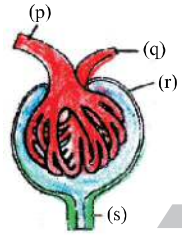


Chapter - 19

Excretory products and Their Elimination

Points To Remember

Ammonotelism :

The animals which excrete ammonia are called ammonotelic and excretion of ammonia is known as ammonotelism eg. Amoeba, sycon, hydra, liver fluke, tapeworm, Leech, Prawn, bony fishes etc.

Ureotelism :

excretion of urea is known as ureotelism and the animals which excrete urea are ureotelic animals eg. mammals, many terrertrial amphibians and marine fishes and sting rays etc.

uricotelism :

Excretion of uric-acid is known as uricotelism and the animals are called uricotelic eg. most insects, land snails, lizards, snakes and birds.

Nephrons :

The structural and functional unit of kidneys. Each kidney contains about one million of nephrons.

Structure of Nephron :

A nephron consists of Glomerulus, Bowman's capsule, PCT (Proximal convoluted tubule). JG A (Juxaglomerular Apparatus) and the collecting duct. (Refer fig., 19.3, page 292 (NCERT Text Book of Biology for Class XI)

Structure of Kidney :

Size 10-12 cm in length, 5-7 cm in width, 2-3 cm thick, average weight about 120-170 g.

- The blood vessels, ureter and nerves enter in the kidney through hilum (a notch).

- The outer layer of kidney is a tough capsule.
- The outer zone of kidney is cortex and the inner is medulla.
- The medulla is divided into few conical masses (medullary pyramids) projecting into calyces.
- The cortex extends between medullary pyramids called columns of Bertini. Refer figure 19.2, page 292 (NCERT—Class XI Biology)

Glomerular Filtration :

The filtration of blood in glomerulus, about 1100-1200 ml of blood is filtered by the kidney per minute.

Glomerular Filtration Rate (GFR) :

The amount of filtrate formed by the kidney per minute is called GFR. In a healthy individual it is about, 125 ml/minute, i.e. 180 litres per day.

Types of Nephrons :

(i) Juxtamedullary Nephron—About 15% of total nephrons, Glomeruli are found in inner region of cortex, large in size, long loop of Henle and found deep in medulla, associated with vasa recta control plasma volume when water supply is short.

(ii) Cortical Nephron—About 85% of total nephron mainly lie in renal cortex, glomeruli found in outer cortex, short loop of Henle, extends very little in medulla. They do not have vasa recta.

Functions of Tubules :

(i) PCT—absorption of all essential nutrients and 70-80% of electrolytes and water, helps to maintain the pH and ionic balance of body fluids by selective secretion of H^+, ammonia and K^+ into filtrate.

(ii) Henele's Loop—reabsorption in this segment is minimum, it plays a significant role in maintenance of higher molarity of medullary interstitial fluid.

(iii) DCT—conditional reabsorption of Na^+ and water takes place here, reabsorption of HCO_3 and selective secretion of H^+ and K^+ and ammonia to maintain the pH and sodium-potassium balance in blood.

(iv) Collecting duct—Large amount of water is absorbed from this region to produce concentrated urine, it plays a role in maintenance of pH and ionic balance of blood by selective secretion of H^+ and K^+ ions.

Steps of Urine Formation

1. **Gromerular Filtration**—Blood is filtered by glomerules through three membranes i.e., endothelium of blood vessel, filtration slits of Bowman's capsule and basement membrance between these two layers. This filtration is called ultrafiltration as all constituents of plasma comes into filterate except proteins.
2. **Reabsorption**—90% of filtrate is reabsorbed by the renal tubules by active or passive mechanism.

   It is evident by the fact that out of 180L of filtrate formed per day only 1.5 L of urine released.
3. **Secretion**—Tubular cells secrete H^+, K^+, ammonia into the urine. It maintains acid-base balance of body fluids.

Mechanism of concentration of the Filtrate (Countercurrent Mechanism) :

Refer fig 19.6 page 296 (NCERT-Class XI Biology)

- This mechanism is said to be countercurrent mechanism because the out flow (in the ascending limb) runs parallel to and in the opposite direction of the inflow (in the descending limb).
- NaCl 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.**
- Henle's loop and vasarecta as well as the counter current in them help to maintain an increasing osmolality towards the inner medullary interstitium i.e., from 300 mosmol/L in cortex to about 1200 mosmol/L in inner medulla.
- Small amount of urea enter, the thin segment of ascending limb of Henle's loop which is transported back to the interstitium by the collecting tubule.
- This mechanism helps to maintain a concentration gradient in the medullary tubule interstitium.
- It helps in an easy passage of water from the collecting tubule to concentrate the filtrate i.e. urine.

