

Review questions for Urinary system lecture

Multiple choice review questions

- 1) The return of filtered molecules from the nephron tubules back into the blood is called
 - A) filtration.
 - B) reabsorption.
 - C) secretion.
 - D) excretion.

- 2) The liver detoxifies ammonia by converting it to
 - A) bilirubin.
 - B) urea.
 - C) uric acid.
 - D) nothing. Ammonia is processed by the kidneys and not the liver.

- 3) Which statement about the renal pyramids is false?
 - A) They are located in the medulla
 - B) They contain glomeruli
 - C) They contain collecting ducts
 - D) They empty into the renal pelvis

- 4) The portion of the nephron responsible for filtering the blood is the...
 - A) glomerular capsule.
 - B) proximal convoluted tubule.
 - C) nephron loop.
 - D) distal convoluted tubule.

- 5) Most reabsorption occurs in the
 - A) glomerular capsule.
 - B) proximal convoluted tubule.
 - C) nephron loop.
 - D) distal convoluted tubule.

- 6) The blood vessel delivering blood directly to the kidney is the
 - A) renal artery.
 - B) peritubular artery.
 - C) renal vein
 - D) afferent arteriole.

7) Which of the following are too large to be filtered by the glomerulus and thus are not normally found in the filtrate?

- A) red and white blood cells
- B) glucose
- C) amino acids
- D) electrolytes

8) Filtration is driven by

- A) Osmosis
- B) Diffusion
- C) Blood pressure

9) If a substance is neither filtered, reabsorbed, nor secreted, where would you expect to find it?

- A) filtrate
- B) blood in the renal vein
- C) urine
- D) All of the above.

10) If a substance is filtered and also secreted but not reabsorbed, where would you NOT expect to find it?

- A) glomerular filtrate
- B) blood in the renal vein
- C) urine
- D) All of the above.

11) Blood leaving the glomerulus goes into the efferent arteriole, then next to the

- A) peritubular capillary.
- B) renal artery
- C) collecting duct
- D) renal vein.

12) Monosaccharides will enter the glomerular filtrate because of...

- A) their size.
- B) their use as an energy source by the nephron
- C) their attraction to receptor proteins in the collecting duct
- D) All of the above

13) Examining the structure of the kidney reveals that the...

- A) medulla contains the most nephrons
- B) cortex contains renal pyramids.
- C) medulla contacts the renal pelvis
- D) urethra transports urine to the urinary bladder.

- 14) Which of the following statements about the micturition reflex is true?
- A) The reflex is under voluntary control
 - B) Only the internal urethral sphincter is under voluntary control.
 - C) The reflex causes urine to exit the urethra (urination).
 - D) The reflex causes the urge to urinate.
- 16) Which of the following is filtered but not reabsorbed?
- A) K^+
 - B) Sodium
 - C) urea
 - D) glucose
- 19) The kidney regulates all of the following except
- A) volume of blood plasma.
 - B) concentrations of certain electrolytes and waste products in the blood.
 - C) absorption of substances from the gastrointestinal tract.
 - D) acid-base balance (pH) of the blood plasma.
- 20) When the concentration of antidiuretic hormone rises in the blood,
- A) The urine becomes more dilute and has increased volume
 - B) The urine becomes more dilute and has decreased volume
 - C) The urine becomes more concentrated and has increased volume
 - D) The urine becomes more concentrated and has decreased volume
- 21) Which statement about antidiuretic hormone (ADH) is false?
- A) ADH is secreted from the posterior pituitary gland.
 - B) ADH binds to receptors on the nephron cells
 - C) ADH secretion is increased during body dehydration
 - D) ADH is secreted when osmoreceptors in the hypothalamus sense a decrease in the blood osmolarity.
- 22) When ADH _____, _____ water moves _____ of the filtrate.
- A) increases; more, out
 - B) increases; less, out
 - C) decreases, more, into
 - D) decreases, more, out
- 25) Aldosterone
- A) is the major hormone secreted by the kidney.
 - B) promotes the secretion of Na^+ into the nephron
 - C) stimulates the secretion of K^+ from the peritubular blood into the nephron
 - D) is a protein hormone secreted by the pituitary gland

26) If a diuretic inhibits sodium reabsorption, then (because of osmosis) urinary volume will _____ and blood volume will _____.

