

## Chapter 14 a--The Urinary System

1. Which of the following is not a function of the kidneys?
  - A. excreting metabolic wastes
  - B. maintaining proper plasma volume
  - C. secreting aldosterone to regulate sodium
  - D. maintaining proper osmolarity of body fluids
  - E. assisting in maintaining the proper acid-base balance of the body
2. Which of the following is not a function of the kidneys?
  - A. They contribute significantly to long-term regulation of arterial blood pressure by maintaining the proper plasma volume.
  - B. They act directly on the interstitial fluid, the fluid that bathes the cells, to maintain constancy in its composition.
  - C. They excrete the metabolic waste products.
  - D. They assist in maintaining the proper acid-base balance of the body.
  - E. They secrete a hormone.
3. The functional unit of the kidney is the
  - A. glomerulus
  - B. nephron
  - C. medulla
  - D. pyramid
  - E. juxtaglomerular apparatus
4. The specialized nephron capillary bed where filtration occurs is the
  - A. afferent arteriole
  - B. efferent arteriole
  - C. glomerulus
  - D. peritubular bed
  - E. none of these
5. Which of the following statements about juxtamedullary nephrons is incorrect?
  - A. Their glomeruli lie in the renal medulla.
  - B. They are important in the ability of the kidneys to concentrate urine.
  - C. Their loops of Henle dip deep into the medulla.
  - D. Their peritubular capillaries form vasa recta.
  - E. They are not the predominant type of nephron found in human kidneys.

6. Which of the following is not associated with juxtamedullary nephrons?
- A. glomeruli located in medulla
  - B. long loops of Henle
  - C. peritubular capillaries forming vasa recta
  - D. collecting duct in medulla
  - E. important role in the ability of the kidneys to produce urine of varying concentration

7. Below is a listing of nephron components and associated structures.

- 1. descending limb of loop of Henle
- 2. Bowman's capsule
- 3. collecting tubule
- 4. ascending limb of loop of Henle
- 5. distal tubule
- 6. proximal tubule

Indicate the correct flow of filtrate through these structures.

- A. 4, 6, 5, 3, 2, 1
  - B. 2, 6, 1, 4, 5, 3
  - C. 2, 5, 6, 3, 1, 4
  - D. 3, 2, 6, 1, 4, 5
  - E. 2, 1, 4, 3, 5, 6
8. The peritubular capillaries
- A. supply nutrients and  $O_2$  to the tubular cells
  - B. take up the substances that are reabsorbed by the tubules
  - C. supply substances that are secreted by the tubules
  - D. all of these
  - E. none of these
9. Which nephron structure is especially important in the kidney's ability to produce urine of varying concentration?
- A. Bowman's capsule
  - B. proximal tubule
  - C. distal tubule
  - D. loop of Henle
  - E. glomerulus
10. Vasa recta are associated with
- A. afferent arterioles
  - B. efferent arterioles
  - C. cortical nephrons
  - D. juxtamedullary nephron
  - E. renal papillae

11. The renal process whereby substances are selectively transferred from the peritubular blood into the renal tubule is
- A. filtration
  - B. secretion
  - C. reabsorption
  - D. excretion
  - E. none of these
12. The blood that flows through the kidneys is
- A. normally about 20 to 25 percent of the total cardiac output
  - B. all filtered through the glomeruli
  - C. all used to supply the renal tissue with O<sub>2</sub> and nutrients
  - D. all of these
  - E. normally about 20 to 25 percent of the total cardiac output, and all filtered through the glomeruli
13. The glomerular filtration rate
- A. averages 125 ml/min
  - B. averages 75 liters/day
  - C. represents 60 to 65 percent of the cardiac output
  - D. is less than the rate of renal reabsorption
  - E. all of these
14. The glomerular filtrate
- A. is a protein-free plasma
  - B. is formed as a result of passive forces acting across the glomerular membrane
  - C. does not contain foreign compounds because these substances are secreted by special transport mechanisms in the proximal tubule instead
  - D. is a protein-free plasma and is formed as a result of passive forces acting across the glomerular membrane
  - E. is a protein-free plasma and does not contain foreign compounds because these substances are secreted by special transport mechanisms in the proximal tubule instead
15. Filtrate passes through all of these except
- A. glomerular capillary pores
  - B. basement membrane
  - C. podocytes
  - D. filtration slits
  - E. Bowman's capsule

16. The glomerular capillary blood pressure in the nephron is 78 mm Hg. The Bowman's capsular hydrostatic pressure is 24 mm Hg. The colloidal osmotic pressure is 18 mm Hg. The net filtration pressure is \_\_\_\_\_ mm Hg.
- A. 18
  - B. 26
  - C. 36
  - D. 42
  - E. 78
17. Which of the following is not part of the nephron?
- A. collecting duct
  - B. Bowman's capsule
  - C. ureter
  - D. descending limb
  - E. proximal tubule
18. Changes in the glomerular filtration rates are accomplished through
- A. autoregulation
  - B. myogenic activity
  - C. vasoactive responses in the afferent arteriole
  - D. all of these
  - E. none of these
19. Which factor would reduce the net filtration pressure the most?
- A. vasodilation of the afferent arteriole
  - B. vasoconstriction of the efferent arteriole
  - C. a large increase in blood colloid osmotic pressure
  - D. a low capsular hydrostatic pressure
  - E. a high glomerular hydrostatic pressure
20. Identify the correct statement(s).
- A. Bowman's capsule hydrostatic pressure opposes filtration.
  - B. The glomerular filtration rate is limited by a  $T_m$ .
  - C. All of the plasma that enters the glomerulus is filtered.
  - D. The glomerular filtration rate is limited by a  $T_m$ , and all of the plasma that enters the glomerulus is filtered.
  - E. All of these.

21. Glomerular filtration
- A. occurs in the loop of Henle
  - B. is the process by which plasma water, electrolytes, and small molecules, which enter Bowman's capsule, are separated from blood cells and protein, which remain in the glomerular capillaries
  - C. is the process by which a substance is transported from the tubular fluid to the peritubular capillaries
  - D. occurs in the loop of Henle, and is the process by which plasma water, electrolytes, and small molecules, which enter Bowman's capsule, are separated from blood cells and protein, which remain in the glomerular capillaries and
  - E. none of these
22. Which of the following factors would decrease the GFR?
- A. a fall in plasma protein concentration
  - B. an obstruction such as a kidney stone in the tubular system, which increases Bowman's capsule hydrostatic pressure
  - C. vasodilation of the afferent arterioles
  - D. a fall in plasma protein concentration and vasodilation of the afferent arterioles
  - E. none of these
23. The macula densa
- A. consists of specialized tubular cells in the juxtaglomerular apparatus
  - B. consists of specialized arteriolar smooth-muscle cells in the juxtaglomerular apparatus
  - C. secretes renin
  - D. consists of specialized tubular cells in the juxtaglomerular apparatus and secretes renin
  - E. consists of specialized arteriolar smooth-muscle cells in the juxtaglomerular apparatus and secretes renin
24. Which of the following is involved in autoregulation of the GFR?
- A. a myogenic mechanism in which the afferent arteriole automatically constricts when it is stretched
  - B. a tubulo-glomerular feedback mechanism in which vasoactive chemicals released from the juxtaglomerular apparatus bring about afferent arteriolar vasoconstriction
  - C. sympathetically induced vasoconstriction of the afferent arterioles
  - D. a myogenic mechanism in which the afferent arteriole automatically constricts when it is stretched, and a tubulo-glomerular feedback mechanism in which vasoactive chemicals released from the juxtaglomerular apparatus bring about afferent arteriolar vasoconstriction
  - E. none of these
25. Which of the following forces oppose glomerular filtration?
- A. blood colloid osmotic pressure
  - B. Bowman's capsule hydrostatic pressure
  - C. glomerular-capillary blood pressure
  - D. blood colloid osmotic pressure and Bowman's capsule hydrostatic pressure
  - E. Bowman's capsule hydrostatic pressure and glomerular-capillary blood pressure

26. Afferent arteriolar vasoconstriction \_\_\_\_\_ blood flow into the glomerulus, which causes the glomerular-capillary blood pressure to \_\_\_\_\_, leading to a(n) \_\_\_\_\_ in the net filtration pressure and a resultant \_\_\_\_\_ in the GFR.
- A. increases; increase; increase; increase
  - B. decreases; decrease; decrease; decrease
  - C. increases; increase; decrease; decrease
  - D. decreases; decrease; increase; increase
  - E. none of these
27. The myogenic mechanism
- A. causes the afferent arteriole to constrict when blood pressure is too high
  - B. may result from stretching of vascular smooth muscle
  - C. is an autoregulatory mechanism
  - D. reduces GFR
  - E. all of these
28. Stimulation of the macula densa cells
- A. results in vasodilation of the afferent arteriole
  - B. results in vasoconstriction of the afferent arteriole
  - C. increases GFR
  - D. results in vasodilation of the afferent arteriole and results in vasoconstriction of the afferent arteriole
  - E. results in vasodilation of the afferent arteriole and increases GFR
29. Extrinsic control of the GFR
- A. is mediated by sympathetic nervous system input to the afferent arterioles
  - B. is aimed at the regulation of arterial blood pressure
  - C. does not require a special mechanism but occurs as part of the baroreceptor reflex
  - D. decreases the GFR
  - E. all of these
30. When arterial blood pressure is elevated above normal, which of the following compensatory changes in renal function occur as a result of the baroreceptor reflex?
- A. afferent arteriolar vasoconstriction
  - B. afferent arteriolar vasodilation
  - C. reduction in GFR
  - D. afferent arteriolar vasoconstriction and reduction in GFR
  - E. all of these

31. Tubular reabsorption
- A. refers to the movement of a substance from the peritubular capillary blood into the tubular fluid
  - B. occurs by either active or passive transport
  - C. involves the process of transepithelial transport
  - D. occurs by either active or passive transport and involves the process of transepithelial transport
  - E. none of these
32. Which statement about tubular reabsorption is incorrect?
- A. It refers to the movement of a substance from the tubular fluid to the peritubular capillary blood.
  - B. It is important for the conservation of substances important to the body, such as  $\text{Na}^+$ ,  $\text{Cl}^-$ , glucose, and amino acids.
  - C. It can occur by active or passive transport mechanisms.
  - D. It involves the process of transepithelial transport.
  - E. It takes place only in the proximal tubule.
33. Tubular reabsorption
- A. involves the movement of substances from the peritubular capillaries into the tubular fluid
  - B. involves the movement of substances from the tubular fluid into the peritubular capillaries
  - C. is considered to be active if any one of the five steps of transepithelial transport is active
  - D. involves the movement of substances from the peritubular capillaries into the tubular fluid and is considered to be active if any one of the five steps of transepithelial transport is active
  - E. involves the movement of substances from the tubular fluid into the peritubular capillaries and is considered to be active if any one of the five steps of transepithelial transport is active
34. Tubular reabsorption involves
- A. active transport
  - B. cotransport
  - C. facilitated diffusion
  - D. countertransport
  - E. all of these
35. Which of the following is not a step in transepithelial transport?
- A. movement of the substance through the cytosol of the tubular cell
  - B. movement of the substance across the glomerular capillary wall
  - C. movement of the substance across the luminal membrane of the tubular cell
  - D. movement of the substance through the interstitial fluid
  - E. movement of the substance across the basolateral membrane of the tubular cell

36. The  $\text{Na}^+ - \text{K}^+$  ATPase transport system that plays a pivotal role in much of tubular reabsorption is located in the
- A. luminal membrane of tubular cells
  - B. basolateral membrane of tubular cells
  - C. podocytes
  - D. glomerular capillary membrane
  - E. basement membrane
37. Which is reabsorbed by the proximal convoluted tubule?
- A. sodium
  - B. amino acids
  - C. glucose
  - D. all of these
  - E. none of these
38. Into which structure does most reabsorption occur?
- A. proximal convoluted tubule
  - B. glomerulus
  - C. distal convoluted tubule
  - D. loop of Henle
  - E. none of these
39. Glucose is not normally found in the urine because
- A. It does not get filtered out of glomerulus.
  - B. It is not found in the blood.
  - C. It is usually reabsorbed by renal tubule cells.
  - D. It is kept in the blood.
  - E. None of these.
40. The proximal tubule
- A. reabsorbs about 65 percent of the filtered water
  - B. is not the site of action of renin
  - C. is the location where glucose is reabsorbed
  - D. reabsorbs about 65 percent of the filtered water and is the location where glucose is reabsorbed
  - E. all of these



