



SCIENCE OLYMPIAD
— AT THE —
UNIVERSITY OF FLORIDA

Northern Regional: January 19th, 2019

Anatomy and Physiology C Test

Name(s): _____

Team Name: _____

School Name: _____

Team Number: _____

Rank: _____

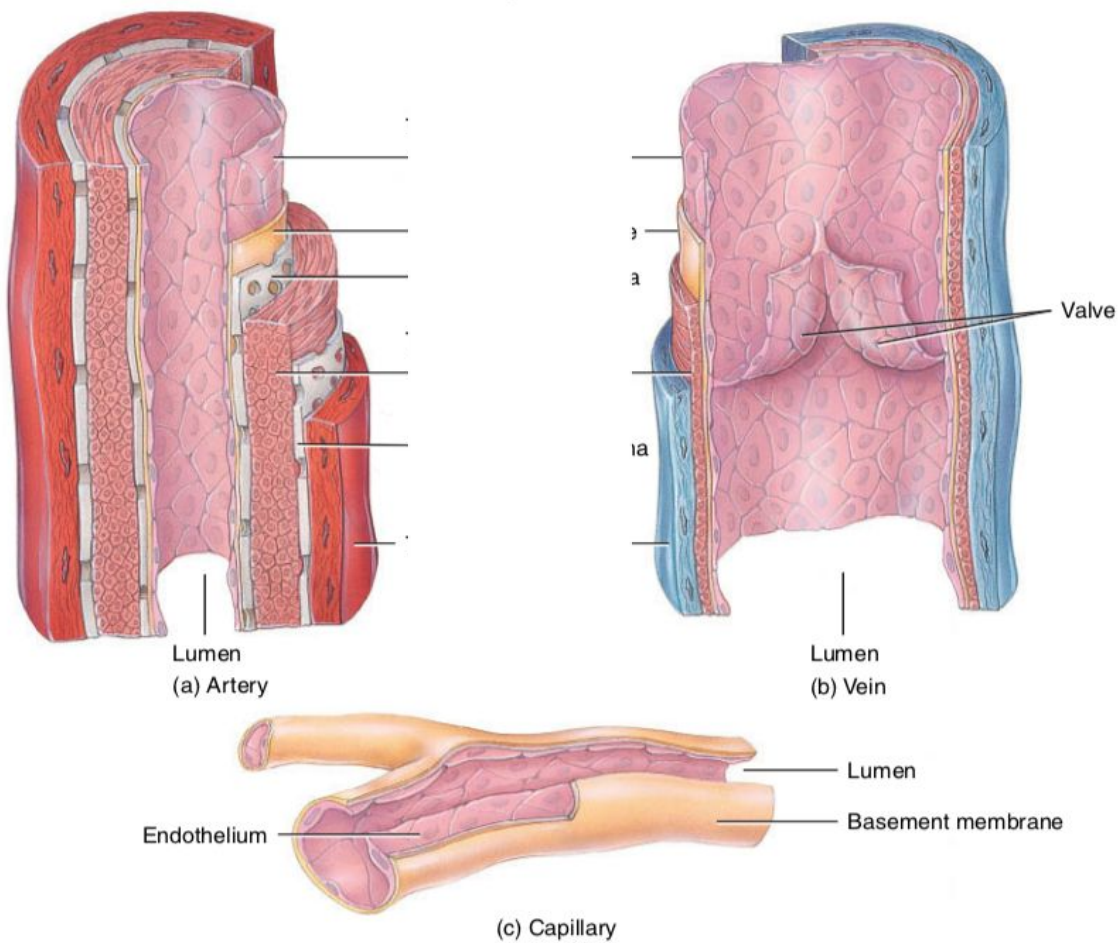
Score: _____

Cardiovascular System

*Please don't call me **heartless** after taking this test.*

Station 1 - Part 1 (26 points)

Instructions: Label the structure of blood vessels. (24 points)



Station 1 - Part 2 (60 points)

Instructions: The descriptions below refer to a cardiovascular disease. Determine if it is referring to congestive heart failure, atrial fibrillation, myocardial infarction, atherosclerosis, bradycardia, or tachycardia.