- A) increase; increase
- B) increase; decrease
- C) decrease; increase
- D) decrease; decrease

27) Excess blood potassium (hyperkalemia) is removed by increasing secretion of the hormone _____ which stimulates an increase in secretion of potassium by cells within the _____.

- A) aldosterone; collecting duct
- B) aldosterone; nephron
- C) anti-diuretic hormone (ADH); collecting duct
- D) anti-diuretic hormone (ADH); nephron

28) Which action listed below could be used by the body to lower high blood volume (and therefore to lower high blood pressure)?

- A) increased renin secretion.
- B) increased aldosterone secretion.
- C) decreased sweat gland activity.
- D) increased urinary Na^+ .

29) Which statement about the role of the kidneys in the regulation of plasma blood pH is false?

- A) Bicarbonate ion is too large to enter the nephron.
- B) Hydrogen ion (H^+) enters the filtrate in two ways: by glomerular filtration and by secretion into the nephron tubule.
- C) H^+ reabsorption increases during alkalosis.
- D) During acidosis, more bicarbonate is reabsorbed and less bicarbonate is excreted in the urine.

30) The two organs most responsible for acid-base balance are the

- A) heart and kidneys.
- B) liver and lungs.
- C) kidneys and lungs.
- D) lungs and heart.

Answers to multiple choice review questions

- | | | |
|-------|-------|-------|
| 1) B | 11) A | 21) D |
| 2) B | 12) A | 22) A |
| 3) B | 13) C | |
| 4) A | 14) D | |
| 5) B | | 25) C |
| 6) A | 16) C | 26) B |
| 7) A | | 27) B |
| 8) C | | 28) D |
| 9) B | 19) C | 29) A |
| 10) B | 20) D | 30) C |

Fill-in-the-blank review questions

- 1) The kidneys' major role is to _____ the blood (which means to remove waste products) and to _____ the blood (which means to adjust the blood's water and nutrient concentrations to their correct levels).
- 2) The most abundant waste molecule that the kidneys clean from the blood is _____. This nitrogen-containing waste product is made by the liver from ammonia that it detoxifies.
- 3) The kidney forms _____ out of the wastes, excess solutes, and excess water that it has removed from the blood.
- 4) Blood reaches the kidney via the _____ (a blood vessel). In the kidney, this artery branches into smaller arteries that pass through the medulla region in areas called renal _____, which are located between the renal pyramids.
- 5) The region of the kidney where the blood is cleaned and balanced is the _____.
- 6) The tube that drains urine from the urinary bladder to the outside of the body is called the _____.
- 7) In the blank in each phrase, write the most correct and specific anatomical direction term (such as Superior, Inferior, Anterior, Posterior, Medial, Lateral, Superficial, or Deep).
 - a) The kidneys are _____ to the bladder
 - b) The renal pelvis is _____ to the ureter
 - c) The kidney is _____ to the adrenal gland
 - d) The medulla is _____ to the renal pelvis

