Excretory Products and Their Elimination

Multiple Choice Questions

Q1. The following substances are the excretory products in animals. Choose the least toxic from among them.
(a) Urea (b) Uric acid
(c) Ammonia (d) Carbon dioxide
Ans: (b) Ammonia is the most toxic form and requires large amount of water for its elimination, whereas uric acid, being the least toxic, can be removed with a minimum loss of water.

Q2. Filtration of the blood takes place at
(a) PCT (b) DCT
(c) Collecting ducts (d) Malpighian body
Ans: (d) Filtration of the blood takes place at malpighian body.

Q3. Which of the following statements is incorrect?
a. ADH—prevents conversion **of angiotensinogen in blood to angiotensin**
b. Aldosterone—facilitates water reabsorption
c. ANF—enhances sodium reabsorption
d. Renin—causes vasodilation
Ans: (a) ADH is a hormone released from the posterior pituitary gland that causes an increase in blood pressure through reabsorption of water.

Q4. A large quantity of one of the following is removed from our body by lungs
(a) C02 only (b) H20 only
(c) C02 and H20 (d) Ammonia
Ans: (a) A large quantity of C02 is removed from our body by lungs.

Q5. The pH of human urine is approximately
(a) 6.5 (b) 7 (c) 6 (d) 7.5
Ans: (c) The pH of human urine is approximately 6.

Q6. Different types of excretory structures and animals are given below. Match them appropriately and mark the correct answer from among those given below:

Excretory structure/ organ		Animals	
A.	Protonephridia	(i)	Prawn
B.	Nephridia	(ii)	Cockroach
C.	Malpighian tubules	(iii)	Earthworm
D.	Green gland or Antennal gland	(iv)	Flatworms

Options:
(a) D—(i), (C)—(ii), B—(iii), A—(iv)

(b) B— (i), (C)—(ii), A—(iii), B—(iv)
(c) D—(i), (C)—(ii), A—(iii), B-(iv)
(d) B—(i), (C)—(ii), B—(iii), D—(iv)

Ans. (a)

Excretory structure/ organ		Animals	
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B.	Nephridia	(iii)	Earthworm
C.	Malpighian tubules	(ii)	Cockroach
D.	Green gland or Antennal gland	(i)	Prawn

Q7. Which one of the following statements is incorrect?
(a) Birds and land snails are uricotelic animals.
(b) Mammals and frogs are ureotelic animals.
(c) Aquatic amphibians and aquatic insects are ammonotelic animals.
(d) Birds and reptiles are ureotelic.
Ans: (d) Reptiles (snakes and lizards), birds, land snails and insects excrete nitrogenous wastes as uric acid in the form of pellet or paste with a minimum loss of water and are called uricotelic animals.

Q8. Which of the following pairs is wrong?
(a) Uricotelic — Birds (b) Ureotelic — Insects
(c) Ammonotelic — Tadpole (d) Ureotelic — Elephant
Ans: (b) Insects — Uricotelic

Q9. Which one of the following statements is incorrect?
(a) The medullary zone of kidney **is divided into a few conical masses called medullary pyramids projecting into the calyces.**
(b) Inside the kidney **the cortical region extends in between the medullary pyramids as renal pelvis**
(c) Glomerulus along with Bowman's capsule is called the renal corpuscle
(d) Renal corpuscle, proximal convoluted tubule (PCT) and distal convoluted tubule (DCT) of the nephron are situated in the cortical region of kidney
Ans: (b) The cortex extends in between the medullary pyramids as renal columns called Columns of Bertini.

Q10. The condition of accumulation of urea in the blood is termed as
(a) Renal Calculi (b) Glomerulonephritis
(c) Uremia (d) Ketonuria
Ans: (c) The condition of accumulation of urea in the blood is termed as uremia.

Q11. Which one of the following is also known as antidiuretic **hormone?**
(a) Oxytocin (b) Vasopressin (c) Adrenaline (d) Calcitonin

Ans: (b) Vasopressin is also known as antidiuretic hormone (ADH).

