Fundamentals of Anatomy & Physiology, 12e **(Martini)**
Chapter 26 The Urinary System

Multiple Choice Questions

1) The urinary system does all of the following **except**
   A) excreting excess albumin molecules.
   B) regulating blood volume.
   C) helping to stabilize blood pH.
   D) eliminating organic waste products.
   E) regulating plasma concentrations of electrolytes.
   Answer: A
   Learning Outcome: 26-1
   Bloom's Taxonomy: Remembering
2) Functions of the urinary system include all of the following **except**
   A) regulation of blood volume and blood pressure.
   B) regulation of plasma concentration of certain ions.
   C) helping to stabilize blood pH.
   D) conservation of valuable nutrients.
   E) storage of fat-soluble vitamins.
   Answer: E
   Learning Outcome: 26-1
   Bloom's Taxonomy: Remembering
3) Micturition occurs through the
   A) liver.
   B) glomerulus.
   C) kidney.
   D) ureter.
   E) urethra.
   Answer: E
   Learning Outcome: 26-1
   Bloom's Taxonomy: Remembering
4) Urine is carried to the urinary bladder by
   A) blood vessels.
   B) lymphatics.
   C) the ureters.
   D) the urethra.
   E) the calyces.

Answer: C

Learning Outcome: 26-1

Bloom's Taxonomy: Remembering

5) Each of the following organs is part of the urinary system **except** the

A) kidney.

B) urinary bladder.

C) rectum.

D) ureter.

E) urethra.

Answer: C

Learning Outcome: 26-1

Bloom's Taxonomy: Remembering

6) Urine is temporarily stored in the

A) urethra.

B) urinary bladder.

C) kidney.

D) ureter.

E) renal pelvis.

Answer: B

Learning Outcome: 26-1

Bloom's Taxonomy: Remembering

7) Urine is carried from the urinary bladder to the outside of the body by the

A) urethra.

B) glomerulus.

C) convoluted tubule.

D) ureter.

E) collecting duct.

Answer: A

Learning Outcome: 26-1

Bloom's Taxonomy: Remembering

8) Which of the following activities is not related to kidney function?

A) control of hydrogen ion and pH in the blood

B) control of wastes in the blood

C) lipid digestion

D) regulation of blood pressure

E) maintenance of various blood ion concentrations

Answer: C

Learning Outcome: 26-1

Bloom's Taxonomy: Understanding

9) The excretory functions of the urinary system are performed by the
A) urethra.
B) ureters.
C) renal arteries.
D) urinary bladder.
E) kidneys.
Answer: E
Learning Outcome: 26-1
Bloom's Taxonomy: Remembering

10) When the bladder is full, urine is eliminated through the process known as
A) beta-oxidation.
B) defecation.
C) emesis.
D) micturition.
E) segmentation.
Answer: D
Learning Outcome: 26-1
Bloom's Taxonomy: Remembering

11) A glomerulus is
A) the expanded end of a nephron.
B) a knot of capillaries within the renal corpuscle.
C) the source of erythropoietin.
D) attached to the collecting duct.
E) the horseshoe-shaped segment of the nephron.
Answer: B
Learning Outcome: 26-2
Bloom's Taxonomy: Remembering

12) All of the following are true of the kidneys **except** that they are
A) located in a position that is retroperitoneal.
B) surrounded by a fibrous capsule.
C) located partly within the pelvic cavity.
D) held in place by the renal fascia.
E) covered by peritoneum.
Answer: C
Learning Outcome: 26-2
Bloom's Taxonomy: Remembering

13) The prominent indentation on the medial surface of the kidney is the
A) calyx.
B) pelvis.

C) ureter.
D) hilum.
E) pyramid.
Answer: D
Learning Outcome: 26-2
Bloom's Taxonomy: Remembering

14) The renal sinus is
A) the innermost layer of kidney tissue.
B) part of a renal pyramid.
C) an internal cavity lined by the fibrous capsule.
D) a large branch of the renal pelvis.
E) part of a renal column.
Answer: C
Learning Outcome: 26-2
Bloom's Taxonomy: Remembering

15) The outermost layer of the kidney is the
A) renal cortex.
B) renal medulla.
C) major calyx.
D) fibrous capsule.
E) renal pelvis.
Answer: D
Learning Outcome: 26-2
Bloom's Taxonomy: Remembering

16) The cavity of the kidney that receives urine from the calyces is called the
A) renal papilla.
B) renal pelvis.
C) renal medulla.
D) renal cortex.
E) renal sinus.
Answer: B
Learning Outcome: 26-2
Bloom's Taxonomy: Remembering

17) Blood leaves the glomerulus through a blood vessel called the
A) afferent arteriole.
B) efferent arteriole.
C) vasa recta.
D) interlobular arteriole.
E) peritubular capillary.

Answer: B

Learning Outcome: 26-2

Bloom's Taxonomy: Remembering

18) The condition called _____ is especially dangerous because the ureters or renal blood vessels can become twisted or kinked during movement.

A) polycystic kidney disease

B) floating kidney

C) pyelonephritis

D) renal calculi

E) renal failure

Answer: B

Learning Outcome: 26-2

Bloom's Taxonomy: Understanding

19) The _____ delivers urine to a minor calyx.

A) nephron loop (loop of Henle)

B) distal convoluted tubule

C) papillary duct

D) renal corpuscle

E) ureter

Answer: C

Learning Outcome: 26-2

Bloom's Taxonomy: Understanding

20) Typical renal blood flow is about _____ ml/min under resting conditions.

A) 500

B) 800

C) 1200

D) 1800

E) 2500

Answer: C

Learning Outcome: 26-2

Bloom's Taxonomy: Remembering

21) The visceral layer of the renal corpuscle is composed of specialized cells called

A) glomerulocytes.

B) juxtaglomerular cells.

C) tubular cells.

D) macula densa cells.

E) podocytes.

Answer: E

Learning Outcome: 26-2

Bloom's Taxonomy: Remembering

22) What is the proper order for the structures of the renal corpuscle through which a substance travels during filtration?

1. filtration slit (slit pore)
2. capsular space
3. basement membrane
4. fenestrated endothelium

A) 4 - 3 - 2 - 1

B) 4 - 1 - 2 - 3

C) 4 - 3 - 1 - 2

D) 3 - 1 - 4 - 2

E) 2 - 4 - 3 - 1

Answer: C

Learning Outcome: 26-2

Bloom's Taxonomy: Understanding

23) Capillaries that surround the proximal convoluted tubules are

A) proximal capillaries.

B) corticoradiate capillaries.

C) vasa recta capillaries.

D) efferent arterioles.

E) peritubular capillaries.

Answer: E

Learning Outcome: 26-2

Bloom's Taxonomy: Remembering

24) _____ is an inflammatory disorder of the glomeruli that affects the filtration mechanism of the kidneys.