Anti Diuretic Hormone (ADH) Controls the urine formation when there is less blood volume due to excessive loss of fluid from the body, osmareceptors send the signal to hypothalamus to release ADH which in turn facilitates water reabsorption thus preventing diuresis (increase in frequency of urination)

Micturition :

The expulsion of urine from the urinary bladder is called micturition. It is a reflex process but can be controlled voluntarily up to some extent in grown up children and adults.

- The CNS (Central Nervous System) sends the signal which cause the stretching of the urinary bladder when it gets filled with urine.
- In response, the stretch receptors on the walls of the bladder sends signals to the CNS.
- The CNS passes on motor message to initiate the contraction of smooth muscles of the bladder and simultaneous relaxation of the urethral sphincter causing the release of urine.
- An adult human excretes on an average 1 to 1.5 lit res of urine per day.
- On an average 25-30 gram of urea is excreted out per day.

Renin Angiotensin System

Fall in GFR

↓ Renin from JG cells

Angiotensinogen → Angiotensin I → Angiotensin II

↓ Acts on

Adrenal Cortex

↓ Secretesaldosterone

Reabsorptin from DCT

↓

Increase in GFR

Role of other organs in excretion :

- **Lungs**—removes CO_2 (18L/day) and water.
- **Liver**—secretes bilirubin, biliverdin etc. helps to eliminate these substances along. with cholesterol, vitamins, drugs and degraded steroid hormones through digesive wastes.
- **Sweat and sebaceous glands**—These glands of skin help to eliminate small amount of urea, NaCl and lactic acid etc. through sweat while sebaceous glands help to eliminate some substances like steroids, hydrocarbons and waxes through sebum.
- **Saliva**—It can help to eliminate small amount of nitrogenous wastes.

Disorders of Excretory system :

- **Uremia**—The accumulation of urea in blood due to malfunctioning of kidney.
  Hemodialysis—The process; of removal of urea from the blood artificially. In this process the blood from an artery is passed into dialysing unit after adding an anticoagulant like heparin. The blood passes through coiled cellophane tube surrounding by dialysing fluid. The nitrogenous wastes from the concentration gradient and the blood becomes clear. This blood is pumped back to the body through vein after adding anti-heparin to it.
- **Renal calculi**—The format ion of insoluble mass of crystallised salts (oxalates or phosphates of calcium.
- **Glomerulonephritis**—Inflamation of glomeruli of kindney.

Questions

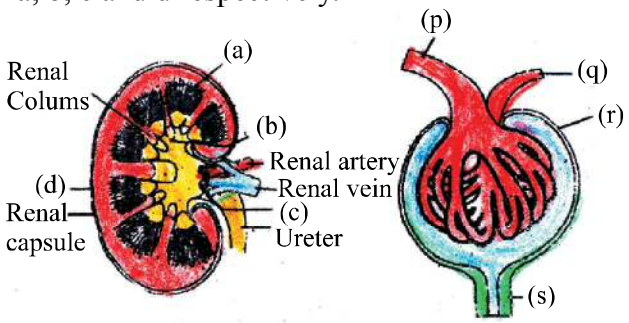
Very Short Answer Questions (1 marks each)

1. Which gland **secretes** sebum ?
2. One part of loop of Hanle is impermeable to water. Name it.
3. Besides water, name any two contnents of human sweat.
4. Explain the function of vasa rectae.
5. Name two types of nephrons found in human kidney.
6. Define GFR (Glomerular Filtration Rate).
7. The mechanism of concentration of filtrate is also known as counter current mechanism. Justify the statement.
8. What is micturition ?
9. Write the function of hormone 'renin' produced by kidney.
10. Name the excretary product of (i) reptiles (ii) Prawns.
11. What is vasa recta ?

Short Answer Questions-I (2 marks each)

12. Mark the odd ones is each of the following—
    (a) Renal pelvis, medullary pyramid, renal cortex, ureter.
    (b) Afferent arteriole, Henle's loop, vasa recta, efferent arteriole.
    (c) Glomerular filtration, antidiuretic hormone, hypertonic urine, collecting duct.
    (d) Proximal convoluted tubule, distal convolated tubule, Henle's loop renal corpuscle.

