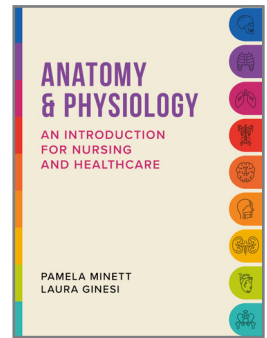




Lantern



Questions to accompany *Anatomy and Physiology*

CHAPTER 8 THE URINARY SYSTEM

Multiple Choice Questions (MCQs)

Each question consists of a stem statement or question, and 5 options. You must pick the one correct answer.

- 1. Which of the following structures is found within the urinary system?**
 - A. gall bladder
 - B. ureter
 - C. sphincter of Oddi
 - D. larynx
 - E. hypothalamus
- 2. Which of the following substances would NOT normally be expected to appear in urine?**
 - A. water
 - B. urea
 - C. sodium ions
 - D. glucose
 - E. chloride ions
- 3. Which of the following structures is NOT a part of a nephron?**
 - A. renal pelvis
 - B. distal tubule
 - C. collecting duct
 - D. proximal tubule
 - E. loop of Henle
- 4. Each kidney contains about a million nephrons, each of which begins in a filtration apparatus called:**
 - A. the distal tubule
 - B. the proximal tubule
 - C. the glomerular capsule
 - D. the loop of Henle
 - E. pyramids of the kidney
- 5. What volume of glomerular filtrate do adults make every day?**
 - A. 1–5 litres
 - B. 80 litres
 - C. 130 litres
 - D. 180 litres
 - E. 250 litres
- 6. Which of the following substances does NOT normally pass through from glomerular capillaries into the filtrate?**
 - A. albumin
 - B. sodium ions
 - C. water
 - D. urea
 - E. chloride ions
- 7. Which of the following statements about antidiuretic hormone (ADH) is incorrect?**
 - A. ADH regulates the amount of water reabsorbed by the kidneys
 - B. ADH is also known as vasopressin
 - C. without ADH, the proximal parts of the nephron are impermeable to water
 - D. ADH is synthesised in the hypothalamus and stored in the pituitary gland
 - E. ADH plays a key role in the homeostatic process called osmoregulation
- 8. Which hormone, produced by the kidneys, plays a role in the production of red blood cells?**
 - A. adrenaline
 - B. oxytocin
 - C. renin
 - D. aldosterone
 - E. erythropoietin

9. Which part of the human body produces urea?

- A. bone marrow
- B. kidneys
- C. liver
- D. muscles
- E. brain

10. Ultrafiltration by the glomerulus is enhanced by:

- A. large surface area of the capillaries
- B. large numbers of glomeruli
- C. thin semipermeable barrier
- D. high pressure in the capillaries
- E. all of the above

11. Through which vessel does blood leave the glomerulus?

- A. afferent arteriole
- B. interlobular vessel
- C. renal calyx
- D. efferent arteriole
- E. renal vein

12. The process of voiding urine from the bladder is known as:

- A. menstruation
- B. implantation
- C. excretion
- D. micturition
- E. emptying

Critical thinking: ARQs (assertion reasoning questions)

These questions consist of two statements:

- an assertion, and
- a reason.

You must first determine whether each statement is *TRUE* or *FALSE*.

- If both statements are true, you must next determine whether the reason correctly explains the assertion. The answer will be option 1 or option 2.
- If one statement is true and the other is false then the answer is option 3 or option 4, depending on which of the statements is correct.
- If both statements are false, then the answer is option 5.

There is one option for each possible outcome.