A) Glomerulonephritis

B) Floating kidney

C) Polycystic kidney disease

D) Pyelonephrosis

E) Cystitis

Answer: A

Learning Outcome: 26-2

Bloom's Taxonomy: Remembering

25) Glomerulonephritis may occur as a consequence of an infection with the bacterium

A) *Clostridium.*

B) *Escherichia.*

C) *Streptococcus.*

D) *Staphylococcus.*

E) *Salmonella.*

Answer: C

Learning Outcome: 26-2

Bloom's Taxonomy: Understanding

26) _____ is an inherited abnormality that affects the development and structure of kidney tubules.

A) Glomerulonephritis

B) Polycystic kidney disease

C) Nephrolithiasis

D) Congenital renal failure

E) Floating kidney syndrome

Answer: B

Learning Outcome: 26-2

Bloom's Taxonomy: Remembering

27) Renal columns are

A) internal cavities lined by the fibrous capsule.

B) expanded ends of the ureters.

C) the basic functional units of the kidney.

D) bundles of tissue that extend between pyramids from the cortex.

E) conical structures that are located in the renal medulla.

Answer: D

Learning Outcome: 26-2

Bloom's Taxonomy: Remembering

28) The expanded beginning of the ureter is the

A) renal sinus.

B) renal pelvis.

C) renal calyx.

D) renal hilum.

E) renal corpuscle.

Answer: B

Learning Outcome: 26-2

Bloom's Taxonomy: Remembering

29) Major calyces

A) merge to form the renal pelvis.

B) are expanded ends of nephrons.

C) are the basic functional units of the kidney.

D) are conical structures that are located in the renal medulla.

E) are between the renal pyramids.

Answer: A

Learning Outcome: 26-2

Bloom's Taxonomy: Remembering

30) The glomerular (Bowman's) capsule and the glomerulus make up the

A) renal pyramid.

B) nephron loop (loop of Henle).

C) renal corpuscle.

D) renal papilla.

E) collecting tubule system.

Answer: C

Learning Outcome: 26-2

Bloom's Taxonomy: Remembering

31) The region known as the macula densa is part of

A) the proximal convoluted tubule.

B) the distal convoluted tubule.

C) the collecting duct.

D) the nephron loop (loop of Henle).

E) glomerular (Bowman's) capsule.

Answer: B

Learning Outcome: 26-2

Bloom's Taxonomy: Remembering

32) The cells of the macula densa, the juxtaglomerular cells, and the extraglomerular mesangial cells form the

A) renal corpuscle.

B) filtration membrane.

C) nephron loop (loop of Henle).

D) juxtaglomerular complex.

E) afferent arteriole.

Answer: D

Learning Outcome: 26-2

Bloom's Taxonomy: Remembering

33) You have been diagnosed with lupus erythematosus, a severe autoimmune disorder with a wide variety of organ-related disorders. Your doctor is worried about how this will affect your kidney function. He says that you are susceptible to _____ because of the lupus.

A) polycystic kidney disease

B) glomerulonephritis

C) cystitis

D) pyelonephritis

E) renal calculi

Answer: B

Learning Outcome: 26-2

Bloom's Taxonomy: Applying

34) Filtrate first passes from the glomerular capsule to the

A) nephron loop (loop of Henle).

B) proximal convoluted tubule.

C) distal convoluted tubule.

D) collecting duct.

E) minor calyx.

Answer: B

Learning Outcome: 26-2

Bloom's Taxonomy: Remembering

35) The portion of the nephron that empties into the collecting duct is the

A) nephron loop (loop of Henle).

B) proximal convoluted tubule.

C) distal convoluted tubule.

D) papillary tubule.

E) calyx.

Answer: C

Learning Outcome: 26-2

Bloom's Taxonomy: Remembering

36) Which of the following descriptions best matches the term renal papilla?

A) It releases renin.

B) It creates high interstitial NaCl concentration.

C) Urine enters here.

D) Initial filtrate enters here.

E) It is the apex of the renal pyramid.

Answer: E

Learning Outcome: 26-2

Bloom's Taxonomy: Remembering

37) The efferent arteriole of a nephron divides to form a network of capillaries within the cortex called the _____ capillaries.

A) peritubular

B) glomerular

C) vasa recta

D) cortical

E) efferent

Answer: A

Learning Outcome: 26-2

Bloom's Taxonomy: Remembering

38) The primary function of the proximal convoluted tubule is

A) filtration.

B) reabsorption of ions, organic molecules, vitamins, and water.

C) secretion of acids and ammonia.

D) secretion of drugs.

E) adjusting the urine pH.

Answer: B

Learning Outcome: 26-2

Bloom's Taxonomy: Remembering

39) The following is a list of the blood vessels that carry blood to the kidney. In what order does blood pass through these vessels starting at the renal artery?

1. afferent arteriole
2. arcuate artery
3. interlobar artery
4. segmental artery
5. glomerulus
6. cortical radiate artery
7. efferent arteriole
8. peritubular capillary

A) 4 - 6 - 2 - 3 - 1 - 5 - 7 - 8

B) 4 - 3 - 2 - 6 - 1 - 5 - 7 - 8

C) 4 - 3 - 2 - 6 - 7 - 5 - 1 - 8

D) 4 - 6 - 2 - 3 - 7 - 5 - 1 - 8

E) 4 - 3 - 6 - 2 - 1 - 5 - 7 - 8

Answer: B

Learning Outcome: 26-2

Bloom's Taxonomy: Understanding

40) The filtration barrier in the renal corpuscle consists of which three layers?

A) podocyte filtration slits, podocyte foot processes, and glomerular capillary fenestrations

B) glomerular capillary fenestrations, matrix, and podocyte foot processes

C) glomerular capillary fenestrations, basement membrane, and podocyte filtration slits

D) basement membrane, podocyte foot processes, and capsular outer layer

E) podocyte filtration slits, matrix cells in the glomerulus, and extraglomerular mesangial cells

Answer: C

Learning Outcome: 26-2

Bloom's Taxonomy: Remembering

41) Eighty percent of nephrons in the human kidney are located in the _____ and have short nephron loops.

A) cortex

B) medulla

C) pyramids

D) capsule

E) pelvis

Answer: A

Learning Outcome: 26-2

Bloom's Taxonomy: Remembering

42) Nephrons located close to the medulla with long nephron loops are called _____ nephrons.

A) cortical

B) juxtaglomerular

C) vasa recta

D) juxtamedullary

E) Henle

Answer: D

Learning Outcome: 26-2

Bloom's Taxonomy: Remembering

43) The _____ is a capillary bed that parallels the nephron loop (loop of Henle).

