

Urinary System Practice Unit Test

Multiple Choice (10 marks)

Circle the best answer for the following questions.

- Which of the following receives blood from the efferent arteriole?
 - the renal vein
 - the glomerulus
 - the afferent arteriole
 - the peritubular capillary network
- The cells of which structures contain relatively large numbers of mitochondria?
 - the glomerulus
 - the afferent arteriole
 - the proximal convoluted tubule
 - the Bowman's capsule
- Urine enters the bladder through which structure?
 - the ureter
 - the collecting duct
 - the kidney
 - the urethra
- Which of the following are located in the renal cortex?
 - the afferent arteriole and the ureter
 - the Bowman's capsule and the glomerulus
 - the distal convoluted tubule and the loop of Henle
 - the collecting duct and the proximal convoluted tubule
- Which of the following surrounds the glomerulus?
 - the proximal convoluted tubule
 - the afferent arteriole
 - the peritubular capillaries
 - the Bowman's capsule
- Which of these hormones is likely to cause a RISE in blood pressure?
 - aldosterone
 - renin
 - ADH
 - None of the hormones mentioned would cause a rise in blood pressure
 - Both a and b are correct
- If the blood is acidic the body will re-balance the pH by...
 - increasing the rate and depth of breathing
 - excreting bicarbonate ions (HCO_3^-) (into the collecting duct) at the distal convoluted tubule of the nephron
 - reabsorbing bicarbonate ions (HCO_3^-) from the filtrate at the distal convoluted tubule
 - secreting more uric acid
 - Both a and c

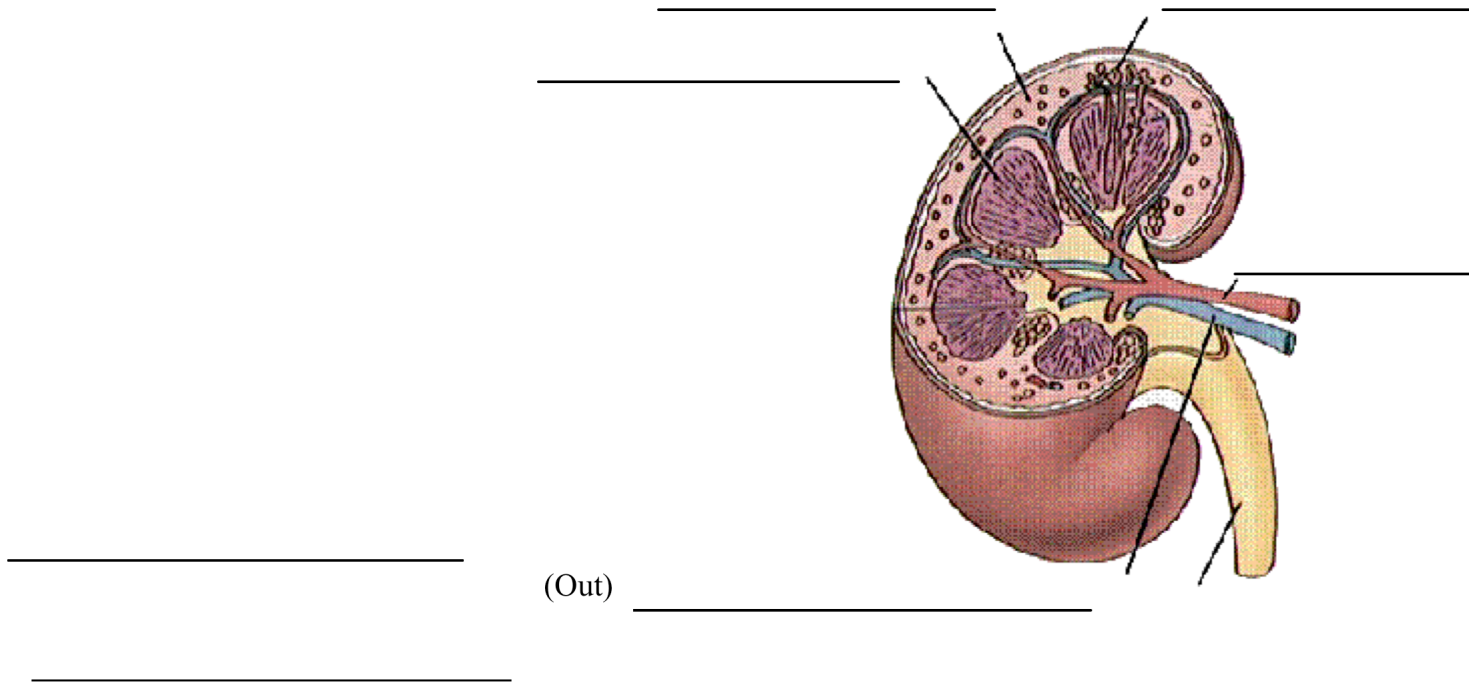
- 8) One of the main differences between tubular excretion and selective reabsorption is
- a) that tubular excretion is largely passive whereas selective reabsorption is mediated by active processes
 - b) that selective reabsorption occurs ONLY in the distal convoluted tubule
 - c) that tubular excretion actively secretes chemicals such as histamines and penicillin
 - d) that selective reabsorption takes place only in the renal medulla
- 9) The presence of ADH causes an individual to excrete
- a) sugars
 - b) less water
 - c) more water
 - d) both a and c are correct
- 10) Normally, in humans, glucose
- a) is always found in the filtrate and the urine
 - b) is always in the filtrate, with little or none in the urine
 - c) undergoes tubular secretion and is in the urine
 - d) undergoes tubular secretion and is not in the urine