Q12. Match the terms given in Column I with their physiological processes given in Column II and choose the correct answer

Column I		Column II	
A.	Proximal convoluted tubule	(i)	Formation of concentrated urine
B.	Distal convoluted tubule	(ii)	Filtration of blood
C.	Henle's loop	(iii)	Reabsorption of 70-80% of electrolytes
D.	Counter-current mechanism	(iv)	Ionic balance
E.	Renal corpuscle	(v)	Maintenance of concentration gradient in medulla

Options:

(a) A—(iii), B—(v), C—(iv), D—(ii), E—(i)
(b) A—(iii), B—(iv), C—(i), D—(v), E—(ii)
(c) A—(i), B—(iii), C—(ii), D—(v), E—(iv)
(d) A—(iii), B—(i), C—(iv), D—(v), E—(ii)

Ans: **(b)**

A.	Proximal convoluted tubule	(iii)	Reabsorption of 70-80% of electrolytes
B.	Distal convoluted tubule	(iv)	Ionic balance
C.	Henle's loop	(i)	Formation of concentrated urine
D.	Counter-current mechanism	(v)	Maintenance of concentration gradient in medulla
E.	Renal corpuscle	(ii)	Filtration of blood

Q13. Match the abnormal conditions given in Column A with their explanations given in Column B and choose the correct option.

Column A		Column B	
A.	Glycosuria	(i)	Accumulation of uric acid in joints
B.	Renal calculi	(ii)	Inflammation in glomeruli
C.	Glomerulonephritis	(iii)	Mass of crystallised salts within the kidney
D.	Gout	(iv)	Presence of glucose in urine

Options:
(a) A—(i), B—(iii), C—(ii), D—(iv)
(b) A—(iii), B—(ii), C—(iv), D—(i)
(c) A—(iv), B—(iii), C—(ii), D—(i)
(d) A—(iv), B—(ii), C—(iii), D—(i)

Ans. (c)

A.	Glycosuria	(iv)	Presence of glucose in urine
B.	Renal calculi	(iii)	Mass of crystallised salts within the kidney
C.	Glomerulonephritis	(ii)	Inflammation in glomeruli
D.	Gout	(i)	Accumulation of uric acid in joints

Q14. We can produce concentrated/dilute urine. This is facilitated by a special mechanism. Identify the mechanism.
(a) Reabsorption from PCT
(b) Reabsorption from collecting duct
(c) Reabsorption/secretion in DCT
(d) Counter current mechanism in Henle's loop/Vasa recta
Ans: (d) We can produce concentrated/dilute urine. This is facilitated by a special mechanism called counter current mechanism in Henle's loop/Vasa recta.

Q15. Dialysing unit (artificial kidney) contains a fluid which is almost same as plasma except that it has
(a) High glucose
(b) High urea
(c) No urea
(d) High uric acid
Ans: (c) Dialysing fluid = Plasma – nitrogenous wastes (urea)

Very Short Answer Type Questions

Q1. Where does the selective reabsorption of Glomerular filtrate take place?
Ans: DCT

Q2. What is the excretory product from kidneys of reptiles?
Ans: Uric acid

Q3. What is the composition of sweat produced by sweat glands?
Ans: Water, minerals, lactic acid and urea.

Q4. Identify the glands that perform the excretory function in prawns.
Ans: Antennal glands or green glands

Q5. What is the excretory structure in amoeba?
Ans: Contractile vacuole

Q6. The following abbreviations are used in the context of excretory functions, what do they stand for?
a.ANF
b. ADH
c. GFR
d. DCT
Ans: a. ANF—Atrial Natriuretic factor
b. ADH—Antidiuretic hormone
c. GFR—Glomerular Filtration Rate
d. DCT—Distal Convoluted Tubule

Q7. Differentiate Glycosuria from Ketonuria.
Ans: Glycosuria—Presence of glucose in urine.
Ketonuria—Presence of ketone bodies in urine.