A) glomerulus

B) peritubular capillary bed

C) afferent arteriolar bed

D) medullary capillaries

E) vasa recta

Answer: E

Learning Outcome: 26-2

Bloom's Taxonomy: Remembering

44) The majority of glomeruli are located in the _____ of the kidney.

A) vasa recta

B) medulla

C) cortex

D) pelvis

E) calyces

Answer: C

Learning Outcome: 26-2

Bloom's Taxonomy: Remembering

45) Which of the following is largely confined to the renal medulla?

A) glomerular (Bowman's) capsule

B) distal convoluted tubule

C) collecting ducts

D) proximal convoluted tubule

E) glomerulus

Answer: C

Learning Outcome: 26-2

Bloom's Taxonomy: Understanding

46) Each kidney has about _____ nephrons.

A) 100,000

B) 500,000

C) 1 million

D) 1.25 million

E) 5 million

Answer: D

Learning Outcome: 26-2

Bloom's Taxonomy: Remembering

47) The majority of renal innervation is by the

A) parasympathetic nervous system.

B) somatic nervous system.

C) sympathetic nervous system.

D) enteric nervous system.

Answer: C

Learning Outcome: 26-2

Bloom's Taxonomy: Remembering

48) The epithelial cells of the proximal convoluted tubule are

A) cuboidal cells with microvilli.

B) cuboidal cells without microvilli.

C) squamous cells.

D) columnar cells with microvilli.

E) columnar cell without microvilli.

Answer: A

Learning Outcome: 26-2

Bloom's Taxonomy: Remembering

49) Which of the following has intercalated cells for pH balance?

A) glomerulus

B) proximal convoluted tubule

C) nephron loop

D) collecting duct

E) papillary duct

Answer: D

Learning Outcome: 26-2

Bloom's Taxonomy: Understanding

50) Modified smooth muscle cells in the wall of the afferent arteriole that secrete renin are called

A) macula densa cells.

B) juxtaglomerular cells.

C) extraglomerular mesangial cells.

D) podocytes.

E) principal cells.

Answer: B

Learning Outcome: 26-2

Bloom's Taxonomy: Remembering

51) Which of the following substances should **not** be filtered?

A) glucose

B) water

C) proteins

D) amino acids

E) fatty acids

Answer: C

Learning Outcome: 26-2

Bloom's Taxonomy: Understanding

52) The functional units of kidneys for plasma filtration and urine formation are the

A) pyramids.

B) nephrons.

C) calyces.

D) lobules.

E) lobes.

Answer: B

Learning Outcome: 26-2

Bloom's Taxonomy: Remembering

53) Glomerular blood flow is unique because it flows
A) through a glomerular portal vein.
B) directly from the renal artery into the glomerular capillaries.
C) from arteriole to capillary bed to arteriole.
D) from arteriole to capillary bed to vasa recta.
E) from the peritubular capillaries to the glomerular capillaries.
Answer: C
Learning Outcome: 26-2
Bloom's Taxonomy: Understanding

54) An important structure which monitors blood pressure and volume is the
A) collecting duct.
B) nephron loop.
C) papillary duct.
D) proximal convoluted tubule.
E) juxtaglomerular complex.
Answer: E
Learning Outcome: 26-2
Bloom's Taxonomy: Remembering

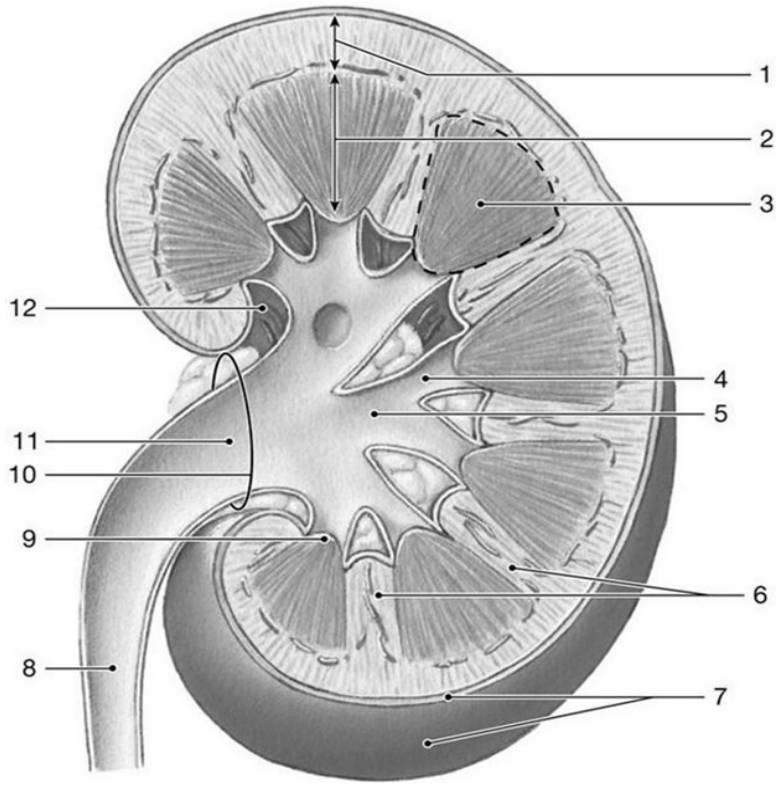

Figure 26-1 The Structure of the Kidney

Use Figure 26-1 to answer the following questions:

55) Identify the structure labeled " 4."
A) renal pelvis
B) minor calyx
C) ureter
D) major calyx
E) renal column
Answer: B
Learning Outcome: 26-2
Bloom's Taxonomy: Understanding

56) Identify the structure labeled " 8."
A) renal pelvis
B) minor calyx
C) ureter
D) major calyx
E) renal column
Answer: C
Learning Outcome: 26-2
Bloom's Taxonomy: Understanding

57) Identify the region labeled " 1."
A) renal cortex
B) renal medulla
C) renal papilla
D) renal sinus
E) fibrous capsule
Answer: A
Learning Outcome: 26-2
Bloom's Taxonomy: Understanding

58) Identify the structure labeled " 9."
A) renal sinus
B) fibrous capsule
C) renal pyramid
D) renal papilla
E) renal column
Answer: D
Learning Outcome: 26-2
Bloom's Taxonomy: Understanding

59) Identify the structure labeled " 3."
A) renal sinus
B) fibrous capsule
C) renal pyramid
D) renal papilla
E) renal column
Answer: C
Learning Outcome: 26-2
Bloom's Taxonomy: Understanding

60) Plasma filtration takes place in the
A) nephron loop (loop of Henle).
B) distal convoluted tubule.
C) papillary duct.
D) renal corpuscle.
E) ureter.
Answer: D
Learning Outcome: 26-3
Bloom's Taxonomy: Remembering

61) Reabsorbed water and solutes enter the
A) afferent arteriole.
B) efferent arteriole.
C) peritubular fluid.
D) tubular fluid.
E) glomerulus.
Answer: C
Learning Outcome: 26-3
Bloom's Taxonomy: Remembering

62) _____ is the most abundant organic waste.
A) Uric acid
B) Ammonia
C) Carbon dioxide
D) Creatinine
E) Urea
Answer: E
Learning Outcome: 26-3
Bloom's Taxonomy: Remembering

63) The process that transports solutes, including many drugs, into the tubular fluid is called
A) filtration.
B) reabsorption.