41. Tubular maximum ( $T_m$ )
- A. is the maximum amount of a substance that the tubular cells can actively transport within a given time period
  - B. is the maximum rate at which a substance is filtered at the glomerulus
  - C. occurs when the membrane carrier becomes saturated
  - D. is the maximum amount of a substance that the tubular cells can actively transport within a given time period, and occurs when the membrane carrier becomes saturated
  - E. is the maximum rate at which a substance is filtered at the glomerulus, and occurs when the membrane carrier becomes saturated
42.  $T_m$  is the maximum
- A. rate of glomerular filtration
  - B. rate a substance can be reabsorbed because of saturation of the carrier molecule
  - C. rate of urine excretion
  - D. rate a substance can be cleared from the blood
  - E. percentage of renal blood flow that can be converted to filtrate
43. The renal threshold is the
- A. maximum amount of a particular substance that can be excreted in the urine per unit of time
  - B. maximum amount of a particular substance that the tubular cells are capable of actively reabsorbing per unit of time
  - C. plasma concentration of a particular substance at which its  $T_m$  is reached and the substance first appears in the urine
  - D. maximum amount of waste products that can be concentrated in the urine per unit of time
  - E. maximum amount of water that can be osmotically absorbed across the tubules per unit of time
44. Which of the following plasma constituents is not regulated by the kidneys?
- A. glucose
  - B.  $\text{Na}^+$
  - C.  $\text{H}^+$
  - D. phosphate
  - E. water
45. Reabsorption of chloride is
- A. active
  - B. passive
  - C. dependent on the amount of sodium reabsorbed
  - D. active and dependent on the amount of sodium reabsorbed
  - E. passive and dependent on the amount of sodium reabsorbed

46. Select the major waste product of nitrogen metabolism.
- A. plasma proteins
  - B. urea
  - C. glucose
  - D. PO<sub>4</sub>
  - E. amino acids
47. Given the following data for substance X (GFR = 125 ml/min, T<sub>r</sub> = 125 mg/min, at a plasma concentration of 200 mg/100 ml), how much of substance X is filtered, reabsorbed, and excreted?
- A. 200 mg/min filtered, 125 mg/min reabsorbed, 75 mg/min excreted
  - B. 250 mg/min filtered, 125 mg/min reabsorbed, 125 mg/min excreted
  - C. 125 mg/min filtered, 125 mg/min reabsorbed, 0 mg/min excreted
  - D. 250 mg/min filtered, 200 mg/min reabsorbed, 50 mg/min excreted
  - E. none of these
48. The juxtaglomerular apparatus
- A. secretes renin in response to sodium depletion or plasma volume reduction
  - B. is a thickened region of specialized cells at a point where the distal tubule comes into intimate contact with the afferent and efferent arterioles of the same nephron
  - C. is where reabsorption of sodium occurs
  - D. secretes renin in response to sodium depletion or plasma volume reduction, and is a thickened region of specialized cells at a point where the distal tubule comes into intimate contact with the afferent and efferent arterioles of the same nephron
  - E. all of these
49. The maximum normal glucose concentration in the plasma is about \_\_\_\_ mg per 100 ml.
- A. 30
  - B. 60
  - C. 100
  - D. 180
  - E. 250
50. Which statement regarding sodium reabsorption is not accurate?
- A. It plays a role in glucose, amino acid, and urea reabsorption in the proximal tubule.
  - B. It is under hormonal control in the distal tubule.
  - C. In the loop of Henle, it contributes to the formation of concentrated urine.
  - D. Approximately 0.5% of sodium in the filtrate is reabsorbed on a daily basis.
  - E. Aldosterone is a key hormone involved in facultative reabsorption.

51. The juxtaglomerular apparatus
- A. is a combination of specialized tubular and vascular cells at a point where the beginning of the distal tubule comes into intimate contact with the afferent and efferent arterioles of the same nephron
  - B. secretes aldosterone
  - C. secretes renin
  - D. is a combination of specialized tubular and vascular cells at a point where the beginning of the distal tubule comes into intimate contact with the afferent and efferent arterioles of the same nephron and secretes aldosterone
  - E. is a combination of specialized tubular and vascular cells at a point where the beginning of the distal tubule comes into intimate contact with the afferent and efferent arterioles of the same nephron and secretes renin
52. Aldosterone
- A. stimulates  $\text{Na}^+$  reabsorption in the distal and collecting tubules
  - B. is secreted by the JG apparatus
  - C. stimulates  $\text{K}^+$  secretion in the distal tubule
  - D. stimulates  $\text{Na}^+$  reabsorption in the distal and collecting tubules and is secreted by the JG apparatus
  - E. stimulates  $\text{Na}^+$  reabsorption in the distal and collecting tubules and stimulates  $\text{K}^+$  secretion in the distal tubule
53. Aldosterone secretion
- A. occurs in the kidney
  - B. is stimulated by angiotensin II
  - C. is controlled by the concentration of  $\text{Cl}^-$
  - D. all of these
  - E. none of these
54.  $\text{Na}^+$  reabsorption
- A. uses 80% of the energy requirement of the kidney
  - B. is under control of the hormone aldosterone in the distal portions of the nephron
  - C. is linked to the reabsorption of water,  $\text{Cl}^-$ , glucose, amino acids, and urea
  - D. requires that tubule cells expend energy
  - E. all of these
55. The greatest percentage of  $\text{Na}^+$  reabsorption takes place in the
- A. proximal tubule
  - B. loop of Henle
  - C. distal tubule
  - D. collecting tubule
  - E. renal pelvis

56. When blood volume becomes abnormally low
- Sodium reabsorption is diminished.
  - Dilute urine is formed.
  - Renin catalyzes the conversion of angiotensinogen.
  - Aldosterone is secreted by the kidney.
  - All of these.
57. Angiotensin I
- is formed as a result of activation of angiotensinogen by renin
  - is transformed into angiotensin II as a result of converting enzyme action in the lungs
  - acts on the adrenal cortex to stimulate aldosterone secretion
  - is formed as a result of activation of angiotensinogen by renin, and is transformed into angiotensin II as a result of converting enzyme action in the lungs
  - all of these
58. Sodium reabsorption in the distal portions of the nephron is stimulated by
- atrial natriuretic peptide
  - vasopressin
  - angiotensin II
  - aldosterone
  - renin
59. Which of the following is not attributable to atrial natriuretic peptide (ANP)?
- It is released from the cardiac atria when the ECF volume is reduced.
  - It inhibits  $\text{Na}^+$  reabsorption in the distal parts of the nephron.
  - It inhibits renin secretion by the kidneys.
  - It inhibits aldosterone secretion by the adrenal cortex.
  - It inhibits sympathetic nervous activity to the heart and blood vessels.
60. The energy requirement for glucose reabsorption is used to
- run the  $\text{Na}^+ - \text{K}^+$  ATPase pump
  - run the  $\text{Na}^+$ -glucose co-transport carrier
  - synthesize renin, which controls glucose reabsorption
  - maintain the  $T_m$  for glucose
  - produce aldosterone-induced protein, which increases the permeability of the proximal tubular cells to glucose
61. Atrial natriuretic peptide
- is secreted by the heart when atrial pressure is high
  - results in an increased glomerular filtration rate
  - inhibits aldosterone activity
  - promotes renal excretion of water
  - all of these

62. Which of the following does not play a role in  $\text{Na}^+$  reabsorption?
- A. renin
  - B. vasopressin
  - C. angiotensinogen
  - D. aldosterone
  - E. atrial natriuretic peptide
63. The distal and collecting tubules are the site of
- A. the cotransport carriers for glucose and amino acid reabsorption
  - B. the organic ion secretory systems
  - C. aldosterone and vasopressin action
  - D. the cotransport carriers for glucose and amino acid reabsorption, and aldosterone and vasopressin action
  - E. the organic ion secretory systems and aldosterone and vasopressin action
64. Water reabsorption is under the control of vasopressin
- A. along the entire length of the nephron
  - B. only in the loop of Henle
  - C. only in the distal and collecting tubules
  - D. only in the proximal tubule
  - E. only in the glomerulus
65. Water reabsorption
- A. occurs passively by osmosis in the proximal tubule
  - B. is under the control of vasopressin in the distal and collecting tubules
  - C. occurs by active transport in the distal and collecting tubules
  - D. all of these
  - E. occurs passively by osmosis in the proximal tubule and is under the control of vasopressin in the distal and collecting tubules
66. Which statement is correct?
- A. Water reabsorption is under control of vasopressin throughout the length of the nephron.
  - B. The ascending limb of the loop of Henle is always impermeable to water.
  - C. Vasopressin makes the distal and collecting tubules impermeable to water.
  - D. Fifteen percent of the filtered water osmotically follows the absorption of  $\text{Na}^+$  and other solutes in the proximal tubule.
  - E. Water reabsorption is passive in the early portions of the nephron but is active in the distal portions of the nephron.

67. Water reabsorption

- A. cannot occur from any portion of the nephron in the absence of vasopressin
- B. occurs to the greatest extent in the proximal convoluted tubule
- C. is under vasopressin control in the proximal tubule
- D. is under vasopressin control in the distal and collecting tubules
- E. occurs to the greatest extent in the proximal convoluted tubule and is under vasopressin control in the distal and collecting tubules

68. Urea

- A. is the waste product with the smallest molecular size in the glomerular filtrate
- B. is in greater concentration at the end of the proximal tubule than in other body fluids
- C. has a clearance rate greater than GFR
- D. is the waste product with the smallest molecular size in the glomerular filtrate and is in greater concentration at the end of the proximal tubule than in other body fluids
- E. all of these

69. Urea

- A. is a waste product resulting from the breakdown of protein
- B. is passively reabsorbed at the end of the proximal tubule down a urea concentration gradient created by the osmotic-induced reabsorption of water from the proximal tubule
- C. recycling between the late portion of the collecting tubule and the long loops of Henle contributes to medullary hypertonicity
- D. is found in the blood, filtrate, and urine
- E. all of these

70. When the extracellular fluid becomes too acidic, the tubular secretion of

- A. no ionic substance is affected
- B. hydrogen ions decreases
- C. hydrogen ions increases
- D. sodium ions decreases
- E. sodium ions increases

71. Tubular secretion

- A. refers to the movement of a substance from the peritubular capillary blood into the tubular lumen
- B. can occur by active or passive transport mechanisms
- C. of  $K^+$  occurs in the distal and collecting tubules and is stimulated by aldosterone
- D. of organic anions and cations occurs in the proximal tubule by two distinct types of carriers
- E. all of these

72. Tubular secretion
- A. involves transepithelial transport
  - B. is the movement of a substance from the peritubular capillary blood into the tubular fluid
  - C. always occurs by active transport
  - D. involves transepithelial transport and is the movement of a substance from the peritubular capillary blood into the tubular fluid
  - E. is the movement of a substance from the peritubular capillary blood into the tubular fluid and always occurs by active transport
73. Tubular secretion is important
- A. in the renal regulation of hydrogen ion concentration
  - B. for the elimination of metabolic waste products from the body
  - C. in the renal regulation of sodium balance
  - D. in the secretion of renin
  - E. all of these
74. Tubular secretion of foreign substances, such as drugs, generally occurs in the
- A. Bowman's capsule
  - B. loop of Henle
  - C. proximal tubule
  - D. collecting duct
  - E. glomerulus
75. Potassium
- A. is actively reabsorbed in the proximal tubule
  - B. is actively secreted in the distal and collecting tubules
  - C. secretion is controlled by aldosterone
  - D. is filtered, reabsorbed, and secreted in the kidney
  - E. all of these
76. Which substance is normally secreted into the tubule?
- A. hydrogen ions
  - B. potassium ions
  - C. organic ions
  - D. hydrogen ions and potassium ions
  - E. all of these
77. Which of the following has a positive effect on aldosterone secretion?
- A. an increase in plasma  $K^+$
  - B. a decrease in plasma  $K^+$
  - C. activation of the renin-angiotensin pathway
  - D. an increase in plasma  $K^+$  and activation of the renin-angiotensin pathway
  - E. a decrease in plasma  $K^+$  and activation of the renin-angiotensin pathway

78. Plasma clearance is the
- A. time required to filter blood in the glomerulus
  - B. amount of a substance appearing in the urine in one minute of time
  - C. amount of a substance that is filtered in one minute of time
  - D. amount of a substance secreted in one minute of time
  - E. volume of plasma that is completely cleared of a substance by the kidneys in one minute of time
79. If a substance has a plasma concentration of 150 mg/ml and a urine concentration of 1.7 mg/ml, and the urine flow rate is 1.3 ml/min, what is the clearance of this substance?
- A. 15 ml/min
  - B. 196 ml/min
  - C. 0.4 ml/min
  - D. cannot be determined with these data
  - E. none of these
80. Inulin is
- A. filtered, not reabsorbed, but secreted
  - B. filtered, not reabsorbed, and not secreted
  - C. filtered, reabsorbed, and not secreted
  - D. filtered, reabsorbed, and secreted
  - E. not filtered
81. The plasma clearance of a substance can be used to calculate the glomerular filtration rate (GFR) if that substance is freely filtered at the glomerulus and
- A. secreted and reabsorbed by the tubules
  - B. neither reabsorbed nor secreted by the tubules
  - C. secreted by the tubules
  - D. reabsorbed by the tubules
  - E. none of these
82. Which statement about the medullary vertical osmotic gradient is incorrect?
- A. The loops of Henle of juxtamedullary nephrons establish a medullary vertical osmotic gradient by means of countercurrent multiplication.
  - B. The vasa recta enable the medulla to be supplied with blood while conserving the medullary vertical osmotic gradient by means of countercurrent exchange.
  - C. The countercurrent system establishes and maintains a medullary vertical osmotic gradient ranging from 300 to 1,200 mOsm/liter.
  - D. The collecting tubules of the juxtamedullary nephrons, but not the cortical nephrons, descend through the medullary vertical osmotic gradient before emptying into the renal pelvis.
  - E. The medullary vertical osmotic gradient permits excretion of urine of differing concentrations by means of vasopressin-controlled, variable H<sub>2</sub>O reabsorption from the final tubular segments.