Q8. What is the role of sebaceous glands?
Ans: Sebaceous glands eliminate certain substances like sterols, hydrocarbons and waxes through sebum. This secretion provides a protective oily covering for the skin.

Q9. Name two actively transported substances in Glomerular **filtrate.**
Ans: Glucose and aminoacids

Q10. Mention any two metabolic disorders, which can be diagnosed by analysis of urine.
Ans: Glycosuria and ketonuria

Q11. What are the main processes of urine formation?
Ans: The main processes are filtration, reabsorption, secretion and concentration/ dilution

Q12. Sort the following into actively or passively transported substances during reabsorption of GFR:
glucose, aminoacids, nitrogenous wastes, Na^+, water
Ans: Actively transported—Glucose, aminoacids and Na^+
Passively transported—Nitrogenous wastes and water

Q13. Complete the following:
a. Urinary excretion = Tubular reabsorption + tubular secretion
b. Dialysis fluid = Plasma

Ans: a. Urinary excretion = Glomerular filtration – tubular reabsorption + tubular secretion
b. Dialysis fluid = Plasma – nitrogenous wastes

Q14. Mention the substances that exit from the tubules in order to maintain a concentration gradient in the medullary interstitium.
Ans: NaCl and Urea.

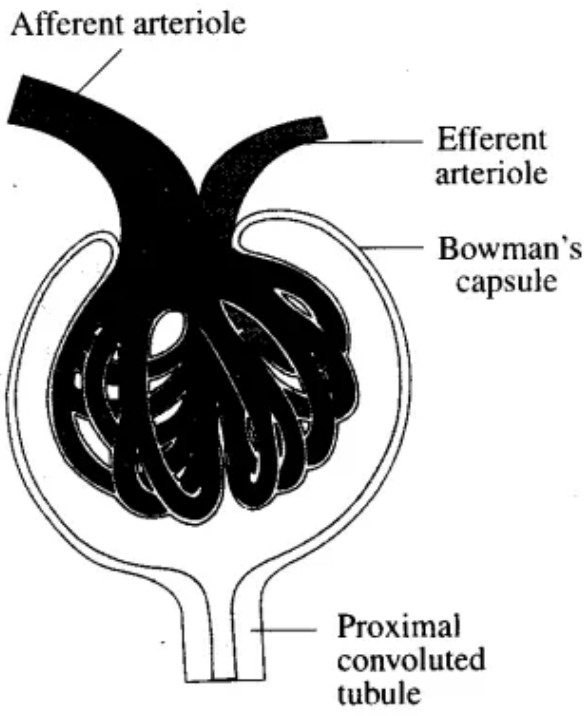
Q15. Fill in the blanks appropriately .

Organ	Excretory wastes

1. **Kidneys _____**
2. **Lungs _____**
3. **Liver _____**
4. **Skin _____**

Ans: a. Kidneys — Urea
b. Lungs — $C0_2$ and H_zO
c. Liver — Bilirubin, biliverdin, cholesterol, degraded steroid hormones, vitamins and drugs
d. Skin — Sweat (NaCl, urea, lactic acid) and sebum (sterols, hydrocarbons and waxes).

Short Answer Type Questions
Q1. Show the structure of a renal corpuscle with the help of a diagram.
Ans:



Malpighian body (renal corpuscle)

Q2. What is the role played by Renin-Angiotensin in the regulation of kidney function?
Ans: Renin is released from JGA on activation due to fall in the glomerular blood pressure/flow. Renin converts angiotensinogen in blood to angiotensin-I and further to angiotensin-II. Angiotensin-II being a powerful vasoconstrictor, increase the glomerular blood pressure and thereby GFR. Angiotensin-II also activates the adrenal cortex to release aldosterone. Aldosterone causes reabsorption of Na^+ and water

from the distal parts of the tubule. This also leads to.an increase in blood pressure and thereby GFR. This is generally known as the Renin-Angiotensin mechanism.