C) absorption.
D) excretion.
E) secretion.
Answer: E
Learning Outcome: 26-3
Bloom's Taxonomy: Remembering

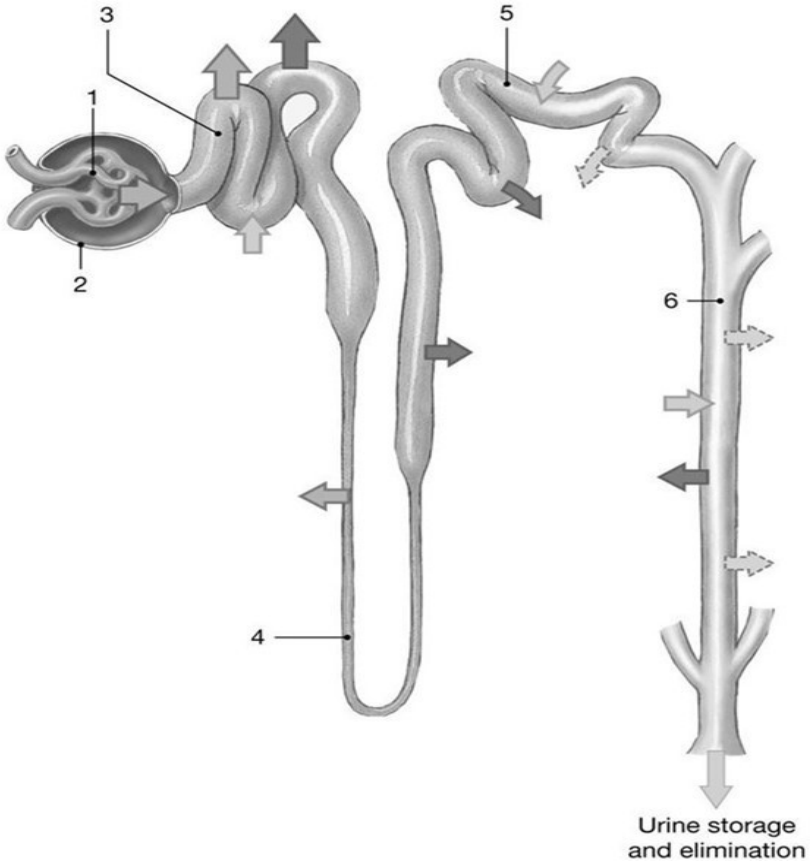

Figure 26-2 The Nephron

Use Figure 26-2 to answer the following questions:

64) What physiological process occurs at the structure labeled " 1"?
A) reabsorption
B) excretion
C) secretion
D) filtration
E) micturition
Answer: D
Learning Outcome: 26-3
Bloom's Taxonomy: Understanding

65) Where does most nutrient reabsorption occur?

A) 2

B) 3

C) 4

D) 5

E) 6

Answer: B

Learning Outcome: 26-3

Bloom's Taxonomy: Understanding

66) Which area(s) allow variable water reabsorption and is/are sensitive to the hormone ADH?

A) 1 and 3

B) 3 and 4

C) 4 and 5

D) 5 and 6

E) 3 and 6

Answer: D

Learning Outcome: 26-3

Bloom's Taxonomy: Understanding

67) Where would penicillin be secreted?

A) 6

B) 5

C) 4

D) 3

E) 1

Answer: B

Learning Outcome: 26-3

Bloom's Taxonomy: Understanding

68) Where does secretion mostly occur?

A) 5

B) 1

C) 3

D) 4

E) 2

Answer: A

Learning Outcome: 26-3

Bloom's Taxonomy: Understanding

69) Which area is sensitive to aldosterone?

A) 2

B) 1

C) 4
D) 3
E) 5
Answer: E
Learning Outcome: 26-3
Bloom's Taxonomy: Understanding

70) Identify the structure labeled " 5."
A) proximal convoluted tubule
B) distal convoluted tubule
C) collecting duct
D) nephron loop
E) glomerulus
Answer: B
Learning Outcome: 26-3
Bloom's Taxonomy: Understanding

71) Identify the structure labeled " 6."
A) proximal convoluted tubule
B) distal convoluted tubule
C) collecting duct
D) nephron loop
E) glomerulus
Answer: C
Learning Outcome: 26-3
Bloom's Taxonomy: Understanding

72) The process of filtration is driven mainly by
A) active transport.
B) blood colloid osmotic pressure.
C) glomerular hydrostatic pressure.
D) renal pumping.
E) solvent drag.
Answer: C
Learning Outcome: 26-4
Bloom's Taxonomy: Remembering

73) Approximately _____ liters of glomerular filtrate enter glomerular capsules each day.
A) 480
B) 180
C) 125
D) 18
E) 1.8

Answer: B

Learning Outcome: 26-4

Bloom's Taxonomy: Remembering

74) Under normal conditions, what are the three main pressures that cause glomerular filtration?

1. glomerular hydrostatic pressure
2. capsular hydrostatic pressure
3. capsular colloid osmotic pressure
4. blood colloid osmotic pressure

A) 1, 2, and 3

B) 2, 3, and 4

C) 1, 3, and 4

D) 1, 2, and 4

Answer: D

Learning Outcome: 26-4

Bloom's Taxonomy: Understanding

75) Which of the following formulas will allow you to calculate the net filtration pressure (NFP)?

A) NFP = GHP + CsHP – BCOP

B) NFP = GHP – (CsHP + BCOP)

C) NFP = CsHP + GHP – BCOP

D) NFP = BCOP – GHP + CsHP

E) NFP = BCOP + (GHP – CsHP)

Answer: B

Learning Outcome: 26-4

Bloom's Taxonomy: Understanding

76) Nephron measurements reveal a glomerular hydrostatic pressure of 69 mm Hg, and a capsular hydrostatic pressure of 15 mm Hg. Assuming that the blood colloid osmotic pressure is 30 mm Hg, and that essentially no plasma proteins are filtered by the glomerulus, what is the net filtration pressure in this case?

A) 30 mm Hg

B) 24 mm Hg

C) 69 mm Hg

D) 84 mm Hg

E) 99 mm Hg

Answer: B

Learning Outcome: 26-4

Bloom's Taxonomy: Understanding

77) One mechanism the kidney uses to raise systemic blood pressure is to

A) increase secretion of renin.

B) decrease secretion of aldosterone.