83. The \_\_\_\_ establish the medullary vertical osmotic gradient by means of countercurrent multiplication.
- A. loops of Henle of juxtamedullary nephrons
  - B. loops of Henle of cortical nephrons
  - C. vasa recta of juxtamedullary nephrons
  - D. vasa recta of cortical nephrons
  - E. vasopressin-secreting cells
84. The ascending limb of the loop of Henle of a juxtamedullary nephron
- A. actively transports NaCl out of the lumen into the interstitial fluid
  - B. is highly impermeable to H<sub>2</sub>O
  - C. is always impermeable to H<sub>2</sub>O
  - D. all of these
  - E. actively transports NaCl out of the lumen into the interstitial fluid and is always impermeable to H<sub>2</sub>O
85. Which of the following does not contribute to the establishment of a vertical osmotic gradient in the interstitial fluid of the renal medulla?
- A. the renin-angiotensin-aldosterone system
  - B. countercurrent multiplication in the long loops of Henle of juxtamedullary nephrons
  - C. urea recycling between the late portion of the collecting tubule and the long loops of Henle
  - D. all of these
  - E. none of these
86. The tubular fluid is \_\_\_\_ as it enters Bowman's capsule, \_\_\_\_ at the beginning of the loop of Henle, \_\_\_\_ at the tip of the loop, and \_\_\_\_ as it leaves the loop to enter the distal tubule.
- A. isotonic; hypertonic; hypertonic; isotonic
  - B. isotonic; isotonic; hypotonic; hypotonic
  - C. isotonic; isotonic; hypertonic; hypotonic
  - D. hypertonic; hypotonic; hypertonic; isotonic
  - E. none of these
87. What mechanisms are responsible for producing concentrated urine?
- A. The juxtamedullary nephrons become active.
  - B. The counter-current mechanism pulls out much water.
  - C. Vasopressin causes facultative water reabsorption in distal tubule.
  - D. All of these.
  - E. The counter-current mechanism pulls out much water, and vasopressin causes facultative water reabsorption in distal tubule.

88. The vertical osmotic gradient in the kidney
- A. is established and maintained by the countercurrent system
  - B. makes it possible to put out urine of variable concentration depending on the needs of the body by varying the degree of water permeability of the distal portions of the nephron
  - C. is found in the renal cortex
  - D. is established and maintained by the countercurrent system, and makes it possible to put out urine of variable concentration depending on the needs of the body by varying the degree of water permeability of the distal portions of the nephron
  - E. is established and maintained by the countercurrent system and is found in the renal cortex
89. The ascending limb of the loop of Henle is where
- A. NaCl passively leaves the tubular fluid down its concentration gradient.
  - B. NaCl is actively transported into the interstitial fluid, leaving water behind because the tubular cells are not permeable to water.
  - C.  $K^+$  is secreted.
  - D. Aldosterone stimulates  $Na^+$  reabsorption.
  - E. None of these.
90. The ascending limb of the loop of Henle
- A. actively transports NaCl into the surrounding interstitial fluid
  - B. is impermeable to water
  - C. is found in the renal cortex
  - D. drains into the proximal convoluted tubule
  - E. actively transports NaCl into the surrounding interstitial fluid and is impermeable to water
91. Which part of the juxtamedullary nephron is responsible for establishing the vertical osmotic gradient in the medulla of the kidney?
- A. collecting duct
  - B. afferent arteriole
  - C. loop of Henle
  - D. juxtaglomerular apparatus
  - E. distal tubule
92. Select the incorrect statement about ADH.
- A. It is also called vasopressin.
  - B. It is not secreted if the body consumes large amounts of water.
  - C. It is produced by the distal convoluted tubule.
  - D. It is secreted if the body fluids become hypertonic.
  - E. It stimulates reabsorption of water.

93. Which of the following statements about the loop of Henle of juxtamedullary nephrons is correct?
- A. The ascending limb of the loop of Henle is freely permeable to  $H_2O$  and  $NaCl$ .
  - B. The filtrate is isotonic as it enters the loop of Henle, hypertonic at the tip of the loop, and hypotonic as it leaves the loop of Henle.
  - C. The descending limb of the loop of Henle actively transports  $NaCl$  out of the tubule into the interstitial fluid.
  - D. All of these.
  - E. None of these.
94. Which statement is incorrect?
- A. The loops of Henle of juxtamedullary nephrons are responsible for establishing a vertical osmotic gradient in the interstitial fluid of the renal medulla by countercurrent multiplication.
  - B. The active  $NaCl$  pump of the ascending limb of the loop of Henle can establish a 1,200 mOsm/liter concentration difference between the ascending and descending limbs at any given horizontal level.
  - C. By means of countercurrent exchange, the vasa recta preserve the vertical osmotic gradient while supplying blood to the medullary tissue.
  - D. The collecting tubules of all nephrons utilize the driving force of the vertical osmotic gradient to accomplish variable  $H_2O$  reabsorption under the control of vasopressin, which governs their permeability.
  - E. The filtrate is isotonic as it enters the loop of Henle, hypertonic at the tip of the loop of Henle, and hypotonic as it leaves the loop of Henle.
95. Vasopressin
- A. secretion is stimulated by a water deficit
  - B. increases the permeability of the distal and collecting tubules to water
  - C. increases the permeability of the late portion of the collecting tubule to urea
  - D. secretion is stimulated by a water deficit and increases the permeability of the distal and collecting tubules to water
  - E. all of these
96. Vasopressin
- A. is produced in the hypothalamus
  - B. increases the permeability of the distal and collecting tubules to water
  - C. secretion is stimulated by a water deficit in the body
  - D. promotes water reabsorption
  - E. all of these

97. Vasopressin
- A. can completely halt urine production during periods of water deprivation to conserve water for the body
  - B. activates the cyclic AMP second-messenger system within the tubular cells
  - C. renders the distal and collecting tubules impermeable to water
  - D. increases  $\text{Na}^+$  reabsorption by the distal portions of the nephron
  - E. stimulates the active salt pump of the ascending limb of the loop of Henle to establish the medullary vertical osmotic gradient
98. Vasopressin secretion
- A. induces the kidneys to produce a small volume of concentrated urine
  - B. is stimulated when the body fluids are hypertonic
  - C. is inhibited when the arterial blood pressure is dangerously low
  - D. induces the kidneys to produce a small volume of concentrated urine and is stimulated when the body fluids are hypertonic
  - E. is stimulated when the body fluids are hypertonic and is inhibited when the arterial blood pressure is dangerously low
99. The osmoreceptors contributing to water balance are located in the
- A. adrenal cortex
  - B. hypothalamus
  - C. juxtaglomerular apparatus
  - D. renal cortex
  - E. renal medulla
100. The \_\_\_\_ and \_\_\_\_ enable the kidneys to produce urine of varying concentrations and volumes depending on the body's needs.
- A.  $\text{Na}^+$ - $\text{K}^+$  ATPase pump; co-transport carriers
  - B. juxtaglomerular apparatus; vasa recta
  - C. podocytes; peritubular capillaries
  - D. medullary vertical osmotic gradient; vasopressin
  - E. renin-angiotensin-aldosterone system; renal pyramids
101. The segment of the nephron that is not permeable to  $\text{H}_2\text{O}$  even in the presence of vasopressin is the
- A. proximal tubule
  - B. ascending limb of the loop of Henle
  - C. descending limb of the loop of Henle
  - D. distal tubule
  - E. collecting tubule

102. Which of the following is a potential consequence of kidney disease?

- A. cardiac disturbances
- B. skeletal abnormalities
- C. anemia
- D. acidosis
- E. all of these

103. Excretion

- A. is the removal of substances that were filtered at the glomerulus or secreted but not reabsorbed
- B. is the process by which a substance moves from the peritubular capillary blood to the tubular fluid
- C. conserves substances that are important to the body
- D. occurs by active transport of substances into the urinary bladder
- E. is controlled by sympathetic activity

104. Urine moves from the kidneys to the urinary bladder through the ureters

- A. by active transport
- B. passively by the force of gravity
- C. by peristaltic contraction of the smooth muscle of the ureters
- D. when the bladder empties and creates a negative pressure that pulls the urine to the bladder
- E. none of these

105. Micturition

- A. is the process of emptying the bladder
- B. is a parasympathetic reflex
- C. is initiated when stretch receptors in the bladder wall are excited
- D. requires a relaxed external urethral sphincter
- E. all of these

106. The urinary bladder

- A. is a temporary storage site for urine
- B. wall is stretched by 200 to 400 ml of urine, which stimulates stretch receptors that initiate the micturition reflex
- C. contracts when parasympathetic nerves stimulate it
- D. all of these
- E. none of these

107. When the bladder wall is distended as a result of urine accumulation, the stretch receptors are stimulated and send afferent impulses to the spinal cord that
- A. stimulate parasympathetic nerves, which return to the bladder and cause it to contract
  - B. inhibit the motor neurons that normally keep the external urethral sphincter closed
  - C. stimulate nerves that go to the kidney and prevent glomerular filtration until the bladder is empty
  - D. stimulate parasympathetic nerves, which return to the bladder and cause it to contract and inhibit the motor neurons that normally keep the external urethral sphincter closed
  - E. none of these
108. When the bladder of an infant is filled with urine, the
- A. stretch receptors in the bladder wall are inhibited
  - B. parasympathetic nerve supplying the bladder is inhibited, allowing the bladder to relax
  - C. motor neuron supplying the external urethral sphincter is stimulated, causing the sphincter to open
  - D. motor neuron supplying the external urethral sphincter is inhibited, allowing the sphincter to open
  - E. parasympathetic nerve supplying the internal urethral sphincter is stimulated, causing the sphincter to close
109. The process of preventing micturition in spite of initiation of the reflex involves
- A. the cerebral cortex
  - B. voluntary stimulation of the motor neuron supplying the external urethral sphincter
  - C. voluntary stimulation of the internal urethral sphincter via its parasympathetic nerve supply
  - D. the cerebral cortex and voluntary stimulation of the motor neuron supplying the external urethral sphincter
  - E. all of these
110. Which of the following does not occur during the micturition reflex in a baby?
- A. The motor neuron supplying the external sphincter is stimulated.
  - B. The parasympathetic nerve supply to the bladder is stimulated.
  - C. The internal urethral sphincter mechanically opens due to changes in the shape of the bladder.
  - D. The external urethral sphincter is relaxed.
  - E. The bladder contracts.
111. The kidneys are the organs that are primarily responsible for maintaining constancy of the volume and electrolyte composition of the internal fluid environment.
- True False
112. The kidneys keep the urine volume and composition essentially constant.
- True False
113. The three major processes involved in urine formation are filtration, reabsorption, and excretion.
- True False

114. The afferent arteriole is the blood vessel that carries blood to the glomerular capillaries.  
True False
115. Only juxtamedullary nephrons contain a juxtaglomerular apparatus.  
True False
116. The group of cells located where the distal tubule comes into contact with the afferent and efferent arterioles of the same nephron is known as the juxtaglomerular apparatus.  
True False
117. In the kidney, blood is filtered in the cortex, drains through the renal pelvis into the renal medulla, and from there travels in the ureter to the urinary bladder.  
True False
118. Glomerular filtration occurs primarily by active transport.  
True False
119. Twenty-five percent of the cardiac output goes to the kidneys because of their tremendous nutrient requirement for the active transport of  $\text{Na}^+$ .  
True False
120. Plasma proteins are normally filtered in the nephron.  
True False
121. All of the plasma that enters the glomerulus is normally filtered into Bowman's capsule except for the plasma proteins.  
True False
122. The glomerular filtrate is almost identical in composition to the plasma.  
True False
123. The vast majority of the filtered fluid is reabsorbed.  
True False
124. In general, the substances in the filtrate that need to be conserved are selectively reabsorbed whereas the unwanted substances that need to be eliminated fail to be reabsorbed.  
True False