Question 13

| A = the Assertion | R = the Reason |
|--|---|
| An important function of the kidneys is to produce urine and disturb homeostasis | The urinary system excretes water, salt, urea, drugs and other substances from the human body in urine, which is eliminated |
| Options | |
| 1) Both A and R are true and R is the correct explanation of A | |
| 2) Both A and R are true but R is NOT the explanation of A | |
| 3) A is true but R is false | |
| 4) A is false but R is true | |
| 5) Both A and R are false | |

Question 14

| A = the Assertion | R = the Reason |
|--|---|
| Urine should not normally contain significant amounts of protein | The glomerular filter should not allow large particles like protein to pass into the Bowman's capsule |
| Options | |
| 1) Both A and R are true and R is the correct explanation of A | |
| 2) Both A and R are true but R is NOT the explanation of A | |
| 3) A is true but R is false | |
| 4) A is false but R is true | |
| 5) Both A and R are false | |

Question 15

| A = the Assertion | R = the Reason |
|--|--|
| The proximal convoluted tubule (PCT) of the nephron provides a large surface area for absorption | The PCT is responsible for reabsorbing most of the solutes and water from filtrate |
| Options | |
| 1) Both A and R are true and R is the correct explanation of A | |
| 2) Both A and R are true but R is NOT the explanation of A | |
| 3) A is true but R is false | |
| 4) A is false but R is true | |
| 5) Both A and R are false | |

Question 16

| A = the Assertion | R = the Reason |
|--|---|
| If blood pressure falls, blood flow to the kidneys is reduced, which increases activity of the renin-angiotensin-aldosterone cascade and, in turn, restores blood pressure to its original level | Aldosterone plays a key role in blood pressure homeostasis because it determines the levels of angiotensin II that circulate in blood at any given time |
| Options | |
| 1) Both A and R are true and R is the correct explanation of A | |
| 2) Both A and R are true but R is NOT the explanation of A | |
| 3) A is true but R is false | |
| 4) A is false but R is true | |
| 5) Both A and R are false | |

Question 17

| A = the Assertion | R = the Reason |
|--|---|
| Ultrafiltration occurs in glomerular capillaries which are found in the medulla of the kidneys | The renal pyramids in the medulla are the functional units of the kidneys |
| Options | |
| 1) Both A and R are true and R is the correct explanation of A | |
| 2) Both A and R are true but R is NOT the explanation of A | |
| 3) A is true but R is false | |
| 4) A is false but R is true | |
| 5) Both A and R are false | |

Match the terms

Question 18

Match each anatomical part to its description.

| Part | Description |
|-----------------|-------------|
| Medulla | |
| Cortex | |
| Nephron | |
| Ureters | |
| Urinary bladder | |
| Urethra | |

1. Paired tubular organs that drain urine from each kidney to the urinary bladder
2. A hollow, muscular sac that collects, stores and eliminates urine
3. The darker, outer layer of kidney tissue containing glomeruli
4. The hollow, tubular organ that transmits urine to the exterior during micturition
5. The middle layer of the kidney tissue with pyramid-shaped areas
6. The microscopic functional unit of the kidney

Putting it all together

Question 19

Explain, in your own words, whether the following substances would normally be expected to be present in urine.

- a) Protein
- b) Glucose

Suggest some reasons for the presence of these substances in urine.

Question 20

Some people may need to undergo kidney dialysis. Explain, in your own words, how this intervention is used to manage chronic kidney disease.

Answers to questions

Answers are supplied to most, but not all questions. Some may require you to carry out further research using the book.

Multiple Choice Questions (MCQs)

Each question consists of a stem statement or question, and 5 options. You must pick the one correct answer.

- 1. Which of the following structures is found within the urinary system?**
B. ureter
- 2. Which of the following substances would NOT normally be expected to appear in urine?**
D. glucose
- 3. Which of the following structures is NOT a part of a nephron?**
A. renal pelvis
- 4. Each kidney contains about a million nephrons, each of which begins in a filtration apparatus called:**
C. the glomerular capsule
- 5. What volume of glomerular filtrate do adults make every day?**
D. 180 litres
- 6. Which of the following substances does NOT normally pass through from glomerular capillaries into the filtrate?**
A. albumin
- 7. Which of the following statements about antidiuretic hormone (ADH) is incorrect?**
C. without ADH, the proximal parts of the nephron are impermeable to water
- 8. Which hormone, produced by the kidneys, plays a role in the production of red blood cells?**
E. erythropoietin
- 9. Which part of the human body produces urea?**
C. liver
- 10. Ultrafiltration by the glomerulus is enhanced by:**
E. all of the above
- 11. Through which vessel does blood leave the glomerulus?**
D. efferent arteriole
- 12. The process of voiding urine from the bladder is known as:**
D. micturition

Critical thinking: ARQs (assertion reasoning questions)

These questions consist of two statements:

- an assertion, and
- a reason.

