These review questions for the urinary system lecture were adapted from our textbook and its website, and also from 1800+ Review Questions for Anatomy and Physiology II (2nd edition) by R. Michael Anson, Ph.D.

You are required to know and understand all the material on the urinary system that is covered in the lecture and in the laboratory. Questions marked with an asterisk are from material presented in the laboratory section of the course.

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 "filter" of the nephron (where liquids enter the nephron) is formed by…
   a) The ureter and the renal pelvis
   b) The glomerulus and the glomerular capsule
   c) The proximal convoluted tubule and the distal convoluted tubule
   d) The collecting duct
   e) The renal pelvis and the bladder

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 renal corpuscle and thus are **not** normally found in the filtrate?

A) red and white blood cells

B) glucose

C) amino acids

D) sodium ions

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 to the efferent arteriole, then next to the

A) peritubular capillary.

B) renal artery

C) collecting duct

D) renal vein.

12) Monosaccharides (such as glucose) 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 renal columns
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) Firing of the reflex causes urine to exit the urethra (urination).
D) The reflex causes the urge to urinate.

15) Which of these substances is normally filtered and then completely (100%) reabsorbed by the nephron?
A) protein
B) sodium
C) urea
D) glucose

16) Which of the following is filtered but not reabsorbed?
A) K+
B) sodium
C) urea
D) glucose

17) Glucose and amino acids are normally
A) not in the blood and not in the filtrate (they are only found inside cells)
B) found in the urine.
C) partially reabsorbed
D) reabsorbed completely

18) The presence of hemoglobin in the urine
A) Occurs normally
B) Indicates the presence of a kidney disease where the nephron cannot

reabsorb hemoglobin from the filtrate
C) May occur in diabetes mellitus
D) May indicate a hemolytic disease

19) The kidney regulates all of the following except
A) blood pressure
B) the concentrations of electrolytes and waste products in the blood.
C) the absorption of substances from the gastrointestinal tract.
D) the 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 released from the pituitary gland
B) The target cells of ADH are the nephron cells
C) More ADH is released when the body is dehydrated
D) More ADH is released when there is an increase in the blood's water content

22) When ADH _____, _____ water moves _____ of the filtrate.
A) increases; more, out
B) increases; less, out
C) decreases, more, into
D) decreases, more, out

23) The normal blood pH is
A) 0 - 14
B) 7.4
C) Exactly 7.0 (neutral) because of acid/base balancing
D) 4.6 – 8.0

24*) The normal urine pH range is
A) 0 - 14
B) 7.4
C) Exactly 7.0 (neutral) because of acid/base balancing
D) 4.6 – 8.0

25) Aldosterone

A) is the major hormone secreted by the kidney.
B) promotes the filtration of Na+ into the nephron
C) promotes the reabsorption of Na+ from the nephron
D) is a protein hormone secreted by the pituitary gland

26) If aldosterone levels _____, then (because of osmosis) blood volume will _____, and blood pressure will _____.

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

27*) The normal urine specific gravity range is

A) 7.0
B) 1.01 – 1.03
C) 4/5 (80%)
D) 4.6 – 8.0

28*) If a person drank a very large amount of water, their urine's specific gravity would

A) increase
B) decrease
C) stay the same (as long as the water was pH 7.0)
D) stay the same (regardless of the water pH)

29) Which response would NOT be observed in a person with low blood pressure?

A) increased renin secretion.
B) increased aldosterone secretion.
C) increased ADH secretion
D) increased urinary Na+.

30) 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, so it is not part of the filtrate
B) Hydrogen ion (H+) are part of the filtrate
C) H^+ reabsorption increases during alkalosis.

D) During acidosis, more bicarbonate is reabsorbed and less bicarbonate is excreted in the urine.

31) 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
2) B
3) B
4) B
5) B
6) A
7) A
8) C
9) B
10) B
11) A
12) A
13) C
14) D
15) D
16) C
17) D
18) D
19) C
20) D
21) D
22) A
23) B
24) D
25) C
26) A
27) B
28) B
29) D
30) A
31) 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 ion 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. The regions of the medulla where the blood vessels pass through are called renal _____. They 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 removed 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 eventually flows through small blood vessels called 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 in the nephron that came from the blood 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 reabsoption of _____ and _____.