- 8) What substance passes through the renal pyramids? _____. What substance passes through the renal columns? _____. What substance passes through the renal pelvis? _____.
- 9) What structure in the kidney is where the final water and NaCl is reabsorbed from the filtrate? _____
- 10) One of the most important functions of the kidney is the return of specific filtered molecules from the filtrate back into the blood. This returning process is known as _____.
- 11) Blood that needs to be cleaned and balanced arrives at each kidney via the _____ (a blood vessel). Blood that has been cleaned and balanced exits the kidney via the _____ (a blood vessel).
- 12) _____ are the microscopic tubular structures within the kidney that clean and balance the blood.
- 13) The blood that has entered the kidney flows through afferent arterioles, which bring the blood to _____ (which are ball-shaped capillary beds in the _____ region of the kidney) where it is filtered into the nephron.
- 14) The liquid from the blood that enters the nephron is called the _____.
- 15) Each kidney contains roughly this many nephrons: _____.
- 16) The first region of the nephron is called _____. It surrounds the glomerulus and together with the glomerulus forms the blood filtering apparatus.
- 17) The correct term for one blood filtering apparatus (a glomerular capsule and a glomerulus together) is a _____.
- 18) After the glomerular capsule, the next region of the nephron is called the _____.
- 19) Most reabsorption of water and solutes from the filtrate takes place in the _____ region of the nephron.
- 20) The proximal and distal tubules of the nephron are connected by a hairpin-like loop called the _____, which extends toward or into the renal pyramids. Its primary function is reabsorption of _____ and _____.
- 21) The _____ receives the filtrate from the distal convoluted tubules of several adjacent nephrons and conducts this fluid from the cortex to the renal pelvis via the renal pyramid. The filtrate that exits the renal pyramids is called the urine. The urine pools in a hollow space in the kidney called the _____, then it exits the kidney in through the _____, which is a tube that carries it to the bladder.

- 22) Each renal pyramid is striated. The striations extend from the cortex to the renal pelvis and are actually _____ (a tubule connected to the nephrons).
- 23) Blood leaves the glomerulus via the _____ arteriole which takes it to a capillary bed that surrounds the entire nephron, called the _____.
- 24) _____ is the force that makes liquid from the blood filter into the nephron.
- 25) The process of _____ in the kidney means when the small molecules of the blood (such as water and small solutes) are separated from the larger blood components (such as blood cells and proteins) by passing through small openings in the glomerulus and the glomerular capsule.
- 26) The process of _____ in the kidney means when glucose, amino acids, water, ions, and other nutrient molecules are transported from the filtrate back into the blood.
- 27) To summarize the previous two review questions, the process of small molecules entering the nephron from the blood by passing through the renal corpuscle (the “filter”) is called _____. The process of molecules from the filtrate being returned by the nephron to the blood is called _____.
- 28) Water and solutes that have been reabsorbed are returned to the blood in the _____ capillary bed and eventually exit the kidney in the _____ (a blood vessel).
- 29) In addition to their function of collecting and transporting filtrate from nephrons, collecting ducts in the kidney also help balance the blood by reabsorbing _____ and _____ from the filtrate.
- 30) Urine is formed in the two _____ (organs). From each of these organs, a tube called the _____ propels the urine downward to the _____ where it is stored until its release is convenient, at which time it flows out of the body through the _____.
- 31) Urine is prevented from leaving the bladder prematurely by two rings of muscle: The _____ (which is the one closer to the bladder) and the _____ (which is the one farther from the bladder) .
- 32) The _____ urethral sphincter is composed of smooth muscle and is under autonomic (involuntary) control; The _____ urethral sphincter is composed of skeletal muscle and is therefore under voluntarily controlled.
- 33) Urine leaves the bladder through the _____. This tube is much longer in males than in females.
- 34) _____ is another word for urination.

35) The type of muscle that makes up the muscular wall of the urinary bladder is _____ muscle.

36) Bladder distension is sensed by stretch receptors in the bladder walls. When about _____ ml of urine has accumulated in the bladder, the stretch receptors cause the smooth muscle in the bladder to _____. This causes the urge to urinate.

38) You have an empty bladder. Then you drink a very large amount of water. Within a short time you feel the urge to urinate, so you walk to the restroom and urinate. Write the numbers 1 – 6 to show what order the following events occurred in your urinary system.

The urine passes through your internal urethral sphincter: _____

The bladder contracts _____

The volume of urine in your bladder reaches 200 ml _____

The urine passes through your external urethral sphincter: _____

The external urethral sphincter relaxes: _____

The internal and external urethral sphincters are closed: _____

39) What effect do general anesthetics have on the urinary system? (Your answer must be the proper term for this effect): _____

Which organ of the urinary system and which tissue of that organ is affected?

Organ = _____

Tissue = _____

40) Anesthetics are one common cause of urinary retention. Another common cause is _____, which affects many male senior citizens.

