Chapter – 19

Excretory Products & Their Elimination

NCERT Back Exercises:

Ques 1: Define Glomerular Filtration Rate (GFR)

Ans 1: Glomerular filtration rate is the amount of glomerular filtrate formed in all the nephrons of both the kidneys per minute. In a healthy individual, it is about 125 mL/minute. Glomerular filtrate contains glucose, amino acids, sodium, potassium, urea, uric acid, ketone bodies, and large amounts of water.

Ques 2: Explain the auto regulatory mechanism of GFR.

Ans 2: Kidneys regulate the glomerular filtration rate through the mechanism which is auto regulatory. It involves the action of juxtaglomerular apparatus, which is a microscopic structure present between the returning distal convoluted tubule and vascular pole of the renal corpuscle of the same nephron. It regulates the glomerular filtration rate and renal blood flow. When the glomerular filtration rate declines, the juxtaglomerular cells are activated for the release of renin. This triggers the glomerular blood flow causing the GFR to revert to normal. Renin causes GFR to revert to normalcy by activating the renin-angiotensin mechanism.

Ques 3: Indicate whether the following statements are true or false:

(i) Micturition is carried out by a reflex.

(ii) ADH helps in water elimination, making the urine hypotonic.

(iii) Protein-free fluid is filtered from blood plasma into the Bowman's capsule.

(iv) Henle's loop plays an important role in concentrating the urine.

(v) Glucose is actively reabsorbed in the proximal convoluted tubule.

Ans 3:

(i) True

(ii) False

(iii) True

(iv) True

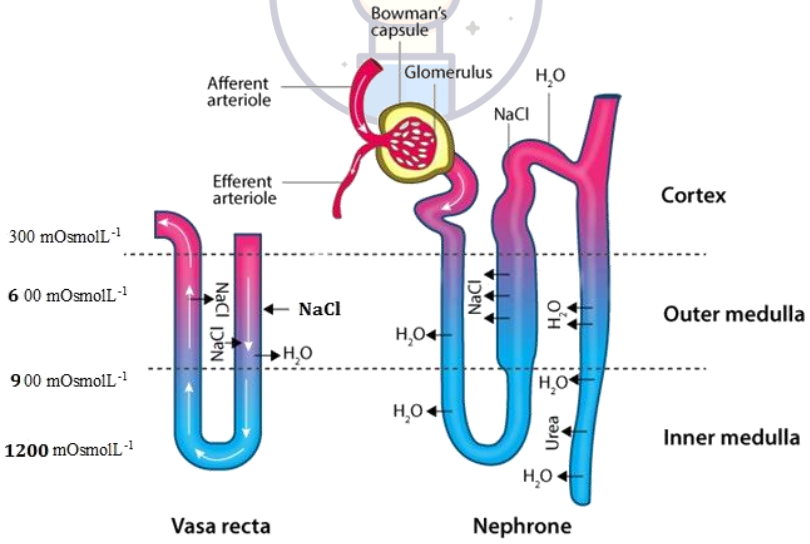
(v) True

Ques 4: Give a brief account of the counter current mechanism.

Ans 4: The counter current mechanism operating inside the kidney is the main adaptation for the conservation of water. There are two counter current mechanisms inside the kidneys. They are Henle's loop and vasa rectae.

Henle's loop is a U-shaped part of the nephron. Blood flows in the two limbs of the tube in opposite directions and this gives rise to counter currents.

The Vasa recta is an efferent arteriole, which forms a capillary network around the tubules inside the renal medulla. It runs parallel to Henley's loop and is U-shaped. Blood flows in opposite directions in the two limbs of vasa recta. As a result, blood entering the renal medulla in the descending limb comes in close contact with the outgoing blood in the ascending limb.



The osmolarity increases from 300 mOsmolL $^{-1}$ in the cortex to 1200 mOsmolL $^{-1}$ in the inner medulla by counter current mechanism. It helps in maintaining the concentration gradient, which in turn helps in easy movement of water from collecting tubules. The gradient is a result of the movement of NaCl and urea.

Ques 5: Describe the role of liver, lungs and skin in excretion.

Ans 5: Liver, lungs, and skin also play an important role in the process of excretion.

Role of the liver: Liver is the largest gland in vertebrates. It helps in the excretion of cholesterol, steroid hormones, vitamins, drugs, and other waste materials through bile. Urea is formed in the liver by the ornithine cycle. Ammonia – a toxic substance – is quickly changed into urea in the liver and thence eliminated from the body. Liver also changes the decomposed haemoglobin pigment into bile pigments called bilirubin and biliverdin.

Role of the lungs: Lungs help in the removing waste materials such as carbon dioxide from the body.

