b. Germinal centers
  - c. Lymph sinuses
  - d. Trabeculae

**Short Answer** (10 questions; 2 points each)

1. Lymph ultimately ends up in one of two large ducts in the upper part of the body. Name both of them. **Right lymphatic duct and thoracic duct**
2. Lighter-staining centers of lymphoid follicles where proliferating B cells predominate are called... **Germinal centers**
3. This part of the spleen has immune function, lymphocytes suspended on reticular fibers, and forms cuffs/clusters around central arteries. **White pulp**
4. These developmental structures bud from developing veins and form a branching system of lymphatic vessels. **Lymph sacs**
5. All parts of the lymphatic system are derived from mesodermal mesenchymal cells (migrate and develop into reticular tissue) except for this organ, which is derived from endodermal cells. **Thymus**
6. Concentric whorls of keratinized epithelial cells involved in development of regulatory T cells (prevent autoimmune responses) in the thymus are called. **Thymic corpuscles**
7. This lymphoid organ grows throughout puberty, then atrophies (by old age is replaced by fibrous and fatty tissue). **Thymus**
8. Name at least two of the types of tonsils. **Palatine tonsils, lingual tonsil, pharyngeal tonsil, tubal tonsils (any two)**
9. This type of lymphoid tissue is characterized by loose arrangement of lymphoid cells and some reticular fibers. It is found in almost every organ and the lamina propria of mucous membranes lining the digestive tract. **Diffuse lymphoid tissue**
10. Fibroblast-like cells that produce stroma (network that supports other cell types in lymphoid organs and tissues) are called... **Reticular cells**

**Free Response** (1 question; 5 points)

1. Describe the minivalve system in lymphatic capillaries in as much detail as you can.

Endothelial cells forming walls are not tightly joined; edges of adjacent cells overlap loosely, easily opened, flaplike minivalves. Collagen filaments anchor endothelial cells. Increase in interstitial fluid volume opens minivalves. When fluid pressure outside (interstitial) greater than in vessel, pressure forces minivalve flaps open and fluid enters lymphatic capillary. When fluid pressure inside vessel is greater than interstitial, pressure forces minivalve flaps shut and prevents leakage.