C) decrease release of angiotensin II.

D) increase filtration into glomerular (Bowman's) capsule.

E) decrease urinary albumin concentration.

Answer: A

Learning Outcome: 26-4

Bloom's Taxonomy: Remembering

78) Calculate net filtration pressure (NFP) in a nephron with a glomerular hydrostatic pressure of 55 mm Hg, a blood colloid osmotic pressure of 25 mm Hg, and a capsular hydrostatic pressure of 15 mm Hg.

A) NFP = 10 mm Hg

B) NFP = 95 mm Hg

C) NFP = 55 mm Hg

D) NFP = 45 mm Hg

E) NFP = 15 mm Hg

Answer: E

Learning Outcome: 26-4

Bloom's Taxonomy: Understanding

79) Blood colloid osmotic pressure (BCOP) in the glomerulus is generated by

A) blood pressure.

B) proteins in blood plasma.

C) constriction of the efferent arteriole.

D) protein in the filtrate.

E) filtrate in the capsular space.

Answer: B

Learning Outcome: 26-4

Bloom's Taxonomy: Understanding

80) The main force that causes filtration in a nephron is

A) blood colloid osmotic pressure.

B) glomerular hydrostatic pressure.

C) osmotic pressure of the urine.

D) capsular hydrostatic pressure.

E) capsular colloid osmotic pressure.

Answer: B

Learning Outcome: 26-4

Bloom's Taxonomy: Understanding

81) Substances larger than _____ are normally not allowed to pass through the filtration membrane.

A) sodium ions

B) glucose

C) albumin

D) amino acids

E) urea

Answer: C

Learning Outcome: 26-4

Bloom's Taxonomy: Remembering

82) Sympathetic stimulation of the kidney can do all of the following **except**

A) produce powerful vasoconstriction of the afferent arterioles.

B) increase the glomerular filtration rate.

C) trigger renin release.

D) produce renal ischemia.

E) reduce blood flow to kidneys.

Answer: B

Learning Outcome: 26-4

Bloom's Taxonomy: Remembering

83) The net filtration pressure at the glomerulus is equal to

A) glomerular hydrostatic pressure – (capsular hydrostatic pressure + interstitial fluid osmotic pressure).

B) capsular hydrostatic pressure + capsular colloid osmotic pressure + glomerular hydrostatic pressure.

C) glomerular hydrostatic pressure – (capsular hydrostatic pressure + blood colloid osmotic pressure).

D) (capsular hydrostatic pressure + capsular colloid osmotic pressure) – glomerular hydrostatic pressure.

E) glomerular hydrostatic pressure – (capsular hydrostatic pressure + capsular colloid osmotic pressure).

Answer: C

Learning Outcome: 26-4

Bloom's Taxonomy: Understanding

84) The amount of filtrate produced by the kidneys each minute is called the

A) net filtration rate.

B) renal filtration rate.

C) urine volume.

D) kidney filtrate volume.

E) glomerular filtration rate.

Answer: E

Learning Outcome: 26-4

Bloom's Taxonomy: Remembering

85) A drug that inhibits angiotensin converting enzyme (ACE) may lead to all of the following **except**

A) less secretion of aldosterone.

B) increased urinary loss of sodium.

C) reduction of blood pressure.

D) decreased sodium reabsorption.

E) increased fluid retention.

Answer: E

Learning Outcome: 26-4

Bloom's Taxonomy: Understanding

86) All of the following would result in an increase in renin release **except**

A) decreased blood pressure at the glomerulus.

B) blockage in the renal artery.

C) increased blood volume.

D) stimulation of juxtaglomerular cells.

E) decreased osmotic concentration at the macula densa.

Answer: C

Learning Outcome: 26-4

Bloom's Taxonomy: Understanding

87) Immediate local responses of the kidney to changes in blood flow to maintain GFR occur via

A) autoregulation.

B) countercurrent multiplication.

C) hormonal regulation.

D) autonomic regulation.

E) cephalic reflexes.

Answer: A

Learning Outcome: 26-4

Bloom's Taxonomy: Understanding

88) Damage to the glomerular filtration membrane allowing proteins into the capsular space would result in all of the following **except**

A) an increase in capsular colloid osmotic pressure.

B) a decrease in blood colloid osmotic pressure.

C) an increase in net filtration pressure.

D) an increase in GFR.

E) a decrease in capsular hydrostatic pressure.

Answer: E

Learning Outcome: 26-4

Bloom's Taxonomy: Applying

89) Which of the following opposes glomerular hydrostatic pressure?
A) capsular hydrostatic pressure
B) capsular colloid osmotic pressure
C) net filtration pressure
D) glomerular blood pressure
E) efferent arteriole hydrostatic pressure
Answer: A
Learning Outcome: 26-4
Bloom's Taxonomy: Understanding

90) The myogenic mechanism best maintains GFR in which of the following situations?
A) hypotension
B) hypertension
C) acute renal failure
D) hypernatremia
E) hyperkalemia
Answer: B
Learning Outcome: 26-4
Bloom's Taxonomy: Understanding

91) Why might a person take an ACE-inhibitor?
A) high blood sodium
B) high blood lipids
C) high blood pressure
D) low blood pressure
E) low blood potassium
Answer: C
Learning Outcome: 26-4
Bloom's Taxonomy: Applying

92) Tubular reabsorption involves all of the following **except**
A) active transport.
B) facilitated diffusion.
C) cotransport.
D) countertransport.
E) exocytosis.
Answer: E
Learning Outcome: 26-5
Bloom's Taxonomy: Remembering

93) Reabsorption of filtered glucose from the lumen in the PCT is by
A) diffusion.
B) facilitated diffusion.

C) active transport.

D) cotransport.

E) countertransport.

Answer: D

Learning Outcome: 26-5

Bloom's Taxonomy: Remembering

94) Secretion of hydrogen ions by the PCT is by

A) diffusion.

B) facilitated diffusion.

C) active transport.

D) cotransport.

E) countertransport.

Answer: E

Learning Outcome: 26-5

Bloom's Taxonomy: Remembering

95) Chloride ions are reabsorbed in the thick ascending limb of the nephron loop by

A) simple diffusion.

B) facilitated diffusion.

C) active transport.

D) cotransport with Na and K ions.

E) countertransport with bicarbonate ion.

Answer: D

Learning Outcome: 26-5

Bloom's Taxonomy: Remembering

96) The renal threshold for glucose is approximately _____ mg/dl.

A) 75

B) 90

C) 100

D) 140

E) 180

Answer: E

Learning Outcome: 26-5

Bloom's Taxonomy: Remembering

97) The concentration at which all of the carriers in the renal tubules for a given substance are saturated is the

A) renal maximum.

B) hydrostatic threshold.

C) blood colloid maximum.

D) transport maximum.

E) renal threshold.