Short Answers (28 marks)

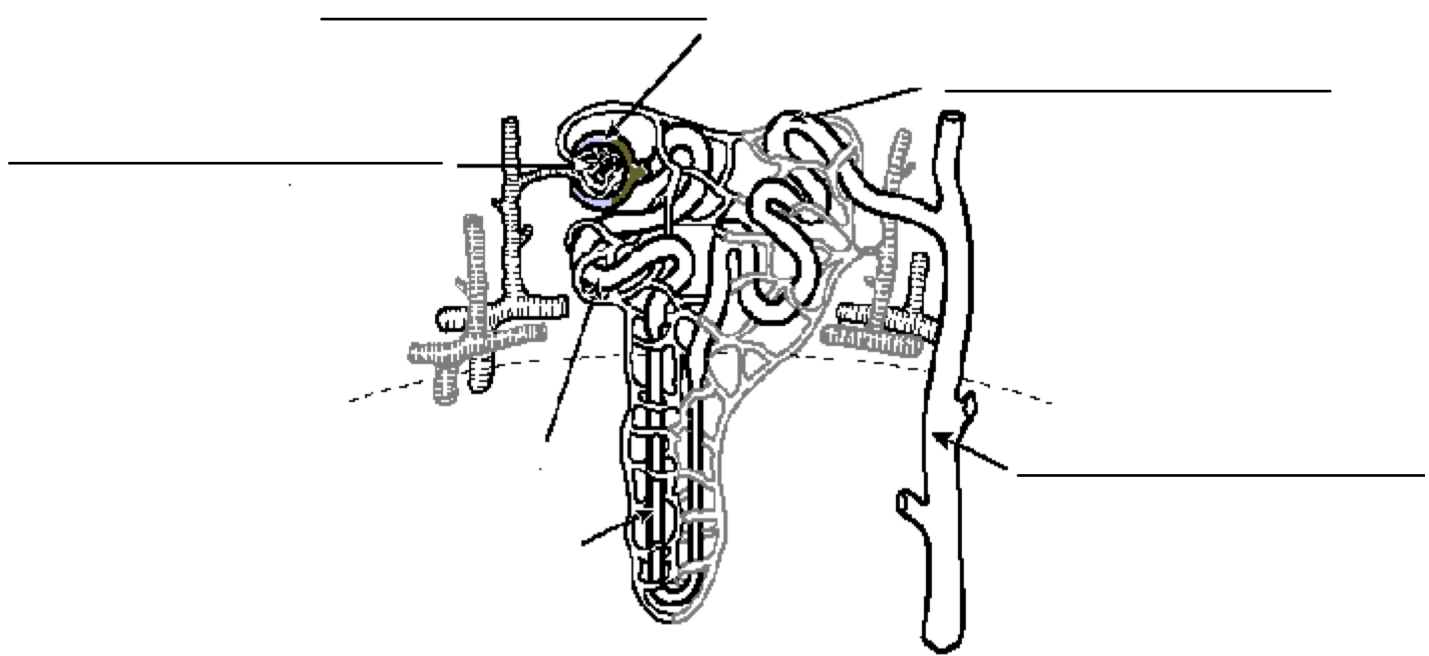
1. What are the two main functions of the urinary system? (Be specific) (4 marks)
2. Match the following components of the urinary system to their respective functions: (4 marks)