41) Involuntary urination is called _____.

42) All the substances listed below can be found in urine. Some of these substances, however, are not present in normal healthy urine.

- Water
- Red blood cells
- Bicarbonate ion
- Cl⁻
- Uric acid
- Na⁺
- K⁺
- H⁺

Put a + next to the substance(s) that are not normally found in the urine.

Put a * next to the substance(s) that are reabsorbed most strongly when the hormone aldosterone is present.

Circle the substance(s) that are reabsorbed most strongly when the hormone ADH (anti-diuretic hormone) is present.

51) What are the four routes that water is regularly lost to the body?

- a) _____
- b) _____
- c) _____
- d) _____

52) Insufficient water concentration in the plasma is called _____. Common causes are _____, _____, and _____.

53) Over-hydration (too much water in the blood) is generally caused by _____.

54) Osmoreceptors within the _____ region of the brain monitor the osmolarity of the blood to regulate the secretion of _____ hormone from the pituitary gland. This hormone promotes the reabsorption of _____ from the filtrate.

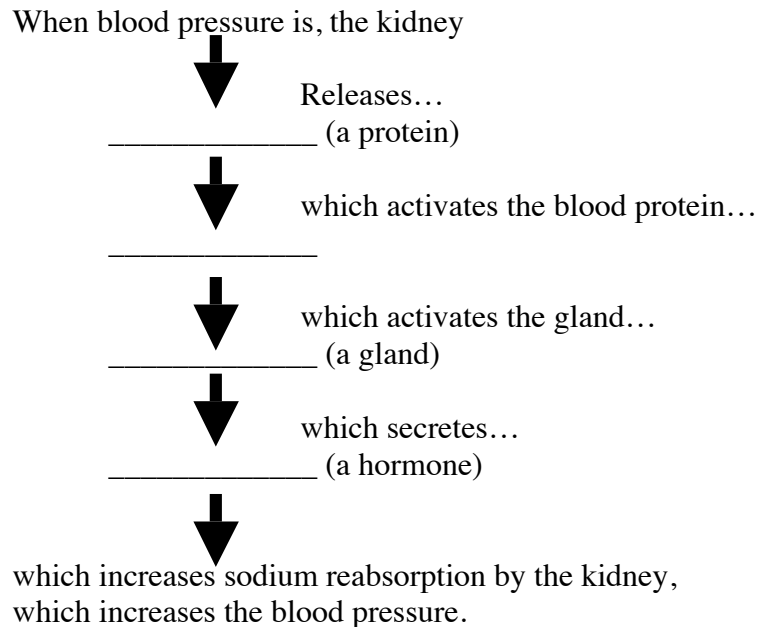
55) ADH is secreted from the anterior/posterior (circle one) pituitary gland.

56) ADH is secreted when the hypothalamus senses an increase/decrease (circle one) in blood osmolarity. Another way of saying the same thing is that ADH is secreted when the hypothalamus senses an increase/decrease (circle one) in the water concentration of the blood. (Note: These same conditions also result in the sensation of thirst).

- 57) Antidiuretic hormone (ADH) causes _____ (what action?) by the _____ organ.
- 58) When ADH levels are high, more filtered water is reabsorbed, resulting in urine that is low/high (circle one) volume.
- 59) When ADH levels are low, less filtered water is reabsorbed, resulting in urine that is low/high (circle one) volume.
- 61) The hormone _____ controls sodium and potassium levels in the blood.
- 62) Aldosterone is secreted by the _____ gland (name the gland and the region of the gland).
- 63) Aldosterone is secreted in response to low blood levels of _____ ion or high blood levels of _____ ion.
- 64) Most molecules enter the nephron through the glomerulus and the glomerular capsule (this process is called “filtration”) and exit the nephron by being transported back into the blood (this process is called “reabsorption”). But there is a third type of transport process that takes place in the nephron: Some molecules enter the nephron by moving from the peritubular capillaries into the nephron. This process is called _____.
- 65) K^+ secretion into the nephron is caused by the same hormone (aldosterone) that causes Na^+ to be reabsorbed out of the nephron. Therefore, if the body increases aldosterone because blood K^+ is high, the blood’s Na^+ concentration will _____.
- 66) When blood pressure is low, the kidney secretes a protein called _____ into the blood, which indirectly causes an increase in blood pressure because it leads to the activation of the protein _____ which in turn raises blood pressure by causing vasoconstriction.
- 67) The concentration of sodium and potassium are the major triggers of aldosterone secretion. But aldosterone is also secreted in response to increased/decreased (circle one) blood pressure.
- 68) When aldosterone is secreted in response to low blood pressure, it is because the protein _____ (which is a potent vasoconstrictor) has activated the adrenal gland to release aldosterone.
- 69) Aldosterone increases blood pressure in this way: Aldosterone increases the blood concentration of _____, which raises the osmolarity of the blood. The high osmolarity blood attracts _____ from the tissues of the body, which increases blood volume and pressure.