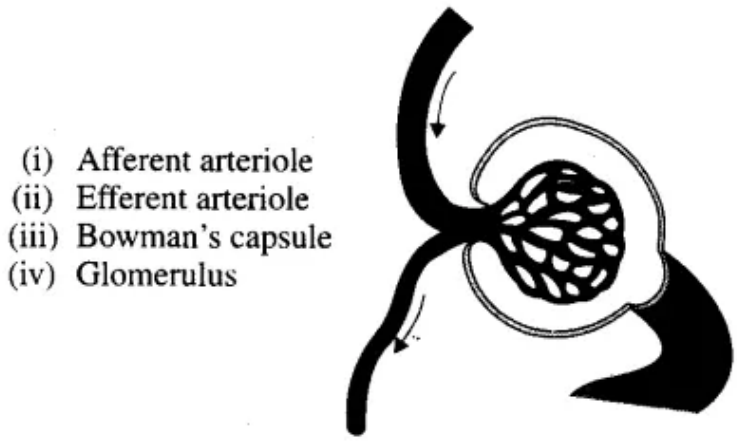
Q3. Aquatic animals generally are ammonotelic in nature whereas terrestrial forms are not. Comment.
Ans: Ammonia is the most toxic form and requires large amount of water for its elimination, terrestrial adaptation necessitated the production of lesser toxic nitrogenous wastes like urea and uric acid for conservation of water. Mammals, many terrestrial amphibians and marine fishes mainly excrete urea and are called ureotelic animals. Ammonia produced by metabolism is converted into urea in the liver of these animals and released into the blood which is filtered and excreted out by the kidneys.

Q4. The composition of glomerular filtrate and urine is not same. Comment.
Ans: A comparison of the volume of the filtrate formed per day (180 litres per
day) with that of the urine released (1.5 litres), suggest that nearly 99% of the filtrate has to be reabsorbed by the renal tubules. This process is called reabsorption. For example, substances like glucose, amino acids, Na+, etc.,
in the filtrate are reabsorbed actively so, these substances are not present in urine.

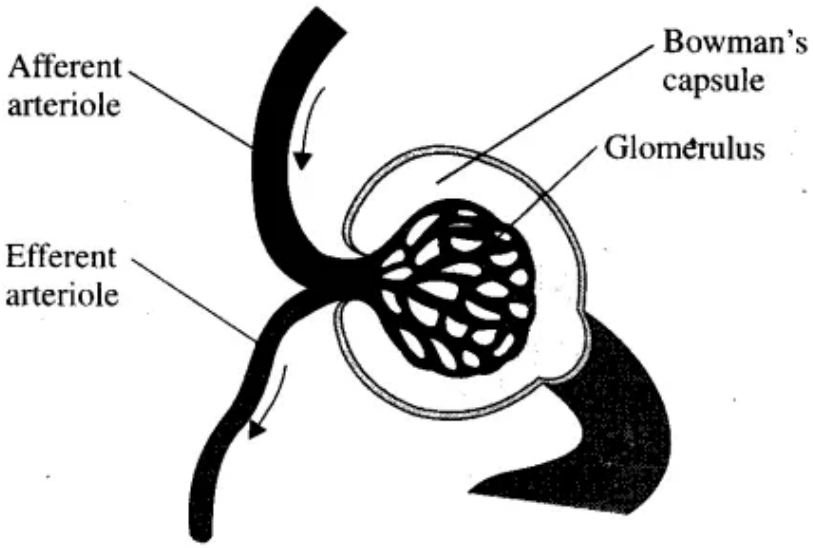
Q5. What is the procedure advised for the correction of extreme renal failure? Give a brief account of it.
Ans: Kidney transplantation is the ultimate method in the correction of acute renal failures (kidney failure). A functioning kidney is used in transplantation from a donor, preferably a close relative, to minimise its chances of rejection by the immune system of the host. Modem clinical procedures have increased the success rate of such a complicated technique.