Ureter	Where urine is produced
Kidney	Where urine is stored
Urethra	Brings urine from the kidneys to the bladder
Urinary Bladder	Where urine is eliminated from the body

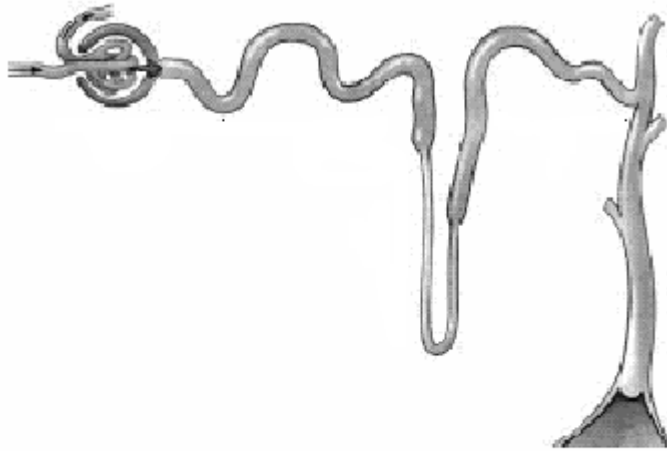
3. Label the following diagram of a kidney. (6 marks)



4. Label the following diagram of a nephron. (6 marks)



5. On the following diagram, label
- where the three major processes involved in urine formation occur; (Include the names of these processes) (6 marks)
 - where ADH acts (2 marks)
- (Total: 8 marks)



Long Answers (32 marks)

6. List the structures in the correct order, through which a glucose molecule passes as it travels through the urinary system starting at the renal artery and ending at the peritubular capillary network. Be very specific about the structures. In addition, with respect to urea and glucose content, contrast the composition of blood in the renal artery and the renal vein. (10 marks)
7. In a form of diabetes, called “diabetes mellitus”, the small blood vessels of the body are injured resulting in the retention of water and salt. Describe the role of the blood vessels that surround the nephrons in the kidneys with respect to maintaining water and salt balance. Also, hypothesize as to why people suffering from diabetes mellitus retain water and salt. (8 marks)
8. Many active processes are involved in changing the filtrate as it passes through the nephron. Describe what substances are actively removed from or added to the filtrate (7 marks) as well as WHY it is removed from or added to the filtrate (7 marks). (Total: 14 marks)

TEST TOTAL: 70 marks

Urinary System Unit Test Answer Key

Multiple Choice (1 mark each, 10 marks total)

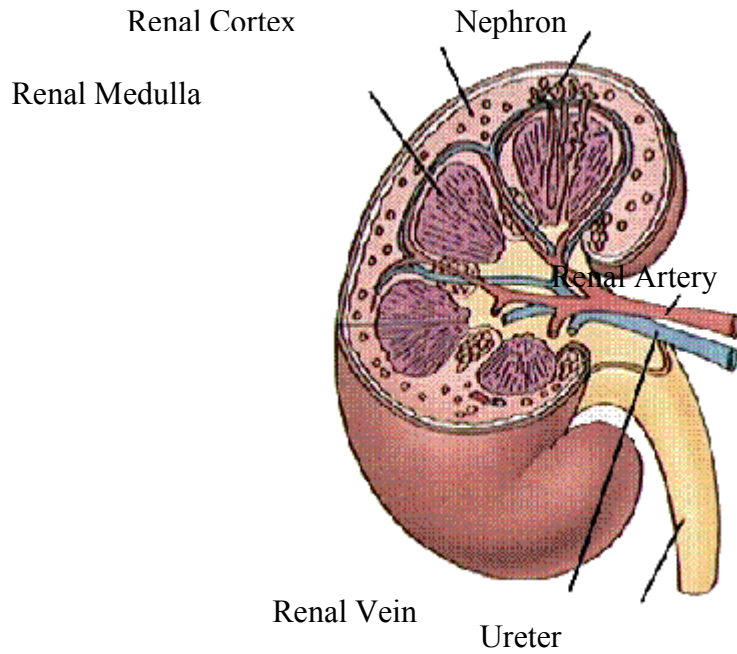
1. d) The efferent arteriole carries blood away from the glomerulus and connects to the peritubular capillary network.
2. c) Each cell of the proximal convoluted tubule has many mitochondria that supply energy for active transport of molecules from the lumen to the peritubular capillary network.
3. a) The ureter moves urine from the kidney to the urinary bladder through peristalsis
4. b) The glomerulus is a knot of capillaries inside the glomerular capsule and both are found in the renal cortex portion of the kidney.
5. d) The glomerulus is a knot of capillaries surrounded by the Bowman's capsule, also known as the glomerular capsule.
6. e) Both aldosterone and renin will cause an increase in blood pressure. Aldosterone causes the kidney to retain Na⁺ and water, while renin is released to increase blood pressure to enhance filtration (remember that high b.p. is required at Bowman's capsule to properly filter the blood).
7. e) Remember that BOTH the kidneys AND the lungs are involved in maintaining proper blood pH.
8. c) Tubular excretion – and not selective reabsorption – secretes chemicals such as histamines and penicillin into the filtrate.
9. b) Recall that antidiuretic hormone is the anti-“pee more” hormone!
10. b) Remember that glucose, being a small molecule, WILL enter the proximal convoluted tubule BUT that at this point in the nephron it is quickly removed and taken up into the blood. This is ACTIVELY accomplished.