21) The _____ receives the filtrate from the distal convoluted tubules of several adjacent nephrons and carries 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 pushes the blood through the nephron's filter.

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 renal corpuscle (the glomerulus and 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 the filtrate that exits nephrons, collecting ducts in the kidney also help balance the blood by reabsorbing _____ and _____ from the filtrate.

30) Urine is formed in the two _____ (a pair of 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.

37) In females, the outer urethral opening is located immediately superior to/inferior to inside of/ (circle one of the three) the vaginal opening.

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 been found in urine. Some of these substances, however, are not present in normal healthy urine.

Water
Red blood cells
Glucose
Bicarbonate ion
Cl^-
Uric acid
Na^+
K^+
Bilirubin
H^+

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

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

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

43*) If a person has diabetes mellitus you would expect to find _____ in their urine.

44*) Trauma to the organs of the urinary system (such as the bladder, the ureters, or the kidneys) can result in the presence of _____ in the urine.

45) Most organic nutrients in the filtrate, such as glucose and amino acids, are totally secreted/excreted/reabsorbed/metabolized (circle one of the four) by the nephron.

46*) The term that means the density of a liquid compared to water is _____. For urine, the normal range of this is _____ to _____.

47*) The term that relates to the hydrogen ion (H+) concentration of a solution is _____. For urine, the normal range of this is _____ to _____.

48) Bilirubin is/isn't (circle one) are normal part of urine.

49*) After bilirubin is released into the blood, it is transported to the liver where it is used as a main ingredient in the digestive substance called _____.

50*) Bilirubin is yellow, so if liver disease impairs the liver's ability to remove bilirubin from the blood, the result is _____, a visible yellowing of the skin, the whites of the eyes, and other external body structures.

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) Sensors in the brain monitor the blood's water concentration. In response to changes in water concentration, these brain regions regulate the release of _____ hormone from the pituitary gland. This hormone promotes the reabsorption of ____ from the filtrate.

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

56) ADH is released when the brain 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 and low/high (circle one) in solute concentration.

59) When ADH levels are low, less filtered water is reabsorbed, resulting in urine that is low/high (circle one) volume and low/high (circle one) concentration.

60*) Diuretics are drugs that block the action of ADH. Diuretic drugs, therefore, cause an increase/decrease (circle one) in blood pressure by causing the kidney to reabsorb more/less (circle one) _____from the filtrate.

61) The hormone _____ controls sodium and potassium levels in the blood.

62) Aldosterone is released 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 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 neprhon: 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 release. But aldosterone is also secreted in response to increased/decreased (circle one) blood pressure.

68) When aldosterone is released 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 blood pressure.

70) Since aldosterone secretion is controlled by angiotensin II, which is in turn controlled by renin, aldosterone release 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.

When blood pressure is, the kidney

Releases…

_____ (a protein)

which activates the blood protein…

_____

which activates the gland…

_____ (a gland)

which releases…

_____ (a hormone)

which increases sodium reabsorption by the kidney,
which increases the blood pressure.

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

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

74) A _____ is a substance which, when in solution, is able to stabilize 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 <u>lowers</u> 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 are absorbed by the buffering molecule _____. This chemical reaction forms a _____ molecule.
78) When hydrogen ions are lost from the body (such as might occur from excessive vomiting), the blood buffering molecule _____ releases hydrogen ions to replace those that were removed.

79) Although the bicarbonate buffer system is the major buffer in the blood, other major molecules that buffer the blood are the blood _____ such as albumin.

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

81) When blood pH increases, breathing rate will automatically 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 from the peritubular capillary bed into the nephron if the blood has_____ (a blood pH abnormality), and they are reabsorbed from the nephron into the peritubular capillary bed if the blood has _____ (a blood pH abnormality),

86) Very few bicarbonate ions are reabsorbed from the nephron into the peritubular capillary bed if the blood has _____ (a blood pH abnormality). Very many bicarbonate ions are reabsorbed from the nephron into the peritubular capillary bed if the blood has _____ (a blood pH abnormality).