70) Since aldosterone secretion is controlled by angiotensin II, which is in turn controlled by renin, aldosterone secretion is indirectly controlled by the _____ (organs), the organs which produce the renin.

71) When blood pressure is low, a series of events that lead to an increase in the kidney's reabsorption of sodium occur. These events are outlined below. Fill in the missing terms in the blanks. Some blanks require more than one word answers. Hints appear next to some blanks.



72) pH is a measure of the concentration of _____ ion.

73) The normal pH of blood is _____ to _____ (state the normal pH range). If the blood pH is greater than _____, the person has the blood condition _____; if the blood pH is less than _____, the person has the blood condition _____.

74) A _____ is a substance which, when in solution, is able to stabilize the solution's pH.

75) Blood pH can be regulated by three of the body's systems: the _____, _____, and _____.

76) The blood contains two molecules that buffer to help keep blood pH within the normal range. Write the chemical formulas and names of the two blood buffer molecules (hint: Both contain carbon):

Circle the molecule above that lowers the pH of the blood.

Write the chemical equation that shows the circled molecule above lowering the pH (hint: It releases an H^+ ion to lower the blood pH)

77) When excess hydrogen ions are added to the blood's buffer system, they bind to _____ to form _____.

78) When hydrogen ions are removed from the blood's buffer system, _____ releases hydrogen ions to replace those that were removed.

80) When blood pH decreases, breathing rate must increase/decrease (circle one) to help return the pH to its normal value.

81) When blood pH increases, breathing rate must increase/decrease (circle one) to help return the pH to its normal value.

82) Accelerating the breathing rate removes _____ from the blood, and therefore counteracts the blood pH imbalance called _____.

83) Lowering the breathing rate adds _____ to the blood, and therefore counteracts the blood pH imbalance called _____.

84) The kidneys help counteract acidosis is by secreting _____ into the filtrate and by reabsorbing _____ from the filtrate.

85) Hydrogen ions are secreted into the nephron if the blood has less than _____ pH, and they are reabsorbed if the blood has more than _____ pH.

86) Bicarbonate ions are reabsorbed if the blood has less than _____ pH.