Answer: D

Learning Outcome: 26-5

Bloom's Taxonomy: Remembering

98) The _____ is the plasma concentration at which a specific compound will begin appearing in the urine.

A) tubular maximum

B) hydrostatic threshold

C) blood colloid maximum

D) osmotic pressure

E) renal threshold

Answer: E

Learning Outcome: 26-5

Bloom's Taxonomy: Remembering

99) The process of _____ involves a carrier protein transporting a molecule down its concentration gradient.

A) simple diffusion

B) facilitated diffusion

C) osmosis

D) bulk transport

E) active transport

Answer: B

Learning Outcome: 26-5

Bloom's Taxonomy: Remembering

100) Movement of a substance against its concentration gradient by using ATP is

A) simple diffusion.

B) facilitated diffusion.

C) osmosis.

D) bulk transport.

E) active transport.

Answer: E

Learning Outcome: 26-5

Bloom's Taxonomy: Remembering

101) In the process of _____, two substances are moved across a cell membrane in the same direction without directly using cellular energy. One of the substances can be moved against a concentration gradient by this process.

A) countertransport

B) cotransport

C) simple diffusion

D) active transport

E) co-osmosis

Answer: B

Learning Outcome: 26-5

Bloom's Taxonomy: Remembering

102) Diuretics are used for all of the following reasons **except**

A) to reduce body weight.

B) to reduce water retention.

C) to reduce blood pressure.

D) to treat congestive heart failure.

E) to reduce glucose levels.

Answer: E

Learning Outcome: 26-5

Bloom's Taxonomy: Understanding

103) The majority of water is reabsorbed in the

A) proximal convoluted tubule.

B) nephron loop.

C) distal convoluted tubule.

D) collecting duct.

E) papillary duct.

Answer: A

Learning Outcome: 26-5

Bloom's Taxonomy: Remembering

104) The majority of cotransporters and countertransporters are linked to the reabsorption of what ion?

A) hydrogen

B) sodium

C) potassium

D) bicarbonate

E) chloride

Answer: B

Learning Outcome: 26-5

Bloom's Taxonomy: Understanding

105) Prolonged aldosterone stimulation of the distal convoluted tubule may result in

A) hypercalcemia.

B) hypocalcemia.

C) hypokalemia.

D) hyperkalemia.

Answer: C

Learning Outcome: 26-5

Bloom's Taxonomy: Applying

106) Increased secretion of which of the following may result in hyperchloremia?

A) antidiuretic hormone

B) aldosterone

C) atrial natriuretic peptide

D) parathyroid hormone

Answer: B

Learning Outcome: 26-5

Bloom's Taxonomy: Applying

107) Which of the following does not use ATP directly but is dependent on the activity of the Na^+/K^+ pump?

A) osmosis

B) facilitated diffusion of sodium ions

C) cotransport of sodium and glucose in the proximal convoluted tubule

D) hydrogen ion secretion in the proximal convoluted tubule

E) simple diffusion

Answer: C

Learning Outcome: 26-5

Bloom's Taxonomy: Applying

108) Which of the following will result in a more concentrated urine?

A) Drinking an extra-large soda during a movie marathon.

B) Taking the drug spironolactone (a competitive inhibitor of aldosterone).

C) Overexpression of aquaporins.

D) Taking the drug furosemide (a non-competitive inhibitor of pumps in the nephron loop).

E) Overproduction of ADH.

Answer: C

Learning Outcome: 26-5

Bloom's Taxonomy: Applying

109) Why is the presence of microvilli in the proximal convoluted tubule important?

A) for filtration to occur

B) for toxins and ions to be actively secreted

C) for the majority of tubular reabsorption to occur

D) for ADH to control water reabsorption

E) for acid/base balance

Answer: C

Learning Outcome: 26-5

Bloom's Taxonomy: Understanding

110) Which of the following is **not** normally found in urine?

A) hydrogen ions

B) urea

C) large proteins

D) amino acids

E) creatinine

Answer: C

Learning Outcome: 26-6

Bloom's Taxonomy: Remembering

111) The _____ test is often used to estimate the glomerular filtration rate.

A) creatinine to albumin ratio

B) glucose tolerance

C) CBC or complete blood count

D) specific gravity

E) creatinine clearance

Answer: E

Learning Outcome: 26-6

Bloom's Taxonomy: Remembering

112) What occurs in the countercurrent multiplier process?

A) Sodium is pumped into the blood while potassium is actively transported out of the blood back into the tissues.

B) A higher sodium concentration is produced in the renal medulla that osmotically draws water out of the tubules and urine.

C) Glucose and sodium are cotransported from urine back into blood.

D) Creatinine is actively transported out of the blood into urine.

E) Uric acid is excreted into the kidney tubules while urea is reabsorbed in the nephron loop.

Answer: B

Learning Outcome: 26-6

Bloom's Taxonomy: Understanding

113) The ability to form concentrated urine depends on the functions of the

A) proximal convoluted tubule.

B) distal convoluted tubule.

C) collecting duct.

D) nephron loop (loop of Henle).

E) nephron loop, distal convoluted tubule and the collecting duct.

Answer: E

Learning Outcome: 26-6

Bloom's Taxonomy: Remembering

114) The mechanism for producing a concentrated urine involves all of the following **except**

A) the secretion of antidiuretic hormone (ADH) by the posterior pituitary gland.

B) aquaporins being inserted into the membranes of the collecting duct cells.

C) a high concentration of NaCl in the interstitial fluid that surrounds the collecting ducts.

D) an increase in facultative water reabsorption.

E) water reabsorption in the proximal convoluted tubule.

Answer: E

Learning Outcome: 26-6

Bloom's Taxonomy: Understanding

115) A patient consistently produces a large volume of dilute urine. This may be due to

A) excess ADH.

B) absence of ADH.

C) hematuric oliguria.

D) excess aldosterone.

E) dilation of the afferent arterioles.

Answer: B

Learning Outcome: 26-6

Bloom's Taxonomy: Understanding

116) Antidiuretic hormone

A) increases the permeability of the collecting ducts to water.

B) is secreted in response to low potassium ion in the blood.

C) causes the kidneys to produce a larger volume of very dilute urine.

D) is secreted by the anterior pituitary.

E) release is insensitive to the osmolarity of interstitial fluid.

Answer: A

Learning Outcome: 26-6

Bloom's Taxonomy: Understanding

117) If a urine sample is dark yellow in color, which of the following will be **true**?

A) It will have a low pH.

B) It will have the odor of ammonia.

C) It will contain large amounts of urobilin.

D) It will contain excess chloride ion.

E) It will have a high pH.

Answer: C

Learning Outcome: 26-6

Bloom's Taxonomy: Understanding

118) When the level of ADH (antidiuretic hormone) decreases,

A) a concentrated urine is produced.

B) less urine is produced.