Q6. How have the terrestrial organisms adapted themselves for conservation **of water?**
Ans: Terrestrial adaptation necessitated the production of lesser toxic nitrogenous wastes like urea and uric acid for conservation of water. Mammals, many terrestrial amphibians and marine fishes mainly excrete urea and are called ureotelic animals. Ammonia produced by metabolism is converted into urea in the liver of these animals and released into the blood which is filtered and excreted out by the kidneys. Some amount of urea may be retained in the kidney matrix of some of these animals to maintain a desired osmolarity. Reptiles, birds, land snails and insects excrete nitrogenous wastes as uric acid ‘ in the form of pellet or paste with a minimum loss of water and are called uricotelic animals.

Q7. Label the parts in the following diagram



Ans.



Q8. Explain, why a haemodialysing uhit called'artificial kidney?

Ans: Malfunctioning of kidneys can lead to accumulation of urea in blood, a condition called uremia, which is highly harmful and may lead to kidney failure. In such patients, urea can be removed by a process called hemodialysis. Blood drained from a convenient artery is pumped into a dialysing unit (also called artificial kidney) after adding an anticoagulant like heparin. The unit contains a coiled cellophane tube surrounded by a fluid (dialysing fluid) having the same composition as that of plasma except the nitrogenous wastes. The porous cellophane membrane of the tube allows the passage of molecules based on concentration gradient. As nitrogenous wastes are absent in the dialysing fluid, these substances freely move out, thereby clearing the blood. The cleared blood is pumped back to the body through a vein after adding anti-heparin to it.

Q9. Comment upon the hormonal regulation of selective reabsorption.

Ans: Osmoreceptors in the body are activated by changes in blood volume, body fluid volume and ionic concentration. An excessive loss of fluid from the body can activate these receptors which stimulate the hypothalamus to release antidiuretic hormone (ADH) or vasopressin from the neurohypophysis. ADH facilitates water reabsorption from latter parts of the tubule, thereby preventing diuresis.

Long Answer Type Questions

Q1. Explain the mechanism of formation of concentrated urine in mammals.

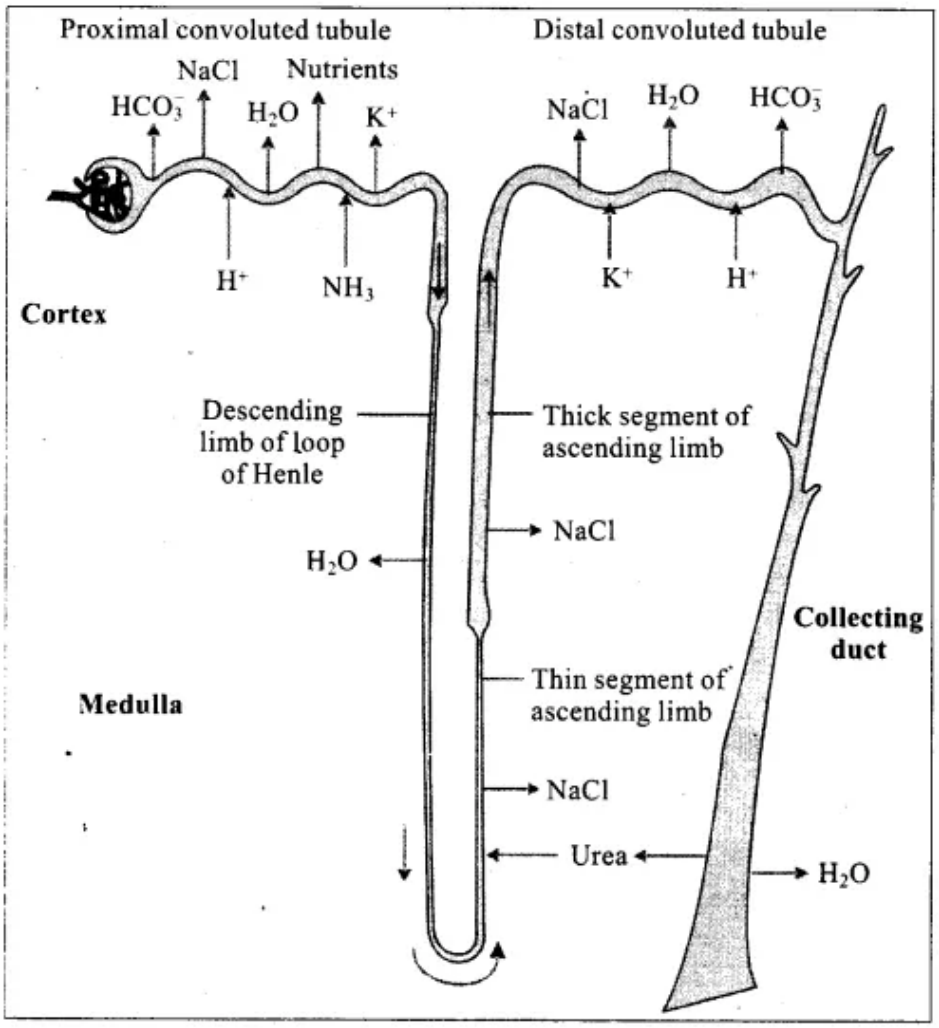
Ans: Mechanism of Concentration of the Filtrate:

Mammals have the ability to produce a concentrated urine. The Henle's loop and vasa recta play a

significant role in this. The flow of filtrate in the two limbs of Henle's loop is in opposite directions and thus forms a counter current. The flow of blood through the two limbs of vasa recta is also in a counter current pattern. The proximity between the Henle's loop and vasa recta, as well as the counter current in them help in maintaining an increasing osmolarity towards the inner medullary interstitium, i.e., from 300 mOsmo1L in the cortex to about 1200 mOsmolLin the inner medulla. This gradient is mainly caused by NaC1 and urea. NaC1 is transported by the ascending limb of Henle's loop which is exchanged with the descending limb of vasa recta. NaCl is returned to the interstitium by the ascending portion of vasa recta. Similarly, small amounts of urea enter the thin segment of the ascending limb of Henle's ioop which is transported back to the interstitium by the collecting tubule. The above described transport of substances facilitated by the special arrangement of Henle's loop and vasa recta is called the counter current mechanism. This mechanism helps to maintain a concentration gradient in the medullary interstitium. Presence of such interstitial gradient helps in an easy passage of water from the collecting tubule thereby concentrating the filtrate (urine). Human kidneys can produce urine nearly four times concentrated than the initial filtrate formed.

Q2. Draw a labelled diagram shewing **reabsorption and secretion of major substances at different parts of the nephron.**
Ans:

Ans.



Reabsorption and secretion of major substances at different parts of the nephron (Arrows indicate direction of movement of materials)

Q3. Explain briefly, micturition and disorders of the excretory system.
Ans:
• Micturition: Urine formed by the nephrons is ultimately carried to the urinary bladder where it is stored till

a voluntary signal is given by the central nervous system (CNS). This signal is initiated by the stretching of the urinary bladder as it gets filled with urine. In response, the stretch receptors on the walls of the bladder send signals to the CNS. The CNS passes on motor messages to initiate the contraction of smooth muscles of the bladder and simultaneous relaxation of the urethral sphincter causing the release of urine. The process of release of urine is called micturition and the neural mechanisms causing it is called the micturition reflex.

• Disorders of the Excretory System: Malfunctioning of kidneys can lead to accumulation of urea in blood, a condition called uremia, which is highly harmful and may lead to kidney failure. In such patients, urea can be removed by a process called hemodialysis. Kidney transplantation is the ultimate method in the correction of acute renal failures (kidney failure).

• Renal calculi: Stone or insoluble mass of crystallised salts (oxalates, etc.) formed within the kidney.

• Glomerulonephritis: Inflammation of glomeruli of kidney.

Q4. How does tubular secretion help in maintaining ionic and acid-base balance in body fluids?