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 (or lateral)
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
37) Superior to
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 +
Glucose +
Bicarbonate ion
Cl^- *
Uric acid
Na^+ *
K^+
Bilirubin +
H^+
43*) Glucose
44*) Red blood cells
45) Reabsorbed

46*) Specific gravity
1.010 – 1.030
47*) pH
4.5 – 8.0
48) Isn't
49*) Bile
50*) Jaundice
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) Antidiuretic hormone (ADH)
Water
55) Posterior
56) Decrease
57) Water reabsorption
Kidney
58) Low
High
59) High
Low

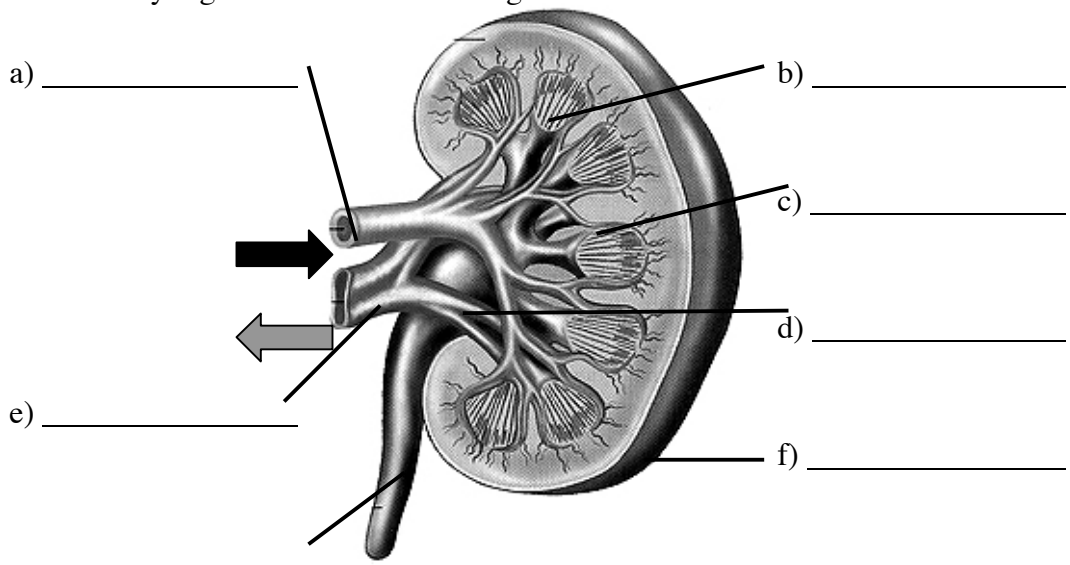
60*) Decrease
Less
Water
61) Aldosterone
62) Adrenal cortex
63) Na^+
K^+
64) Secretion
65) Increase
66) Renin
Angiotensin II
67) Decrease
68) Angiotensin II
69) Sodium
Water
70) Kidneys
71) Renin
Angiotensin II
Adrenal gland
Aldosterone
72) H^+
73) 7.4
Alkalosis
Acidosis
74) Buffer
75) Blood buffers
Respiratory system
Urinary system
76) H_2CO_3 (carbonic acid) [circled]
HCO_3^- (bicarbonate ion)
$H_2CO_3 \rightarrow HCO_3^- + H^+$
77) HCO_3^- (bicarbonate ion)
H_2CO_3 (carbonic acid)
78) H_2CO_3 (carbonic acid)
79) Proteins
80) Increase
81) Decrease
82) H^+
Acidosis
83) H^+
Alkalosis
84) H^+
HCO_3^-
85) Acidosis
Alkalosis
86) Alkalosis
Acidosis

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.