C) the osmolarity of the urine decreases.

D) permeability to water in the collecting system increases.

E) water reabsorption increases in the nephron loop.

Answer: C

Learning Outcome: 26-6

Bloom's Taxonomy: Remembering

119) As the filtrate passes through the renal tubules, approximately what percentage is reabsorbed and returned to the circulation?

A) 1

B) 38

C) 63

D) 74

E) 99

Answer: E

Learning Outcome: 26-6

Bloom's Taxonomy: Remembering

120) In response to increased levels of aldosterone, the kidneys produce

A) a larger volume of urine.

B) urine with a higher concentration of sodium ions.

C) urine with a lower concentration of potassium ions.

D) urine with a lower concentration of sodium ions.

E) urine with less glucose.

Answer: D

Learning Outcome: 26-6

Bloom's Taxonomy: Remembering

121) Which of the following is a **not** a true statement regarding the countercurrent multiplication system?

A) The thin limb of the nephron loop is permeable to water.

B) The thick limb of the nephron loop is permeable to solutes.

C) The osmotic concentration of the fluid in the nephron loop decreases in the thin limb.

D) Tubule fluid arrives at the DCT at about 100 mOsm/L.

E) The maximum solute concentration is about 1200 mOsm/L.

Answer: C

Learning Outcome: 26-6

Bloom's Taxonomy: Understanding

122) Excess release of natriuretic peptides would cause
A) a large volume of concentrated urine.
B) a large volume of dilute urine.
C) a small volume of concentrated urine.
D) a small volume of dilute urine.
Answer: B
Learning Outcome: 26-6
Bloom's Taxonomy: Applying

123) The final composition of urine is represented by which of the following statements?
A) Urine = substances reabsorbed + substances secreted.
B) Urine = substances filtered + substances reabsorbed + substances secreted.
C) Urine = substances secreted – substances reabsorbed – substances filtered.
D) Urine = substances filtered – substances reabsorbed + substances secreted.
E) Urine = substances reabsorbed – substances secreted – substances filtered.
Answer: D
Learning Outcome: 26-6
Bloom's Taxonomy: Understanding

124) How would the absence of an osmolarity gradient in the renal medulla affect the volume and concentration of urine produced?
A) decrease volume; decrease concentration
B) decrease volume; increase concentration
C) increase volume; decrease concentration
D) increase volume; increase concentration
E) It would have no effect on either urine volume or concentration.
Answer: C
Learning Outcome: 26-6
Bloom's Taxonomy: Understanding

125) Which of the following locations would you expect to utilize the most ATP?
A) glomerulus
B) thin descending limb of the nephron loop
C) thick ascending limb of the nephron loop
D) collecting duct
Answer: C
Learning Outcome: 26-6
Bloom's Taxonomy: Applying

126) Facultative water reabsorption occurs in which portion of the nephron?
A) glomerulus
B) proximal convoluted tubule
C) thin descending limb of the nephron loop

D) thick ascending limb of the nephron loop

E) distal convoluted tubule

Answer: E

Learning Outcome: 26-6

Bloom's Taxonomy: Understanding

127) The ureters and urinary bladder are lined by _____ epithelium.

A) stratified squamous

B) pseudostratified columnar

C) simple cuboidal

D) transitional

E) simple columnar

Answer: D

Learning Outcome: 26-7

Bloom's Taxonomy: Remembering

128) The detrusor muscle

A) moves urine along the ureters by peristalsis.

B) compresses the urinary bladder expelling urine.

C) compresses the urethra expelling urine.

D) functions as the external urethral sphincter.

E) surrounds the renal pelvis.

Answer: B

Learning Outcome: 26-7

Bloom's Taxonomy: Remembering

129) Which of the following describes when the kidneys are unable to maintain homeostasis?

A) glomerulonephritis

B) polycystic kidney disease

C) calculi

D) renal failure

E) hematuria

Answer: D

Learning Outcome: 26-7

Bloom's Taxonomy: Remembering

130) The area of the urinary bladder bounded by the openings of the two ureters and the urethra is called the

A) renal pelvis.

B) JG apparatus.

C) pyramid.

D) trigone.

E) vasa recta.

Answer: D

Learning Outcome: 26-7

Bloom's Taxonomy: Remembering

131) Insoluble deposits that form within the urinary tract from calcium salts, magnesium salts, or uric acid are called kidney stones or renal

A) calculi.

B) plaque.

C) caries.

D) otoliths.

E) lithotrophs.

Answer: A

Learning Outcome: 26-7

Bloom's Taxonomy: Remembering

132) You complain to the doctor about constant pain and discomfort in the low back area. What test might logically be recommended?

A) an MRI

B) a pyelogram

C) a liver biopsy

D) an angiogram

E) a liver enzyme assay

Answer: B

Learning Outcome: 26-7

Bloom's Taxonomy: Applying

133) The pontine storage center controls micturition by

A) stimulating bladder contractions.

B) increasing contraction of the detrusor muscle and the internal urethral sphincter.

C) relaxing the internal urethral sphincter and increasing detrusor muscle activity.

D) increasing contraction of the external urethral sphincter and reducing detrusor muscle activity.

E) stimulating the micturition reflex.

Answer: D

Learning Outcome: 26-7

Bloom's Taxonomy: Understanding

134) Which of the following statements is **false** regarding micturition?

A) When you relax the external urethral sphincter, the internal sphincter will relax.

B) Urination can occur despite voluntary opposition.

C) Parasympathetic control is involved with the micturition reflex.

D) The micturition reflex requires the vagus nerve.

E) Bladder contractions can force open the internal urethral sphincter.

Answer: D

Learning Outcome: 26-7

Bloom's Taxonomy: Understanding

135) Changes that occur in the urinary system with aging include all of the following **except**

A) a decline in the number of functional nephrons.

B) a reduction in the GFR (glomerular filtration rate).

C) increased sensitivity to ADH.

D) less control of the micturition reflex.

E) loss of sphincter muscle tone.

Answer: C

Learning Outcome: 26-8

Bloom's Taxonomy: Remembering

136) Your doctor has diagnosed you with prostatitis, an inflammation and swelling of the prostate gland. One of your primary symptoms is

A) urinating small volumes.

B) renal failure.

C) hematuria.

D) glycosuria.

E) large amounts of dilute urine.

Answer: A

Learning Outcome: 26-8

Bloom's Taxonomy: Applying

137) Each of the following organ systems excretes wastes to some degree **except** the _____ system.