Ans: During urine formation, the tubular cells secrete substances like H^+, K^+ and ammonia into the filtrate. Tubular secretion is also an important step in urine formation as it helps in the maintenance of ionic and acid base balance of body fluids. .

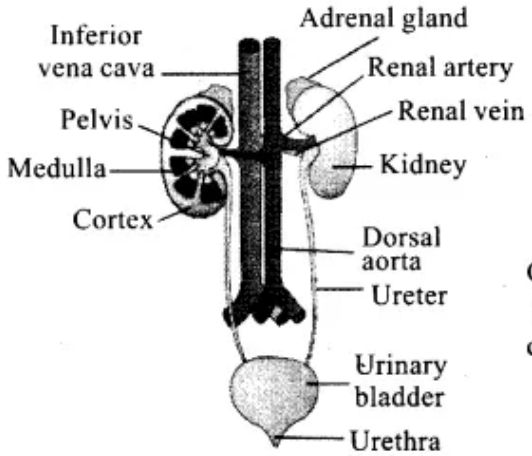
- PCT helps to maintain the pH and ionic balance of the body fluids by selective secretion of hydrogen ions, ammonia and potassium ions into the filtrate
- DCT is also capable of selective secretion of hydrogen and potassium ions and NH_3 to maintain the pH and sodium-potassium balance in blood.
- Collecting duct also plays a role in the maintenance of pH and ionic balance of blood by the selective secretion of H^+ and K^+

Q5. The" glomerular filtrate in the loop of Henle gets concentrated in the descending and then gets diluted in the ascending limbs. Explain.

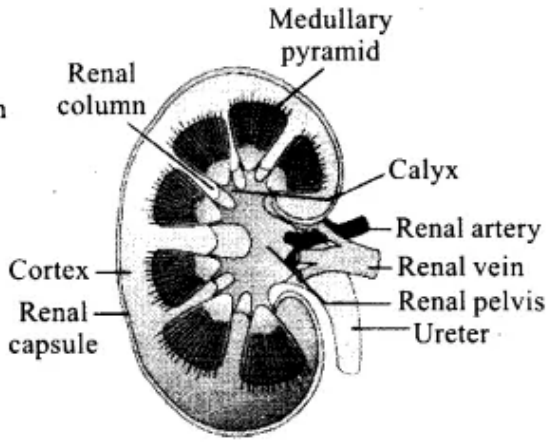
Ans: A hairpin shaped Henle's loop has a descending and an ascending limb. Reabsorption is minimum in its ascending limb. However, this region plays a significant role in the maintenance of high osmolarity of medullary interstitial fluid. The descending limb of loop of Henle is permeable to water but almost impermeable to electrolytes. This concentrates the filtrate as it moves down. The ascending limb is impermeable to water but allows transport of electrolytes actively or passively. Therefore, as the concentrated filtrate pass upward, it gets diluted due to the passage of electrolytes to the medullary fluid.

Q6. Describe the structure of a human kidney with the help of a labelled diagram.

Ans: In humans, the excretory system consists of a pair of kidneys, one pair of ureters, a urinary bladder and a urethra. Kidneys are reddish brown, bean shaped structures situated between the levels of last thoracic and third lumbar vertebra close to the dorsal inner wall of the abdominal cavity. Each kidney of an adult human measures 10-12 cm in length, 5-7 cm in width, 2-3 cm in thickness with an average weight of 120-170 g. Towards the centre of the inner concave surface of the kidney is a notch called hilum through which ureter, blood vessels and nerves enter. Inner to the hilum is a broad funnel shaped space called the renal pelvis with projections called calyces. The outer layer of kidney is a tough capsule. Inside the kidney, there are two zones, an outer cortex and an inner meditlla. The medulla is divided into a few conical masses (medullary pyramids) projecting into the calyces (sing.: calyx). The cortex extends in between the medullary pyramids as renal columns called Columns of Bertini. Each kidney has nearly one million complex tubular structures called nephrons, which are the functional units.



Human Urinary system



Longitudinal section of kidney