125. Glomerular filtration occurs by active transport of  $\text{Na}^+$ , which then creates an osmotic gradient for the filtration of water.
- True False
126. The glomerular filtrate contains only substances that are not needed by the body.
- True False
127. The Bowman's capsule hydrostatic pressure opposes filtration.
- True False
128. Blood pressure in the glomerular capillaries is the same as in capillaries elsewhere in the body.
- True False
129. The glomerular capillary blood pressure is higher than capillary pressure elsewhere in the body, primarily because the afferent arteriole has a larger diameter than the efferent arteriole.
- True False
130. If a kidney stone blocked the renal pelvis and consequently caused a build-up of fluid pressure in the tubules and Bowman's capsule, the net filtration pressure across the glomerular capillary membrane would increase.
- True False
131. Because of autoregulation, changes in mean arterial blood pressure between the range of 80 to 180 mm Hg do not directly produce changes in the GFR.
- True False
132. Autoregulation of the GFR is accomplished by activation of the sympathetic nervous system.
- True False
133. The glomerular capillary wall contains filtration slits formed by the clefts between the foot processes of adjacent podocytes.
- True False
134. The pores in the glomerular membrane are too small for albumin to pass through.
- True False
135. The kidneys receive a disproportionately large share of the cardiac output for the purpose of adjusting and purifying the plasma.
- True False



136. Autoregulation is important in preventing unintentional shifts in the GFR that could lead to dangerous imbalances of fluid, electrolytes, and wastes.
- True False
137. Sympathetic vasoconstriction of the afferent arterioles and a resultant fall in the GFR occur as part of the baroreceptor reflex response when the blood pressure is too low.
- True False
138. Contraction of mesangial cells closes off a portion of the filtering capillaries, which leads to a decrease in GFR if the filtration pressure remains unchanged.
- True False
139. For filtration to occur, blood osmotic pressure + capsular hydrostatic pressure must be less than blood hydrostatic pressure + capsular osmotic pressure.
- True False
140. When a substance is reabsorbed, it moves from the tubular fluid into the peritubular capillaries.
- True False
141. By tubular secretion, substances leave the blood and enter the tubular portion of the nephron.
- True False
142. In active reabsorption, all of the steps involved in transepithelial transport are active.
- True False
143. Transepithelial transport occurs only for substances that are actively reabsorbed.
- True False
144. The  $T_m$  represents the maximum amount of a particular substance that can be excreted in the urine per unit of time.
- True False
145. The amount of glucose filtered is directly proportional to the plasma glucose concentration at all plasma glucose concentrations.
- True False
146. The amount of glucose reabsorbed is directly proportional to the plasma glucose concentration at all plasma glucose concentrations.
- True False

147. The renal threshold represents the maximum amount of a particular substance that the tubular cells are capable of actively reabsorbing per unit of time.
- True False
148. For a substance to be actively reabsorbed, all of the steps of transepithelial transport require energy expenditure.
- True False
149. The tubular cells display a  $T_m$  for urea.
- True False
150. The renal threshold for glucose is well above the normal plasma glucose concentration, but the renal threshold for  $PO_4$  is equal to the normal plasma  $PO_4$  concentration.
- True False
151. During acidosis,  $H^+$  secretion increases.
- True False
152. The secretion of aldosterone stimulates the tubular reabsorption of sodium and the tubular secretion of potassium.
- True False
153. A rise in ECF  $K^+$  concentration leads to increased excitability of heart muscle, possibly producing fatal cardiac arrhythmias.
- True False
154. The  $Na^+$  cotransport system in the proximal tubule facilitates elimination of foreign organic compounds from the body.
- True False
155. Water reabsorption cannot occur from any portion of the nephron in the absence of vasopressin.
- True False
156. Vasopressin increases  $H_2O$  reabsorption in the proximal tubule.
- True False
157. The secretion of vasopressin increases if the extracellular fluid becomes hypertonic.
- True False

158. Urea is passively reabsorbed down the osmotic gradient created by active  $\text{Na}^+$  reabsorption.

True False

159. Tubular secretion involves the movement of substances from the peritubular capillary blood into the tubular fluid.

True False

160. The liver converts many foreign organic compounds into an anionic form that can be secreted by the organic anion secretory system.

True False

161. Angiotensinogen is produced by the kidney.

True False

162. Tubular reabsorption and tubular secretion are highly selective processes, whereas glomerular filtration is not.

True False

163. The clearance rate for a substance that is filtered and secreted but not reabsorbed is greater than the GFR.

True False

164. The clearance rate for inulin is greater than the GFR.

True False

165. A plasma clearance of 135 ml/min for a substance when the GFR is 125 ml/min indicates that net secretion of the substance occurs.

True False

166. If a substance is filtered and secreted but not reabsorbed its plasma clearance rate is always less than the GFR.

True False

167. The osmolarity of the medullary interstitial fluid always equilibrates with the descending limb of the loop of Henle.

True False

168. The driving force for  $H_2O$  reabsorption across all permeable segments of the kidney tubule is an osmotic gradient.
- True False
169. The receptor sites for vasopressin binding are located on the basolateral border, yet the end result is an increase in  $H_2O$  permeability of the luminal border of the tubular cells.
- True False
170. In the tubular segments permeable to  $H_2O$ , solute reabsorption is always accompanied by comparable  $H_2O$  reabsorption.
- True False
171. ADH release is the main stimulus for the secretion of aldosterone.
- True False
172. The permeability and transport properties of the loops of Henle of juxtamedullary nephrons are important in establishing the vertical osmotic gradient in the renal medulla.
- True False
173. NaCl is actively transported from the descending limb of the loop of Henle to establish the medullary osmotic gradient.
- True False
174. When tubular fluid enters the distal tubule, it is hypotonic.
- True False
175. Aldosterone promotes water reabsorption by controlling the reabsorption of salt.
- True False
176. The presence of vasopressin acts to prevent the reabsorption of water from the distal and collecting tubules.
- True False
177. Because of countercurrent multiplication, the loop of Henle is able to establish a vertical osmotic gradient in the renal medulla, ranging from 300 to 1,200 mosm/liter, despite the fact that the active salt pump of the ascending limb is only able to produce a 200 mOsm/liter osmotic gradient at each horizontal level.
- True False

178. A pure loss or gain of  $H_2O$  that is not accompanied by comparable solute deficit or excess in the body leads to changes in ECF<sup>2</sup> osmolarity.
- True False
179. Changes in the osmolarity of the extracellular fluid are detected by osmoreceptors in the hypothalamus.
- True False
180. Acute renal failure may be reversible, whereas chronic renal failure is not reversible.
- True False
181. Urine moves from the kidneys to the urinary bladder through the ureters passively by the force of gravity.
- True False
182. The micturition reflex controls bladder emptying in adults.
- True False
183. When urine is eliminated from the body, the sphincter muscles in the urethra relax.
- True False
184. During the micturition reflex, the motor neuron supplying the external urethral sphincter is stimulated.
- True False
185. The average rate of urine formation is 1 ml/min.
- True False
186. The epithelial lining of the bladder passively stretches to accommodate a larger volume during bladder filling.
- True False
187. One can deliberately prevent urination in spite of the micturition reflex by voluntarily inhibiting the parasympathetic supply to the bladder to halt bladder contraction.
- True False
188. Vasopressin is secreted from the anterior pituitary gland.
- True False

189. The smooth muscle of the bladder is innervated by parasympathetic fibers.

True False

190. Complete each of the following statements.

The functional unit of the kidneys is the \_\_\_\_\_.

\_\_\_\_\_

191. Complete each of the following statements.

Urine is eliminated from the bladder through the \_\_\_\_\_.

\_\_\_\_\_

192. Complete each of the following statements.

The two regions of the kidney are an outer \_\_\_\_\_ and an inner

\_\_\_\_\_.

\_\_\_\_\_

193. Complete each of the following statements.

Tubular \_\_\_\_\_ and tubular \_\_\_\_\_ are selective processes that occur in the nephron.

\_\_\_\_\_

194. Complete each of the following statements.

GFR = \_\_\_\_\_ x \_\_\_\_\_.

\_\_\_\_\_

195. Complete each of the following statements.

The specialized cells of the \_\_\_\_\_, located within the \_\_\_\_\_, detect changes in the rate at which fluid is flowing past them through the distal tubule. In response, they secrete vasoactive chemicals that influence the GFR by making adjustments in the caliber of the \_\_\_\_\_ arterioles. This is known as the \_\_\_\_\_ feedback mechanism.

\_\_\_\_\_

**196. Complete each of the following statements.**

The energy-dependent step in  $\text{Na}^+$  reabsorption involves the \_\_\_\_\_, located at the \_\_\_\_\_ membrane of the tubular cell.

\_\_\_\_\_

**197. Complete each of the following statements.**

\_\_\_\_\_ is a group of intrinsic mechanisms in the kidneys that prevent changes in the GFR.

\_\_\_\_\_

**198. Complete each of the following statements.**

If the plasma concentration of substance X is 200 mg/100 ml and the GFR is 125 ml/min, the filtered load of this substance is \_\_\_\_\_.

\_\_\_\_\_

**199. Complete each of the following statements.**

If the  $T_m$  for substance X is 200 mg/min, how much of the substance will be reabsorbed at a plasma concentration of 200 mg/100 ml and a GFR of 125 ml/min? \_\_\_\_\_ How much of substance X will be excreted? \_\_\_\_\_

\_\_\_\_\_

**200. Complete each of the following statements.**

The plasma concentration of a particular substance at which its  $T_m$  is reached and the substance first starts appearing in the urine is known as the \_\_\_\_\_.

\_\_\_\_\_

**201. Complete each of the following statements.**

Each tuft of glomerular capillaries is held together by \_\_\_\_\_ cells.

\_\_\_\_\_

**202. Complete each of the following statements.**

The \_\_\_\_\_ transforms many foreign organic compounds into ionic form, which facilitates their elimination from the body because such conversion enables them to be secreted by the organic anion transport system.

\_\_\_\_\_

**203. Complete each of the following statements.**

On average, of the 125 ml/min of plasma filtered, \_\_\_\_\_ ml/min is reabsorbed and \_\_\_\_\_ ml/min is excreted as urine.

\_\_\_\_\_

**204. Complete each of the following statements.**

By reabsorption, substances leave the tubules of the nephrons and return to the blood in the \_\_\_\_\_.

\_\_\_\_\_

**205. Complete each of the following statements.**

The plasma clearance of the harmless foreign compound called \_\_\_\_\_ is equal to the GFR.

\_\_\_\_\_

**206. Complete each of the following statements.**

The plasma clearance of the organic anion \_\_\_\_\_ is equal to the renal plasma flow.

\_\_\_\_\_

**207. Complete each of the following statements.**

\_\_\_\_\_ are water channels in the tubular cells of the nephron.

\_\_\_\_\_

**208. Complete each of the following statements.**

\_\_\_\_\_ % of the filtered  $H_2O$  is variably reabsorbed under the control of the hormone \_\_\_\_\_ in the distal and collecting tubules.

\_\_\_\_\_

**209. Complete each of the following statements.**

Vasopressin is also known as \_\_\_\_\_, indicative of its effect on the kidneys.

\_\_\_\_\_



**210. Complete each of the following statements.**

\_\_\_\_\_ is an actively reabsorbed substance that does not have a tubular maximum for reabsorption.

\_\_\_\_\_

**211. Complete each of the following statements.**

\_\_\_\_\_ renal failure has a rapid onset but may be reversible; \_\_\_\_\_ renal failure is slow, progressive, and irreversible.

\_\_\_\_\_

**212. Complete each of the following statements.**

\_\_\_\_\_ % of the renal tissue can adequately perform all excretory and regulatory functions of the kidney.

\_\_\_\_\_

**213. Complete each of the following statements.**

\_\_\_\_\_ is the inability to prevent the discharge of urine.

\_\_\_\_\_

**214. Complete each of the following statements.**

Two means by which substances can enter the renal tubules are \_\_\_\_\_ and \_\_\_\_\_. Two means by which substances can leave the kidney tubules are \_\_\_\_\_ and \_\_\_\_\_.

\_\_\_\_\_

**215. Complete each of the following statements.**

Body fluids are \_\_\_\_\_ at 300 mOsm/liter.

\_\_\_\_\_

**216. Complete each of the following statements.**

The micturition reflex is initiated by stimulating \_\_\_\_\_ receptors in the bladder.

\_\_\_\_\_

**217. Complete each of the following statements.**

The micturition reflex center is located in the \_\_\_\_\_ region of the spinal cord.