Role of the skin: Skin has many glands which help in excreting waste products through pores. It has two types of glands – sweat and sebaceous glands.
Sweat glands are highly vascular and tubular glands that separate the waste products from the blood and excrete them in the form of sweat. Sweat excretes excess salt and water from the body.
Sebaceous glands are branched glands that secrete an oily secretion called sebum.

Ques 6: Explain micturition.

Ans 6: Micturition is the process by which the urine from the urinary bladder is excreted. As the urine accumulates, the muscular walls of the bladder expand. The walls stimulate the sensory nerves in the bladder, setting up a reflex action. This reflex stimulates the urge to pass out urine. To discharge urine, the urethral sphincter relaxes and the smooth muscles of the bladder contract. This forces the urine out from the bladder.
An adult human excretes about 1 – 1.5 litres of urine per day.

Ques 7: Match the items of column I with those of column II:

Column I		Column II	
(a)	**Ammonotelism**	**(i)**	**Birds**
(b)	**Bowman's capsule**	**(ii)**	**Water reabsorption**
(c)	**Micturition**	**(iii)**	**Bony fish**
(d)	**Uricotelism**	**(iv)**	**Urinary bladder**
(d)	**ADH**	**(v)**	**Renal tubule**

Ans 7:

Column I		Column II	
(a)	Ammonotelism	**(iii)**	Bony fish
(b)	Bowman's capsule	**(v)**	Renal tubule
(c)	Micturition	**(iv)**	Urinary bladder
(d)	Uricotelism	**(i)**	Birds
(d)	ADH	**(ii)**	Water reabsorption

Ques 8: What is meant by the term osmoregulation?

Ans 8: Osmoregulation is a homeostatic mechanism that regulates the optimum temperature of water and salts in the tissues and body fluids. It maintains the internal environment of the body by water and ionic concentration.

Ques 9: Terrestrial animals are generally either ureotelic or uricotelic, not ammonotelic, why?

Ans 9: Terrestrial animals are either ureotelic or uricotelic, and not ammonotelic.
This is because of the following two main reasons:

(i) Ammonia is highly toxic in nature. Therefore, it needs to be converted into a less toxic form such as urea or uric acid.

(ii) Terrestrial animals need to conserve water. Since ammonia is soluble in water, it cannot be eliminated continuously. Hence, it is converted into urea or uric acid. These forms are less toxic and also insoluble in water. This helps terrestrial animals conserve water.

Ques 10: What is the significance of juxtaglomerular apparatus (JGA) in kidney function?

Ans 10: The juxtaglomerular apparatus is a specialized sensitive region that is formed by the cellular modifications in the distal convoluted tubule and the afferent arteriole at the location of their contact.

Significance:

(i) Its mechanism is via the renin-angiotensin-aldosterone system (RAAS)

(ii) When the glomerular filtration rate dips, the juxtaglomerular apparatus stimulates causing the secretion of renin

(iii) This renin converts a protein into a peptide, i.e., angiotensinogen to angiotensin

(iv) Angiotensin is a hormone that elevates the GFR and the flow of blood in these three ways:

(a) Narrowing the efferent arterioles to cause an increase in the glomerular pressure
(b) Triggering the walls of the PCT in order to reabsorb more of water and NaCl
(c) Triggers the adrenal gland to secrete aldosterone that facilitates reabsorption of water and NaCl in the DCT.

(v) The volume of blood and blood pressure thereby increases. The hypertonic urine and urine volume decreases.

Ques 11: Name the following:

(i) A chordate animal having flame cells as excretory structures

(ii) Cortical portions projecting between the medullary pyramids in the human kidney

(iii) A loop of capillary running parallel to the Henle's loop.

Ans 11:

(i) Amphioxus is an example of a chordate that has flame cells as excretory structures. Flame cell is a type of excretory and osmoregulatory system.

(ii) The cortical portions projecting between the medullary pyramids in the human kidney are the columns of Bertini. They represent the cortical tissues present within the medulla.

(iii) A loop of capillary that runs parallel to Henle's loop is known as vasa rectae. Vasa rectae, along with Henle's loop, helps in maintaining a concentration gradient in the medullary interstitium.

Ques 12: Fill in the gaps:

(i) Ascending limb of Henle's loop is_____to water whereas the descending limb is_____to it.

(ii) Reabsorption of water from distal parts of the tubules is facilitated by hormone_____.

(iii) Dialysis fluid contains all the constituents as in plasma except_____.

(iv) A healthy adult human excretes (on an average)_____gm of urea/day.

Ans 12:

(i) Ascending limb of Henle's loop is impermeable to water, whereas the descending limb is permeable to it.

(ii) Reabsorption of water from distal parts of the tubules is facilitated by the Hormone vasopressin.

(iii) Dialysis fluid contains all the constituents as in plasma, except the nitrogenous waste.

(iv) A healthy adult human excretes (on an average) 25 - 30 gm of urea/day.