Short Answers (28 marks total)

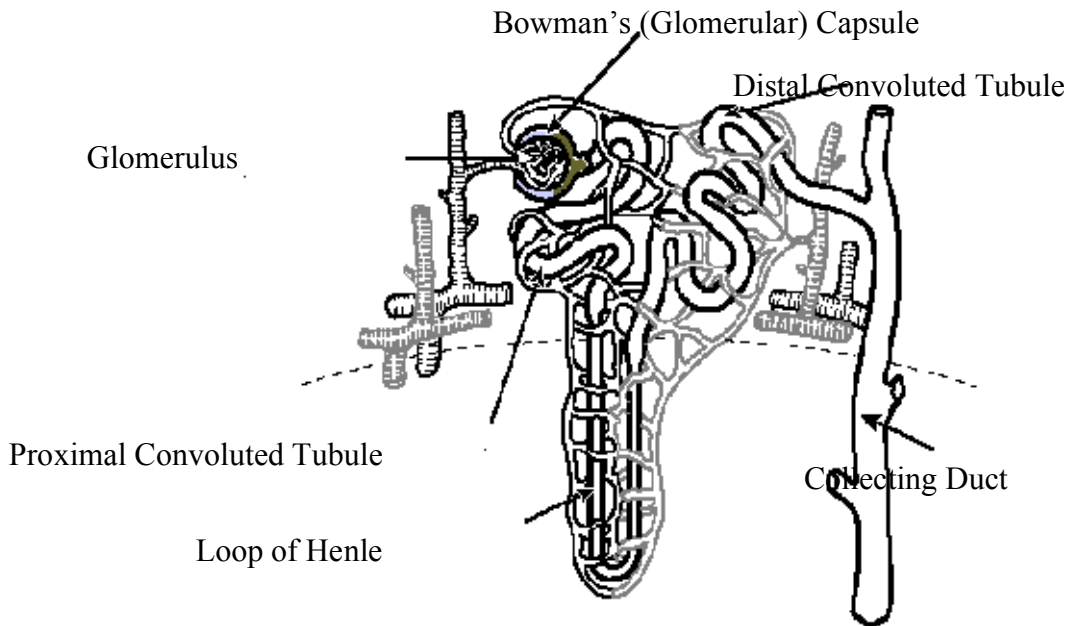
1. The two main functions of the urinary system are 1) the elimination of chemical/metabolic wastes from the body such as nitrogenous wastes (byproducts of chemical reactions that are no longer useful) and 2) to control the volume and composition of body fluids that is, water-salt balance and acid-base balance. (2 marks for each of the main functions, 4 marks total)
2. The ureter brings urine from the kidneys to the bladder
The kidney is where urine is produced
The urethra is where urine is eliminated from the body
The urinary bladder is where urine is stored

(1 mark for each correctly matched structure and function, 4 marks total)