\_\_\_\_\_

## Chapter 14 a--The Urinary System **Key**

1. Which of the following is not a function of the kidneys?
  - A. excreting metabolic wastes
  - B. maintaining proper plasma volume
  - C.** secreting aldosterone to regulate sodium
  - D. maintaining proper osmolarity of body fluids
  - E. assisting in maintaining the proper acid-base balance of the body
2. Which of the following is not a function of the kidneys?
  - A. They contribute significantly to long-term regulation of arterial blood pressure by maintaining the proper plasma volume.
  - B.** They act directly on the interstitial fluid, the fluid that bathes the cells, to maintain constancy in its composition.
  - C. They excrete the metabolic waste products.
  - D. They assist in maintaining the proper acid-base balance of the body.
  - E. They secrete a hormone.
3. The functional unit of the kidney is the
  - A. glomerulus
  - B.** nephron
  - C. medulla
  - D. pyramid
  - E. juxtaglomerular apparatus
4. The specialized nephron capillary bed where filtration occurs is the
  - A. afferent arteriole
  - B. efferent arteriole
  - C.** glomerulus
  - D. peritubular bed
  - E. none of these
5. Which of the following statements about juxtamedullary nephrons is incorrect?
  - A.** Their glomeruli lie in the renal medulla.
  - B. They are important in the ability of the kidneys to concentrate urine.
  - C. Their loops of Henle dip deep into the medulla.
  - D. Their peritubular capillaries form vasa recta.
  - E. They are not the predominant type of nephron found in human kidneys.

6. Which of the following is not associated with juxtamedullary nephrons?
- A.** glomeruli located in medulla
  - B. long loops of Henle
  - C. peritubular capillaries forming vasa recta
  - D. collecting duct in medulla
  - E. important role in the ability of the kidneys to produce urine of varying concentration

7. Below is a listing of nephron components and associated structures.

- 1. descending limb of loop of Henle
- 2. bowman's capsule
- 3. collecting tubule
- 4. ascending limb of loop of Henle
- 5. distal tubule
- 6. proximal tubule

Indicate the correct flow of filtrate through these structures.

- A. 4, 6, 5, 3, 2, 1
- B.** 2, 6, 1, 4, 5, 3
- C. 2, 5, 6, 3, 1, 4
- D. 3, 2, 6, 1, 4, 5
- E. 2, 1, 4, 3, 5, 6

8. The peritubular capillaries

- A. supply nutrients and  $O_2$  to the tubular cells
- B. take up the substances that are reabsorbed by the tubules
- C. supply substances that are secreted by the tubules
- D.** all of these
- E. none of these

9. Which nephron structure is especially important in the kidney's ability to produce urine of varying concentration?

- A. Bowman' capsule
- B. proximal tubule
- C. distal tubule
- D.** loop of Henle
- E. glomerulus

10. Vasa recta are associated with

- A. afferent arterioles
- B. efferent arterioles
- C. cortical nephrons
- D.** juxtamedullary nephron
- E. renal papillae

11. The renal process whereby substances are selectively transferred from the peritubular blood into the renal tubule is
- A. filtration
  - B. secretion**
  - C. reabsorption
  - D. excretion
  - E. none of these
12. The blood that flows through the kidneys is
- A. normally about 20 to 25 percent of the total cardiac output**
  - B. all filtered through the glomeruli
  - C. all used to supply the renal tissue with O<sub>2</sub> and nutrients
  - D. all of these
  - E. normally about 20 to 25 percent of the total cardiac output, and all filtered through the glomeruli
13. The glomerular filtration rate
- A. averages 125 ml/min**
  - B. averages 75 liters/day
  - C. represents 60 to 65 percent of the cardiac output
  - D. is less than the rate of renal reabsorption
  - E. all of these
14. The glomerular filtrate
- A. is a protein-free plasma
  - B. is formed as a result of passive forces acting across the glomerular membrane
  - C. does not contain foreign compounds because these substances are secreted by special transport mechanisms in the proximal tubule instead
  - D. is a protein-free plasma and is formed as a result of passive forces acting across the glomerular membrane**
  - E. is a protein-free plasma and does not contain foreign compounds because these substances are secreted by special transport mechanisms in the proximal tubule instead
15. Filtrate passes through all of these except
- A. glomerular capillary pores
  - B. basement membrane
  - C. podocytes**
  - D. filtration slits
  - E. Bowman's capsule

16. The glomerular capillary blood pressure in the nephron is 78 mm Hg. The Bowman's capsular hydrostatic pressure is 24 mm Hg. The colloidal osmotic pressure is 18 mm Hg. The net filtration pressure is \_\_\_\_\_ mm Hg.
- A. 18
  - B. 26
  - C. 36**
  - D. 42
  - E. 78
17. Which of the following is not part of the nephron?
- A. collecting duct
  - B. Bowman's capsule
  - C. ureter**
  - D. descending limb
  - E. proximal tubule
18. Changes in the glomerular filtration rates are accomplished through
- A. autoregulation
  - B. myogenic activity
  - C. vasoactive responses in the afferent arteriole
  - D. all of these**
  - E. none of these
19. Which factor would reduce the net filtration pressure the most?
- A. vasodilation of the afferent arteriole
  - B. vasoconstriction of the efferent arteriole
  - C. a large increase in blood colloid osmotic pressure**
  - D. a low capsular hydrostatic pressure
  - E. a high glomerular hydrostatic pressure
20. Identify the correct statement(s).
- A. Bowman's capsule hydrostatic pressure opposes filtration.**
  - B. The glomerular filtration rate is limited by a  $T_m$ .
  - C. All of the plasma that enters the glomerulus is filtered.
  - D. The glomerular filtration rate is limited by a  $T_m$ , and all of the plasma that enters the glomerulus is filtered.
  - E. All of these.

21. Glomerular filtration
- A. occurs in the loop of Henle
  - B.** is the process by which plasma water, electrolytes, and small molecules, which enter Bowman's capsule, are separated from blood cells and protein, which remain in the glomerular capillaries
  - C. is the process by which a substance is transported from the tubular fluid to the peritubular capillaries
  - D. occurs in the loop of Henle, and is the process by which plasma water, electrolytes, and small molecules, which enter Bowman's capsule, are separated from blood cells and protein, which remain in the glomerular capillaries and
  - E. none of these
22. Which of the following factors would decrease the GFR?
- A. a fall in plasma protein concentration
  - B.** an obstruction such as a kidney stone in the tubular system, which increases Bowman's capsule hydrostatic pressure
  - C. vasodilation of the afferent arterioles
  - D. a fall in plasma protein concentration and vasodilation of the afferent arterioles
  - E. none of these
23. The macula densa
- A.** consists of specialized tubular cells in the juxtaglomerular apparatus
  - B. consists of specialized arteriolar smooth-muscle cells in the juxtaglomerular apparatus
  - C. secretes renin
  - D. consists of specialized tubular cells in the juxtaglomerular apparatus and secretes renin
  - E. consists of specialized arteriolar smooth-muscle cells in the juxtaglomerular apparatus and secretes renin
24. Which of the following is involved in autoregulation of the GFR?
- A. a myogenic mechanism in which the afferent arteriole automatically constricts when it is stretched
  - B.** a tubulo-glomerular feedback mechanism in which vasoactive chemicals released from the juxtaglomerular apparatus bring about afferent arteriolar vasoconstriction
  - C. sympathetically induced vasoconstriction of the afferent arterioles
  - D. a myogenic mechanism in which the afferent arteriole automatically constricts when it is stretched, and a tubulo-glomerular feedback mechanism in which vasoactive chemicals released from the juxtaglomerular apparatus bring about afferent arteriolar vasoconstriction
  - E. none of these
25. Which of the following forces oppose glomerular filtration?
- A. blood colloid osmotic pressure
  - B. Bowman's capsule hydrostatic pressure
  - C. glomerular-capillary blood pressure
  - D.** blood colloid osmotic pressure and Bowman's capsule hydrostatic pressure
  - E. Bowman's capsule hydrostatic pressure and glomerular-capillary blood pressure

26. Afferent arteriolar vasoconstriction \_\_\_\_ blood flow into the glomerulus, which causes the glomerular-capillary blood pressure to \_\_\_\_, leading to a(n) \_\_\_\_ in the net filtration pressure and a resultant \_\_\_\_ in the GFR.
- A. increases; increase; increase; increase
  - B.** decreases; decrease; decrease; decrease
  - C. increases; increase; decrease; decrease
  - D. decreases; decrease; increase; increase
  - E. none of these
27. The myogenic mechanism
- A. causes the afferent arteriole to constrict when blood pressure is too high
  - B. may result from stretching of vascular smooth muscle
  - C. is an autoregulatory mechanism
  - D. reduces GFR
  - E.** all of these
28. Stimulation of the macula densa cells
- A. results in vasodilation of the afferent arteriole
  - B.** results in vasoconstriction of the afferent arteriole
  - C. increases GFR
  - D. results in vasodilation of the afferent arteriole and results in vasoconstriction of the afferent arteriole
  - E. results in vasodilation of the afferent arteriole and increases GFR
29. Extrinsic control of the GFR
- A. is mediated by sympathetic nervous system input to the afferent arterioles
  - B. is aimed at the regulation of arterial blood pressure
  - C. does not require a special mechanism but occurs as part of the baroreceptor reflex
  - D. decreases the GFR
  - E.** all of these
30. When arterial blood pressure is elevated above normal, which of the following compensatory changes in renal function occur as a result of the baroreceptor reflex?
- A. afferent arteriolar vasoconstriction
  - B.** afferent arteriolar vasodilation
  - C. reduction in GFR
  - D. afferent arteriolar vasoconstriction and reduction in GFR
  - E. all of these



31. Tubular reabsorption
- A. refers to the movement of a substance from the peritubular capillary blood into the tubular fluid
  - B. occurs by either active or passive transport
  - C. involves the process of transepithelial transport
  - D.** occurs by either active or passive transport and involves the process of transepithelial transport
  - E. none of these
32. Which statement about tubular reabsorption is incorrect?
- A. It refers to the movement of a substance from the tubular fluid to the peritubular capillary blood.
  - B. It is important for the conservation of substances important to the body, such as  $\text{Na}^+$ ,  $\text{Cl}^-$ , glucose, and amino acids.
  - C. It can occur by active or passive transport mechanisms.
  - D. It involves the process of transepithelial transport.
  - E.** It takes place only in the proximal tubule.
33. Tubular reabsorption
- A. involves the movement of substances from the peritubular capillaries into the tubular fluid
  - B. involves the movement of substances from the tubular fluid into the peritubular capillaries
  - C. is considered to be active if any one of the five steps of transepithelial transport is active
  - D. involves the movement of substances from the peritubular capillaries into the tubular fluid and is considered to be active if any one of the five steps of transepithelial transport is active
  - E.** involves the movement of substances from the tubular fluid into the peritubular capillaries and is considered to be active if any one of the five steps of transepithelial transport is active
34. Tubular reabsorption involves
- A. active transport
  - B. cotransport
  - C. facilitated diffusion
  - D. countertransport
  - E.** all of these
35. Which of the following is not a step in transepithelial transport?
- A. movement of the substance through the cytosol of the tubular cell
  - B.** movement of the substance across the glomerular capillary wall
  - C. movement of the substance across the luminal membrane of the tubular cell
  - D. movement of the substance through the interstitial fluid
  - E. movement of the substance across the basolateral membrane of the tubular cell

36. The  $\text{Na}^+ - \text{K}^+$  ATPase transport system that plays a pivotal role in much of tubular reabsorption is located in the
- A. luminal membrane of tubular cells
  - B.** basolateral membrane of tubular cells
  - C. podocytes
  - D. glomerular capillary membrane
  - E. basement membrane
37. Which is reabsorbed by the proximal convoluted tubule?
- A. sodium
  - B. amino acids
  - C. glucose
  - D.** all of these
  - E. none of these
38. Into which structure does most reabsorption occur?
- A.** proximal convoluted tubule
  - B. glomerulus
  - C. distal convoluted tubule
  - D. loop of Henle
  - E. none of these
39. Glucose is not normally found in the urine because
- A. It does not get filtered out of glomerulus.
  - B. It is not found in the blood.
  - C.** It is usually reabsorbed by renal tubule cells.
  - D. It is kept in the blood.
  - E. None of these.
40. The proximal tubule
- A. reabsorbs about 65 percent of the filtered water
  - B. is not the site of action of renin
  - C. is the location where glucose is reabsorbed
  - D. reabsorbs about 65 percent of the filtered water and is the location where glucose is reabsorbed
  - E.** all of these

41. Tubular maximum ( $T_m$ )
- A. is the maximum amount of a substance that the tubular cells can actively transport within a given time period
  - B. is the maximum rate at which a substance is filtered at the glomerulus
  - C. occurs when the membrane carrier becomes saturated
  - D.** is the maximum amount of a substance that the tubular cells can actively transport within a given time period, and occurs when the membrane carrier becomes saturated
  - E. is the maximum rate at which a substance is filtered at the glomerulus, and occurs when the membrane carrier becomes saturated
42.  $T_m$  is the maximum
- A. rate of glomerular filtration
  - B.** rate a substance can be reabsorbed because of saturation of the carrier molecule
  - C. rate of urine excretion
  - D. rate a substance can be cleared from the blood
  - E. percentage of renal blood flow that can be converted to filtrate
43. The renal threshold is the
- A. maximum amount of a particular substance that can be excreted in the urine per unit of time
  - B. maximum amount of a particular substance that the tubular cells are capable of actively reabsorbing per unit of time
  - C.** plasma concentration of a particular substance at which its  $T_m$  is reached and the substance first appears in the urine
  - D. maximum amount of waste products that can be concentrated in the urine per unit of time
  - E. maximum amount of water that can be osmotically absorbed across the tubules per unit of time
44. Which of the following plasma constituents is not regulated by the kidneys?
- A.** glucose
  - B.  $\text{Na}^+$
  - C.  $\text{H}^+$
  - D. phosphate
  - E. water
45. Reabsorption of chloride is
- A. active
  - B. passive
  - C. dependent on the amount of sodium reabsorbed
  - D. active and dependent on the amount of sodium reabsorbed
  - E.** passive and dependent on the amount of sodium reabsorbed