You must first determine whether each statement is *TRUE* or *FALSE*.

- If both statements are true, you must next determine whether the reason correctly explains the assertion. The answer will be option 1 or option 2.
- If one statement is true and the other is false then the answer is option 3 or option 4, depending on which of the statements is correct.

- If both statements are false, then the answer is option 5.
There is one option for each possible outcome.

Question 13

| A = the Assertion | R = the Reason |
|--|---|
| An important function of the kidneys is to produce urine and disturb homeostasis | The urinary system excretes water, salt, urea, drugs and other substances from the human body in urine, which is eliminated |
| 4. <i>A is false but R is true</i> | |
| <p><i>Explanation</i></p> <p>The Assertion (A) is <i>FALSE</i>. The kidneys function to maintain homeostasis, not disturb it.</p> <p>The Reason (R) is <i>TRUE</i>. A range of unwanted and potentially toxic substances is eliminated from the body via urine.</p> <p>Option 4 is therefore correct.</p> | |

Question 14

| A = the Assertion | R = the Reason |
|--|---|
| Urine should not normally contain significant amounts of protein | The glomerular filter should not allow large particles like protein to pass into the Bowman's capsule |
| 1. <i>Both A and R are true and R is the correct explanation of A</i> | |
| <p><i>Explanation</i></p> <p>The Assertion (A) is <i>TRUE</i>. The presence of protein in urine – called proteinuria – is a sign of problems with kidney function.</p> <p>The Reason (R) is <i>TRUE</i>. Normally, plasma proteins are not filtered at the glomerulus, so they are not cleared from blood. They should not cross the glomerular barrier so they do not enter the Bowman's capsule. As a result, proteins should not be in filtrate or final urine.</p> <p>Option 1 is the correct answer.</p> | |

Question 15

| A = the Assertion | R = the Reason |
|--|--|
| The proximal convoluted tubule (PCT) of the nephron provides a large surface area for absorption | The PCT is responsible for reabsorbing most of the solutes and water from filtrate |
| 1. Both A and R are true and R is the correct explanation of A | |
| <p><i>Explanation</i></p> <p>The Assertion (A) is <i>TRUE</i>. The proximal tubule is the first segment of the nephron and the epithelial surface (the cells which are directly in contact with the filtrate in the lumen) have many microvilli, which provide a very large surface area. The function of the microvilli is to reabsorb solutes and water from filtrate. These cells also have lots of mitochondria, which provide the energy needed for the active transport processes that move the solutes from the lumen and into the cells against their concentration gradient.</p> <p>The Reason (R) is <i>TRUE</i>. Solute that are reabsorbed from glomerular filtrate include sodium ions (by active transport) and glucose (by facilitated diffusion). Chloride ions, which are negatively charged, passively follow sodium ions to maintain electroneutrality.</p> <p>Many of the solutes exert an osmotic effect so water passively follows sodium, glucose and other solutes by osmosis.</p> <p>Thus option 1 is correct.</p> | |

Question 16

| A = the Assertion | R = the Reason |
|--|---|
| If blood pressure falls, blood flow to the kidneys is reduced, which increases activity of the renin-angiotensin-aldosterone cascade and, in turn, restores blood pressure to its original level | Aldosterone plays a key role in blood pressure homeostasis because it determines the levels of angiotensin II that circulate in blood at any given time |
| 3. A is true but R is false | |
| <p><i>Explanation</i></p> <p>The Assertion (A) is <i>TRUE</i>. Renin is the first hormone within the renin-angiotensin-aldosterone system (RAAS), the activity of which is regulated by renal blood flow. The function of this hormone cascade is vital for blood pressure homeostasis, because it is essential for determining systemic vascular resistance and it is an important determinant of plasma volume and composition.</p> <p>The Reason (R) is <i>FALSE</i>. It is not aldosterone but renin which catalyses the cleavage of angiotensinogen to form angiotensin I.</p> <p>Renin is the first hormone in the RAAS, angiotensin II is the second and aldosterone, a steroid hormone, is the third one to be activated. Angiotensin I is a precursor substance that is further changed to make angiotensin II by angiotensin-converting enzyme (ACE) in the lung and other tissues. Angiotensin II is a powerful vasoconstrictor and it also stimulates the release of aldosterone from the adrenal cortex. In turn, aldosterone increases reabsorption of sodium and water by the distal tubule of nephrons.</p> <p>Option 3 is the correct one.</p> | |