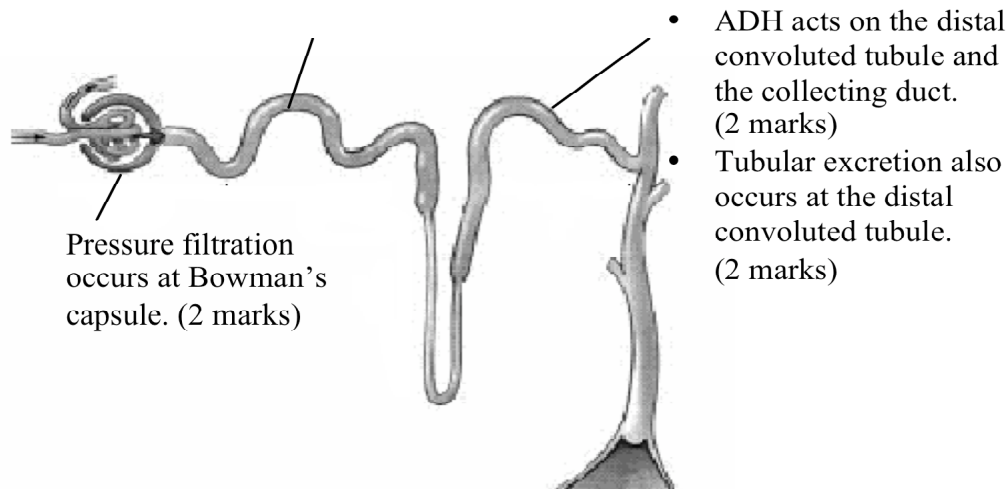
3. (1 mark for each correctly labeled structure, 6 marks total)



4. (1 mark for each correctly labeled structure, 6 marks total)



5.



Selective Reabsorption occurs at the proximal convoluted tubule (arrow without a label)

To get both marks for the each of the major processes involved in urine formation, both the names and the locations (within the nephron diagram) must be correct.

(8 marks total)

Long Answers (32 marks total)

6. The glucose molecule would start in the renal artery and proceeds to the afferent arteriole that brings it to the nephron (1 mark). From there it goes to the glomerulus and through it into the Bowman's capsule (2 marks). After entering the Bowman's capsule, the glucose molecule is actively transported from the proximal convoluted tubule to the peritubular capillaries (2 marks).

The concentration of glucose in the renal artery should be almost identical to that of the renal vein (in a healthy individual). Remember, glucose is a molecule that the body does not want to waste, and therefore, it actively reabsorbs this at the proximal distal tubule.

The concentration of urea, however, is different in the renal artery compared to the renal vein. The table from lesson 3 shows that 50% of the urea in the blood is reclaimed while the rest is excreted (in urine). Therefore, the concentration of urea in the renal vein (*leaving* the kidney) is *less than* the concentration of urea entering the kidney (through the renal artery). (5 marks)

(10 marks total)

7. The blood vessels that surround the nephron (called the peritubular network) reabsorb water and nutrients (including salts) to keep the water and salt levels of the blood balanced (1 mark). With respect to water withholding, if the blood pressure is low (not enough water) the kidneys will increase sodium retention, resulting in water retention (1 mark). As far as salt balance, the kidneys will balance this by controlling the excretion and the reabsorption of various ions (2 marks). This can be done actively or passively (1 mark)

A variety of correct answers regarding why people with diabetes may retain water are possible. Reward the student if he or she gives good reasons. Recall that high blood pressure at Bowman's capsule is required for proper filtration of blood (2 marks). If small blood vessels throughout the body are damaged, this will decrease blood pressure and the amount of blood that makes it to the kidneys (2 marks). This means that salt and water are not sufficiently excreted (resulting in the retention of water and salt) (1 mark).

(Maximum: 10 marks. Question only out of 8 marks total)

8. Many substances are added to and removed from the filtrate actively. Here are those mentioned in the notes:

Selective reabsorption:

Glucose, amino acids, vitamin C, potassium ions and some salts (Na^+ Cl^-) are actively reabsorbed. (1 mark for each – out of 4 marks total)

The reason that the first three of these might be reabsorbed is because they are nutrients that body wants to hold on to. The others (ions) are to maintain the osmolarity of the blood at a higher level than to that of the filtrate. This way, water from the filtrate will move back into the blood. (1.5 marks for each – out of 3 marks total)

Tubular secretion:

Non-filterable molecules are secreted into the filtrate in this process. Those mentioned in the notes: Penicillin, histamine, H^+ ions, potassium ions and NH_3 . (1 mark for each – out of 4 marks total)

The reasons for this: The H^+ ions are secreted to maintain the blood's pH level (if the blood is overly-acidic). Penicillin and histamine are removed because the accumulation of these chemicals can be toxic. (1.5 marks for each answer – out of 3 marks total)

(14 marks total)

TEST TOTAL: 70 marks