1. Blood cannot pump enough oxygen and nutrients to meet the body's demands because blood moves at a slower rate and pressure in the heart increases.
2. Congested lungs, fluid and water retention, dizziness, rapid or irregular heartbeats
3. Heart beats fewer than 60 times/minute
4. Common name is heart attack
5. Systolic dysfunction and diastolic dysfunction are types of this disease
6. Near-fainting, dizziness, fatigue, shortness of breath, chest pains, confusion or memory problems, easily tiring during physical activities
7. Heart tissue starved of oxygen and nutrients die
8. Irregular and often rapid heart rate
9. Could be caused by hypothyroidism
10. The atria beat irregularly and are not coordinated with the ventricles
11. Electrical signals are slow or possibly blocked
12. Palpitations, weakness, reduced ability to exercise, fatigue, lightheadedness, dizziness, confusion, shortness of breath
13. Could be occasional, persistent, long-standing persistent, or permanent
14. Can be caused by heart tissue damage related to aging
15. Heart failure, arrhythmias, cardiac arrest, cardiogenic shock, death
16. Sinus node discharges electrical impulses slower than is normal, pauses or fails to discharge at a regular rate, or discharges electrical impulse that is blocked before causing atrial contraction.
17. Electrical signals transmitted through the atria are not transmitted to the ventricles (heart block)
18. Most are caused by coronary artery disease/atherosclerosis.
19. Could be caused by an inflammatory disease like rheumatic fever or lupus
20. Buildup of fats, cholesterol, and other substances in and on the walls of arteries as plaque
21. Smooth lining of plaque may rupture and spill cholesterol into the bloodstream, causing a blood clot
22. Typical trigger is a blood clot that blocks coronary artery flow.
23. Associated with obstructive sleep apnea
24. The atria experience chaotic electrical signals and quiver
25. Heart beats faster than normal (60-100 bpm)

26. Ventricles beat fast but not as fast as the atria
27. Types are atrial flutter, SVT, Ventricular, Ventricular fibrillation
28. Can be caused by high blood pressure, high cholesterol, high triglycerides, smoking and tobacco products, insulin resistance, obesity, diabetes, inflammation
29. Shortness of breath, lightheadedness, rapid pulse rate, heart palpitations, chest pain, syncope
30. Can be caused by hyperthyroidism

Station 2 - Part 1 (30 points)

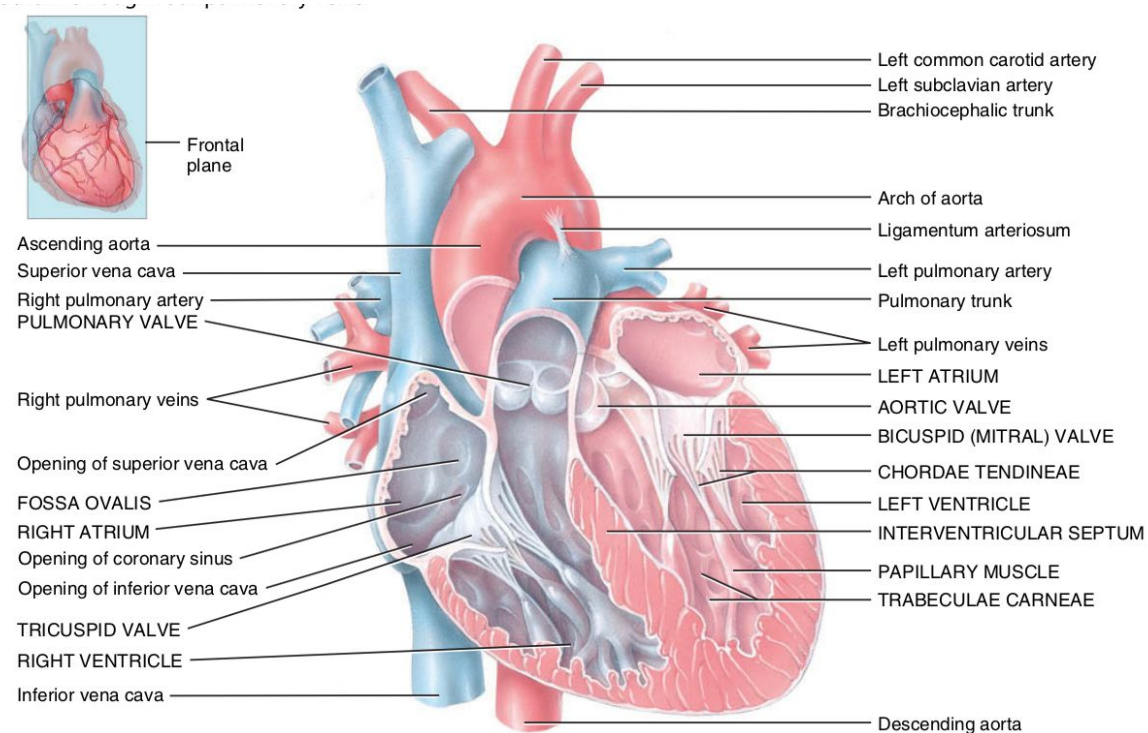
1. **True or False:** Blood is a connective tissue. (1 point)
2. Which of the following does blood regulate? Circle the correct answers. (3 points)
 - a. pH
 - b. Body temperature
 - c. Water content of cells
3. Which of the following is the pH of blood? (1 point)
 - a. 7.35-7.45
 - b. 6.25-6.75
 - c. 5.67-6.80
 - d. 8.1-8.2
4. Blood is about ____% blood plasma and ____% formed elements. (1 point)
 - a. 50, 50
 - b. 55, 45
 - c. 60, 40
 - d. 40, 60
5. What is the term for the percentage of total blood volume occupied by red blood cells? (2 points)
6. Blood plasma consists of ____% water and ____% solutes. (1 point)
 - a. 95, 5
 - b. 91.5, 8.5
 - c. 98, 2
 - d. 97.5, 2.5
7. List three formed elements present in blood. (3 points)
8. Deoxyhemoglobin is not interested in binding with an oxygen, but when one oxygen molecule attaches, the second one binds more easily to hemoglobin. The third and fourth oxygen molecular then binds easier compared with the former. What is the name for this effect? (4 points)
9. Blood typing is used to figure out the blood type of a person. There are two major steps in this test. State and describe the process for each major step.
10. What is the name for the second step in question #9? (4 points)