A) urinary

B) integumentary

C) digestive

D) endocrine

E) respiratory

Answer: D

Learning Outcome: 26-9

Bloom's Taxonomy: Remembering

In-Text Figure-Based Questions

1) In which region of the kidney is a glomerulus located? (Figure 26-5)

A) fibrous capsule

B) renal hilum

C) medullary pyramid

D) renal cortex

E) renal medulla

Answer: D

Learning Outcome: 26-2

Bloom's Taxonomy: Remembering

2) What structure connects the proximal convoluted tubule to the distal convoluted tubule? (Figure 26-6)

A) renal corpuscle

B) collecting duct

C) papillary duct

D) glomerular capsule

E) nephron loop

Answer: E

Learning Outcome: 26-2

Bloom's Taxonomy: Remembering

3) What four factors shown result in an increased blood volume? (Figure 26-11)

A) increased sodium retention, increased fluid consumption, increased fluid retention, and constriction of systemic veins

B) decreased cardiac output, decreased fluid retention, decreased sodium retention, and systemic vasodilation

C) increased glomerular hydrostatic pressure, increased blood colloid osmotic pressure, decreased capsular hydrostatic pressure, decreased capsular colloid osmotic pressure

D) decreased glomerular hydrostatic pressure, decreased blood colloid osmotic pressure, increased capsular hydrostatic pressure, increased capsular colloid osmotic pressure

E) increased sodium excretion, increased potassium retention, decreased fluid consumption, increased fluid retention

Answer: A

Learning Outcome: 26-4

Bloom's Taxonomy: Applying

4) Aldosterone-sensitive portions of the distal convoluted tubule and collecting duct allow for the exchange of which ions? (Figure 26-13)

A) reabsorption of hydrogen ions in exchange for chloride ions

B) reabsorption of chloride ions in exchange for hydrogen ions

C) reabsorption of sodium ions in exchange for potassium ions

D) reabsorption of potassium ions in exchange for sodium ions

E) reabsorption of bicarbonate ions in exchange for hydrogen ions

Answer: C

Learning Outcome: 26-5

Bloom's Taxonomy: Understanding

5) ADH creates a (*small* or *large*) volume of (*dilute* or *concentrate*) urine. (Figure 26-15)

A) small; dilute

B) small; concentrated

C) large; dilute

D) large; concentrated

Answer: B

Learning Outcome: 26-6

Bloom's Taxonomy: Understanding

6) The (*ureter* or *urethre*) transports urine *to* the bladder. (Figure 26-18)

A) ureter

B) urethra

Answer: A

Learning Outcome: 26-7

Bloom's Taxonomy: Remembering

Essay Questions

1) List each organ of the urinary system and concisely describe its function.

Answer: Consisting of the kidneys, ureters, urinary bladder, and urethra, the urinary system has three primary functions: (1) excretion, the removal of organic waste products from body fluids, (2) elimination, the discharge of these waste products into the environment, and (3) homeostatic regulation of the volume and solute concentration of blood plasma. The excretory and homeostatic regulation functions of the urinary system are performed by the two kidneys that produce urine, a fluid containing water, ions, and small soluble compounds. Urine leaving the kidneys flows along paired tubes called ureters to the urinary bladder, a muscular sac for temporary storage of urine. On being forced out of the urinary bladder, urine passes through the urethra to the exterior. The urinary bladder and the urethra are responsible for the elimination of urine, a process called urination or micturition.

Learning Outcome: 26-1

Bloom's Taxonomy: Understanding

2) In glomerulonephritis, the normal filtration barrier is damaged and becomes far more permeable to plasma proteins, such as albumin along with other solutes. How would that affect glomerular filtration?

Answer: GFR would go up for two reasons. (1) The leakage of protein into the capsular filtrate will lower the effectiveness of BCOP and thus raise the net filtration pressure. (2) Filtration will increase also because of the increased leakiness of the glomerulus to water, ions, and other solutes. A distinct proteinuria will appear, and the loss of protein will lower BCOP, making matters worse and promoting edema formation in the peripheral tissues.

Learning Outcome: 26-4

Bloom's Taxonomy: Applying

3) You have just been diagnosed with hypertension and your physician orders blood work that includes information about your renal function. Why might she be concerned about this?

Answer: Answers will vary but should include that glomerular hydrostatic pressure is already a high pressure and adding additional pressure to it may damage the capillary endothelium and result in larger volumes of urine and protein loss.

Learning Outcome: 26-4

Bloom's Taxonomy: Applying

4) Explain why a person with heart failure may be prescribed an ACE-inhibitor?

Answer: Answers will vary but should include that with decreased angiotensin II, the blood pressure will be lower because of less activity of angiotensin II and decreased aldosterone secretion. Together these will decrease preload, making it easier for the failing heart to eject blood. (Term preload may not be used if the heart chapter has not been covered and students may use blood pressure instead.)

Learning Outcome: 26-4

Bloom's Taxonomy: Applying

5) Glucosuria and polyuria are characteristics of diabetes mellitus. Explain how hyperglycemia causes these.

Answer: Answers will vary but should include a discussion of blood glucose being higher than the renal threshold leading to more glucose in the filtrate than can be reabsorbed in the proximal convoluted tubule because transport maximum was met. This causes the glucose to remain in the urine. The glucose remaining in the urine decreases the ability of the collecting duct to reabsorb water because the osmotic gradient will be less.

Learning Outcome: 26-5

Bloom's Taxonomy: Applying

6) What is the creatinine clearance test? How can it be used to estimate GFR? How accurate is it?

Answer: This test relies on measuring total creatinine excreted in the urine in 24 hours and measuring the plasma concentration of creatinine. Since essentially none of the filtered load is returned to bloodstream, the amount in the urine relates directly to the volume of blood that filtered in the glomeruli. GFR can be calculated by dividing creatinine excretion rate (mg/hr) by plasma concentration of creatinine (g/dL) to get the GFR in dL/hour, from which the per-minute rate is calculated by dividing by 60. The test is not entirely accurate because up to 15 percent of the excreted creatinine enters the urine by tubular secretion.

Learning Outcome: 26-6

Bloom's Taxonomy: Applying

7) Sarah has been suffering from a stomach virus. As a result, she is dehydrated and her plasma ADH and aldosterone levels are elevated. Explain how each of these hormones independently affects the nephron including the specific location(s) of the nephron affected. Finally, state how the combined effects of these two hormones will alter urine concentration and volume.

Answer: ADH will increase the number of aquaporins inserted into the apical plasma membrane of the distal convoluted tubule and collecting ducts. The presence of aquaporins will allow water to be reabsorbed by the osmotic gradient in this portion of the nephron to match the rising intramedullary concentration. Thus, the tubule fluid becomes very concentrated as water is removed. Aldosterone increases sodium reabsorption in the distal

convoluted tubule and collecting duct. When sodium is reabsorbed, water will follow to keep the osmotic gradient equal. Together, ADH and aldosterone yield significant water reabsorption in the late distal convoluted tubule and collecting ducts resulting in a small volume of highly concentrated urine.

Learning Outcome: 26-6

Bloom’s Taxonomy: Applying