Question 17

| A = the Assertion | R = the Reason |
|---|---|
| Ultrafiltration occurs in glomerular capillaries which are found in the medulla of the kidneys | The renal pyramids in the medulla are the functional units of the kidneys |
| 5. Both A and R are false | |
| <p><i>Explanation</i></p> <p>The Assertion (A) is <i>FALSE</i>. Ultrafiltration does take place in the glomerular capillaries. However, this part of the nephron (renal tubule) is always located in the cortex, which is the outer region of the kidney. The term medulla is used to describe the middle region, which is located between the cortex and the renal pelvis.</p> <p>The Reason (R) is <i>FALSE</i>. Nephrons are the microscopic functional units of the kidneys, and each kidney contains over a million of them. The term renal pyramid is used to describe the cone-shaped structures that exist in the medulla. They have a striped appearance because of the many parallel nephrons that they contain.</p> <p>Since both A and R are untrue, option 5 is the right answer.</p> | |

Match the terms

Question 18

Match each anatomical part to its description.

| Part | Description |
|-----------------|-------------|
| Medulla | 5 |
| Cortex | 3 |
| Nephron | 6 |
| Ureters | 1 |
| Urinary bladder | 2 |
| Urethra | 4 |

1. Paired tubular organs that drain urine from each kidney to the urinary bladder
2. A hollow, muscular sac that collects, stores and eliminates urine
3. The darker, outer layer of kidney tissue containing glomeruli
4. The hollow, tubular organ that transmits urine to the exterior during micturition
5. The middle layer of the kidney tissue with pyramid-shaped areas
6. The microscopic functional unit of the kidney

Putting it all together

Question 19

Explain, in your own words, whether the following substances would normally be expected to be present in urine.

- a) Protein
- b) Glucose

Suggest some reasons for the presence of these substances in urine.

(a) Everyone has protein in their blood, but protein is not normally filtered at glomeruli (renal filtering units). This means that protein in glomerular capillaries remains in blood and does not enter the proximal convoluted tubule (PCT). Hence, protein should not appear in urine.

- People with proteinuria have eliminated an abnormal amount of protein in urine, and the condition is often a sign of underlying kidney disease.
- The most common risk factors for proteinuria are diabetes and hypertension (high blood pressure) because these disorders can damage the kidneys, causing protein to leak into urine.
- Some medications (e.g. lithium, a drug used to treat bipolar disorder) can be nephrotoxic and some infections, immune disorders and trauma

can contribute to proteinuria. In pregnancy, pre-eclampsia (formerly called toxæmia) can cause high blood pressure and proteinuria.

(b) Glucose is freely filtered out of blood by glomerular capillaries, so it enters Bowman's capsule and flows into the PCT. Glucose is then reabsorbed by carrier-mediated facilitated diffusion and re-enters the blood.

- Glucose in urine, called glucosuria, is an abnormal sign.
- Glucosuria is usually caused because the glucose carrier molecules in nephrons have become saturated. This is because there is more glucose in the ultrafiltrate than the PCT cells can reabsorb. The renal threshold for glucose transport has been exceeded and glucose is being eliminated in the urine.
- The most common cause of glucosuria is hyperglycaemia (high concentration of glucose in blood) caused by diabetes. The individual's blood needs to be tested and blood concentration of glucose measured. If it is outside the normal range, the kidneys may be damaged.