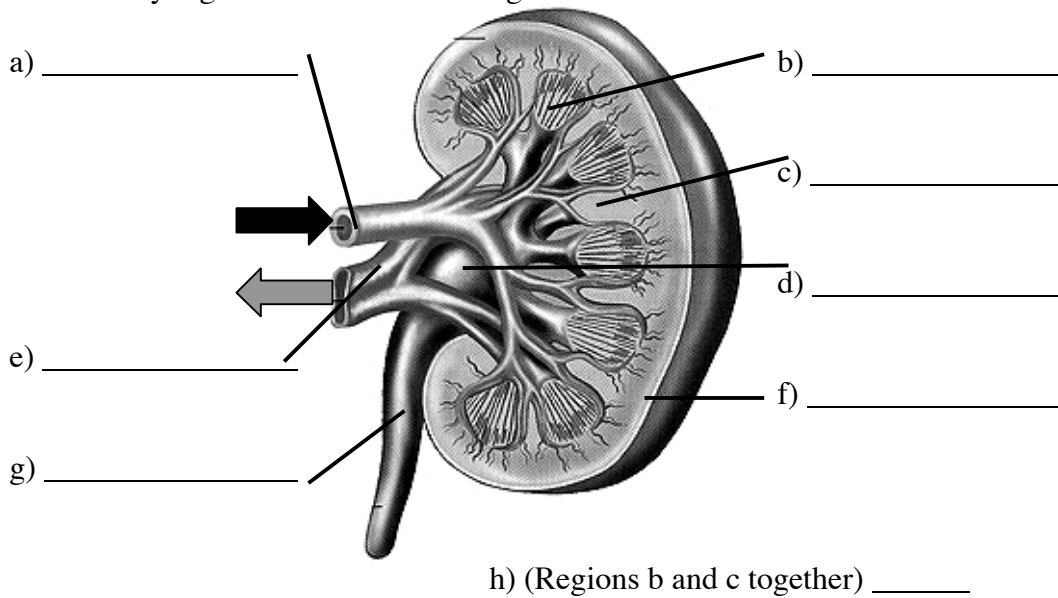
Answers to multiple choice review questions

- 1) Clean
Balance
- 2) Urea
- 3) Urine
- 4) Renal artery
Columns
- 5) Cortex
- 6) Ureter
- 7) a) Superior (or lateral)
b) Superior
c) Inferior
d) Lateral
- 8) Filtrate
Blood
Urine
- 9) The collecting ducts
- 10) Reabsorption
- 11) Renal artery
Renal vein
- 12) Nephrons
- 13) Glomeruli
Cortex
- 14) Filtrate
- 15) One million
- 16) Glomerular capsule
- 17) Renal corpuscle
- 18) Proximal convoluted tubule
- 19) Proximal convoluted tubule
- 20) Nephron loop
NaCl
Water
- 21) Collecting duct
Renal pelvis
Ureter
- 22) Collecting ducts
- 23) Efferent
Peritubular capillary bed
- 24) Blood pressure
- 25) Filtration
- 26) Reabsorption
- 27) Filtration
Reabsorption
- 28) Peritubular
Renal vein
- 29) NaCl
Water
- 30) Kidneys
Ureter
Bladder
Urethra
- 31) Internal urethral sphincter
External urethral sphincter
- 32) Internal
External
- 33) Urethra
- 34) Micturition
- 35) Smooth muscle
- 36) 200 ml
Contract
- 38) 4
3
2
6
5
1
- 39) Urinary retention
The bladder
Smooth muscle
- 40) Enlargement of the prostate gland
- 41) Incontinence
- 42) Water (circled)
Red blood cells +
Bicarbonate ion
Cl⁻ *
Uric acid
Na⁺ *
K⁺
H⁺
- 51) a) Sweating
b) Urination
c) Feces
d) Breathing/lungs
- 52) Dehydration
Excessive sweating
Excessive diarrhea
Not drinking enough water
- 53) Drinking too much water

- | | |
|----------------------------|---|
| 54) Hypothalamus | 73) 7.35 |
| Antidiuretic hormone (ADH) | 7.45 |
| Water | 7.45 |
| 55) Posterior | Alkalosis |
| 56) Increase | 7.35 |
| Decrease | Acidosis |
| 57) Water reabsorption | 74) Buffer |
| Kidney | 75) Blood buffers |
| 58) Low | Respiratory system |
| 59) High | Urinary system |
| 61) Aldosterone | 76) H_2CO_3 (carbonic acid) [circled] |
| 62) Adrenal cortex | HCO_3^- (bicarbonate ion) |
| 63) Na^+ | $\text{H}_2\text{CO}_3 \rightarrow \text{HCO}_3^- + \text{H}^+$ |
| K^+ | 77) HCO_3^- (bicarbonate ion) |
| 64) Secretion | H_2CO_3 (carbonic acid) |
| 65) Increase | 78) H_2CO_3 (carbonic acid) |
| 66) Renin | 80) Increase |
| Angiotensin II | 81) Decrease |
| 67) Decrease | 82) H^+ |
| 68) Angiotensin II | Acidosis |
| 69) Sodium | 83) H^+ |
| Water | Alkalosis |
| 70) Kidneys | 84) H^+ |
| 71) Renin | HCO_3^- |
| Angiotensin II | 85) 7.35 |
| Adrenal gland | 7.45 |
| Aldosterone | 86) 7.35 |
| 72) H^+ | |