46. Select the major waste product of nitrogen metabolism.
- A. plasma proteins
  - B. urea**
  - C. glucose
  - D.  $\text{PO}_4$
  - E. amino acids
47. Given the following data for substance X (GFR = 125 ml/min,  $T_m = 125$  mg/min, at a plasma concentration of 200 mg/100 ml), how much of substance X is filtered, reabsorbed, and excreted?
- A. 200 mg/min filtered, 125 mg/min reabsorbed, 75 mg/min excreted
  - B. 250 mg/min filtered, 125 mg/min reabsorbed, 125 mg/min excreted**
  - C. 125 mg/min filtered, 125 mg/min reabsorbed, 0 mg/min excreted
  - D. 250 mg/min filtered, 200 mg/min reabsorbed, 50 mg/min excreted
  - E. none of these
48. The juxtaglomerular apparatus
- A. secretes renin in response to sodium depletion or plasma volume reduction
  - B. is a thickened region of specialized cells at a point where the distal tubule comes into intimate contact with the afferent and efferent arterioles of the same nephron
  - C. is where reabsorption of sodium occurs
  - D. secretes renin in response to sodium depletion or plasma volume reduction, and is a thickened region of specialized cells at a point where the distal tubule comes into intimate contact with the afferent and efferent arterioles of the same nephron**
  - E. all of these
49. The maximum normal glucose concentration in the plasma is about \_\_\_\_ mg per 100 ml.
- A. 30
  - B. 60
  - C. 100**
  - D. 180
  - E. 250
50. Which statement regarding sodium reabsorption is not accurate?
- A. It plays a role in glucose, amino acid, and urea reabsorption in the proximal tubule.
  - B. It is under hormonal control in the distal tubule.
  - C. In the loop of Henle, it contributes to the formation of concentrated urine.
  - D. Approximately 0.5% of sodium in the filtrate is reabsorbed on a daily basis.**
  - E. Aldosterone is a key hormone involved in facultative reabsorption.

51. The juxtaglomerular apparatus
- A. is a combination of specialized tubular and vascular cells at a point where the beginning of the distal tubule comes into intimate contact with the afferent and efferent arterioles of the same nephron
  - B. secretes aldosterone
  - C. secretes renin
  - D. is a combination of specialized tubular and vascular cells at a point where the beginning of the distal tubule comes into intimate contact with the afferent and efferent arterioles of the same nephron and secretes aldosterone
  - E.** is a combination of specialized tubular and vascular cells at a point where the beginning of the distal tubule comes into intimate contact with the afferent and efferent arterioles of the same nephron and secretes renin
52. Aldosterone
- A. stimulates  $\text{Na}^+$  reabsorption in the distal and collecting tubules
  - B. is secreted by the JG apparatus
  - C. stimulates  $\text{K}^+$  secretion in the distal tubule
  - D. stimulates  $\text{Na}^+$  reabsorption in the distal and collecting tubules and is secreted by the JG apparatus
  - E.** stimulates  $\text{Na}^+$  reabsorption in the distal and collecting tubules and stimulates  $\text{K}^+$  secretion in the distal tubule
53. Aldosterone secretion
- A. occurs in the kidney
  - B.** is stimulated by angiotensin II
  - C. is controlled by the concentration of  $\text{Cl}^-$
  - D. all of these
  - E. none of these
54.  $\text{Na}^+$  reabsorption
- A. uses 80% of the energy requirement of the kidney
  - B. is under control of the hormone aldosterone in the distal portions of the nephron
  - C. is linked to the reabsorption of water,  $\text{Cl}^-$ , glucose, amino acids, and urea
  - D. requires that tubule cells expend energy
  - E.** all of these
55. The greatest percentage of  $\text{Na}^+$  reabsorption takes place in the
- A.** proximal tubule
  - B. loop of Henle
  - C. distal tubule
  - D. collecting tubule
  - E. renal pelvis

56. When blood volume becomes abnormally low
- Sodium reabsorption is diminished.
  - Dilute urine is formed.
  - C.** Renin catalyzes the conversion of angiotensinogen.
  - Aldosterone is secreted by the kidney.
  - All of these.
57. Angiotensin I
- is formed as a result of activation of angiotensinogen by renin
  - is transformed into angiotensin II as a result of converting enzyme action in the lungs
  - acts on the adrenal cortex to stimulate aldosterone secretion
  - D.** is formed as a result of activation of angiotensinogen by renin, and is transformed into angiotensin II as a result of converting enzyme action in the lungs
  - all of these
58. Sodium reabsorption in the distal portions of the nephron is stimulated by
- atrial natriuretic peptide
  - vasopressin
  - angiotensin II
  - D.** aldosterone
  - renin
59. Which of the following is not attributable to atrial natriuretic peptide (ANP)?
- A.** It is released from the cardiac atria when the ECF volume is reduced.
  - It inhibits  $\text{Na}^+$  reabsorption in the distal parts of the nephron.
  - It inhibits renin secretion by the kidneys.
  - It inhibits aldosterone secretion by the adrenal cortex.
  - It inhibits sympathetic nervous activity to the heart and blood vessels.
60. The energy requirement for glucose reabsorption is used to
- A.** run the  $\text{Na}^+ - \text{K}^+$  ATPase pump
  - run the  $\text{Na}^+$ -glucose co-transport carrier
  - synthesize renin, which controls glucose reabsorption
  - maintain the  $T_m$  for glucose
  - produce aldosterone-induced protein, which increases the permeability of the proximal tubular cells to glucose
61. Atrial natriuretic peptide
- is secreted by the heart when atrial pressure is high
  - results in an increased glomerular filtration rate
  - inhibits aldosterone activity
  - promotes renal excretion of water
  - E.** all of these

62. Which of the following does not play a role in  $\text{Na}^+$  reabsorption?
- A. renin
  - B.** vasopressin
  - C. angiotensinogen
  - D. aldosterone
  - E. atrial natriuretic peptide
63. The distal and collecting tubules are the site of
- A. the cotransport carriers for glucose and amino acid reabsorption
  - B. the organic ion secretory systems
  - C.** aldosterone and vasopressin action
  - D. the cotransport carriers for glucose and amino acid reabsorption, and aldosterone and vasopressin action
  - E. the organic ion secretory systems and aldosterone and vasopressin action
64. Water reabsorption is under the control of vasopressin
- A. along the entire length of the nephron
  - B. only in the loop of Henle
  - C.** only in the distal and collecting tubules
  - D. only in the proximal tubule
  - E. only in the glomerulus
65. Water reabsorption
- A. occurs passively by osmosis in the proximal tubule
  - B. is under the control of vasopressin in the distal and collecting tubules
  - C. occurs by active transport in the distal and collecting tubules
  - D.** all of these
  - E. occurs passively by osmosis in the proximal tubule and is under the control of vasopressin in the distal and collecting tubules
66. Which statement is correct?
- A. Water reabsorption is under control of vasopressin throughout the length of the nephron.
  - B.** The ascending limb of the loop of Henle is always impermeable to water.
  - C. Vasopressin makes the distal and collecting tubules impermeable to water.
  - D. Fifteen percent of the filtered water osmotically follows the absorption of  $\text{Na}^+$  and other solutes in the proximal tubule.
  - E. Water reabsorption is passive in the early portions of the nephron but is active in the distal portions of the nephron.

67. Water reabsorption
- A. cannot occur from any portion of the nephron in the absence of vasopressin
  - B. occurs to the greatest extent in the proximal convoluted tubule
  - C. is under vasopressin control in the proximal tubule
  - D. is under vasopressin control in the distal and collecting tubules
  - E.** occurs to the greatest extent in the proximal convoluted tubule and is under vasopressin control in the distal and collecting tubules
68. Urea
- A. is the waste product with the smallest molecular size in the glomerular filtrate
  - B. is in greater concentration at the end of the proximal tubule than in other body fluids
  - C. has a clearance rate greater than GFR
  - D.** is the waste product with the smallest molecular size in the glomerular filtrate and is in greater concentration at the end of the proximal tubule than in other body fluids
  - E. all of these
69. Urea
- A. is a waste product resulting from the breakdown of protein
  - B. is passively reabsorbed at the end of the proximal tubule down a urea concentration gradient created by the osmotic-induced reabsorption of water from the proximal tubule
  - C. recycling between the late portion of the collecting tubule and the long loops of Henle contributes to medullary hypertonicity
  - D. is found in the blood, filtrate, and urine
  - E.** all of these
70. When the extracellular fluid becomes too acidic, the tubular secretion of
- A. no ionic substance is affected
  - B. hydrogen ions decreases
  - C.** hydrogen ions increases
  - D. sodium ions decreases
  - E. sodium ions increases
71. Tubular secretion
- A. refers to the movement of a substance from the peritubular capillary blood into the tubular lumen
  - B. can occur by active or passive transport mechanisms
  - C. of  $K^+$  occurs in the distal and collecting tubules and is stimulated by aldosterone
  - D. of organic anions and cations occurs in the proximal tubule by two distinct types of carriers
  - E.** all of these



72. Tubular secretion
- A. involves transepithelial transport
  - B. is the movement of a substance from the peritubular capillary blood into the tubular fluid
  - C. always occurs by active transport
  - D.** involves transepithelial transport and is the movement of a substance from the peritubular capillary blood into the tubular fluid
  - E. is the movement of a substance from the peritubular capillary blood into the tubular fluid and always occurs by active transport
73. Tubular secretion is important
- A.** in the renal regulation of hydrogen ion concentration
  - B. for the elimination of metabolic waste products from the body
  - C. in the renal regulation of sodium balance
  - D. in the secretion of renin
  - E. all of these
74. Tubular secretion of foreign substances, such as drugs, generally occurs in the
- A. Bowman's capsule
  - B. loop of Henle
  - C. proximal tubule
  - D.** collecting duct
  - E. glomerulus
75. Potassium
- A. is actively reabsorbed in the proximal tubule
  - B. is actively secreted in the distal and collecting tubules
  - C. secretion is controlled by aldosterone
  - D. is filtered, reabsorbed, and secreted in the kidney
  - E.** all of these
76. Which substance is normally secreted into the tubule?
- A. hydrogen ions
  - B. potassium ions
  - C. organic ions
  - D. hydrogen ions and potassium ions
  - E.** all of these
77. Which of the following has a positive effect on aldosterone secretion?
- A. an increase in plasma  $K^+$
  - B. a decrease in plasma  $K^+$
  - C. activation of the renin-angiotensin pathway
  - D.** an increase in plasma  $K^+$  and activation of the renin-angiotensin pathway
  - E. a decrease in plasma  $K^+$  and activation of the renin-angiotensin pathway

78. Plasma clearance is the
- A. time required to filter blood in the glomerulus
  - B. amount of a substance appearing in the urine in one minute of time
  - C. amount of a substance that is filtered in one minute of time
  - D. amount of a substance secreted in one minute of time
  - E.** volume of plasma that is completely cleared of a substance by the kidneys in one minute of time
79. If a substance has a plasma concentration of 150 mg/ml and a urine concentration of 1.7 mg/ml, and the urine flow rate is 1.3 ml/min, what is the clearance of this substance?
- A. 15 ml/min
  - B. 196 ml/min
  - C. 0.4 ml/min
  - D. cannot be determined with these data
  - E.** none of these
80. Inulin is
- A. filtered, not reabsorbed, but secreted
  - B.** filtered, not reabsorbed, and not secreted
  - C. filtered, reabsorbed, and not secreted
  - D. filtered, reabsorbed, and secreted
  - E. not filtered
81. The plasma clearance of a substance can be used to calculate the glomerular filtration rate (GFR) if that substance is freely filtered at the glomerulus and
- A. secreted and reabsorbed by the tubules
  - B.** neither reabsorbed nor secreted by the tubules
  - C. secreted by the tubules
  - D. reabsorbed by the tubules
  - E. none of these
82. Which statement about the medullary vertical osmotic gradient is incorrect?
- A. The loops of Henle of juxtamedullary nephrons establish a medullary vertical osmotic gradient by means of countercurrent multiplication.
  - B. The vasa recta enable the medulla to be supplied with blood while conserving the medullary vertical osmotic gradient by means of countercurrent exchange.
  - C. The countercurrent system establishes and maintains a medullary vertical osmotic gradient ranging from 300 to 1,200 mOsm/liter.
  - D.** The collecting tubules of the juxtamedullary nephrons, but not the cortical nephrons, descend through the medullary vertical osmotic gradient before emptying into the renal pelvis.
  - E. The medullary vertical osmotic gradient permits excretion of urine of differing concentrations by means of vasopressin-controlled, variable H<sub>2</sub>O reabsorption from the final tubular segments.