Station 2 - Part 2 (70 points)

1. Blood clotting involves reactions that can be divided into three stages. What are these three stages? (6 points)
2. **True or False:** Clotting is initiated only by the extrinsic pathway of blood clotting. The intrinsic pathway is insignificant in this initiation. (2 points)
3. **Choose:** Normal coagulation requires vitamin (A, K) and is followed by (clot retractions, fibrinolysis) and ultimately (clot retraction, fibrinolysis). (6 points)
4. **Fill in:** Clotting in an unbroken blood vessel is called _____. (2 points)
5. What is an embolus? (2 points)
6. **Fill in:** ABO and Rh blood groups are genetically determined and based on _____ - _____ responses. (2 points)
7. In the Rh system, individuals whose RBCs have Rh antigens are classified as Rh (+, -); those who lack the antigen are Rh (+, -). (1 point)
8. How does hemolytic disease occur? (4 points)
9. The near equilibrium between filtration and reabsorption in capillaries is called what? (3 points)
10. _____ is the abnormal increase in interstitial fluid. (1 point)
11. **Choose:** The velocity of blood flow is (directly, inversely) related to the cross-sectional area of blood vessels; blood flows (fastest, slowest) when cross-sectional area is greatest. The velocity of blood flow (increases, decreases) from the aorta to arteries to capillaries and (increases, decreases) in venules and veins. (8 points)
12. What two factors determine blood flow? (4 points)
13. **Choose:** Blood flows from regions of (lower, higher) pressure to (lower, higher) pressure. (1 point)
14. **True or False:** The higher the resistance, the lower the blood flow. (1 point)
15. Define blood pressure. (1 point)
16. **Fill in:** Venous return depends on pressure differences between the _____ and _____ ventricle. (4 points).
17. What three factors maintain the return of the blood to the heart? (6 points)

Station 3 - Part 1 (60 points)

Instructions: Label the diagrams below.