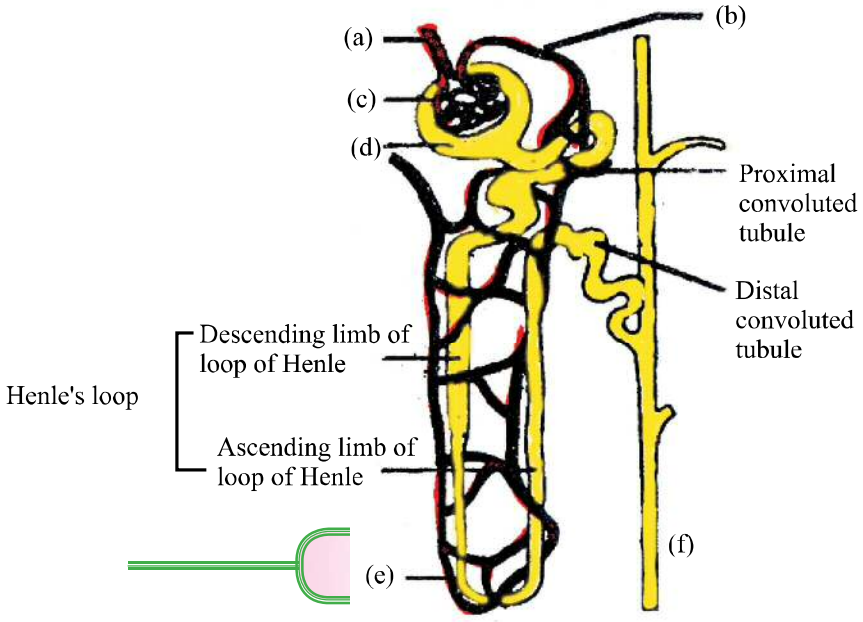
13. In the following diagram of longitudinal section of kidney (Fig.–1) identify and label a, b, c and d respectively.



14. In the diagram (Fig.-2) showing malpighian body (renal corpuscle) identify and label p, q, r, s.
15. Name two metabolic disorder which can be diagnosed by analysis of urine.

Short Answer Questions-II (3 marks each)

16. In the following diagram (Fig.-3) showing structure of a nephron label a, b, c, d, e and f.



17. Describe the hormonal feed back circuit in controlling the renal functions.
18. Give three points of difference between renin and Renin.
19. What are Ammonotelic, ureotelic and uricotelic animals ? Give an example of each type of these.
20. Why do urine formation less during summers ?

Long Answer Questions (5 marks each)

21. Draw a labelled diagram of human urinary system and write one function of each adrenal gland, ureter, urinary bladder, kidney and urethra.
22. Describe how urine is formed in the nephron through filtration reabsorption and secretion.

OR

Explain the steps involved in the process of urine formation.

23. Distinguish between (i) Uricotelism and Ureotelism (ii) Sebum and sweat (iii) Proximal and distal convoluted tubules (iv) Ascending and descending limbs of Henle's loop (v) Cortical and Medullary nephrons.

OR

Explain the process of reabsorption and secretion of major substances at different parts of nephron with the help of schematic diagram.

Answers

Very Short Answer (1 mark each)

1. Sebaceous glands (wax–glands)
2. Ascending limb.
3. Sodium chloride, lactic acid, glucose (any two).
4. It helps to retain reabsorbed ions and urea in the interstitial fluid of the medulla, to maintain its high osmotic pressure.
5. (i) Juxta medullary nephron (ii) Cortical nephron
6. The amount of filtrate formed by the kidney per minute.
7. (in the ascending limb) the out/flow runs parallel to and in the opposite direction of the inflow in the descending limb.
8. The act of passing out urine from urinary bladder.
9. Renin is used to convert angiotensinogen to angiotensin.
10. (i) Uric acid (ii) Ammonia
11. Capillary network running parallel to loop of Henle is known as Vasa recta.

Short Answer-I (2 marks each)

12. (a) Ureter (b) Henlp's loop (c) Glomerular filtration (d) Renal Corpuscle.
13. Refer fig. 19.2, page 292 (NCERT Class XI-Biology)

14. Refer fig. 19.4 page 293 (NQERT class XI-Biology)
15. Glycosuria, Ketonuria

Short Answer-II (3 marks each)

16. Refer fig. 19.3, page 292, (NCERT class XI-Biology)
17. Refer content 19.5, page 297 (NCERT class XI-Biology).
18.

Rennin	Renin
(i) It is aproteolytic enzyme	(i) It is a hormone that acts as an enzyme.
(ii) It helps in the digestion of milk Protein	(ii) It converts the protein angiotensinogen into angiotensin
(iii) It is secreted as an inactive form Prorennin which is activiated to rennin by HC1	(iii) It is secreted as renin
(iv) Its secretion is stimulated by food	(iv) It secretion is stimulated by a reduction of Na^+ level in tissue fluid. (..... any three)

19. Refer content given in the beginning of the chapter or NCERT Text Book page 290 class XI-Biology.
20. Due to sweating in summers blood volume is decreased. ADH is secreted from hypothalamus which increase reabsorption from D.C. tubules thus amount of urine is decreased.

Long Answer (5 mark each)

21. Refer fig. 19.1, page 291 and content 19.1 (NCERT Text Book page Class XII-Biology)
22. Refer content points to remember.
23. Refer the content given in the chapter or NCERT Text Book Class-XI Biology at pages 290, 298 (19.7), 292 and 293 respectively.
24. Refer content 19.3 and content 19.5 at page 294-295 (NCERT Text Book Class XI-Biology)