83. The \_\_\_\_ establish the medullary vertical osmotic gradient by means of countercurrent multiplication.
- A. loops of Henle of juxtamedullary nephrons
  - B. loops of Henle of cortical nephrons
  - C. vasa recta of juxtamedullary nephrons
  - D. vasa recta of cortical nephrons
  - E. vasopressin-secreting cells
84. The ascending limb of the loop of Henle of a juxtamedullary nephron
- A. actively transports NaCl out of the lumen into the interstitial fluid
  - B. is highly impermeable to H<sub>2</sub>O
  - C. is always impermeable to H<sub>2</sub>O
  - D. all of these
  - E. actively transports NaCl out of the lumen into the interstitial fluid and is always impermeable to H<sub>2</sub>O
85. Which of the following does not contribute to the establishment of a vertical osmotic gradient in the interstitial fluid of the renal medulla?
- A. the renin-angiotensin-aldosterone system
  - B. countercurrent multiplication in the long loops of Henle of juxtamedullary nephrons
  - C. urea recycling between the late portion of the collecting tubule and the long loops of Henle
  - D. all of these
  - E. none of these
86. The tubular fluid is \_\_\_\_ as it enters Bowman's capsule, \_\_\_\_ at the beginning of the loop of Henle, \_\_\_\_ at the tip of the loop, and \_\_\_\_ as it leaves the loop to enter the distal tubule.
- A. isotonic; hypertonic; hypertonic; isotonic
  - B. isotonic; isotonic; hypotonic; hypotonic
  - C. isotonic; isotonic; hypertonic; hypotonic
  - D. hypertonic; hypotonic; hypertonic; isotonic
  - E. none of these
87. What mechanisms are responsible for producing concentrated urine?
- A. The juxtamedullary nephrons become active.
  - B. The counter-current mechanism pulls out much water.
  - C. Vasopressin causes facultative water reabsorption in distal tubule.
  - D. All of these.
  - E. The counter-current mechanism pulls out much water, and vasopressin causes facultative water reabsorption in distal tubule.

88. The vertical osmotic gradient in the kidney
- A. is established and maintained by the countercurrent system
  - B. makes it possible to put out urine of variable concentration depending on the needs of the body by varying the degree of water permeability of the distal portions of the nephron
  - C. is found in the renal cortex
  - D.** is established and maintained by the countercurrent system, and makes it possible to put out urine of variable concentration depending on the needs of the body by varying the degree of water permeability of the distal portions of the nephron
  - E. is established and maintained by the countercurrent system and is found in the renal cortex
89. The ascending limb of the loop of Henle is where
- A. NaCl passively leaves the tubular fluid down its concentration gradient.
  - B.** NaCl is actively transported into the interstitial fluid, leaving water behind because the tubular cells are not permeable to water.
  - C.  $K^+$  is secreted.
  - D. Aldosterone stimulates  $Na^+$  reabsorption.
  - E. None of these.
90. The ascending limb of the loop of Henle
- A. actively transports NaCl into the surrounding interstitial fluid
  - B. is impermeable to water
  - C. is found in the renal cortex
  - D. drains into the proximal convoluted tubule
  - E.** actively transports NaCl into the surrounding interstitial fluid and is impermeable to water
91. Which part of the juxtamedullary nephron is responsible for establishing the vertical osmotic gradient in the medulla of the kidney?
- A. collecting duct
  - B. afferent arteriole
  - C.** loop of Henle
  - D. juxtaglomerular apparatus
  - E. distal tubule
92. Select the incorrect statement about ADH.
- A. It is also called vasopressin.
  - B. It is not secreted if the body consumes large amounts of water.
  - C.** It is produced by the distal convoluted tubule.
  - D. It is secreted if the body fluids become hypertonic.
  - E. It stimulates reabsorption of water.

93. Which of the following statements about the loop of Henle of juxtamedullary nephrons is correct?
- A. The ascending limb of the loop of Henle is freely permeable to H<sub>2</sub>O and NaCl.
  - B.** The filtrate is isotonic as it enters the loop of Henle, hypertonic at the tip of the loop, and hypotonic as it leaves the loop of Henle.
  - C. The descending limb of the loop of Henle actively transports NaCl out of the tubule into the interstitial fluid.
  - D. All of these.
  - E. None of these.
94. Which statement is incorrect?
- A. The loops of Henle of juxtamedullary nephrons are responsible for establishing a vertical osmotic gradient in the interstitial fluid of the renal medulla by countercurrent multiplication.
  - B.** The active NaCl pump of the ascending limb of the loop of Henle can establish a 1,200 mOsm/liter concentration difference between the ascending and descending limbs at any given horizontal level.
  - C. By means of countercurrent exchange, the vasa recta preserve the vertical osmotic gradient while supplying blood to the medullary tissue.
  - D. The collecting tubules of all nephrons utilize the driving force of the vertical osmotic gradient to accomplish variable H<sub>2</sub>O reabsorption under the control of vasopressin, which governs their permeability.
  - E. The filtrate is isotonic as it enters the loop of Henle, hypertonic at the tip of the loop of Henle, and hypotonic as it leaves the loop of Henle.
95. Vasopressin
- A. secretion is stimulated by a water deficit
  - B. increases the permeability of the distal and collecting tubules to water
  - C. increases the permeability of the late portion of the collecting tubule to urea
  - D. secretion is stimulated by a water deficit and increases the permeability of the distal and collecting tubules to water
  - E.** all of these
96. Vasopressin
- A. is produced in the hypothalamus
  - B. increases the permeability of the distal and collecting tubules to water
  - C. secretion is stimulated by a water deficit in the body
  - D. promotes water reabsorption
  - E.** all of these

97. Vasopressin
- A. can completely halt urine production during periods of water deprivation to conserve water for the body
  - B.** activates the cyclic AMP second-messenger system within the tubular cells
  - C. renders the distal and collecting tubules impermeable to water
  - D. increases  $\text{Na}^+$  reabsorption by the distal portions of the nephron
  - E. stimulates the active salt pump of the ascending limb of the loop of Henle to establish the medullary vertical osmotic gradient
98. Vasopressin secretion
- A. induces the kidneys to produce a small volume of concentrated urine
  - B. is stimulated when the body fluids are hypertonic
  - C. is inhibited when the arterial blood pressure is dangerously low
  - D.** induces the kidneys to produce a small volume of concentrated urine and is stimulated when the body fluids are hypertonic
  - E. is stimulated when the body fluids are hypertonic and is inhibited when the arterial blood pressure is dangerously low
99. The osmoreceptors contributing to water balance are located in the
- A. adrenal cortex
  - B.** hypothalamus
  - C. juxtaglomerular apparatus
  - D. renal cortex
  - E. renal medulla
100. The \_\_\_\_ and \_\_\_\_ enable the kidneys to produce urine of varying concentrations and volumes depending on the body's needs.
- A.  $\text{Na}^+$ - $\text{K}^+$  ATPase pump; co-transport carriers
  - B. juxtaglomerular apparatus; vasa recta
  - C. podocytes; peritubular capillaries
  - D.** medullary vertical osmotic gradient; vasopressin
  - E. renin-angiotensin-aldosterone system; renal pyramids
101. The segment of the nephron that is not permeable to  $\text{H}_2\text{O}$  even in the presence of vasopressin is the
- A. proximal tubule
  - B.** ascending limb of the loop of Henle
  - C. descending limb of the loop of Henle
  - D. distal tubule
  - E. collecting tubule

102. Which of the following is a potential consequence of kidney disease?
- A. cardiac disturbances
  - B. skeletal abnormalities
  - C. anemia
  - D. acidosis
  - E.** all of these
103. Excretion
- A.** is the removal of substances that were filtered at the glomerulus or secreted but not reabsorbed
  - B. is the process by which a substance moves from the peritubular capillary blood to the tubular fluid
  - C. conserves substances that are important to the body
  - D. occurs by active transport of substances into the urinary bladder
  - E. is controlled by sympathetic activity
104. Urine moves from the kidneys to the urinary bladder through the ureters
- A. by active transport
  - B. passively by the force of gravity
  - C.** by peristaltic contraction of the smooth muscle of the ureters
  - D. when the bladder empties and creates a negative pressure that pulls the urine to the bladder
  - E. none of these
105. Micturition
- A. is the process of emptying the bladder
  - B. is a parasympathetic reflex
  - C. is initiated when stretch receptors in the bladder wall are excited
  - D. requires a relaxed external urethral sphincter
  - E.** all of these
106. The urinary bladder
- A. is a temporary storage site for urine
  - B. wall is stretched by 200 to 400 ml of urine, which stimulates stretch receptors that initiate the micturition reflex
  - C. contracts when parasympathetic nerves stimulate it
  - D.** all of these
  - E. none of these

107. When the bladder wall is distended as a result of urine accumulation, the stretch receptors are stimulated and send afferent impulses to the spinal cord that
- A. stimulate parasympathetic nerves, which return to the bladder and cause it to contract
  - B. inhibit the motor neurons that normally keep the external urethral sphincter closed
  - C. stimulate nerves that go to the kidney and prevent glomerular filtration until the bladder is empty
  - D.** stimulate parasympathetic nerves, which return to the bladder and cause it to contract and inhibit the motor neurons that normally keep the external urethral sphincter closed
  - E. none of these
108. When the bladder of an infant is filled with urine, the
- A. stretch receptors in the bladder wall are inhibited
  - B. parasympathetic nerve supplying the bladder is inhibited, allowing the bladder to relax
  - C. motor neuron supplying the external urethral sphincter is stimulated, causing the sphincter to open
  - D.** motor neuron supplying the external urethral sphincter is inhibited, allowing the sphincter to open
  - E. parasympathetic nerve supplying the internal urethral sphincter is stimulated, causing the sphincter to close
109. The process of preventing micturition in spite of initiation of the reflex involves
- A. the cerebral cortex
  - B. voluntary stimulation of the motor neuron supplying the external urethral sphincter
  - C. voluntary stimulation of the internal urethral sphincter via its parasympathetic nerve supply
  - D.** the cerebral cortex and voluntary stimulation of the motor neuron supplying the external urethral sphincter
  - E. all of these
110. Which of the following does not occur during the micturition reflex in a baby?
- A.** The motor neuron supplying the external sphincter is stimulated.
  - B. The parasympathetic nerve supply to the bladder is stimulated.
  - C. The internal urethral sphincter mechanically opens due to changes in the shape of the bladder.
  - D. The external urethral sphincter is relaxed.
  - E. The bladder contracts.
111. The kidneys are the organs that are primarily responsible for maintaining constancy of the volume and electrolyte composition of the internal fluid environment.
- TRUE**
112. The kidneys keep the urine volume and composition essentially constant.
- FALSE**
113. The three major processes involved in urine formation are filtration, reabsorption, and excretion.
- FALSE**



114. The afferent arteriole is the blood vessel that carries blood to the glomerular capillaries.  
**TRUE**
115. Only juxtamedullary nephrons contain a juxtaglomerular apparatus.  
**FALSE**
116. The group of cells located where the distal tubule comes into contact with the afferent and efferent arterioles of the same nephron is known as the juxtaglomerular apparatus.  
**TRUE**
117. In the kidney, blood is filtered in the cortex, drains through the renal pelvis into the renal medulla, and from there travels in the ureter to the urinary bladder.  
**FALSE**
118. Glomerular filtration occurs primarily by active transport.  
**FALSE**
119. Twenty-five percent of the cardiac output goes to the kidneys because of their tremendous nutrient requirement for the active transport of Na<sup>+</sup>.  
**FALSE**
120. Plasma proteins are normally filtered in the nephron.  
**FALSE**
121. All of the plasma that enters the glomerulus is normally filtered into Bowman's capsule except for the plasma proteins.  
**FALSE**
122. The glomerular filtrate is almost identical in composition to the plasma.  
**TRUE**
123. The vast majority of the filtered fluid is reabsorbed.  
**TRUE**
124. In general, the substances in the filtrate that need to be conserved are selectively reabsorbed whereas the unwanted substances that need to be eliminated fail to be reabsorbed.  
**TRUE**

125. Glomerular filtration occurs by active transport of  $\text{Na}^+$ , which then creates an osmotic gradient for the filtration of water.
- FALSE**
126. The glomerular filtrate contains only substances that are not needed by the body.
- FALSE**
127. The Bowman's capsule hydrostatic pressure opposes filtration.
- TRUE**
128. Blood pressure in the glomerular capillaries is the same as in capillaries elsewhere in the body.
- FALSE**
129. The glomerular capillary blood pressure is higher than capillary pressure elsewhere in the body, primarily because the afferent arteriole has a larger diameter than the efferent arteriole.
- TRUE**
130. If a kidney stone blocked the renal pelvis and consequently caused a build-up of fluid pressure in the tubules and Bowman's capsule, the net filtration pressure across the glomerular capillary membrane would increase.
- FALSE**
131. Because of autoregulation, changes in mean arterial blood pressure between the range of 80 to 180 mm Hg do not directly produce changes in the GFR.
- TRUE**
132. Autoregulation of the GFR is accomplished by activation of the sympathetic nervous system.
- FALSE**
133. The glomerular capillary wall contains filtration slits formed by the clefts between the foot processes of adjacent podocytes.
- FALSE**
134. The pores in the glomerular membrane are too small for albumin to pass through.
- FALSE**
135. The kidneys receive a disproportionately large share of the cardiac output for the purpose of adjusting and purifying the plasma.
- TRUE**

136. Autoregulation is important in preventing unintentional shifts in the GFR that could lead to dangerous imbalances of fluid, electrolytes, and wastes.