(a) Anterior view of frontal section showing internal anatomy

Station 3 - Part 2 (35 points)

1. **Fill in:** The pericardial cavity is found between the _____ and _____ layers of the serous pericardium. (2 points)
2. What is the function of the pericardial fluid? (2 points)
3. Which one of the layers are not the three layers that make up the heart? (1 point)
 - a. Endocardium
 - b. Epicardium
 - c. Myocardium
 - d. Pericardium
4. **Fill in:** The heart chambers include two superior chambers, the right and left _____, and two inferior chambers, the right and left _____. (2 points)
5. The right atrium receives blood from three sources? What are they? (6 points)
6. **Fill in:** The right atrium is separated internally from the left atrium by the interatrial septum, which contains the _____. (1 points)
7. **Choose:** Blood exits the right atrium through the (bicuspid, tricuspid) valve. (1 point)
8. The right ventricle is separated from the left ventricle by the _____ septum. (2 points)
9. **Choose:** Oxygenated blood enters the left atrium from the (bronchial, pulmonary) veins and exits through the (bicuspid, tricuspid) valve. (2 points)
10. Which chamber has the thickest wall? (1 point)
 - a. Left atrium
 - b. Right atrium
 - c. Left ventricle
 - d. Right ventricle
11. **Fill in:** _____ is the alternate expansion and elastic recoil of an artery wall with each heartbeat. (3 points)
12. What is a normal resting heart rate? (in beats/min) (1 point)
 - a. 40-50
 - b. 70-80
 - c. 90-100
 - d. 100-110
13. **Fill in:** _____ is the pressure exerted by blood on the wall of an artery when the left ventricle undergoes systole and then diastole. (3 points)
14. What does a sphygmomanometer measure? (3 points)
15. Define SBP and DBP. (4 points.)
16. **True or False:** Normal BP is less than 120/80. (1 point)

Lymphatic System

*I hope this exam doesn't **drain** too much of your energy.*

Station 4 - Part 1 (25 points)

1. Organs that contain lymphatic tissue also contain what type of tissue? (3 points)
2. List three functions of the lymphatic system. (3 points)
3. Choose: Lymphatic vessels begin as (open/closed)-ended lymphatic capillaries in tissue spaces between cells. (Interstitial fluid, lymph) drains into lymphatic capillaries, thus forming (interstitial fluid, lymph). (6 points)
4. Lymphatic capillaries merge to form larger vessels called what? (1 point)
5. What is the function of the vessels in #4? (2 points)
6. Describe the order of lymph flow using the structures below starting with the capillaries and ending with the subclavian veins. (10 points)
 - ducts (thoracic and right lymphatic duct), lymphatic vessels, lymph trunks, Lymphatic capillaries

Station 4 - Part 2 (25 points)

1. What are the two processes that makes lymph flow? (4 points)
2. What structure within lymphatic vessels help lymph flow? (2 points)
3. True or False: Red bone marrow and the lymph are secondary lymphatic organs. (2 points)
4. True or False: Lymph nodes, the spleen, and lymphatic nodules are primary lymphatic organs. (2 points)
5. What structure lies between the sternum and blood vessels above the heart? (2 points)
6. **Choose:** The structure in #5 is the site of (B/T) cell maturation. (1 point)
7. _____ are encapsulated, egg-shaped structures located along lymphatic vessels. (2 points)
8. **Choose:** Lymph enters the structure in #7 through (afferent, efferent) vessels, is filtered, and exits through (afferent, efferent) vessels. (2 points)
9. What structure is the largest single mass of lymphatic tissue in the body. (2 points)
10. Within the structure in #9, what type of cells carry out immune functions? (2 points)
11. Within the structure in #9, what type of cell destroy blood-borne pathogens and worn-out red blood cells by phagocytosis? (2 points)
12. **Fill in:** Lymphatic nodules can be found throughout the mucosa of the GI, urinary, respiratory, and reproductive tracts. This tissue is called _____ - _____ (MALT). (2 points)

Station 5 - Part 1 (20 points)

Instructions: The descriptions and pictures below refer to a lymphatic disease. Determine if it is referring to lymphedema, Hodgkin lymphoma, non-Hodgkin lymphoma, Lymphadenopathy



- 1.
2. Half of the cases of this disease are due to EBV.