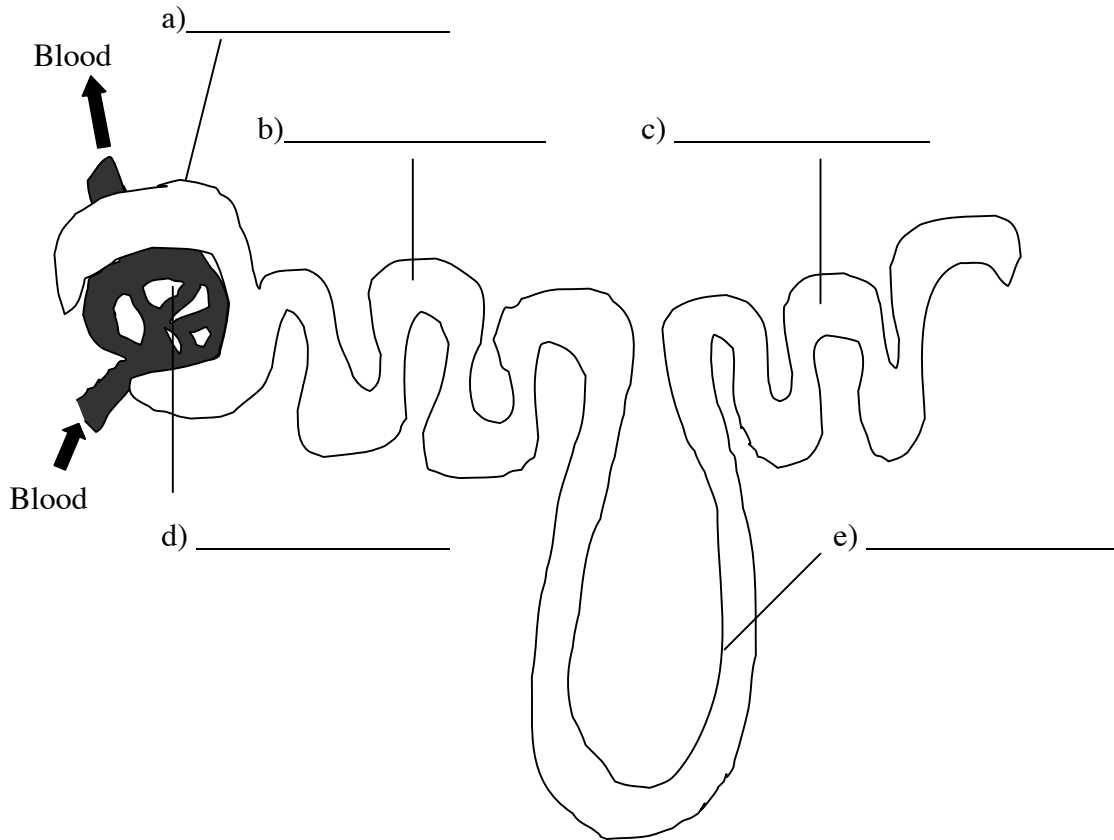
Short answer review questions:

- 1) Describe the purposes of the kidneys in a single sentence.
- 2) The kidneys make urine when they clean and balance the blood. Explain what “clean and balance” the blood means. Your answer should include the names of specific molecules in the blood as examples.
- 3) Name the kidney regions and tubes in the figure below.



- 4) Trace the blood flow through the kidney, from the renal artery to the renal vein. Your answer should include a list of all the blood vessels (in the order that blood passes through them) that were named in this lecture.
- 5) The blood contains many organic molecules, such as proteins and glucose. Explain how proteins are excluded from the filtrate but glucose is not.