**TRUE**

137. Sympathetic vasoconstriction of the afferent arterioles and a resultant fall in the GFR occur as part of the baroreceptor reflex response when the blood pressure is too low.

**TRUE**

138. Contraction of mesangial cells closes off a portion of the filtering capillaries, which leads to a decrease in GFR if the filtration pressure remains unchanged.

**TRUE**

139. For filtration to occur, blood osmotic pressure + capsular hydrostatic pressure must be less than blood hydrostatic pressure + capsular osmotic pressure.

**TRUE**

140. When a substance is reabsorbed, it moves from the tubular fluid into the peritubular capillaries.

**TRUE**

141. By tubular secretion, substances leave the blood and enter the tubular portion of the nephron.

**TRUE**

142. In active reabsorption, all of the steps involved in transepithelial transport are active.

**FALSE**

143. Transepithelial transport occurs only for substances that are actively reabsorbed.

**FALSE**

144. The  $T_m$  represents the maximum amount of a particular substance that can be excreted in the urine per unit of time.

**FALSE**

145. The amount of glucose filtered is directly proportional to the plasma glucose concentration at all plasma glucose concentrations.

**TRUE**

146. The amount of glucose reabsorbed is directly proportional to the plasma glucose concentration at all plasma glucose concentrations.

**FALSE**

147. The renal threshold represents the maximum amount of a particular substance that the tubular cells are capable of actively reabsorbing per unit of time.
- FALSE**
148. For a substance to be actively reabsorbed, all of the steps of transepithelial transport require energy expenditure.
- FALSE**
149. The tubular cells display a  $T_m$  for urea.
- FALSE**
150. The renal threshold for glucose is well above the normal plasma glucose concentration, but the renal threshold for  $PO_4$  is equal to the normal plasma  $PO_4$  concentration.
- TRUE**
151. During acidosis,  $H^+$  secretion increases.
- TRUE**
152. The secretion of aldosterone stimulates the tubular reabsorption of sodium and the tubular secretion of potassium.
- TRUE**
153. A rise in ECF  $K^+$  concentration leads to increased excitability of heart muscle, possibly producing fatal cardiac arrhythmias.
- TRUE**
154. The  $Na^+$  cotransport system in the proximal tubule facilitates elimination of foreign organic compounds from the body.
- FALSE**
155. Water reabsorption cannot occur from any portion of the nephron in the absence of vasopressin.
- FALSE**
156. Vasopressin increases  $H_2O$  reabsorption in the proximal tubule.
- FALSE**
157. The secretion of vasopressin increases if the extracellular fluid becomes hypertonic.
- TRUE**

158. Urea is passively reabsorbed down the osmotic gradient created by active  $\text{Na}^+$  reabsorption.  
**FALSE**
159. Tubular secretion involves the movement of substances from the peritubular capillary blood into the tubular fluid.  
**TRUE**
160. The liver converts many foreign organic compounds into an anionic form that can be secreted by the organic anion secretory system.  
**TRUE**
161. Angiotensinogen is produced by the kidney.  
**FALSE**
162. Tubular reabsorption and tubular secretion are highly selective processes, whereas glomerular filtration is not.  
**TRUE**
163. The clearance rate for a substance that is filtered and secreted but not reabsorbed is greater than the GFR.  
**TRUE**
164. The clearance rate for inulin is greater than the GFR.  
**FALSE**
165. A plasma clearance of 135 ml/min for a substance when the GFR is 125 ml/min indicates that net secretion of the substance occurs.  
**TRUE**
166. If a substance is filtered and secreted but not reabsorbed its plasma clearance rate is always less than the GFR.  
**FALSE**
167. The osmolarity of the medullary interstitial fluid always equilibrates with the descending limb of the loop of Henle.  
**TRUE**

168. The driving force for H<sub>2</sub>O reabsorption across all permeable segments of the kidney tubule is an osmotic gradient.
- TRUE**
169. The receptor sites for vasopressin binding are located on the basolateral border, yet the end result is an increase in H<sub>2</sub>O permeability of the luminal border of the tubular cells.
- TRUE**
170. In the tubular segments permeable to H<sub>2</sub>O, solute reabsorption is always accompanied by comparable H<sub>2</sub>O reabsorption.
- TRUE**
171. ADH release is the main stimulus for the secretion of aldosterone.
- FALSE**
172. The permeability and transport properties of the loops of Henle of juxtamedullary nephrons are important in establishing the vertical osmotic gradient in the renal medulla.
- TRUE**
173. NaCl is actively transported from the descending limb of the loop of Henle to establish the medullary osmotic gradient.
- FALSE**
174. When tubular fluid enters the distal tubule, it is hypotonic.
- TRUE**
175. Aldosterone promotes water reabsorption by controlling the reabsorption of salt.
- TRUE**
176. The presence of vasopressin acts to prevent the reabsorption of water from the distal and collecting tubules.
- FALSE**
177. Because of countercurrent multiplication, the loop of Henle is able to establish a vertical osmotic gradient in the renal medulla, ranging from 300 to 1,200 mosm/liter, despite the fact that the active salt pump of the ascending limb is only able to produce a 200 mOsm/liter osmotic gradient at each horizontal level.
- TRUE**

178. A pure loss or gain of H<sub>2</sub>O that is not accompanied by comparable solute deficit or excess in the body leads to changes in<sup>2</sup>ECF osmolarity.

**TRUE**

179. Changes in the osmolarity of the extracellular fluid are detected by osmoreceptors in the hypothalamus.

**TRUE**

180. Acute renal failure may be reversible, whereas chronic renal failure is not reversible.

**TRUE**

181. Urine moves from the kidneys to the urinary bladder through the ureters passively by the force of gravity.

**FALSE**

182. The micturition reflex controls bladder emptying in adults.

**FALSE**

183. When urine is eliminated from the body, the sphincter muscles in the urethra relax.

**TRUE**

184. During the micturition reflex, the motor neuron supplying the external urethral sphincter is stimulated.

**FALSE**

185. The average rate of urine formation is 1 ml/min.

**TRUE**

186. The epithelial lining of the bladder passively stretches to accommodate a larger volume during bladder filling.

**FALSE**

187. One can deliberately prevent urination in spite of the micturition reflex by voluntarily inhibiting the parasympathetic supply to the bladder to halt bladder contraction.

**FALSE**

188. Vasopressin is secreted from the anterior pituitary gland.

**FALSE**

189. The smooth muscle of the bladder is innervated by parasympathetic fibers.

**TRUE**

190. Complete each of the following statements.

The functional unit of the kidneys is the \_\_\_\_\_.

**nephron**

191. Complete each of the following statements.

Urine is eliminated from the bladder through the \_\_\_\_\_.

**urethra**

192. Complete each of the following statements.

The two regions of the kidney are an outer \_\_\_\_\_ and an inner \_\_\_\_\_.

**cortex, medulla**

193. Complete each of the following statements.

Tubular \_\_\_\_\_ and tubular \_\_\_\_\_ are selective processes that occur in the nephron.

**reabsorption, secretion**

194. Complete each of the following statements.

GFR = \_\_\_\_\_ x \_\_\_\_\_.

**Kf, net filtration pressure**

195. Complete each of the following statements.

The specialized cells of the \_\_\_\_\_, located within the \_\_\_\_\_, detect changes in the rate at which fluid is flowing past them through the distal tubule. In response, they secrete vasoactive chemicals that influence the GFR by making adjustments in the caliber of the \_\_\_\_\_ arterioles. This is known as the \_\_\_\_\_ feedback mechanism.

**macula densa, juxtaglomerular apparatus, afferent, tubulo-glomerular**



196. **Complete each of the following statements.**

The energy-dependent step in  $\text{Na}^+$  reabsorption involves the \_\_\_\_\_, located at the \_\_\_\_\_ membrane of the tubular cell.

**Na<sup>+</sup>-K<sup>+</sup> pump, basolateral**

197. **Complete each of the following statements.**

\_\_\_\_\_ is a group of intrinsic mechanisms in the kidneys that prevent changes in the GRF.

**Autoregulation**

198. **Complete each of the following statements.**

If the plasma concentration of substance X is 200 mg/100 ml and the GFR is 125 ml/min, the filtered load of this substance is \_\_\_\_\_.

**250 mg/min**

199. **Complete each of the following statements.**

If the  $T_m$  for substance X is 200 mg/min, how much of the substance will be reabsorbed at a plasma concentration of 200 mg/100 ml and a GFR of 125 ml/min? \_\_\_\_\_ How much of substance X will be excreted? \_\_\_\_\_

**200 mg/min, 50 mg/min**

200. **Complete each of the following statements.**

The plasma concentration of a particular substance at which its  $T_m$  is reached and the substance first starts appearing in the urine is known as the \_\_\_\_\_.

**renal threshold**

201. **Complete each of the following statements.**

Each tuft of glomerular capillaries is held together by \_\_\_\_\_ cells.

**mesangial**

202. **Complete each of the following statements.**

The \_\_\_\_\_ transforms many foreign organic compounds into ionic form, which facilitates their elimination from the body because such conversion enables them to be secreted by the organic anion transport system.

**liver**

203. **Complete each of the following statements.**

On average, of the 125 ml/min of plasma filtered, \_\_\_\_\_ ml/min is reabsorbed and \_\_\_\_\_ ml/min is excreted as urine.

**124, 1**

204. **Complete each of the following statements.**

By reabsorption, substances leave the tubules of the nephrons and return to the blood in the \_\_\_\_\_.

**peritubular capillaries**

205. **Complete each of the following statements.**

The plasma clearance of the harmless foreign compound called \_\_\_\_\_ is equal to the GFR.

**inulin**

206. **Complete each of the following statements.**

The plasma clearance of the organic anion \_\_\_\_\_ is equal to the renal plasma flow.

**para-aminohippuric acid**

207. **Complete each of the following statements.**

\_\_\_\_\_ are water channels in the tubular cells of the nephron.

**Aquaporins**

208. **Complete each of the following statements.**

\_\_\_\_\_ % of the filtered H<sub>2</sub>O is variably reabsorbed under the control of the hormone \_\_\_\_\_ in the distal and collecting tubules.

**Twenty, vasopressin**

209. **Complete each of the following statements.**

Vasopressin is also known as \_\_\_\_\_, indicative of its effect on the kidneys.

**antidiuretic hormone**

210. **Complete each of the following statements.**

\_\_\_\_\_ is an actively reabsorbed substance that does not have a tubular maximum for reabsorption.

**Sodium**

211. **Complete each of the following statements.**

\_\_\_\_\_ renal failure has a rapid onset but may be reversible;  
\_\_\_\_\_ renal failure is slow, progressive, and irreversible.

**Acute, chronic**

212. **Complete each of the following statements.**

\_\_\_\_\_ % of the renal tissue can adequately perform all excretory and regulatory functions of the kidney.

**Twenty-five**

213. **Complete each of the following statements.**

\_\_\_\_\_ is the inability to prevent the discharge of urine.

**Urinary incontinence**

214. **Complete each of the following statements.**

Two means by which substances can enter the renal tubules are \_\_\_\_\_ and \_\_\_\_\_ . Two means by which substances can leave the kidney tubules are \_\_\_\_\_ and \_\_\_\_\_ .

**glomerular filtration, tubular secretion, tubular reabsorption, urine excretion**

215. **Complete each of the following statements.**

Body fluids are \_\_\_\_\_ at 300 mOsm/liter.

**isotonic**

216. **Complete each of the following statements.**

The micturition reflex is initiated by stimulating \_\_\_\_\_ receptors in the bladder.

**stretch**

217. **Complete each of the following statements.**

The micturition reflex center is located in the \_\_\_\_\_ region of the spinal cord.

**sacral**