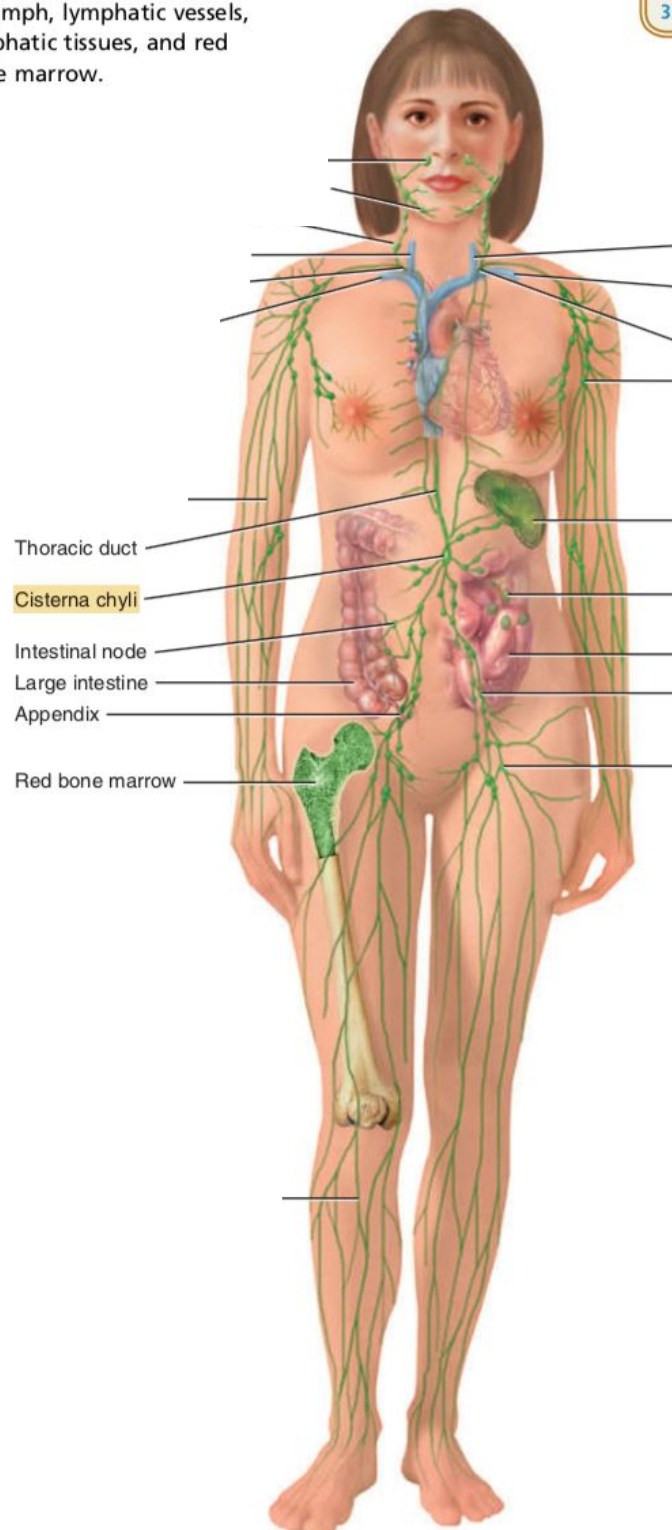
- 3.
4. Lymph nodes are abnormal in size, number, or consistency.
5. Swelling in an arm or leg because of a blockage in the lymphatic system.
6. Reed-Sternberg cell is present.
7. Red-Sternberg cell is not present.
8. Hardening and thickening of the skin.
9. Milroy's disease
10. Meige's disease

Station 5 - Part 2

Instructions: Label each diagram. (Diagram 1 - 46 points)

The lymphatic system consists of lymph, lymphatic vessels, lymphatic tissues, and red bone marrow.

2. Transports dietary lipids from
3. Protects against invasion thro

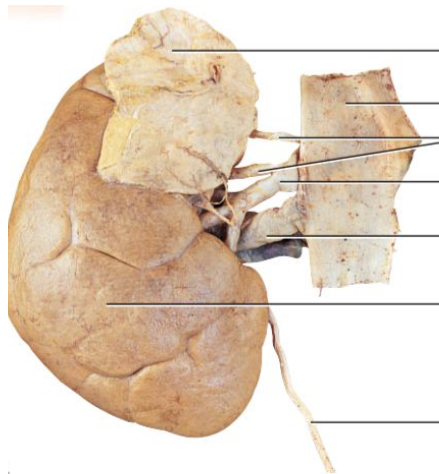


Excretory System

*I'm not **kidding** when I say that **urine** for a treat.*

Station 6 - Part 1 (20 points)