6) Label the parts of the nephron then follow the instructions below the drawing. Some blanks require more than one word answers.



Which part(s) above (a – e)...

Are in the medulla? _____

Specialize in reabsorbing salt and water? _____

Are where most reabsorption takes place? _____

The diagram above does not show the peritubular capillary bed. Draw it on the diagram or describe where it is located.

7) Which regions of the nephron specialize in only water and NaCl reabsorption?

10) If you were injected with very large amounts of penicillin, vitamin C, or any other molecule that the kidney rapidly removes from the blood, would you expect your urine volume increase, decrease, or stay the same? Justify your answer. Hint: Consider osmosis effects on the urine.

11) The kidney responds to low blood pressure by a) Increasing the amount of water reabsorbed from the filtrate, and b) Increasing the amount of sodium reabsorbed from the filtrate. Describe briefly (2 –3 sentences) how reabsorbing more sodium from the filtrate leads to an increase in blood pressure.

Answers to short answer review questions:

1) The kidneys clean and balance the blood.

2) “Clean” means to remove wastes out of the blood. An example waste is the nitrogen containing molecule urea. “Balance” means to adjust the water and nutrient solutes to their proper concentrations. Example molecules that are balanced by the kidney include water, Na^+ , K^+ , Ca^{2+} , glucose, amino acids, and vitamins.

- 3)
- A = Renal artery
 - B = Renal pyramid
 - C = Renal column
 - D = Renal pelvis
 - E = Renal vein
 - F = Renal cortex
 - G = Ureter
 - H = Renal medulla

4) Blood that needs to be cleaned and balanced arrives at each kidney in the renal artery. The renal artery branches into many smaller arteries as it moves to the cortex region of the kidney. In the cortex, the blood enters small blood vessels called afferent arterioles. Each afferent arteriole passes blood into a ball-shaped capillary bed called a glomerulus. Some liquid in the glomerulus blood filters into the nephron, but some blood in the glomerulus exits the glomerulus into an efferent arteriole, and then from there into the peritubular capillary bed. Blood from several peritubular capillary beds merges into small veins which merge into larger veins as they pass from the renal cortex to the renal vein, on the medial side of the kidney. The blood exits the kidney in the renal vein.

5) The cells of the glomerulus and the cells of the glomerular capsule have small gaps between neighboring cells. These two structures together are called a renal corpuscle. It acts as a filter that allows small molecules in the blood (such as glucose) to pass through the gaps into the filtrate inside the nephron. Large blood molecules (such as proteins) are too large to pass the gaps between the cells, and so proteins are not able to filter into the nephron.

- 6)
- A = The glomerular capsule
 - B = Proximal convoluted tubule
 - C = Distal convoluted tubule
 - D = Glomerulus
 - E = Nephron loop

E The nephron loop is in the medulla

E The nephron loop specializes in reabsorbing NaCl and water

B The proximal convoluted tubule is where the most reabsorption occurs.

(The peritubular capillary bed should be added to the drawing. It begins at the efferent arteriole exiting the glomerulus and intertwines with all regions of the nephron)

7) The nephron loop is the only region of the nephron that specializes in only reabsorbing water and NaCl. Although the proximal and distal convoluted tubules of the nephron reabsorb water and NaCl, they also reabsorb many other substances in addition to NaCl and water. The collecting duct, although not considered part of the nephron, also specializes in reabsorbing only water and NaCl.

10) Urine volume will increase. When the kidney removes large amounts of solutes from the blood, those removed solutes become large concentrations of solutes in the filtrate. The principle of osmosis says that large concentrations of any solute will attract water molecules. Water will therefore move into the filtrate by osmosis, increasing the volume of urine. This increased urine volume effect occurs, for example, when the kidneys remove large amounts of glucose from the blood of diabetics.

11) Increased sodium reabsorption from the filtrate increases the blood's sodium concentration. The principle of osmosis says that large concentrations of any solute will attract water molecules. Water will therefore move into the blood by osmosis, increasing the volume of blood. Increased blood volume causes increased blood pressure.