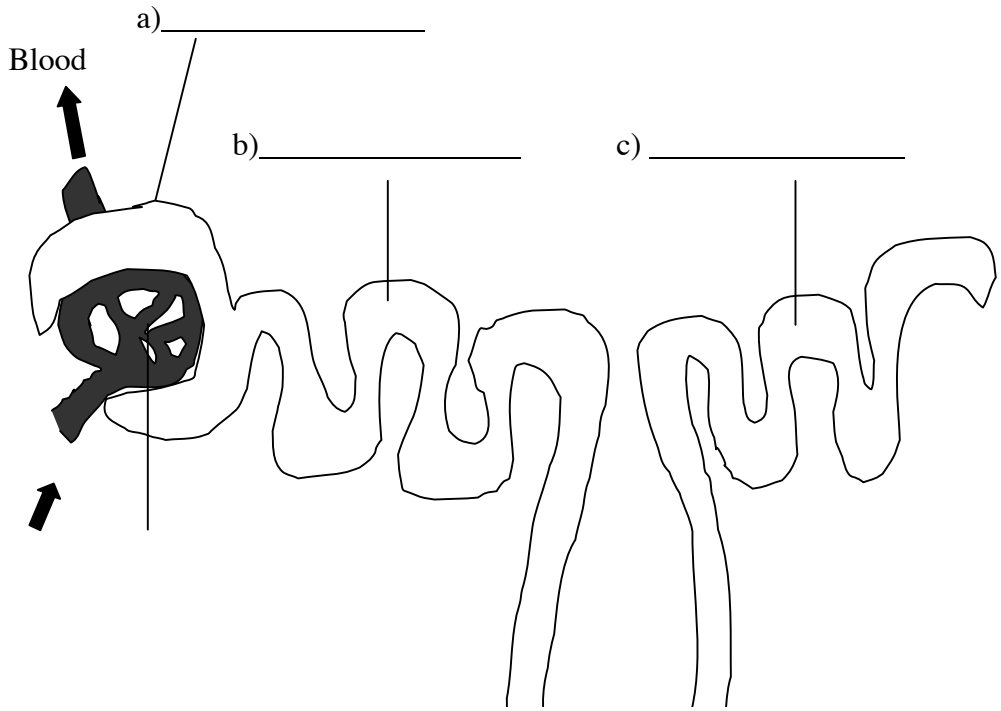
g) _____

h) (Regions b and c together) _____

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.



Blood

d) _____ e) _____

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?

8) Explain how liver disease can lead to bilirubin in the urine. Your answers should include all the molecules and processes that are involved.

9) The body is more easily damaged by changes in potassium ion concentration than it is by changes in sodium ion concentration. If a person had high potassium and high sodium, which hormone would you predict would be used to adjust the imbalance, and would the level of this hormone increase or decrease?

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 what occurs to the urine volume in diabetes mellitus and why it occurs.

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 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 = Glomerular capsule
B = Proximal convoluted tubule
C = Distal convoluted tubule

D = Glomerulus
E = Nephron loop

E (nephron loop) is in the medulla
E (nephron loop) specializes in reabsorbing NaCl and water
B (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.

8) When RBCs become old and worn out, certain molecules inside the RBC are converted into a yellowish pigment called bilirubin. The liver removes the bilirubin from the blood and uses it as a main ingredient for bile (a digestive juice that the liver secretes into the digestive tract). If a person has liver disease (or a blocked bile duct), the liver no longer removes bilirubin from the blood and therefore the blood bilirubin concentration increases. This causes jaundice (yellow skin) and also causes bilirubin to appear in the urine.

9) The hormone aldosterone (which is released from the adrenal gland) is used by the body to adjust sodium and potassium ion imbalances. Aldosterone works by adjusting the amount of sodium and potassium that leave the body in the urine, but aldosterone affects sodium and potassium in opposite ways: The higher the aldosterone level, the more potassium that will leave the body in the urine. But the higher the aldosterone, the less sodium will leave the body in the urine.

If potassium and sodium are both above normal levels, the adrenal gland would secrete more aldosterone. The high level of aldosterone will decrease the potassium levels in the blood. The high aldosterone, however, will also increase sodium in the blood, so the extra aldosterone would actually make the high sodium levels even higher. But since the body is more harmed by high potassium than it is by high sodium, it is more important to lower the potassium, even if this means increasing the sodium.

Also note that high levels of any solute (including sodium or potassium) will cause the pituitary to increase the amount of ADH hormone, which will lower the concentration of all solutes in the blood by adding more water to the blood. So increased Na^+ and/or increased K^+ will also trigger increased ADH hormone.

10) Urine volume will increase. When the kidney removes large amounts of solutes from the blood, they 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 move into the blood by osmosis, increasing the volume of blood. Increased blood volume causes increased blood pressure.