1. List five components/characteristics of blood that is regulated by the kidneys. (5 points)
2. Which one of the following processes are performed by the kidneys? There may or may not be multiple answers. (all or nothing; 5 points).
 - a. Gluconeogenesis.
 - b. Release of calcitriol and erythropoietin.
 - c. Excretion of waste and foreign substances.
 - d. Storage of lipids.
3. What are the three basic tasks of the functional unit of the kidney? (3 points)
4. Label the diagram below. (7 points)



Station 6 - Part 2 (50 points)

1. **Choose:** The kidneys are (peritoneal/retroperitoneal) organs attached to the (anterior, posterior) wall. (4 points)
2. List the three layers of tissue that surround the kidney. (3 points)
3. List the eight internal components of the kidneys. (8 points)
4. Describe the correct sequence of blood flow through the kidney starting with blood flow into the kidney. (14 points)
5. Which nerves from the sympathetic division of the ANS supply the kidney blood vessels? (1 point)
6. What do the nerves in question #5 regulate? (1 point)
7. What is the functional unit of a kidney? List its components. (4 points).
8. A renal tubule consists of a proximal convoluted tubule, a nephron loop, and a distal convoluted tubule.
 - a. What structure do they drain into? (1 point)
 - b. **True or False:** The structure in part (a) is not shared between several nephrons. (2 points *only* if part (a) is answered correctly).
 - c. What are the two components of the nephron loop? (2)
9. **Choose:** A cortical nephron as a (short/long) loop that dips into the (superficial/deep) region of the renal medulla. A juxtamedullary nephron has a (short/long) nephron loop that stretches through the renal medulla almost to the renal papilla. (6 points)
10. **True or False:** Only some parts of the glomerular capsule, renal tubule, and ducts consists of a single layer of epithelial cells. (2 point).
11. The JGA consists of the juxtaglomerular cells of an afferent arteriole and the macula densa of the final portion of the ascending limb of the nephron loop. What does JGA stand for? (2 points).

Station 7 - Part 1 (40 points)

1. Fill in the blanks: The fluid that is filtered by the glomeruli enters the _____ space and is called _____. (2 points).
2. The filtration membrane consists of three components. What are they? (3 points).
 - a. Which of the components slits are found between pedicels of podocytes? (2 points)
3. **True or False:** There is a special transport system in the kidneys because most substances in blood plasma cannot easily pass through the glomerular filter. (1 point)
4. **True or False:** Blood cells and most proteins are usually filtered by the kidneys. (1 point).
5. Glomerular filtrate amounts to how much liters of fluid per day? (2 points)
 - a. 120 L
 - b. 180 L
 - c. 210 L
 - d. 145 L
6. List three main reasons as to why there is a large amount of fluid that is filtered by the kidney. (6 points).
7. What do the following abbreviations stand for: (Total: 15 points)
 - a. GBHP (1 point)
 - b. CHP (1 point)
 - c. BCOP (1 point)
 - d. NFP (1 point)
 - e. Which of the abbreviations promote filtration? (2 points)
 - f. Which ones oppose filtration? (2 points)
 - g. These abbreviations are involved in a formula that calculates the total pressure needed for filtration. What is this formula? (You must use all of the abbreviations.) (5)
 - h. NFP is about _____ mmHg. (2)
8. GFR is the amount of filtrate formed in both kidneys per minute. (Total: 5 points)
 - a. What does GFR stand for? (1 point)
 - b. Provide the range GFR (units are mL/min) (4 points).
9. GFR is regulated by three factors? What are these types of regulation? (3 points).

Station 7 - Part 2 (45 points)

1. What is the name for the process that reclaims materials from tubular fluid and returns them to the bloodstream? (2 points)
2. There are some substances not needed by the body and removed from blood and discharged into the urine. What is the name for this process? (2 points)
3. The following substances below are processed by the body in different ways. Determine which way each substance is processed by the body. *Hint*: Some are processed in both ways. (20 points)

Substances:

Water, certain drugs, glucose, amino acids, urea, Na^+ , Cl^- , K^+ , HCO_3^- , PO_4^{3-} , H^+ , NH_4^+ , creatinine

| Tubular Reabsorption | Tubular Secretion |
|----------------------|-------------------|
| | |

4. About ____% of water reabsorption is obligatory and occurs via osmosis together with reabsorption of solutes, and is not hormonally regulated. (1 point)
 - a. 60%
 - b. 50%
 - c. 85%
 - d. 90%
5. About ____% is facultative water reabsorption, which varies according to body needs and is regulated by ADH. (1 point)
 - a. 50%
 - b. 40%
 - c. 10%
 - d. 15%

6. Na^+ are absorbed throughout the basolateral membrane via what type of transport? (2 points)
7. The nephron loop reabsorbs _____ to _____% of the filtered Na^+ , K^+ , Ca^{2+} , and HCO_3^- ; _____ of the filtered Cl^- ; _____% of the filtered water (4 points)
 - a. 20, 30, 45, 10
 - b. 10, 35, 20, 55
 - c. 80, 90, 10, 25
 - d. 20, 30, 35, 15
8. How does the distal convoluted tubule reabsorb Na^+ and Cl^- ions? (4 points)
9. **Choose:** In the collecting duct, principal cells reabsorb (Na^+/K^+) and secrete (Na^+/K^+); intercalated cells reabsorb (Na^+/K^+) and HCO_3^- , and secrete H^+ . (6 points)
10. List five hormones that regulate solute and water reabsorption. (5 points)

Station 8 - Part 1 (35 points)

1. **Choose:** In the absence of ADH, the kidneys produce (concentrated, dilute) urine; renal tubules absorb (more, less) solutes than water. (2 points)
2. **Choose:** In the presence of ADH, the kidneys produce (concentrated, dilute) urine; large amounts of water are reabsorbed from the (interstitial, tubular) fluid into (interstitial, tubular) fluid, (increasing, decreasing) solute concentration in urine. (6 points).
3. **Fill in and Choose:** The _____ multiplier establishes an osmotic gradient in interstitial fluid of the renal medulla that enables production of (dilute, concentrated) urine when ADH is present. (4 points)
4. Chemically, normal urine contains about _____% water and _____% solutes. (3 point)
 - a. 70, 30
 - b. 95, 5
 - c. 80, 20
 - d. 60, 40
5. **True or False:** The solutes normally include urea, creatinine, uric acid, urobilinogen, and various ions. (1 point)
6. _____ refers to the ability of the kidneys to clear (remove) a specific substance from blood. (3 points).
7. There are several abnormal components that can be detected in urinalysis. Determine whether or not the following are abnormal. Circle your answers. (16 points; -2 for each incorrect/missed answer).
 - a. Albumin
 - b. Glucose
 - c. Red and White Blood Cells
 - d. Ketone Bodies
 - e. Bilirubin
 - f. Excessive Urobilinogen
 - g. Casts
 - h. Microbes

Station 8 - Part 2 (26 points)

1. **Choose:** The ureters are (peritoneal, retroperitoneal) and consists of a mucosa, muscularis, and adventitia. They transport urine from the (renal pelvis, urinary bladder) to the (renal pelvis, urinary bladder), primarily via peristalsis. (3 points.)
2. **True or False:** The urinary bladder is located in the pelvic cavity anterior to the pubic symphysis. (2 points).
3. What is the function of the urinary bladder (1 point).
4. The micturition reflex discharges urine from the urinary bladder via parasympathetic impulses. Determine whether or not the following scenario below is due to the reflex. Write "Yes" or "No" on your answer sheet. (9 points total)
 - a. Relaxation of the detrusor muscle (3 points)
 - b. Relaxation of the internal urethral sphincter muscle (3 points)
 - c. Inhibition of impulses in somatic motor neurons to the external urethral sphincter (3 points)
5. What is the name for the tube leading from the floor of the urinary bladder to the exterior? (1 point)
6. **True or False:** The anatomy and histology of the structure in question #5 differ in females and males. (2 points)
7. **True or False:** In males, the structure in #5 also discharges semen. (2 points)
8. **Matching:** Other tissues, organs, and processes temporarily confine wastes, transport waste materials, recycle materials, and excrete excess/toxic substances. Match them their corresponding actions regarding excretion. Write the corresponding Roman numeral on your answer sheet. (6 points)

| | |
|---|------------------|
| a. Converts toxic substances into less toxic ones | I. Blood |
| b. Eliminates solid wastes | II. Sweat Glands |
| c. Exhale CO ₂ | III. Buffers |
| d. Bind excess H ⁺ | IV. Liver |
| e. Transports wastes | V. Lungs |
| f. Eliminate excess heat | VI. GI tract |